



CLUSTER OF  
EXCELLENCE

Matters of Activity  
Image Space Material

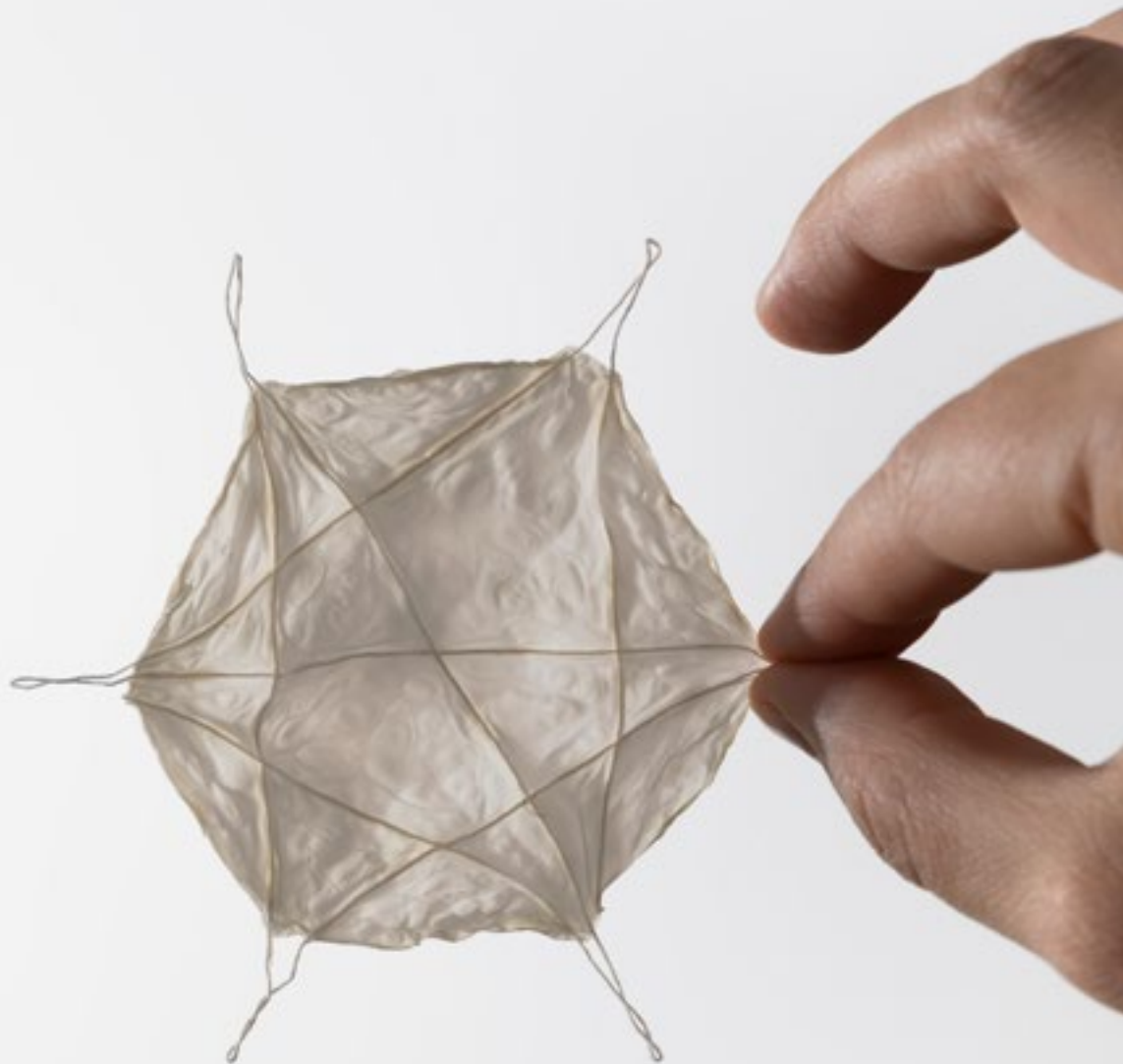
2019—2022

Cluster of Excellence

# **Matters of Activity**

Image Space Material

2019-2022



**»Can materials be considered not as passive carriers but as partners of technological adventures with which one can have an open dialog?«**

**Michael Friedman and Karin Krauthausen**  
Postdoctoral researchers, projects Weaving and Symbolic Material

**»The material activity we address is not opposed to the digital. It moves beyond the digital age. Such transdigital material is the starting point for a material revolution that works to overcome the dichotomy between the digital and the material, between technology and nature.«**

**Wolfgang Schäffner**  
Director of »Matters of Activity«

# TABLE OF CONTENTS

## 6 INTRODUCTION

### ACTIVITIES

#### 10 Events

- 12 Deep Material Futures
- 14 Materials Matter
- 16 Tipping Points. Plastic, Contingent and Unstable Matters
- 18 Filtering Legacies. Filtering Wasted Environments
- 20 Times of Waste. Handling Matter
- 22 The Analog in the Digital Age

#### 24 Exhibitions

- 26 After Nature
- 30 DAOULA | sheen. West African Wild Silk on Its Way
- 34 Design Lab #13: Material Legacies
- 38 Stretching Materialities

#### 42 Science Communication

- 44 Virtual Cluster Space
- 46 CollActive Materials
- 48 Long Night of the Sciences
- 49 Excellence Explained
- 50 Mall Anders

#### 54 Early Career Research

- 56 Doctoral Program
- 58 Early Career Awards
- 60 Teaching

#### 62 International and Cultural Diversity

- 64 Master Open Design
- 66 Autumn School
- 67 Fellowships and International Guest Researchers

#### 68 Selected Publications

### PROJECTS

#### 74 Weaving

#### 82 Filtering

#### 90 Cutting

#### 98 Material Form Function

#### 106 Object Space Agency

#### 114 Symbolic Material

#### 120 SELECTED MEDIA REPORTS

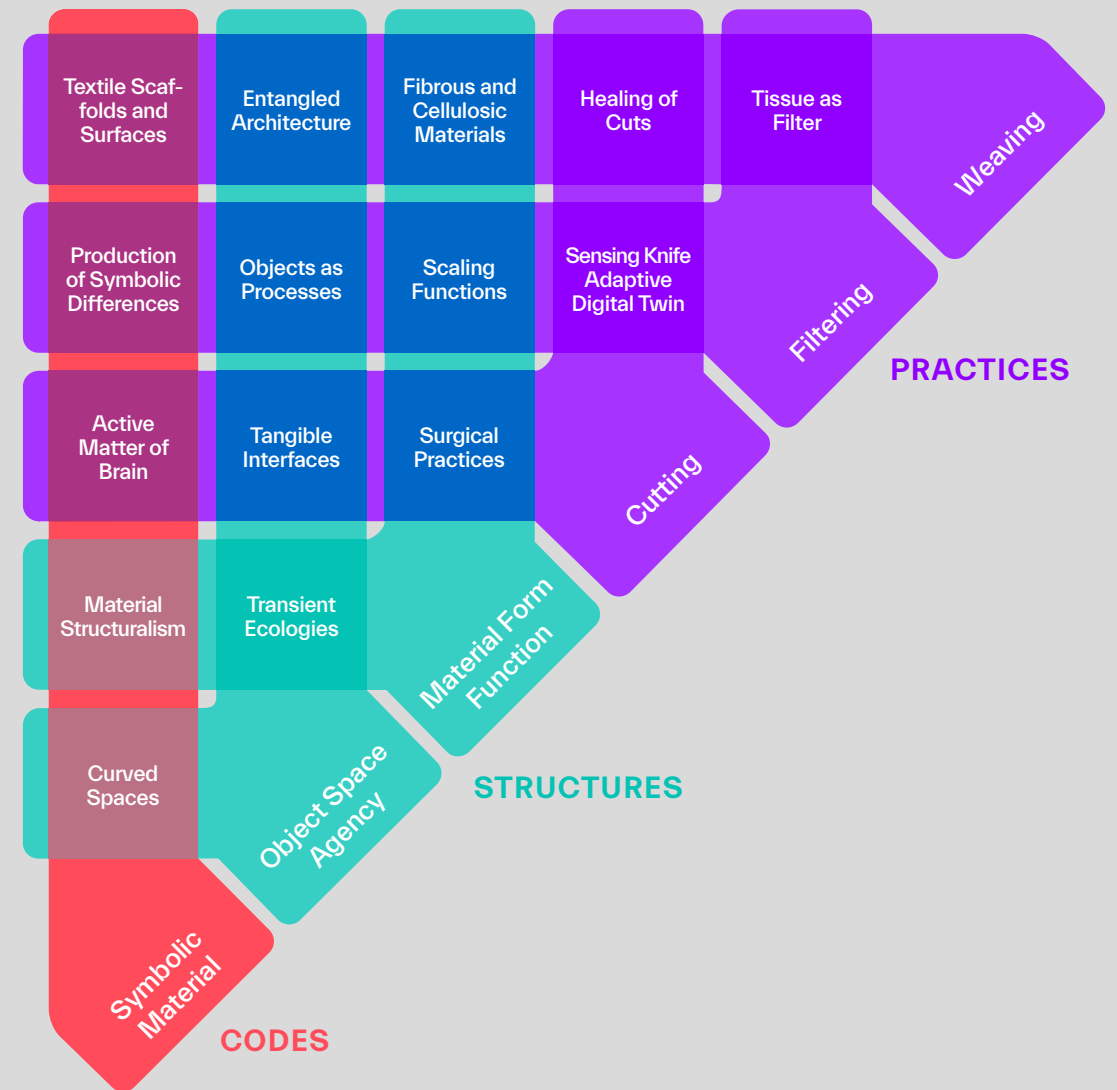
#### 124 IMPRINT

# INTRODUCTION

A groundbreaking event of the 21st century is and will be the reinvention of the analog in the digital age: A new active materiality is beginning to transform research and everyday life. Digital technology gives rise to new modes of agency based on material carriers, spatial structures and images – which, however, are primarily conceived of as passive instruments. As the implementation of the digital into all spheres of life becomes omnipresent, we at the Cluster of Excellence »Matters of Activity« (MoA) propose explorations in the opposite direction by addressing a new culture of the material. For us, both tendencies – digitalization and the reinvention of the material as »active matter« – are deeply connected. Our vision of a new theory and practice of matter can be seen as a »transdigital« consequence that brings the idea of algorithms and code down to earth to reset it within matter itself: we unlock the activity hidden within images, spaces, and materials, revealing their intrinsic symbolic activity and developing them as active construction elements of a new reality in which nature and culture are intertwined in a novel way. The fundamental dichotomy of active and passive material has historically exerted a tremendous impact, not only on crafts and technology but also as a naturalized foundation for Aristotelian gender difference throughout modernity until this day. Treating material as a mere passive entity and ignoring the enormous energy consumption that digital technologies rely on must be seen as major drivers of the Anthropocene crisis of our time. The inner activity of materials analyzed in materials research, physics, and biology, however, points to materials' general activity, which necessarily includes their inner dynamic spatial structures and symbolic and iconic dimensions. The Cluster explores materials' intrinsic activity, which may be taken as a new source of innovative strategies and mechanisms for rethinking the relationship between the analog and the digital and for designing more sustainable, energy-efficient technologies. This shift to active matter draws on important references from the long history of matter and material practices, including European antiquity, prehistoric times, and non-occidental cultures.

MoA builds on the convergent and integrative concept of active matter, a challenging issue driving developments at the core of a whole range of disciplines, including the materials sciences, physics, biology, medicine, mathematics, cultural and science studies, art history, media theory, anthropology, philosophy, and the design disciplines. Since this research topic cannot be addressed adequately by the disciplines individually, a close collaboration between the humanities, the natural sciences, engineering, and design is a fundamental requirement for our Cluster. This interaction helps us to develop matters of activity as a new field of research that intrinsically threads experimentation, theoretical and historical analysis, and design processes as a distributed, but highly integrative research activity: the humanities and design disciplines enter the laboratory, while engineers and scientists conceptually reframe experimentation, thus incorporating their different approaches into convergent project development and the corresponding research processes. The Cluster's collaboration between more than 40 highly specialized disciplines builds on the Interdisciplinary Laboratory established by the Cluster of Excellence »Image Knowledge Gestaltung« in 2012. It connects the heritage of over 200 years of Humboldt-Universität zu Berlin and the legacy of the New Bauhaus, Hochschule für Gestaltung Ulm, and Black Mountain College to form a new type of interdisciplinary and intercultural, dynamic and adaptive research institution.

The Cluster enables an open, but very strategically driven convergent research process centered on *Gestaltung*. Our research approach is conceived as a radical unity of theory and practice: applying the increasing relevance of design to all disciplines, we focus firmly on making.



Project interaction scheme

Incorporating design – traditionally excluded from basic research at universities – as an equal partner recognizes its essential role in the production of knowledge. We consider making a highly sophisticated integration of epistemological theory, experimental practice, design strategies, enactive thinking, and structural operations that combine coding and acting, the material and the symbolic, in the very same process. A vitally important aspect of this is that the new process of making and designing derived from natural materials is a process of unfolding and designing the material's own inner activity.

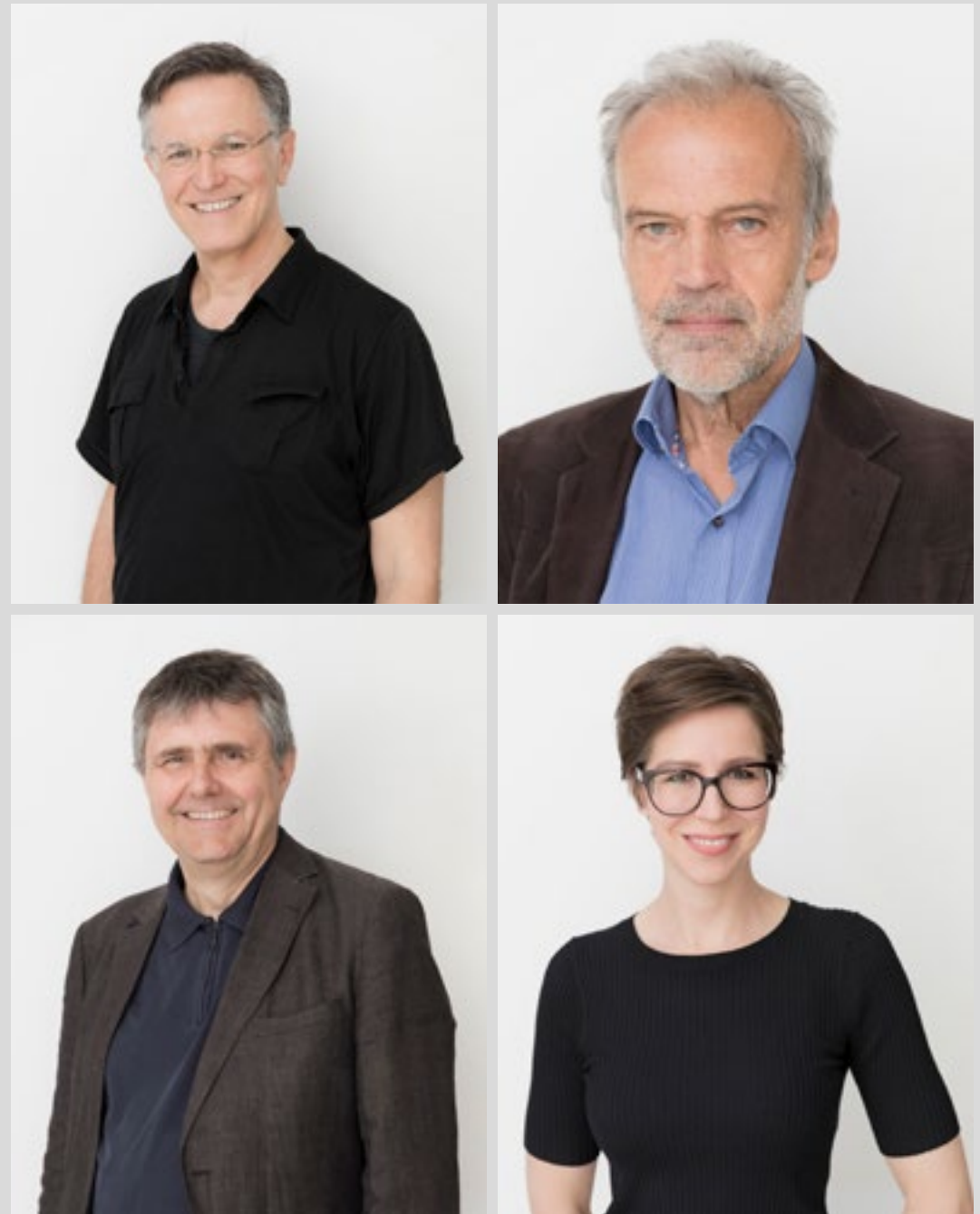
This research focuses on traditional and elementary *practices*, both natural and cultural, such as weaving, filtering, and cutting, that facilitate the analysis of, experimentation with, and design of new forms of processes that rely upon the inherent *structures* and implicit *codes* of active materiality. To address the elementary question of how to rethink matter as an active material and how to identify the ramifications of this fundamental cultural shift, we have developed an integrative research structure that fosters an essentially convergent research process.

Three closely linked research units focus on three different approaches to material activity: from the basic level of cultural and natural material practices and the material's inherent active structures to the challenging idea of novel kinds of material codes. These research units consist of six research projects, their inner architecture providing a high degree of internal connectivity and convergence (see MoA's project interaction scheme in the previous page).

*Practices* serve our fundamental strategic purpose of unifying theory and practice. We take weaving, filtering and cutting as boundary objects or practices, which enable a close connection of very different methods and perspectives and thus play a crucial role for our collaborative research process. Our goal is also to transform practices with a long cultural tradition into innovative processes, thereby generating a fundamental change in our culture. Combining material processes and cultural practices is essential to our research strategy, generating ›tangible‹ but also epistemological and experimental analysis of materials' activity. We conceive weaving as a practice central to nearly all biological materials and as such highly relevant to the analysis of the material's inner activity. Woven tissues are closely linked to filtering, which we also study as a vitally important process in nature and culture. Regarding filtering as a condition of possibility for the production of difference, we combine the analysis of molecular material filters, digital information filters, and other types of cultural filters. Cutting is investigated as a third practice and equally fundamental, subtractive practice of form building: we have selected surgery and anatomy as two critical classic cutting scenarios, in which we envision bodily material in the form of tissue as a foundation for novel ways of smart material-guided cutting. Since these practices are of equal importance in nature and culture, we seek to harness natural processes as inspiration for the design of innovative practices.

Active structures generated through the material's practices and activities constitute a second layer in our research (*structures* research unit). As we regard natural materials as an enormous repository of challenging geometric structures with unknown functions, a central goal of the project Material Form Function is to reveal the intrinsic relationship between the material's form and functional dimensions. It is equally important to analyze the consequences of active structures and materials on the quotidian level of objects, individuals, and architectural spaces. In Object Space Agency, we analyze how our research activities will be transformed by recognizing the activity of materials, images, objects, and even buildings.

Finally, the research unit *codes* addresses the methodological challenge of developing the idea of material code. Our focus on material practices within the project Symbolic Material is the merging of the symbolic and the physical. We no longer perceive the material's inner activity as dysfunctional failures, but as an essential operative coded structure and a reinvention of the analog. Our approach is similar to that adopted with the emergence of the concept of genetic code in the 1950s, when biologists and information scientists started to consider genetic molecules as symbolic code. We extend the idea of coded material from genes to the whole sphere of biological material and hence to matter as such. This fusion of code and matter goes beyond the conventional idea of alphanumeric linear code and addresses the intrinsic relationship between image, matter, and space. Our current research focuses on historical genealogies of an analog code as a prerequisite for describing active materials as coded hardware.



Director Wolfgang Schäffner and co-directors Horst Bredekamp, Peter Fratzl and Claudia Mareis

Based in Berlin and ideally placed to draw on its numerous research facilities, design academies, collections, and museums, as well as its internationally leading design scene, we invite readers to look back with us on highlighted activities and project outcomes from MoA's first research phase from 2019 to 2022.

ACTIVITIES

Events

On a planetary scale, our deep earthly future can be seen as a deep past of other planets, such as Mars. Driven by the flood of sunlight, solid, liquid, and gaseous active matter implies different temporalities inherent to the diverse mineral, biological, or artificial statuses. This very multiplicity of space, time, and scale was addressed by MoA's third annual conference at silent green Kulturquartier. It raised the question of what is going wrong on Earth and how different deep, slow, fast, and future times intervene in the worlds to come. By looking at very different scales, from the internal structures of matter and the interaction of objects and living beings to geological formations and atmospheric dynamics, the conference probed different temporalities of active matter, which shape not only pasts and presents, but also futures. The format discussed and rethought the potentialities, strategies, expectancies, predictions, and imaginaries of desirable futures in terms of interspecies and transgenerational justice. The temporalities of active matter we speak of are always about incommensurable spaces of memory and oblivion, of extinction and survival. »In choosing our topic for the conference, we were inspired by the twin concepts of geological deep time on the one hand and the genealogies or histories of the *longue durée* on the other,« says MoA co-director Prof. Dr. Claudia Mareis. »Coming from different discourses from the earth sciences on the one hand and the humanities on the other, both concepts attempt to make extensive time periods beyond human comprehension graspable and negotiable. However, instead of just interweaving these historiographical perspectives, we also try to project and multiply these concepts onto the future to make it a project of speculative design, which means problematizing the very notion of the future we are speculating upon.«

Organized by MoA's science communication team (Antje Nestler, Carolin Ott and Franziska Wegener), the event brought together international keynote speakers with Cluster members in four panels, moderated by MoA researchers from different disciplines. The day closed with a screening of the film »White Elephant« by Michaela Büsse.

## Panel 1: Wastelands

Prof. Dr. Sandra Jasper (HU Berlin) »Botanical Afterlife«

Moderation: Dr. Anke Gruendel. Discussion: Alwin Cubasch, Prof. Dr. Robert Stock

## Panel 2: Earthly Matter

Prof. Nigel Clark (Lancaster University)

»Igneous Interventions: Working with Fire, Rock and the Inner Earth«

Dr. James Weaver (Harvard University) »High-Resolution Multi-Material Additive Manufacturing: 3D Fabrication of Biologically Inspired Structures«

Moderation: Léa Perraudin. Discussion: Prof. Dr. Karola Dierichs

## Panel 3: Matter Across Scales

Prof. Jeff Diamanti (University of Amsterdam) »Rare Earth and Tender Violence in Greenland«

Prof. Cymene Howe (Rice University) »Elemental Matters, Ethnographic Exposures«

Moderation: Clemens Winkler. Discussion: Michaela Büsse

## Panel 4: Future Materials

Admir Masic, PhD (MIT) »On the Multifunctional Future of Concrete«

Prof. Dr.-Ing. Vera Meyer (TU Berlin) »Fungal Concepts of Time, Space and Vastness«

Moderation: Martin Müller. Discussion: Charlett Wenig





The conversation »Perspectives on Active Materials« aimed to address one of the burning questions of our epoch: the possibility of engineering smart, active, or bioinspired materials and the significance these enhanced materials might have for solving the contemporary and future challenges of these tumultuous times. The event took up questions discussed in the Cluster anthology *Active Materials*, kicking off the workshop »Materials Matter«. As one of the many contributing researchers to the volume, historian of science Prof. Dr. Bernadette Bensaude-Vincent joined the event in presenting its central theses and engaging in a cross-disciplinary conversation with interested participants.

The subsequent workshop focused on new discoveries in the natural and materials sciences that have enabled the development of new, active materials in recent decades: On the one hand, materials are considered entities that »sense« and respond to their environment, while, on the other hand, synthetic and bioinspired materials are fabricated. One of the aims was to unfold the philosophical, historical, and cultural background of these new developments in materials, while looking as well at cutting-edge research on bioinspired materials systems and structures.

The events were a cooperation between MoA and the Cohn Institute for the History and Philosophy of Science and Ideas, Tel Aviv University. They were organized by Dr. Michael Friedman and Dr. Karin Krauthausen and took place at and in cooperation with the Humboldt Lab.

**Bernadette Bensaude-Vincent** *I'm interested in the interface between materiality and societies and how materials can change society, influence societies, shape society and culture. This is of course quite different from the materials science point of view [...], but at some point we have to interact. And that's the main purpose of this meeting, I think.*

**Michaela Eder** *When people start studying materials sciences they're typically dealing with the metals, the polymers, the ceramics and the composites. But biomaterials typically are just an afterthought. [...] I was wondering, Bernadette, at what point biomaterials came into focus for materials science in the US? Were they included or were these treated as separate disciplines?*

**Bensaude-Vincent** *The paradox is that it's really the perspective of making materials by design, making composite materials, which are extremely artificial. When you try to make materials as light as plastic, as strong as metal or as refractory as ceramics, it's a kind of a chimera - there is nothing more artificial. But at this utmost point of extreme artificiality, a shift in perspective occurred: we had to look at nature. Because nature is mainly made of such composites. The beginning of the study of natural materials occurred in the 1970s and 80s, particularly marine shells, which are really organic and minimal at the same - a hybrid material. [...] That was the beginning of research on biomaterials and wood redefined as composite materials.*

**Peter Fratzl** *The interesting thing is that the way you just described the artificiality of composite materials, we are now seeing a trend [in materials science] to say that what nature achieves with its materials is largely thanks to not very performant base substances - for example, nacre is 3.000 times more fracture resistant than the mineral it is made of. The reason is its 1% polymer content - this is just architecture that is built in. And now imagine applying this approach to the kind of materials we know how to make, such as refractory ceramics combined with the structural concept of nature. [...] In the end, the inspiration from nature is taken to be »better« than nature - better in whatever sense! [...] I think the challenge now is designing structures at all scales, from the molecule all the way to the macroscopic.*

Extract from the panel discussion, which is also available as an audio broadcast



Michael Friedman, Michaela Eder, Peter Fratzl, Bernadette Bensaude-Vincent, Richard Weinkamer and Karin Krauthausen in conversation at »Perspectives on Active Materials« at Humboldt Lab

# Tipping Points. Plastic, Contingent and Unstable Matters

16/17 November 2021

Events

ACTIVITIES

Assuming that we live, create, and act in a time of tipping points, the Cluster's second annual conference was all about matter in motion. The format discussed transition and contingency, processes of acquiring and losing form, and the creative potential of the unfinished and indeterminate. On a planetary scale, the tipping point was understood as an abrupt and irreversible change that is causing the Earth's climate and other systems to fall out of their stable state. Such transitional phenomena are particularly significant in climate research, but no less so in material, biological, anthropological, and aesthetic contexts, in filtering processes, and in the formation of models that shape perception. By slowing down plural tipping points, we may be able to view them in our timescale as our lifetime events that are leading to profound changes in processes, behaviors, and actions. Beyond »points of no return«, the focus of the conference was on multistable, ambivalent, and dynamic constellations: From adaptive processes of bacterial growth to fluid structures to plasticity in architecture, ongoing Cluster projects were presented in 13 lectures and virtual lab tours. All conference contributions in the four panels »Plasticity & (In)Stability«, »Indeterminacy and Liveliness«, »Fragile Entanglements« and »Contingent Matters« are still available as part of the »Virtual Cluster Space«.

The event was organized by a group of the Cluster's early career researchers (Frank Bauer, Dr. Lorenzo Guiducci, Skander Hathroubi, PhD, Yoonha Kim, Dr. Sabine Marienberg, Natalija Miodragović, Iva Rešetar and Clemens Winkler) with MoA's science communication team.

16

[www.matters-of-activity.de/tippingpoints](http://www.matters-of-activity.de/tippingpoints)

# Tipping Points: Plastic, Contingent & Unstable Matters

Annual Conference  
16 & 17 November 2021



Matters  
of Activity

Image  
Space  
Material

More information and registration  
<https://www.matters-of-activity.de/tippingpoints>

Save the Date of »Tipping Points«. Animation by Josef Luis Pelz (adapted by NODE Berlin)



Annual conference »Tipping Points«, hybrid set-up in the Cluster's Central Laboratory

# Filtering Legacies. Filtering Wasted Environments

11/12 November 2021

Events

Filtering technologies are at the center of many current processes of our transformational age, as they can alleviate the impact of industrial societies in their planetary dimension. The hybrid workshop »Filtering Legacies. Filtering Wasted Environments« analyzed the interconnectedness of environment, filtering technologies, and waste legacies in its historical dimension and explored how hazardous waste has been both a target and a result of human filtering activities. A cooperation between the project Filtering and Technische Universität Berlin, »Filtering Legacies« was organized by Alwin Cubasch, Vanessa Engelmann and Ronja Quast, together with Heike Weber, professor for the history of technology, and Verena Winiwarter, professor for environmental history at the University of Natural Resources and Life Sciences in Vienna. It aimed to achieve a better understanding of the ecological economy of wastes, sinks, and waste legacies that has resulted from the hope of unmaking the adverse byproducts of filtering activities. What have been the challenges and pitfalls in the past – and what can be learned for the future design and technology of filters? The process of filtering was understood as a scalable enviroing technique that differentiates and maintains symbolic and material environments alike. Filtering is a process that matters in a twofold way: it is both a material process and a symbolic activity. Applying filters means negotiating between the wanted and the unwanted, between the polluted and the untouched environment, and between what is considered dangerous or safe. Yet filters themselves produce and accumulate wastes of condensed toxicity that are in desperate need of a sink. At the same time, many earlier sinks have not been able to contain the waste they were supposed to. Conversely, imaginaries of a »natural«, harmless dissolution of hazardous residues through soil, water, or air have proven to be elusive. The persistence of toxicity and toxic residues highlights the fundamental asymmetry and irreversibility inherent in most filtering processes.

ACTIVITIES

18

## Workshop Filtering Legacies— Filtering Wasted Environments

**Thursday 11 Nov. 2021**

12:30  
Get together

14:30–16:00  
**Session 1**  
(Moderation Alwin Cubasch)

Simone Müller (Rachel Carson Center):  
Contested Boundaries of Hazardous Waste.  
Filter Technologies and the Controversy on  
Waste Incineration in 1980s USA from  
a Global Perspective

Manuel Harms (TU Dresden):  
The 'Reverse' and 'Productive' Toxicity  
of Antimicrobial Resistance

16:30–18:00  
**Session 2**  
(Moderation Heike Weber)

Elena Kunadt (TU Berlin):  
Technische Lösung oder Anwendungsverbot:  
Lässt sich Atrazin aus dem Wasser filtern?

Paulina Grebenstein (urban:eden lab):  
Urbane Naturfilter

18:15  
**Keynote**  
(Moderation Claudia Mareis)

Verena Winiwarter (BOKU):  
Technologically Enhanced Naturally Occurring  
Radioactive Materials: A Borderline Case

20:00  
Dinner

**Friday 12 Nov. 2021**

9:30–11:00  
**Session 3**  
(Moderation Christian Kassung)

Khashayar Razghandi (ExC MOA):  
Rethinking Filter: An Interdisciplinary Inquiry into  
Typology and Concept of Filter

Léa Perraudin (ExC MOA):  
Leakage and Accumulation. A Field Test for Enviroing

11:30–13:00  
**Session 4**  
(Moderation Verena Winiwarter)

Sabine Loewe-Hannatzsch (TU Freiberg):  
Waste Legacies of Uranium Ore Mining by  
the SAG/SDAG Wismut, 1946–1991

Stefan Guth (Universität Tübingen):  
Unfiltered Reality. Facing the Legacies of  
Uranium Mining and Plutonium Production  
in Western Kazakhstan

13:15–14:00  
Conclusion

14:30  
Lunch

**Workshop**  
Thursday 11–12 November 2021  
For physical/digital attendance please register  
till 1 November 2021 here: [ronja.quast@hu-berlin.de](mailto:ronja.quast@hu-berlin.de)

Organisation: Alwin Cubasch, Heike Weber,  
Verena Winiwarter, Ronja Quast, Vanessa Engelmann

Matters of Activity | Energy Science Material | DFG | TU | University of Natural Resources and Life Sciences

# Times of Waste. Handling Matter

17/18 June 2021

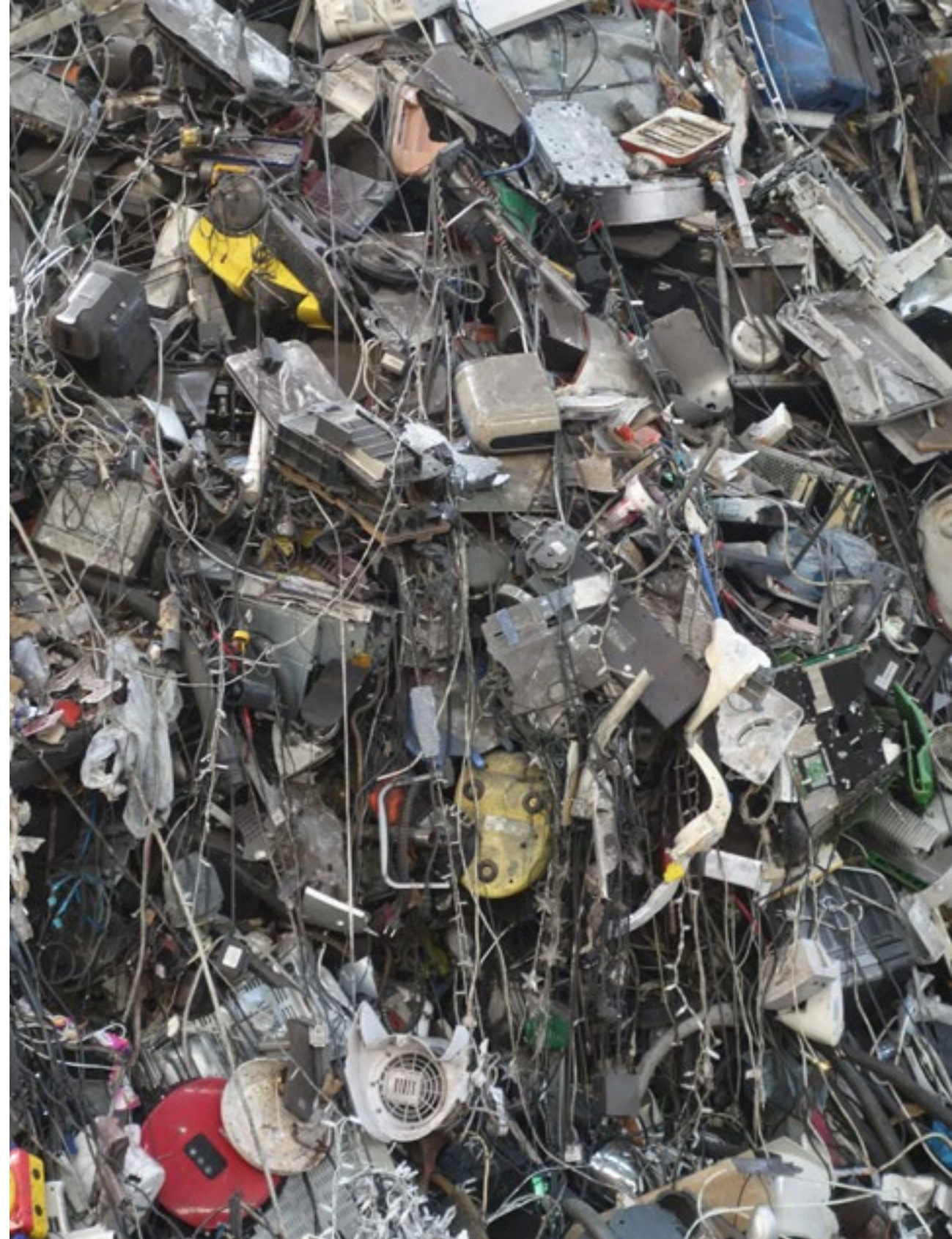
Events

On transport and recycling routes extending from local contexts into global connections, objects undergo not only material transformation, but also economic, social, aesthetic, or rhetorical reassessments.

Continuing on the subject of waste and the question of waste as a »new« resource, the online symposium »Times of Waste – Handling Matter« provided a platform to discuss the engagement with (waste) material and bridges between theoretical studies and a response/able, careful way of handling materiality in the sciences, the arts, and collections. It was conceptualized and curated by the research team »Times of Waste« at the Basel Academy of Art and Design (FHNW) in collaboration with MoA and the Kunstgewerbemuseum (Museum of Decorative Arts) Berlin. This research project studies the purification, treatment, and reuse or disposal of objects and materials as well as at the involved actants and fields of activity. The aim of the project is to deconstruct cultural connotations of waste and to influence the discussion on sustainability in the Basel region and beyond in the context of globalized developments. It does so by applying an artistic-scientific process-oriented approach and its aesthetic implications. The online symposium was accompanied by on-site guided exhibition tours at the Kunstgewerbemuseum.

ACTIVITIES

20



E-waste recycling Immark bei Zürich. © Research project »Times of Waste«

# The Analog in the Digital Age

11 November 2020

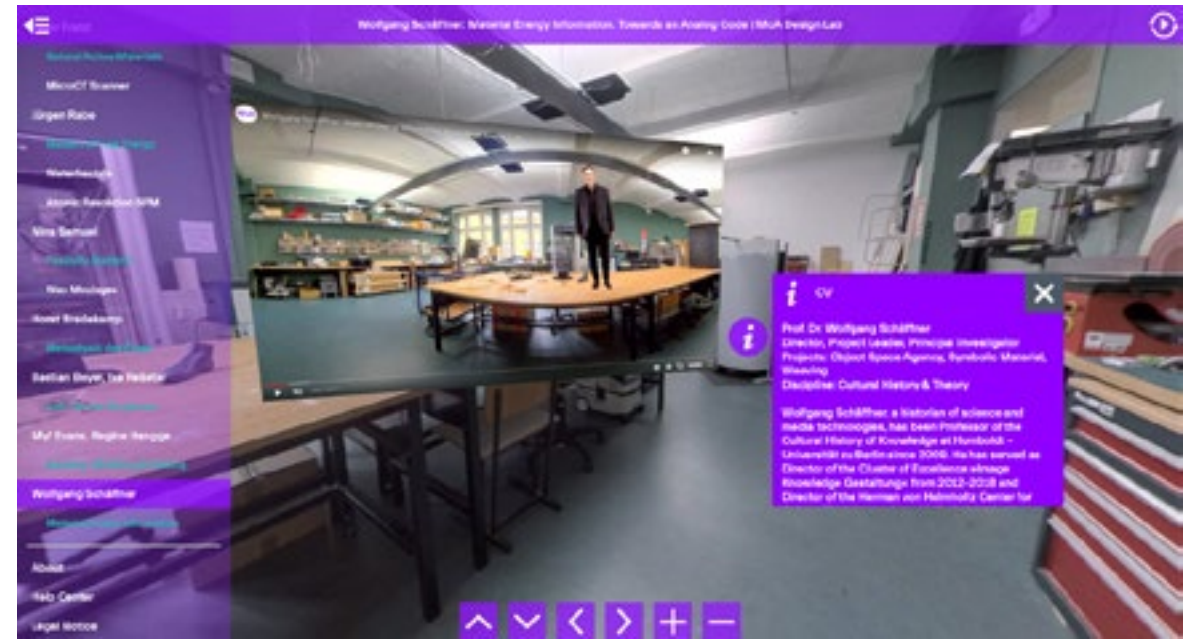
Events

MoA's first annual conference followed one of its central visions to rediscover the analog within activities of images, spaces, and materials in the age of the digital. Challenging times called for new formats: during the initial phase of the organization, an on-site, analog event was planned. Closer to the actual conference day on November 11th, 2020, it became obvious that the global Covid-19 pandemic would not allow for a »regular« conference. Within two months, a digital alternative that would enable analog and active objects to be part of the conference had to be found. The goal was to produce content that would remain accessible long-term and give a broader audience a digital glimpse into the Cluster's architecture, workings, and materials. During the pandemic, when science communication gained a new public, MoA finally opened the doors to its Virtual Cluster Space within the framework of the annual conference, showing laboratories, 3D presentations of selected research objects, as well as current research topics in 360° formats. Prerecorded video lectures from MoA researchers from fields ranging from the natural sciences to the humanities and design disciplines were launched in so-called knowledge rooms, designed as 360° environments, followed by a live Q&A on Zoom to enable personal encounters and exchanges with the lecturers and conference participants.

ACTIVITIES

*»Addressing the material activity as the analog is not a strategy to go back to a pre-digital analog, but to reset symbolic operations within the material itself according to the material's inner activity without silencing its own capacities.«*

**Wolfgang Schäffner**, director



Wolfgang Schäffner holding his lecture »Material Energy Information: Towards an Analog Code« at MoA's design workshop, displayed in the Virtual Cluster Space



Welcome to MoA's first annual conference at the Virtual Cluster Space

ACTIVITIES

Exhibitions

»Can Bacteria Spin a Yarn?« This was the title of an interactive live show by MoA researchers, opening the event series »MitWissenschaft / WeSearch« at the Humboldt Forum on April 29th, 2021. They showed how the natural sciences, humanities, and design disciplines collaborate closely to find innovative solutions to contemporary problems. The discussion round represented the Cluster's holistic approach to pursuing a new material culture. Based on the collaboration across disciplines, the goal is no longer to find partial solutions, but rather to explore the question: do we humans still have a future?

The Humboldt Lab in the Humboldt Forum presents research by the Berlin Clusters of Excellence and other cutting-edge institutes and faculties at HU Berlin. It aims to become a living workshop of ideas where top-level research enters into a dialogue with the public on pressing issues of our time. Visitors see for themselves the significance of scientific inquiry and interdisciplinary work and experience how scientific research affects everyone. In its inaugural exhibition, »After Nature«, MoA contributed to this discourse with a visual introduction and various exhibits, opening up diverse insights into its research projects. One central object is the »Active Curtain«, an ongoing experimental setting which brings together various disciplinary skills in order to rediscover adaptive textile techniques – crafted and grown – in the quest to create an active basis for our relationship with our environment. Woven into a curtain in the entrance area of the Humboldt Lab, various interactive and translucent elements made of bacterially generated plant cellulose react to the room climate. The naturally generated matter moves, connects, swells, and twists – without any conventional mechanical devices. The scale and the hidden speed of its activity are shown in images and films. An interview with architect Bastian Beyer and biologist Skander Hathroubi, also on display in the exhibition, presents the development of the »Active Curtain« in more detail, explaining how they work together to explore new, sustainable materials and bacterial structures. The project involved Cluster members Bastian Beyer (PhD), Skander Hathroubi (PhD), Prof. Dr. Regine Hengge, Natalija Miodragović, Iva Rešetar, Prof. Christiane Sauer, Nelli Singer and Daniel Suarez.

Other Cluster projects are still on display as of 2023. The »Adaptive Digital Twin« is a project that aims to generate adaptive holographic models of the human brain. It is led by Prof. Dr. med. Thomas Picht, Dr. Lucius Fekonja, and Felix Rasehorn in collaboration with researchers from Charité – Universitätsmedizin Berlin and King's College London. »Orobates Pabsti« is a 3D model showing the locomotion of a prehistoric dinosaur. Reminiscent of a reptile, the model symbolizes how scientists work, explains Prof. Dr. John Nyakatura: »The mounted skeleton illustrates our approach to reconstruction and shows that we deal transparently with uncertainties.« »Stone Web« was developed by designers Idalene Rapp and Natascha Unger under the supervision of Prof. Christiane Sauer at weißensee school of art and design berlin. Its aim is to produce multipurpose, lightweight modules for interior design. »After Nature« opened its doors as part of the Berlin Science Week in 2021, providing a closer look at the exhibits and insights into MoA's research.

*»We really tried to collaborate with the micro-organism to build something together – so it's not only about us as humans, and also not only about collaboration between disciplines, but generating a structure by working with a different life form.«*

**Bastian Beyer**, postdoctoral researcher, Weaving



Interview still with Bastian Beyer and Skander Hathroubi showing the making of parts of the »Active Curtain Project«, directed by Anne von Petersdorff. © HU Berlin



The »Active Curtain Project« at the exhibition »After Nature« at Humboldt Lab



Exhibition view of »After Nature« at Humboldt Lab



# DAOULA | sheen. West African Wild Silk on Its Way

November 2022  
— June 2023

Exhibitions

West African wild silk is on its way... The exhibition »DAOULA | sheen« at Tieranatomisches Theater focused on the natural formation and cultural history of wild silk obtained from caterpillars in West Africa and on the many and complex ways in which this unique material is viewed by microbiologists, materials scientists, and architects in Germany. Curated by Laurence Douny (PhD), Dr. Karin Krauthausen, and Felix Sattler and cocreated by a large and diverse multidisciplinary team, this unusual project set out to stimulate a dialogue between West African craft, European science, and design. In Burkina Faso, daoula is a term meaning »sheen« or »charisma«. For the Marka-Dafing community, daoula is one of the natural characteristics of certain animals, humans, and things. However, each community has its own unique access to the meaning of, and knowledge about, daoula: silk producers from Burkina Faso, microbiologists, materials scientists, and architects from Germany each have their own terms and their own specific sets of tools. Wild silk cocoons travelled from Safané (Burkina Faso) to Berlin to be examined by materials scientists, molecular biologists, anthropologists, cultural scientists, architects, and designers, who wanted to understand what they see, what this material can do, and why it does what it does. Is it something intrinsic to the material itself? Or is it due to the spinning and weaving processes? And what is the nature of these processes? And where is the sheen that the local communities in Burkina Faso value so much, but which is so difficult for the human eye educated in European traditions to recognize? The exhibition focused on the exchange of knowledge between different actors with plans for a showing at the Musée de la Musique Georges Ouedraogo in Ouagadougou (Burkina Faso).

ACTIVITIES



Afissata Fofana and Mamadou Séré of Safané (Burkina Faso) wearing traditional cloth at the exhibition opening of »DAOULA | sheen«, watching a film by Thabo Thindi (with footage by Salif Sawadogo and Laurence Douny) on Safané women's production of wild silk textiles



Exhibition view of »DAOULA | sheen«. West African Wild Silk on Its Way at TA T. Photo: Michael Pfisterer

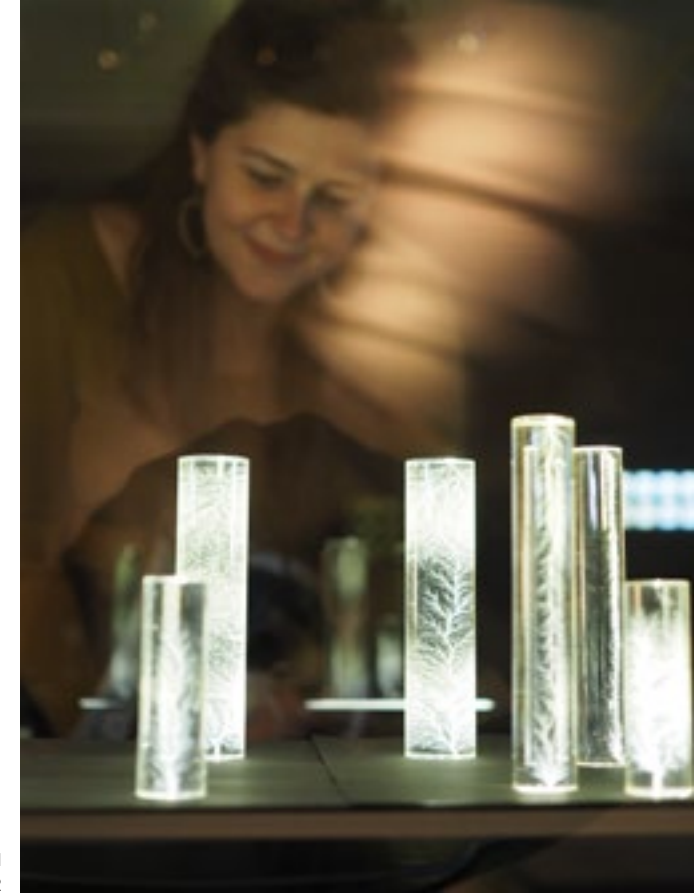
# Design Lab #13: Material Legacies

September 2022  
– February 2023

Exhibitions

ACTIVITIES

Materials tell of futures: not only of futures lost to extraction and consumption, but perhaps of alternative futures that are more sustainable, diverse, careful, and solidary than what we experience and expect today, through a different understanding of materials, their potentials, and legacies. The exhibition »Design Lab #13: Material Legacies« at the Kunstgewerbemuseum Berlin explored contingencies and ruptures between traditional crafts and the most recent developments at the crossroads of materials research, design, engineering, and architecture. It brought together artifacts from the museum's collection with work-in-progress installations by designers and researchers from MoA in order to initiate a dialogue about the historical, contemporary, and future conditions under which materiality unfolds. By engaging with a series of different materials and techniques, the exhibition encompassed both the problematization of unsustainable pasts and presents as well as the imagination of speculative material futures. Accordingly, the material legacies that the exhibition attempted to tell were stories of inextricable entanglements and traces of potentiality and friction. »Design Lab #13: Material Legacies« was curated by Michaela Büsse and Emile de Visscher (PhD) as part of the Design Lab exhibition series at the Kunstgewerbemuseum curated by Dr. Claudia Banz.



»Vascularization« on display at »Material Legacies«, Kunstgewerbemuseum Berlin, 2022



»Tessellated Material Systems« on display at »Material Legacies«, Kunstgewerbemuseum Berlin, 2022



# Stretching Materialities

September 2021  
— March 2022

Exhibitions

Matter is dead? Objects are lifeless? Think again! The liveliness and activity of matter was made tangible in the exhibition »Stretching Materialities«, becoming an interactive playground for its duration at Tieranatomisches Theater in Berlin: An actual cloud levitated in the middle of the room, reacting to body heat and movement, hovering around the visitors like a strange creature. Stones revealed their weathering as a dynamic process of change. Large willow structures, carefully cocrafted by humans and computers, were interwoven with the inhabitable space. Korean *durumagi*, a silk overcoat connecting the digital and physical realms, vibrated on visitors' skin as they interacted with diverse materials. Walking through the room with VR headsets on, visitors could enter a glass elevator and ascend or descend directly into the materials presented – down the CT scan of a stone or high up into the clouds to interact with air molecules. With knowledge gained from the Cluster's research, a hands-on laboratory space was created that allowed unexpected insights into thinking about matter, making the activity of the world around us tangible. The exhibition was curated by multidisciplinary scientists and designers from the project Object Space Agency. Combining interaction design, architecture, art history, computer science, and anthropology, the exhibition also stretched the disciplines in order to enter into sensuous resonance with the vibrant material world. »Stretching Materialities« became an open experimental platform engaging theory and practice and encouraging its visitors to imagine they could expand their senses to feel, see, hear, and touch the material world beyond human sensory abilities. In November, it opened its doors for guided tours and a sound performance as part of the Berlin Science Week 2021. In March 2023, the exhibition was restaged in Buenos Aires under the title »Materiales en Expansión« in cooperation with the Museo de Artes Plásticas Eduardo Sívori.

ACTIVITIES



Visitors on the elevator platform with the cloud above them, selecting new levels to lift to at »Stretching Materialities«, TA T, 2021



»Stretching Materialities« Virtual Reality App: Level »Geological Performers«, Studio Above + Below



Thinking and acting out different connection points in-between weaving, weathering, cutting and virtual layers in the center of the Virtual Elevator at the exhibition »Stretching Materialities«, TA T, 2021

# ACTIVITIES

**Science  
Communication**

# Virtual Cluster Space

The Cluster expanded its efforts in science communication and began the development of a Virtual Cluster Space in November 2020. It aims to present and experience the research work of various MoA projects and topics – particularly contributions to its annual conferences – in an innovative, interactive, fascinating and expandable way that is able to raise users' curiosity, excitement, and engagement, both inside and outside our research community.

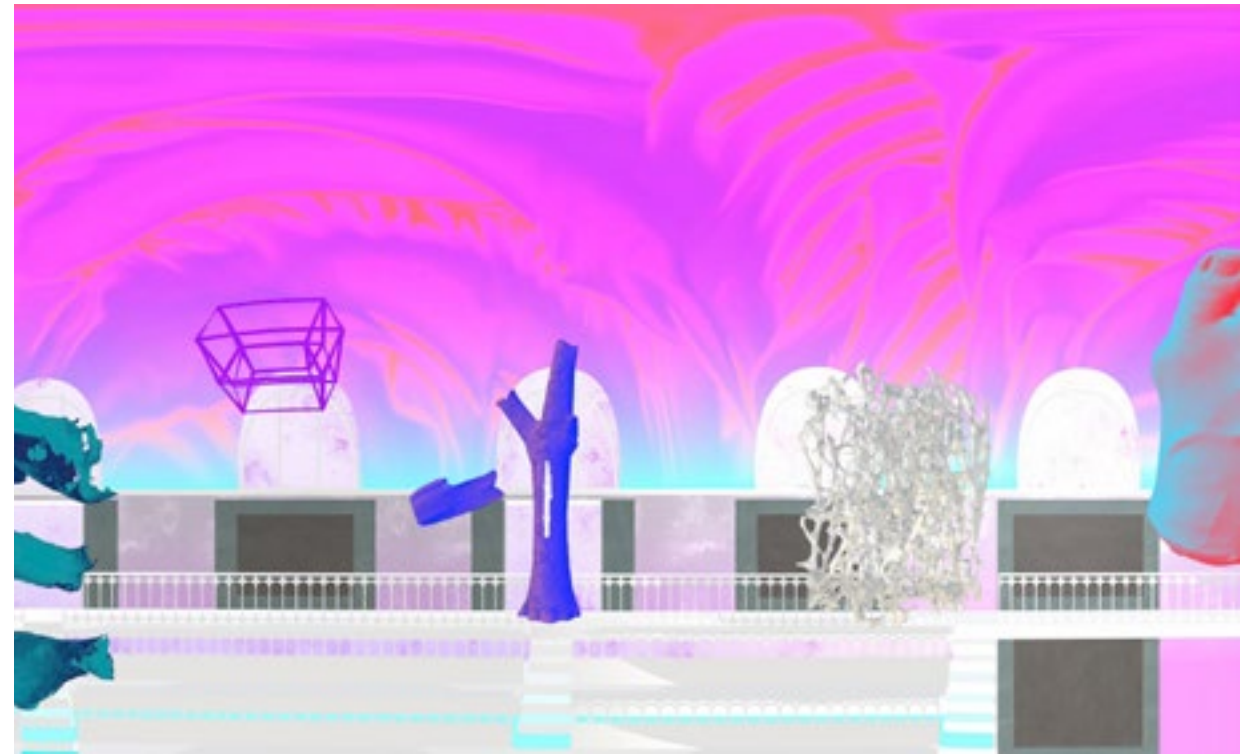
In 2020, the Cluster built its very own greenscreen studio, where lectures and discussions were prerecorded and placed in a so-called Virtual Cluster Space, serving as a conference environment for MoA's first annual conference in 2020. In place of tiring Zoom conferences dominant during the Covid-19 pandemic, the goal was to make digital content public in a sustainable and innovative way. In a second phase in the course of 2022, the platform was further developed to contain the content of the second annual conference from 2021.

The Virtual Cluster Space contains navigable 360° »knowledge rooms«, enabling placement for videos and other information such as images, text, or audio, making the space a virtual exhibition of the Cluster. The 360° images contain information and provide access to otherwise secluded laboratories and materials. Technically, the project was built with the open-source web technology »Marzipan« in order to make the developed content and the written code reusable for other projects.

Cluster member Antje Nestler presented the Virtual Cluster Space as a best-practice example of a virtual exhibition and conference format at Forum Wissenschaftskommunikation 2021.

*»Our goal was to take our audience to places they haven't seen before or don't usually have access to, such as research labs or the inside of material structures invisible to the human eye.«*

**Antje Nestler**, science communication



3D Anchor Room of the Virtual Cluster Space



Claudia Mareis' lecture »Truth to Materials. Entangled Histories of Design and Material Politics« displayed at the Virtual Cluster Space



# CollActive Materials

How do we want to live in the future? What values are important to us? What can and do we want to change? In order to act and decide sustainably in the present, we need visions and ideas of what a desirable future might look like for us – individually and socially. But socially or ecologically sustainable visions of the future are rare: instead of being driven by societal desires and planetary needs, many of the visions of the future that surround us today are driven by technology and sales. The goal of the experimental science communication laboratory CollActive Materials is to develop a methodology that science and civil society can use to jointly develop new visions of possible futures, futures of materials, and material cultures. At workshops and events, participants are invited to think about new material futures: What might they look like or feel like? Could they be more active or more intelligent than the materials of today? Might active materials enable a new way of thinking and acting for our society in the ecological crisis? The methodology focuses on the practice of speculative design, a critically questioning form of (object) design. At the interface between science, art, and everyday life, objects, scenarios, and stories from possible futures are created in workshops, for example, at Berlin Science Week, inviting a larger public to join the debate. The aim of engaging with the emerging future prototypes is to enable new debates and negotiations about what kind of world we – individually and collectively – want to live in in the future. At the heart of this work is the curiosity in trying things out together and learning from each other directly on and with the material. The experimental lab is a joint project of MoA and the Berlin Cluster of Excellence »Science of Intelligence« and is funded by the Berlin University Alliance. It includes postdoctoral researchers Léa Perraudin and Martin Müller as well as MoA coordinators Kristin Werner, Antje Nestler and Eva Bullermann.

*»What if buildings and cities in the future were no longer made of rigid materials, but grew and adapted to their surroundings, like plants? What if materials were not thrown away or burnt after use, but recycled in a self-organized way into different states of matter? What if we could find another way of living with each other by learning from living materials?«*

**CollActive Materials**



At the Kombucha workshop of CollActive Materials at »Mall Anders« participants were able to directly explore the activity of bacterial cellulose. © SCIOI Seesaw



Participants during the first speculative test workshop of CollActive Materials at Berlin Science Week 2022, Museum für Naturkunde. © SCIOI Seesaw

# Long Night of the Sciences

# Excellence Explained



Cube of Physics: <https://cube-of-physics.org>.  
Multimedia installation at the Department of Physics, HU Berlin, 2022. © studio gid

On the occasion of the Long Night of the Sciences, Berlin's seven Clusters of Excellence presented themselves at the Humboldt Lab. As part of the »Meet the Scientist« series, researchers presented their outstanding research projects – in dialogue with the public. For MoA, microbiologist Prof. Dr. Regine Hengge and Cluster director and cultural historian Prof. Dr. Wolfgang Schäffner introduced the »Active Curtain Project«, an ongoing experimental setup on display at Humboldt Lab (see our section on Cluster exhibitions). Moreover, the »Cube of Physics« could be visited at the Department of Physics in Adlershof. The expansive art installation and a lecture addressed the question of whether the entire knowledge of physics can be represented in a cube. The »Cube of Physics« of the Department of Physics and IRIS Adlershof was developed in cooperation with the Department of Cultural History and Theory and the Cluster.

57 Clusters of Excellence – one podcast: »Exzellent erklärt« (»Excellence Explained«) regularly reports from one of the research networks that are funded as part of the Excellence Strategy of the German federal and state governments. The journey goes right across the country, and the topics are just as diverse as the locations: from African studies to the future of medicine. All Clusters of Excellence share a common motivation: they address important issues of our time, work on unusual questions, and conduct research for the society of tomorrow.

For episode 18 of the podcast series, »What Is Our Future Made Of? Active Materials and Bio-inspired Design«, journalist Larissa Vassilian spoke with Cluster co-director Prof. Dr. Claudia Mareis, designer and cultural historian, and research associate Dr. Khashayar Razghandi, materials scientist and design teacher. They explain in what sense MoA is concerned with the question of active materiality, providing insights into how the interdisciplinary approach gives researchers the opportunity to examine central questions from different angles: How do we deal with materiality in the age of digitalization? Can other understandings of materiality lead to other modes of production or other ways of living?

[www.exzellent-erklart.podigee.io/18-neue-episode](http://www.exzellent-erklart.podigee.io/18-neue-episode)

# Mall Anders

Situated in the middle of a shopping mall, »Mall Anders« was a temporary testing ground and laboratory for inter- and transdisciplinary learning and for working on central research topics in an urban space. Due to its location, it was not limited by campus boundaries and exclusive building forms, but rather formed a barrier-free meeting space for all. Initiated by Berlin universities and planned by a team of specialists for transdisciplinary teaching at the TU Berlin, the initiative was funded by the Berlin University Alliance to make the research topics of Berlin's Clusters of Excellence more visible, on the one hand, and, on the other, to test and further develop participatory teaching and learning processes at the interface between academic research and society.

At this remarkable temporary testing ground for learning, discussing, experimenting, and exploring, the Cluster's science communication lab CollActive Materials initially started its conversation about material presents and futures. It hosted two days for science and the public to get together and (re)negotiate the futures of materials. With its pop-up materials lab »What Is The Future Made Of?« and innovative formats for knowledge exchanges on an equal footing, the project was able to test numerous interaction and participation formats tailored to the target group. The informal »Meet the Scientist« and »Storytelling« events, organized in cooperation with the Berlin Clusters of Excellence »MATH+«, »NeuroCure«, »UniSysCat«, »Science of Intelligence«, and »SCRIPTS« introduced a broad public to researchers from very different disciplines, providing insights into their work.



Experiment with materials at the kids lab of CollActive Materials at »Mall Anders«, 2022.  
© SClol Seesaw



Learning Laboratory »Mall Anders« in WILMA Shopping Center. © SClol Seesaw



»Dissect«, a round table live performance on contemporary art and design at TAT Berlin in cooperation with EnsAD, Paris, as part of the Berlin Science Week, November 2022

ACTIVITIES

Early Career Research

# Doctoral Program

The presentation of MoA's doctoral program during the annual retreat at Landgut Stober in Nauen in 2022 was both a review of the doctoral research conducted at the Cluster since the start of the first cohort in 2020 and a future outlook. Under the title »Scaling Matters: From the Lab to the Field«, pre-doctoral researchers at varying stages of their research – from the very beginning to the final phase of their theses – presented their heterogeneous work whilst continuing to negotiate common themes, methods, questions, and tools. On the one hand, the perspective »From the Lab to the Field« points to the interrelationship between laboratory work conducted in Berlin and fieldwork pursued on the activity of matter across the world. On the other, it refers to research development carried out in the program's laboratory within the field of further academic research and practical applications. The format combined talks and an exhibition and invited MoA members to engage individually with the presentation and selection of their research objects. Developed in the regular meetings of MoA's doctoral program as a practice of science communication and of peer-group formation, the presentations can be viewed as a documentation of the program's approach.

MoA's doctoral program enables outstanding dissertations within a period of 36 months and, in addition to disciplinary qualification, establishes a close cooperation between the natural and engineering sciences, the humanities, and design. The small cohort size allows for an intense interdisciplinary exchange, aiding the research and development of sustainable strategies and technologies. It creates an ideal basis for collaboratively researching active materiality to a high scientific standard while simultaneously being application-oriented in approach.

As a member of the Humboldt Graduate School, the program's quality standards are under the supervision and evaluation of the HU Berlin umbrella organization for graduate students, which additionally offers a wide range of services and soft skills training, as well as mentoring programs.

*»Why would one choose scaling as a unifying principle to approach diversity among young researchers inquiring into active materiality? Attempting an answer, the present format understands scaling as a transdisciplinary, operative constant, and it does so from various perspectives – as we learned how many concurring disciplinary perspectives contribute to its image while projecting this collective endeavor. It is fascinating to witness that, whether in the field of design, the natural sciences, or the humanities, researchers use scaling to approach active materials. Therefore, definitions of scale used among the MoA PhD projects are not consistent, and even within a single project, one can find the concept used in manifold and often complementary ways. Rather than suggesting one concise explanation of such complexity, we would like to propose a conversation on the dynamic use of scaling in an interdisciplinary research setting.«*

**Frank Bauer and Yoonha Kim, pre-doctoral researchers**



»Scaling Matter. From the Lab to the Field«, exhibition of MoA's doctoral projects, 2022

# Early Career Awards



Hybrid interactions for neurosurgical planning, project »Digital Twin«

With his project »Adaptive Digital Twin« on brain surgery, pre-doctoral researcher Felix Rasehorn was nominated for the German Design Research Award for young designers in September 2020. His design research project is an ongoing interdisciplinary inquiry into the planning of neurosurgical interventions using hybrid tools. The project emerged as part of an experimental setting within the project Cutting, in which an interdisciplinary team at Charité is working on new methods for visualizing and analyzing the brain.



»Soft Collision«, inflatable membrane as a new form of human-machine interaction

With her project »Soft Collision«, pre-doctoral researcher Anna Schäffner successfully applied to one of the three VOJEXT S+T+ARTS residencies on robotics. The residencies program aims to push for art-driven innovation and societal understanding of human-robot interactions and to integrate them into industrial manufacturing robotics employed in construction, arts, and crafts. Supported by industrial partner and tech provider Fondazione Istituto Italiano di Tecnologia, the residency will provide 30.000 euros of funding as well as mentoring and access to robotics labs.

# Teaching

In addition to its own Master's program (see our section on International and Cultural Diversity), Cluster researchers are engaged in a number of interdisciplinary experimental and innovative teaching formats in cooperation with academic partners and institutions, including weißensee school of art and design and the Max Planck Institute of Colloids and Interfaces (MPIKG).

»Scaling Nature« was initiated by Prof. Christiane Sauer, Dr. Lorenzo Guiducci, and Dr. Khashayar Razghandi. As a three-part teaching series on »Wrinkles«, »Fibers, Muscles, Bones«, and »Growth«, it brought together students from the Department of Textile and Surface Design at weißensee school of art and design with Cluster researchers and researchers from the MPIKG. The project centered on interdisciplinary research into, and the development of, sustainable practices and structures in areas such as textiles, material and digital filters, surgical cutting techniques, architecture, and soft robotics. Also in cooperation with weißensee school of art and design and the MPIKG, the semester projects »Designing Matter« and »Minimal Machines« investigated designed filaments and fabrics as architectural material systems and the development of machines for non-augmented and augmented spinning on an architectural scale. They were supervised by Prof. Dr.-Ing. Karola Dierichs, Jessica Farmer, Dr. Mareike Stoll, Laurence Douny (PhD), Dr. Michaela Eder, Nicolai Rosenthal (MSc), and Charlett Wenig.

Now entering its seventh round, the interdisciplinary course »Coding IxD« (Information Technology x Design) first emerged as a cooperation between the Human-Centered Computing Research Group at Freie Universität Berlin led by Prof. Dr. Claudia Müller-Birn and the Embodied Interaction Group led by Prof. Carola Zwick, Prof. Judith Glaser, and Prof. Thomas Ness at weißensee school of art and design. Within a specific design context, computer science and product design students explored various means of designing neo-analog products, i.e., products that represent a synthesis of the digital and the material in form and function. The Embodied Interaction Group also hosted a practice-based project called »HyperHaptics«, inviting students from the Department of Product Design to explore the potential of intertwining virtual and physical tactility in a direct continuation of the research work within the Cluster project Cutting. Functional prototypes and concepts developed in this context were presented and discussed within the project, enabling critical feedback and exchanges between students and researchers.



»Scaling Nature: Wrinkles«, liquid lacquer. © Luis Magg / weißensee school of art and design berlin



MoA Design Studio »Designing Matter: From Tile to Tessellation«. © Lilo Ming Kiefer / weißensee school of art and design berlin



ACTIVITIES

# International and Cultural Diversity

# Master Open Design

The international double degree program Master Open Design/Maestría en Diseño Abierto para la Innovación, jointly organized by HU Berlin and the Universidad de Buenos Aires (UBA), was first established in 2015 by the previous Cluster of Excellence »Image Knowledge Gestaltung« and continues with MoA. Ever since, these internationally outstanding universities form the basis for an important axis that takes up the historical conditions of a long intercultural history of the Bauhaus in Buenos Aires and further develops it for the challenges of the 21st century. The master's program is an essential component of the education of a young generation of scholars and practitioners, open to graduates from a range of bachelor's programs. It integrates a broad spectrum of empirical methods and methodologies that encompass analysis and historicization from cultural studies and the humanities, scientific experimentation from the natural sciences, and creative synthesis from the design disciplines, the basis being a future-oriented, radically interdisciplinary »open« orientation of design. Students are also introduced to social and intercultural competencies and gain experience in collaboration and communication between internationally differentiated knowledge cultures.

The program is based on the mobility and academic links between Germany and Argentina, but also goes beyond this binational context with a student body including participants from all over the world and many different disciplinary backgrounds. With the first cohort, the program started with 26 students from Argentina, Germany, Mexico, Brazil, Colombia, Venezuela, Turkey, and Australia coming together. The program's second cohort started with a total of 32 students from Argentina, Germany, Mexico, Brazil, Colombia, Ecuador, Guatemala, Turkey, Poland, Switzerland, Kosovo, USA, India, Vietnam, and Singapore. Different languages, ways of living, and knowledge and scientific cultures become an essential and productive component of the program, underlining its special intercultural framework and approach. The central co-teaching format between teachers from the two partner universities not only opens up new opportunities for interdisciplinary exchange and academic mobility for students and lecturers on the program, but also promotes and intensifies cooperation between the universities in teaching and research as well as a productive and reciprocal transfer of knowledge.

Master Open Design graduate Heidi Jalkh received the Humboldt Prize 2022 in the category »Research to Innovation« for her master's thesis *Making Matter Active through Form. Fabricating Bioinspired Behavior with Auxetic Structures*.

Frank Bauer, Hannah Grosser, and Cluster director Wolfgang Schäffner received an external grant from the DAAD as project funding for the Virtual Matters Lab within the »Master Open Design« program (HU Berlin and UBA).



Julia von Blumenthal, president of HU Berlin, presenting the Humboldt Award to Heidi Jalkh, graduate of the master »Open Design«  
© HU Berlin



Students of the Master Open Design in collaboration with Coop Design Research and Bauhaus Foundation



Autumn school participants doing fieldwork at river »Schwärze«

Against a background of ecologies in crisis, the Cluster's first interdisciplinary autumn school »Frictioned Functionality. Un/Designing Un/Sustainable Matter« invited international postdocs, pre-doctoral researchers and MA students from the humanities, the natural sciences, and design to work through the conflicted entanglement of materiality, design, and un/sustainability, using frictioned functionality as the guiding principle. Participants were invited not only to bring their different academic or professional expertise into dialogue, but also to engage in experimental strategies of collaborative designing and making. The speculative inquiry and growth of the projects within the interdisciplinary teams was enriched by participants' interests and their situated research perspectives. In the context of the six-day autumn school, frictioned functionality was understood as a working concept for reopening other narrative and performative spaces of imagination in and beyond unruly times. Following a shared panel of opening lectures, students worked in the field as part of three workshops: »Rethinking biological material systems«, »Designing more-than-human collaborations«, and »Hacking natural-cultural systems«. These different tracks were summarized in a shared final presentation format to enable discussion of the reflections and results in plenum. The school was organized by researchers from the project Material Form Function (Dr. Khashayar Razghandi, Prof. Dr. Robert Stock, Rasa Weber).

Fellowships are an opportunity for MoA projects to obtain additional expertise and experience while strengthening a culture of equal opportunity and diversity within the Cluster. From 2019 to 2022, MoA provided funding for measures, programs, and activities that supported the individual academic and professional qualifications and goals of applying fellows. After the outbreak of the pandemic, digital fellowships were established to enable increased virtual exchanges. A subsequent call for young international fellows aimed to strengthen the Cluster's presence among young researchers in particular and succeeded in recruiting new pre-doctoral researchers. These fellowships focused on researchers from non-European countries, especially the Global South.

Following the Russian invasion of Ukraine in February 2022, Cluster funds were also reallocated to create four fellowships for displaced scholars from and in Ukraine, including students from Egypt and Namibia. Fellowships covered a range of disciplines at both junior and senior levels, including theoretical and practical computer science and environmental technology studies. Jessica Upani, Mostafa Alaa, Seth Ekow Abaidoo, and Seid Mayo Abdul Aziz Sepa were integrated at the Cluster's partner University of Applied Sciences (HTW) while Oleh Basystiuk and Prof. Dr. Natalya Shakhovska received online fellowships enabling them to remain at Lviv Polytechnic National University (LPNU).

Fellowships also enabled the recruitment of new pre-doctoral researchers for the second Cluster term. Experimental designer Emma Sicher, who completed her master's thesis at the Free University of Bozen-Bolzano in cooperation with Aalto University, Finland, held a MoA fellowship in 2022 and is now a pre-doctoral researcher in the project Weaving. The Cluster also successfully integrated guest researchers from different parts of the world: Mahamadi Ilboudo, curator of the Musée de la Musique Georges OUEDRAOGO in Ouagadougou, Burkina Faso, collaborated on and co-constructed the exhibition »DAOULA | sheen« alongside curators from Berlin (see our section on Cluster exhibitions). Guest researcher Salif Sawadogo is an interpreter, translator, and cultural mediator who also worked as a collaborator for the exhibition. Both Ilboudo and Sawadogo are now associated members in the project Weaving. Guest researcher Elisa Strobel do Nascimento, a lecturer at the Design Department in the Federal University of Paraná (UFPR), Brazil, is now associated member in the project Material Form Function.

# SELECTED CLUSTER PUBLICATIONS

## Active Materials

What are active materials? This open-access publication aims to introduce and redefine conceptions of matter by considering materials as entities that »sense« and respond to their environment. By examining the modeling of, experiments on, and the construction of, these materials, and by developing a theory of their structure, collective activity, and functionality, this volume identifies and develops a novel scientific approach to active materials, encompassing interviews with leading materials scientists as well as historical and theoretical reflections from humanities scholars, providing various approaches to active materials within a historical and cultural context.

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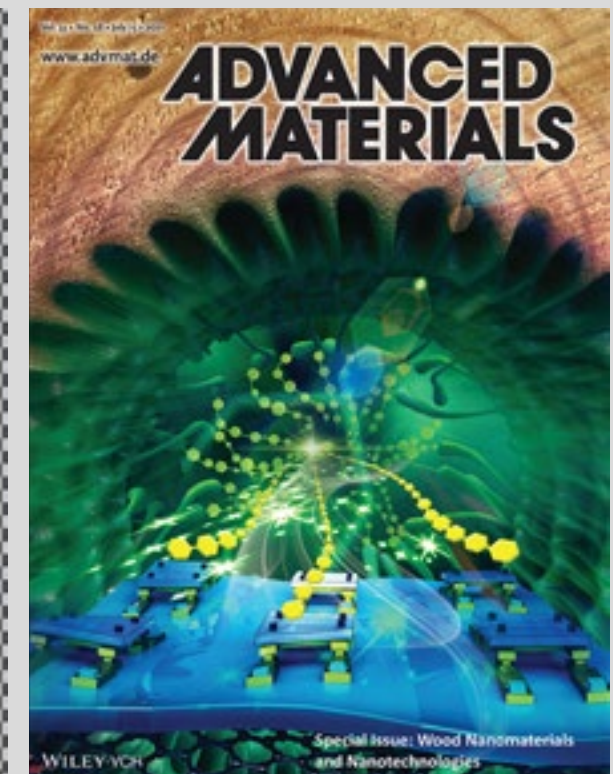
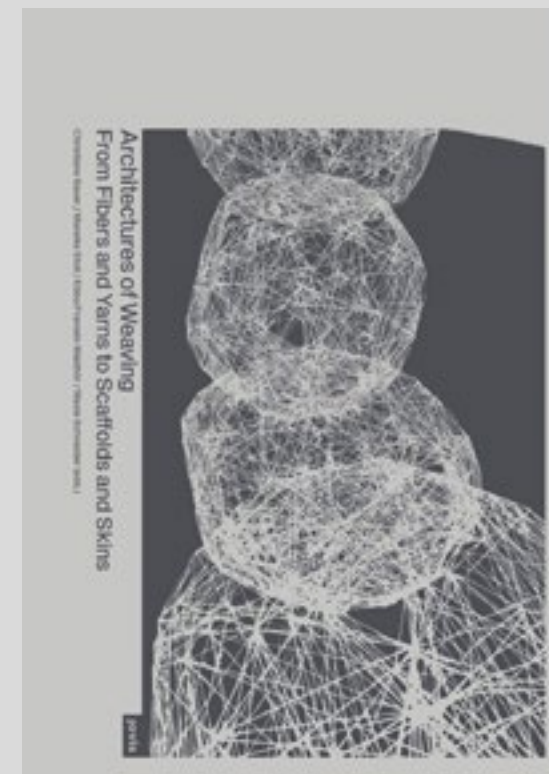
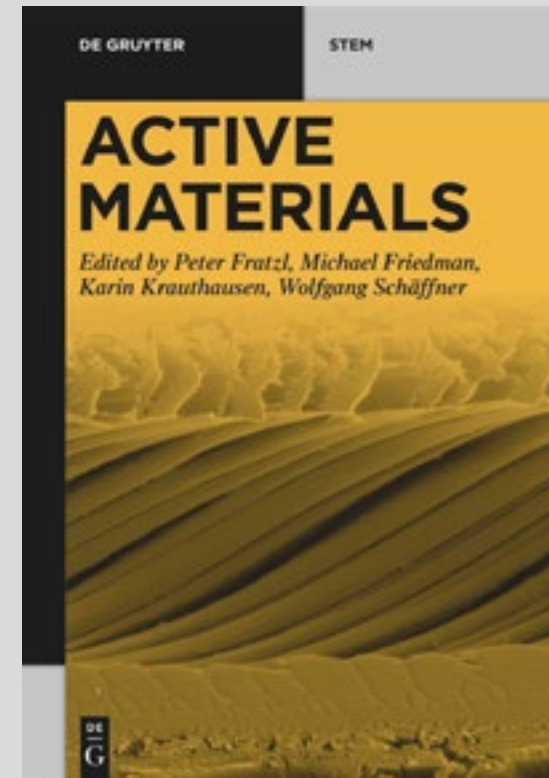
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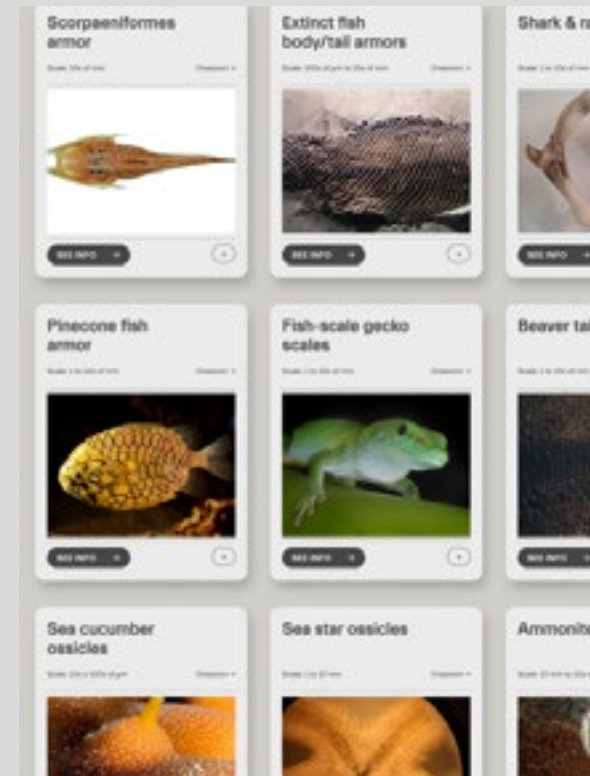
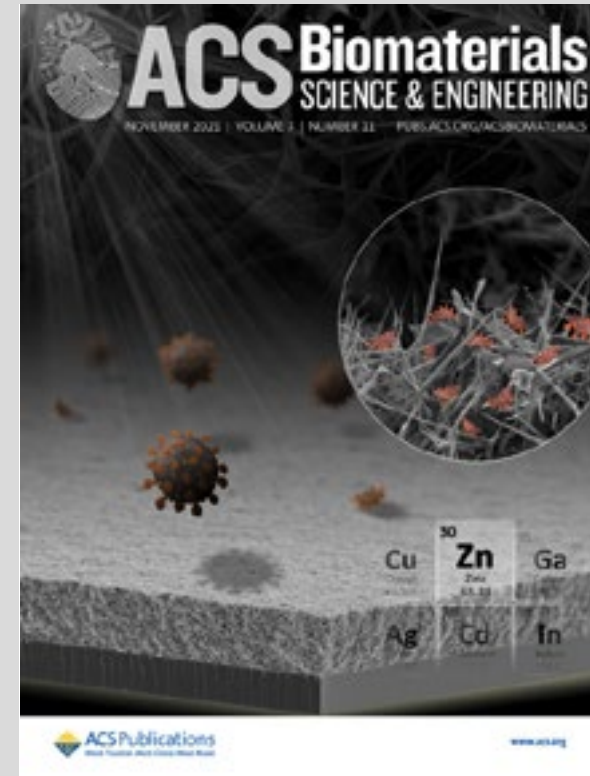
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### Tessellation Archive

Thanks to its interdisciplinary setting, MoA faces the challenges, but also the opportunities of embracing diverse research outcomes that often go beyond conventional publication formats such as articles and book publications. Rather, research objects, prototypes and other heterogenous research outcomes are placed on equal footing, inviting researchers to renegotiate formats of scientific exchange. A result of interdisciplinary collaboration between design research, materials science and biology, the Tessellation Archive is one example.

Tessellations are structural motifs made up of repeating tiles, found in many forms and serving a variety of functions in nature. Perhaps partly inspired by natural examples, tessellations have also been a part of human history in art, design, and culture, commonly in the form of mosaics and more recently in the realm of bioinspired design and engineering. This collection showcases the diversity of this motif, exploring commonalities in structure and function across environments and taxa, to inspire biological and biomaterials research, but also bioinspired design and architecture.

Rasehorn, F., Ciecierska-Holmes, J., Rosenthal N., Dean, M., Eigen, L., Nyakatura, J. A., Le, M.-L. V., Yang, B. 2022. *The Tessellation Archive*. weißensee school of art and design berlin, Max Planck Institute of Colloids and Interfaces, Humboldt-Universität zu Berlin: Comparative Zoology, Cluster of Excellence »Matters of Activity«. [www.tessellated-materials.mpikg.mpg.de](http://www.tessellated-materials.mpikg.mpg.de)





**»We try to see materials as not simply being – they are never just self-contained objects, but embedded in cycles, networks and specific relations to production processes and usage, but also in communication, in symbolic relationships.«**

**Claudia Mareis**  
Co-director

PROJECTS

# Weaving



Wild silk nest spun by processionary caterpillars of Epanaphe species. Photo: Michael Pfisterer

Weaving is one of the oldest cultural techniques, older than agriculture and writing. Even in nomadic cultures, textiles ensure survival: they extend the function of the skin and make it mobile, by means of the garment (*Gewand*) as well as the wall (*Wand* – tent or first huts), which protect against wind and weather, but also regulate the exchange with the environment. In this sense, textiles structure the environment and adapt it to the *anthropos* – and vice versa: humans adapt to their environments through the use of textiles, not only as an individual, but in and for the collective. From the biofilm to the cell structure of the skin to the social communities weaving – as a material and symbolic practice as well as a regulating structure – contributes to the formation of networks. These collectives establish themselves by drawing a boundary between inside and outside that can be flexible or firm, but usually semipermeable and selective. The cocoon manifests this function of weaving and woven structures (tissues, textiles, fabrics), whether as a biofilm, pupation, skin, tent, or hut. The project Weaving investigates woven structures from the micro- to the macroscale made of organic or inorganic materials, from ›nature‹ to ›culture‹, and of material or symbolic factuality. Perspectives and objects come from the participating disciplines, including molecular biology, materials science, mathematics, architecture, design, anthropology, cultural studies, and literary studies, as well as from the collaborations with the projects Symbolic Material and Material Form Function. Many questions arise: What holds collectives together and protects them? How do bacteria weave? How does this affect other cultural techniques? How can architecture, for example, be spun?

The project focuses on structure–form–function relationships of woven materials and understands weaving in its broadest sense. This includes theoretical and practical approaches to weaving as a human practice and cultural technique with its own history as well as 2D or 3D materials with active/activating structures characterized by entanglement, interlacing, braiding, or classical weaving. Importantly, fiber-based matter can be the product of natural or cultural processes and occurs ubiquitously on all scales from the nano/microscale in biological systems (from molecules to cells and organisms) to the meso/macroscale in human cultural contexts (fabrics, garments, and architecture). The project’s practical approaches involve anthropological fieldwork, laboratory studies jointly performed by scientists and designers, as well as experiments with architectural materials and upscaling. These are complemented by studies of the geometry (topology) and the theoretical and historical framework of the cultural practice of weaving, placing special attention on both its material and symbolic dimensions.

#### Principal Investigators

Karola Dierichs – Architecture  
 Michaela Eder – Materials Science  
 Myfanwy Evans – Mathematics  
 Peter Fratzl – Materials Science  
 Regine Hengge – Microbiology  
 Sharon Macdonald – Anthropology  
 Konrad Polthier – Mathematics  
 Christiane Sauer – Architecture  
 Wolfgang Schäffner – Cultural History & Theory  
 Sabine Thümmler – Art & Visual History  
 Joseph Vogl – Literary Studies

#### Research Associates

Bastian Beyer – Architecture  
 Rhoslyn Coles – Physics  
 Laurence Douny – Anthropology  
 Christine Kanow-Scheel – Microbiology  
 Karin Krauthausen – Cultural History & Literature  
 Mareike Stoll – Comparative Literature, Art History & Design

#### Pre-Doctoral Researchers

José I. Hernández Lobato – Microbiology  
 Nikolai Rosenthal – Medical Engineering  
 Maxie Schneider – Architecture & Design  
 Emma Sicher – Experimental Design  
 Charlett Wenig – Material & Product Design

#### Associated Investigators

Cécile Bidan – Materials Science & Biophysics  
 Michael Friedman – Mathematics & Philosophy  
 Felix Sattler – Exhibitions & Media Art

#### Associated Members

Lynette Cegelski – Chemistry & Chemical Engineering  
 Mahamadi Ilboudo – Museology & Curation  
 Heike Illing-Günther – Engineering Chemistry  
 Stephan Kammer – German Language & Literature  
 Aurélie Mossé – Design  
 Lucy Norris – Social Anthropology  
 Salif Sawadogo – Building Design & Translation  
 Diego Serra – Biology  
 Daniel Suarez – Architecture

#### Alumni

Skander Hathroubi – Biology  
 Kim Nguyen – Biology  
 Kim Polenz – Biology  
 Friedrich Reppe – Wood Science  
 Feixuan Xu – Social Anthropology

## Research (2019–2022)

In the first research phase, bacterial biofilms and West African wild silk cocoons were chosen as key biological model objects that generate fibrous materials. The fibrous materials gained from these living objects are bacterial (nano)cellulose and wild silk, respectively. Fundamental insights were obtained into how the microfiber architecture of a bacterial biofilm grows, how it operates to create a protective and homeostatic multicellular biofilm-internal milieu in a permanent controlled exchange with its external environment, and how it drives even macroscopic tissue-like wrinkling and folding, which can be described in principle by hyperbolic geometry. The material properties and design possibilities of bacterial cellulose as a (co)growing fibrous material were explored, also yielding a novel, more efficient production device (the »elevator«). This kind of research led to various publicly presented installations, such as a large-scale curtain-like installation in the exhibition »After Nature« at the Humboldt Forum (open since 2021) as well as installations at the Porto Design Biennale 2021 and the XXIII Triennale di Milano in 2022.

In order to study the topological principles of spun and entangled construction, the internal structure of a communal nest of wild silk cocoons was visualized at high resolution in three dimensions using non-invasive imaging techniques. Complex practices for obtaining wild silk from these cocoons as well as for producing fake silk (to »forge« wild silk) were thoroughly described in anthropological field studies of the Marka-Dafing community (Burkina Faso) and their traditional



knowledge. Rather unexpectedly, a crucial role for natural biofilm formation was discovered in these practices, in particular those for the production of fake silk, which include dying with mud or dung (containing distinct active natural microbiomes) and plants (controlling bacterial activity in this process). The close collaboration with the Marka-Dafing community in Burkina Faso resulted in the joint exhibition »DAOULA | sheen. West African Wild Silk on Its Way« (see our section on Cluster exhibitions), focusing on the natural formation and cultural history of wild silk obtained from caterpillars in West Africa, and on the many and complex ways in which this unique material is viewed by microbiologists, materials scientists, anthropologists, cultural historians, and architects in Germany.

From a materials science and design perspective, fibers and yarns of various biological and synthetic origin were studied on different length scales and up-scaled into architectural yarns, which serve as functional and structural building elements. Just like living and dead fibers and fibrous matter in biological systems, these flexible technical fibers and yarns can gain multiple functionalities, with the code for their making residing in their material (micro)structure. On the theoretical side, these studies were accompanied by investigations of the culture-forming character of weaving practices and their historical translation into, or replacement by, later cultural techniques such as agriculture and, above all, writing. Finally, the notions of the »emergence«, »activity«, and »plasticity« of the fiber-based material structures were theorized from a transdisciplinary perspective together with other Cluster projects.

For the coming years, the project aims to add an even stronger focus on making. Besides thoroughly analyzing, the project will turn to enhancing and augmenting fiber-based materials, envisioning potential applications, and producing speculative prototypes.

## Selected outcomes

### Publications

Friedman, M., Krauthausen, K. eds. 2022. *Model and Mathematics: From the 19th to the 21st Century*. Cham: Birkhäuser.

Sauer, C., Stoll, M., Fransén Waldhör, E., Schneider, M. eds. 2022. *Architectures of Weaving. From Fibers and Yarns to Scaffolds and Skins*. Berlin: Jovis.

Beyer, B., Hathroubi, S. 2021. »La récolte des biofilms.« In *MàJ: design, environnements techniques & pratiques exploratoires*, edited by Bertrand, G., Favard, M., Lartigaud, D. O. Saint-Etienne: Éditions Cité du design. École supérieure d'art et design de Saint-Étienne (ESADSE).

Serra, D. O., Hengge, R. 2021. »Bacterial Multicellularity: The Biology of *Escherichia coli* Building Large-Scale Biofilm Communities.« In *Annual Review of Microbiology*, 75: 269–290.

Krauthausen, K., Ladewig, R. eds. 2021. *Modell Hütte: Von emergenten Strukturen, schützender Haut und gebauter Umwelt*. Zürich: Diaphanes.

### Exhibition

Douny, L. (curator), Krauthausen, K. (curator), Sattler, F. (curator), Thindi, T. (film installation). *DAOULA | sheen. West African Wild Silk on Its Way*. Exhibition. Cluster of Excellence »Matters of Activity«, Humboldt-Universität zu Berlin. Tieranatomisches Theater. 18 November 2022–30 June 2023.

### Architectural Project

Schneider, M., Rešetar, I., Sauer, C. 2022. *Tangled Wall*. Architectural project. With Sächsisches Textilforschungsinstitut e.V. (STFI) Chemnitz. Since 1 January 2022.

### Exhibits

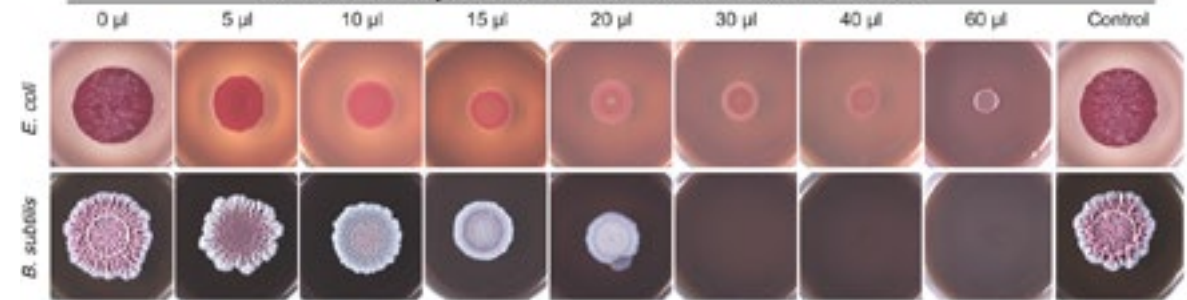
Sauer, C. (project leader), Miodragović, N. (project leader, designer), Beyer, B. (designer), Rešetar, I. (designer), Suarez, D. (designer, video producer), Singer, N. (designer), Hengge, R. (microbiologist), Hathroubi, S. (microbiologist), Eder, M. (materials scientist), Bidan, C. (materials scientist). *Active Curtain*. Humboldt Lab, Humboldt Forum Berlin. Since 29 April 2021.

Beyer, B., De Visscher, E., Hathroubi, S., Hengge, R., Liedtke, M., Mareis C., Miodragović, N., Rešetar, I., Suárez, D. *Bacterial Cellulose: Co-weaving Biofilms*. Exhibition. Installation for the XXIII Triennale: »Unknown Unknowns: An Introduction to Mysteries«. Milan, Italy. 15 July 2022–11 December 2022.

Beyer, B., Suárez, D. *Column Project*. Museum of Vibrant Matter. Porto Design Biennale 2021, Portugal. 2–25 July 2021



## Mud dyeing

Low *Acacia nilotica*High *Acacia nilotica*Bacterial colony biofilms with the addition of *Acacia nilotica*

Fermentative mud dyeing of textiles (top image) can fail when the «wrong» bacteria in the mud take over and form biofilms. This can be prevented by adding a specific plant, which in microbiological experiments (bottom image) was found to act as an anti-biofilm and growth-reducing agent for these bacteria.

Photos: Salif Sawadogo, José I. Hernández Lobato and Regine Hengge

## PROJECTS



# Filtering

For the project »Exploring Filtering«, design professors Thomas Ness and Veronika Aumann tested different kinds and methods of filtering processes hands-on with familiar prototyping materials and techniques, 2020

An immense variety of filters seems to form the epistemic center of many processes of the current transitional age. Both matter and data are selected, extracted, and modified by filters – how they do this, however, is often difficult to understand or even remains invisible. Moreover, these processes occur simultaneously and cannot be separated from each other. Their entanglement is a specific form of activity. The project investigates filters using historical, experimental, and computational approaches. How does new information emerge from parallel filtering processes? What kinds of environments are created by filtering processes, and how do they interact with both historical and current environmental knowledge? And what scaling effects need to be considered when filtering processes become technologically effective at the molecular as well as the global levels?

Filtering is an activity that matters in a two-fold way: it is a material process that is fundamentally important for the associated actors because it simultaneously involves symbolic activities. Starting from this basic concept, different properties of filtering techniques were analyzed. Researchers jointly examine cultural, molecular, and digital filtering. Taking into account different scales, they focus on essential physical mechanisms all the way through to macroscopic processes. In our age of digital culture, the project seeks to research analog filters from a new perspective and reestablish the analog in the digital age.

#### Principal Investigators

Matthias Bruhn – Art & Image History  
 Peter Fratzl – Materials Science  
 Christian Kassung – Cultural History & Theory  
 Claudia Müller-Birn – Computer Science  
 Thomas Ness – Design  
 Jörg Niewöhner – Social Anthropology  
 Konrad Polthier – Mathematics  
 Jürgen P. Rabe – Physics  
 Jürgen Sieck – Computer Science  
 Robert Stock – Cultural History & Theory  
 Carola Zwick – Design

#### Research Associates

José D. Cojal González – Physics  
 Alwin J. Cubasch – History of Science and Technology  
 Mario Cypko – Medical Informatics  
 Lea Timmermann – Surgery  
 Hanna Wiesener – Gestaltung

#### Pre-Doctoral Researchers

Dominic Eger Domingos – Product Design  
 Jakub Rodomanski – Mathematics  
 Anna Schäffner – Interaction Design

#### Associated Investigators

Johann Habakuk Israel – Computer Science  
 Shintaro Miyazaki – Media and Cultural Studies  
 Carlos-Andres Palma – Physics

#### Associated Members

Petra Löffler – Cultural History & Theory  
 Sebastian Nordmann – Musicology  
 Stefan Weinzierl – Audio Communication

#### Alumni

Christoph Kinkeldey – Visualization  
 Julien Letellier – Computer Science  
 Michael Tebbe – Media Informatics

## Research (2019–2022)

The question of structural similarities between seemingly very different filtering settings followed directly from an understanding of cultural techniques that entailed a search for historical constants. It enabled a meaningful linkage of historical and application-related competences within the group as well as the development of common questions. Conceiving historical and current filtering systems as cultural techniques has led to the insight that filtering creates environments. Filtering approaches this both on an epistemic and a material level. Creating material environments presumes a specific knowledge about the environment, and vice versa. The project thus developed a concept of filtering as an enviroing technique.

Filtering held several multidisciplinary workshops, including »Exploring Filtering«, »Filtering Legacies – Filtering Wasted Environments«, »Membranes as Molecular Machines«, and »Automation, Control, and Incompetence«. The organizers and guests elaborated on the historical, molecular, and cultural-political dimensions of filtering and automation processes. The current challenges of human-computer interaction and technology design in the face of diverse actors were at the center of research and teaching, such as the interdisciplinary course »Coding IxD«. By considering filtered environments in AI, robotics, sensing systems, social media, and the gig economy as powerscapes that are shaped by constellations of interests, entangled agencies and power relations were critically questioned. Powerscapes hint at the hierarchical structures within policies, logistics, and labor. They point to the conflictive and algorithmic-driven interaction of diverse actors, entities, and machines. The urgent question is how filtering can be rethought as a responsible technology, both in terms of design processes and concerning emerging socio-technical environments.

Vibrations are essential attributes of matter and the constituents of technologically relevant waves and of geometric shapes and constructions. Based on the mathematical description of vibrating matter, we have designed and studied molecular systems on surfaces in order to develop topological indicators for dynamic matter. These indicators map different types of physical properties (material activities), establishing a matterscape. These maps are filters by definition, and the vibrations, the analog activity within them.

Initiated by the project researchers and funded by the Federal Ministry of Education and Research (BMBF), the network »Visual Communication with Augmented and Virtual Reality (ViCAR)«, in which computing meets health and culture, promoted an international exchange between emerging female scientists from Egypt, Namibia, South Africa, and Germany through workshops and the development of a joint research agenda. Meanwhile, the exhibition project »Cube of Physics«, which sheds light on the entire knowledge of physics, was transformed into an expansive sculpture and a media station.

The concept of environing necessarily leads to the problem of agency: who creates what types of environments through filtering? And by what right? Environing is an action that necessarily transcends one's surroundings. From a historical perspective, the question of agency thus calls into question concepts of subjectivity that primarily center around the notion of the human being.

The project's goal for the second research phase is to formulate a specific understanding of filtering as a ubiquitous technology of nature and culture while exploring the design of responsible filters, for instance, in the form of possible strategies for integrating automated reasoning into human-centered interactive surgical systems.

## Selected outcomes

### Publications

Rezania, B., Valencia, A. M., Cojal González, J. D., Severin, N., Cocchi, C., Rabe, J. P. 2022. »Interfacial Electric Fields Acting on Molecules at Solid Interfaces.« In *The Journal of Physical Chemistry C*, 126 (13): 6028–6035.

Cubasch, A. J., Engelmann, V., Kassung, C. 2021. *Theorie des Filterns. Zur Programmierung eines Experimentalsystems*. Preprint.

Stock, R. 2022. »Coreen McGuire 2020: Measuring Difference, Numbering Normal. Setting the Standards for Disability in the Interwar Period und Jaipreet Viridi 2020: Hearing Happiness. Deafness Cures in History.« In *NTM Zeitschrift für Geschichte der Wissenschaften, Technik und Medizin*, 31: 101–105.

Benjamin, J. J., Kinkeldey, C., Müller-Birn, C. 2020. »Participatory Design of a Machine Learning Driven Visualization System for Non-Technical Stakeholders.« In *Mensch und Computer 2020 - Workshopband*, edited by Hansen, C., Nürnberger, A., Preim, B. Bonn: Gesellschaft für Informatik e.V.

Palma, C.-A. 2020. »Topological Dynamic Matter.« In *The Journal of Physical Chemistry Letters*, 12 (1): 454–462.

Cojal González, J. D., Li, J., Stöhr, M., Kivala, M., Palma, C.-A., Rabe, J. P. 2019. »Edge Phonon Excitations in a Chiral Self-Assembled Supramolecular Nanoribbon.« In *The Journal of Physical Chemistry Letters*, 10 (19): 5830–5835.

### Events

Cubasch, A. J., Engelmann, V., Quast, R., Weber, H., Winiwarter, V. *Filtering Legacies – Filtering Wasted Environments*. Cluster of Excellence »Matters of Activity«, Humboldt-Universität zu Berlin, Technische Universität Berlin. Hybrid. 11–12 November 2021.

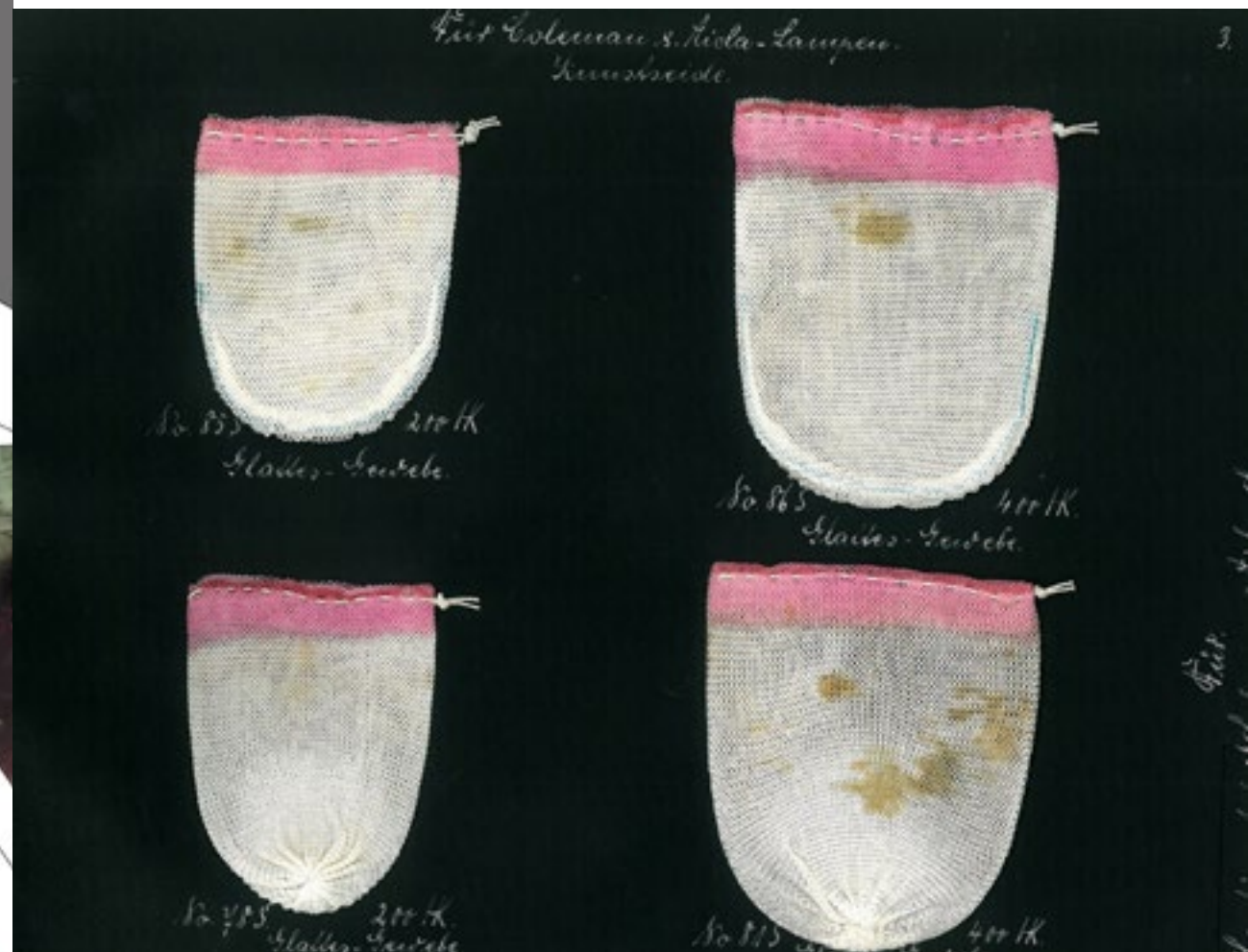
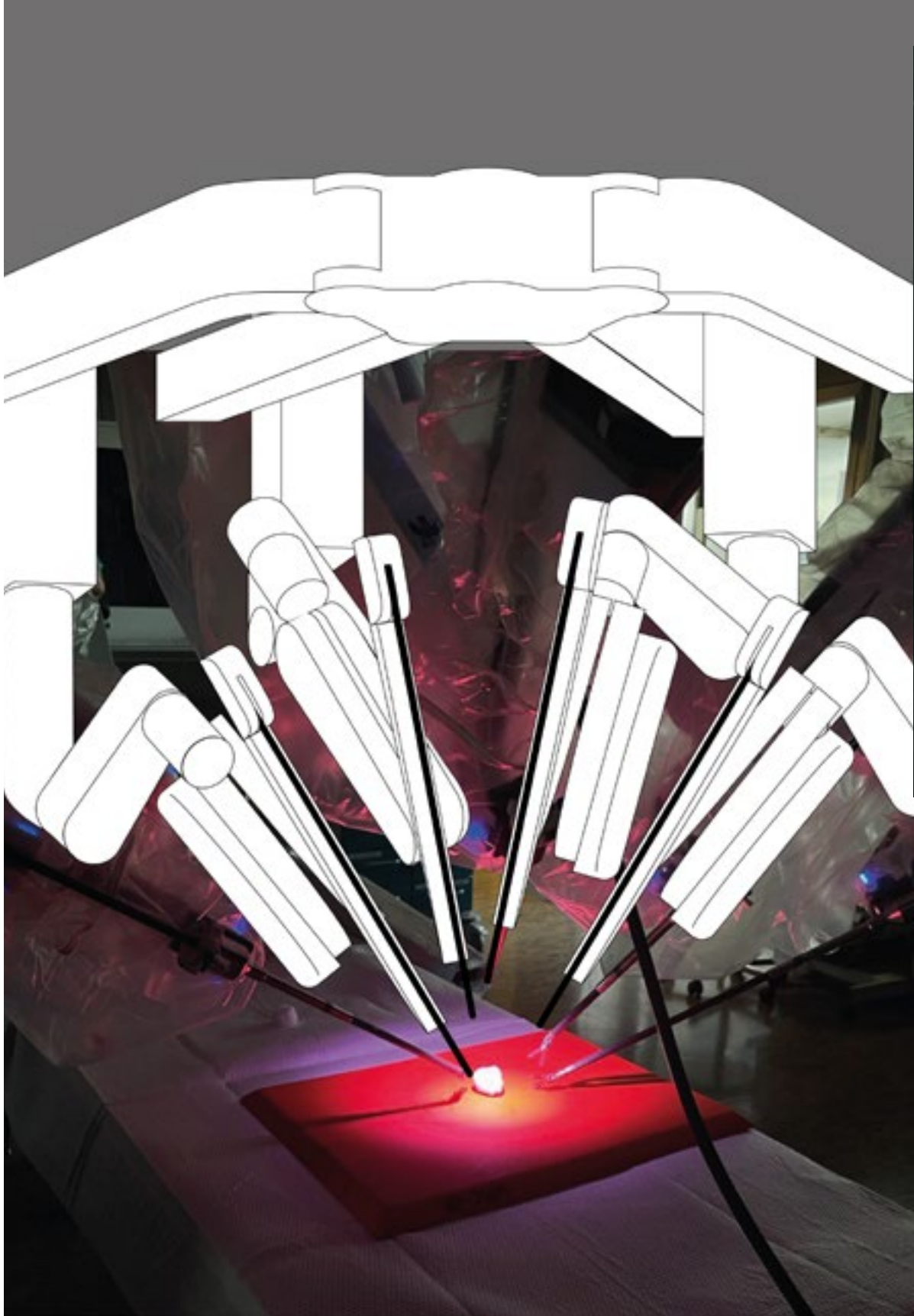
Zwick, C., Ness, T., Groll, F. (supervisors), Wiesener, H. (curator), Paetsch, S. (film), Auth, N., Stankowski, A., Klich, M., Deppe, L. *SOLO – Smart Organic Light Objects*. Digital Exhibition at »Greenhouse 2021«, Stockholm Furniture Fair, Stockholm, Sweden. weißensee school of art and design berlin. Virtual. 10–11 February 2021.

### Network

Simbeck, K., Sieck, J. (project leaders), Kassung, C., Müller-Birn, C. Since 2021. ViCAR – Visual Communication with Augmented and Virtual Reality. The African-German research network with HTW Berlin, Cluster of Excellence »Matters of Activity«, Humboldt-Universität zu Berlin, Namibia University of Science and Technology, German International University, Cairo, and University of Cape Town.

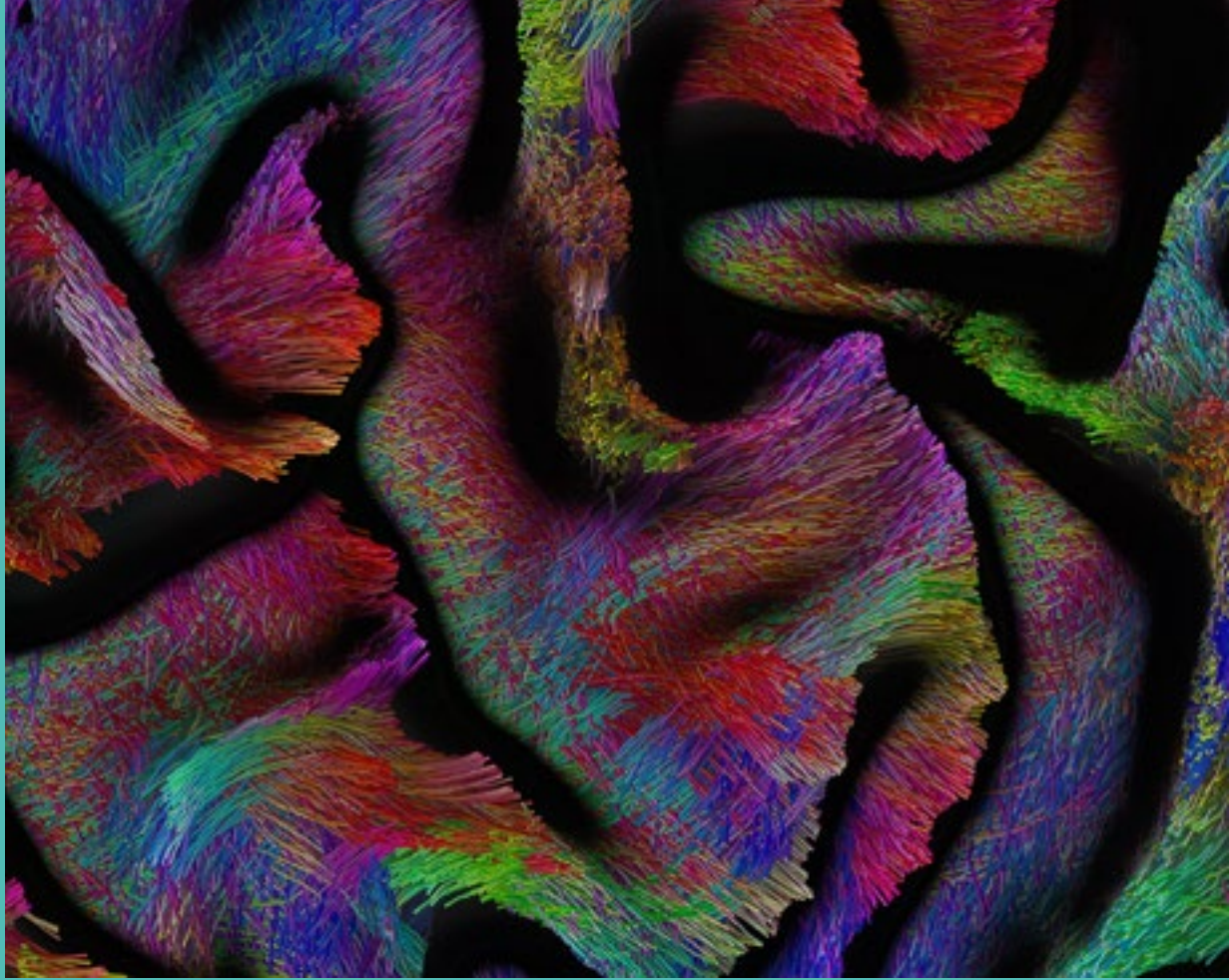
### Exhibition Objects

Kassung, C. (concept & content), Rabe, J. P. (concept & content), Staudacher, M. (concept & content), Cojal González, J. D. (concept & content), Droste, M. (technical implementation), Paul, F. J. (spatial & visual design). 2021. *Cube of Physics*. Presented at the Department of Physics, Humboldt-Universität zu Berlin.



Incandescent mantle for continental lamps, artificial silk. BBWA U3/31 Auergesellschaft/MSA Germany, no. F/14

PROJECTS



Fiber tractography delineating the white matter of the brain. Visualization by Lucius Fekonja, adapted by NODE Berlin

Cutting

Cutting is one of the oldest cultural practices. It is a fundamental way for human beings to enter into correspondence with materials. With these specific gestures and tools, people alter and reshape material boundaries and intertwine different entities. These activities span across wide forms of tacit knowledge, from ancient craftsmanship to contemporary high-tech procedures. In the domain of art, the cutting of text, music, or film material produces new compositions that can provoke new insights. Similarly, in the field of medicine, surgeons cut the body in order to understand and heal it. Embedded in the way we think, write, and speak, the act of cutting is ubiquitous: it means distinguishing and choosing between »good« and »bad« in a multitude of symbolic ways. A key component of cultural techniques, cutting is situated at the interface between analog and digital technologies. Selecting this operation as a starting point opens up new perspectives, interactions, and functions, whose limits and possibilities must be understood, both practically and theoretically. To this end, project researchers, from anthropology, biology, computer science, neurolinguistics, design, media studies, medicine, and physics explore the entanglement of humans, materials, and information. In diverse experimental settings, the researchers examine the epistemological trade-off between precision and uncertainty in the preparation and execution of the cut on different scales and in new modes. These new perspectives are investigated with the goal of contributing to a new repertoire of tools and practices that renegotiate the divide between analog and digital.

#### Principal Investigators

Matthias Bruhn – Art & Visual History  
 Mohammad Fardin Gholami – Physics  
 Claudia Müller-Birn – Computer Science  
 John Nyakatura – Biology  
 Thomas Picht – Neurosurgery  
 Friedemann Pulvermüller – Neuroscience & Linguistics  
 Jürgen P. Rabe – Physics  
 Patricia Ribault – Gestaltung  
 Igor M. Sauer – Medicine & Biotechnology  
 Stefan Zachow – Computer Science  
 Carola Zwick – Design

#### Cluster Professorships

Thomas Ness – Design  
 Moritz Queisner – Digital Health & Media Studies

#### Research Associates

Mario Cypko – Medical Informatics  
 Maxime Le Calvé – Anthropology  
 Lucius Fekonja – Scientific Visualization  
 Boshra Shams – Computational Neuroscience  
 Rosario Tommasello – Neurolinguistics  
 Hanna Wiesener – Design

#### Pre-Doctoral Researchers

Dominic Eger Domingos – Product Design  
 Felix Rasehorn – Design  
 Lucas Rodrigues – Computer Science

#### Associated Investigators

Regula Valérie Burri – Science and Technology Studies  
 Felix Dreyer – Linguistics & Brain Research  
 Judith Glaser – Design  
 Johann Habakuk Israel – Computer Science  
 Petra Ritter – Neurology & Brain Simulation  
 Ingolf Sack – Radiology  
 Timo Torsten Schmidt – Cognitive Science & Neuroimaging

#### Associated Members

Kathrin Mira Amelung – Media & Culture Studies  
 Olaf Avenati – Graphic & Digital Design  
 Samuel Bianchini – Art & Design  
 Ran Xu – Neurosurgery & Neurobiology

#### Alumni

Christoph Kinkeldey – Visualization

## Research (2019–2022)

In the first phase, researchers studied the human brain as an example of complex dynamic matter, paleontological specimens as examples of complex static matter, and nanomaterials as an example of active matter controlled by intrinsic interfaces.

For the »Adaptive Digital Twin«, brain MRI data were enriched with system-level functional information and clinically validated. The current prototype is in the process of being tested and further refined for usability in surgical planning. It is also used for training medical students at Charité and is presented to the public at Humboldt Forum. Furthermore, brain-constrained neural models have been developed to examine the intricate neural underpinnings of symbolic processing, the »material basis of symbols«, with a particular focus on the biological mechanism that governs higher cognitive functions such as verbal working memory, symbolic learning, and plasticity.

A »Speculative Realities Lab« was founded at Charité, and a long-term study on the work of a French neurosurgeon, Hugues Duffau, was initiated. His operative and creative modes of action can be seen as a counterpart to the »Adaptive Digital Twin«, since his unique way of practice is based on a different, complementary methodology. Merging visual representation of data, digital materiality, and physical interactions with haptic feedback contributed to an interdisciplinary understanding of the complex interaction challenges ahead. Haptics as a means of incorporating practitioners' embodied knowledge into human-computer interaction became a central theme for the project. Researchers worked on a unifying language and understanding of haptics across disciplines and experimental settings was initiated. Specialists and researchers from the humanities, physics,



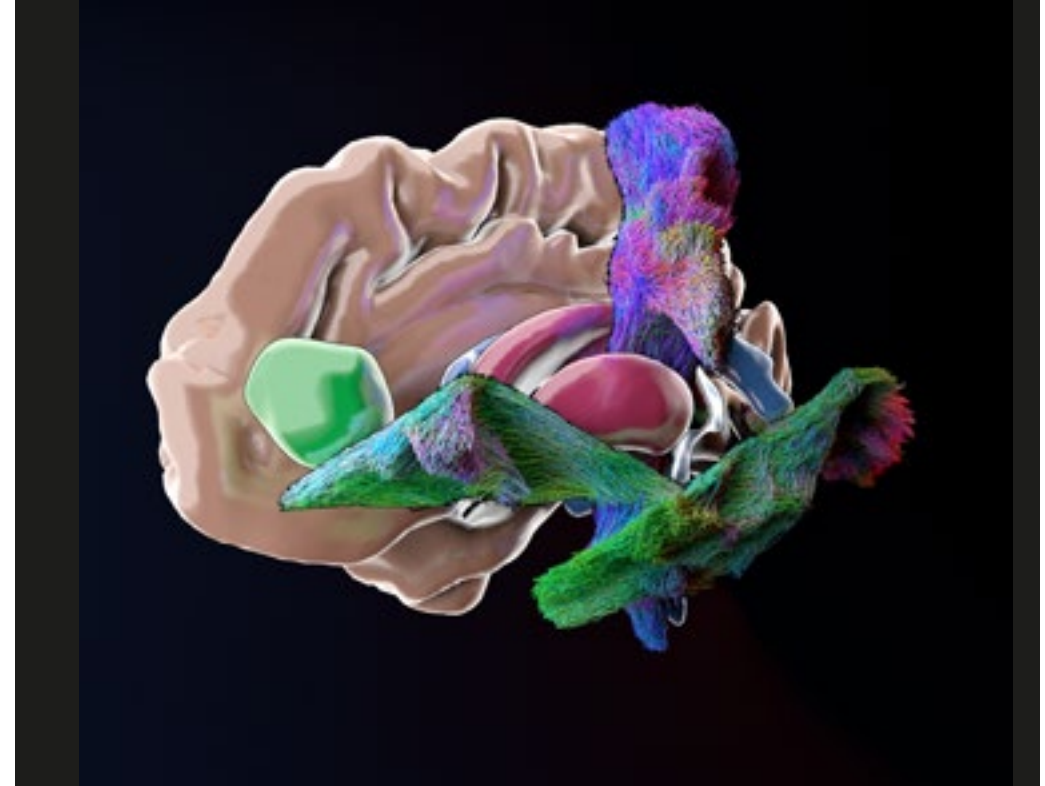
computer science, engineering, and design engaged in explorations of various prototypes.

»Virtual Dissection« has conducted extensive research into fossil preparation as a cutting practice. As an initial step, the project employed ethnographic methods to identify critical challenges and opportunities arising from paleontological tools and techniques from a human-computer interaction perspective. Based on these insights, »Virtual Dissection« has developed a prototype that leverages stereoscopic visualization and force feedback to enable visuo-haptic exploration of tomographic volumes. This design provides informative haptic feedback for digital preparation processes by modeling material properties of digital objects as physical forces for extended physiological proprioception. In addition to this prototype, »Virtual Dissection« has contributed a novel open-source game engine voxel library that supports real-time immersive sculpting of tomographic volumes. This tool enables researchers to design custom solutions that cater to specific tomographic data processing workflows. Although »Virtual Dissection« has primarily focused on the use case of digital fossil preparation, the project's technical contributions have potential applications in other fields that require extensive human interaction with tomographic volumes. For example, medical treatment planning in individualized virtual patient models could benefit from the immersive haptic feedback and real-time tomographic volume processing capabilities developed.

The project studied informed cutting of nanomaterials on both the nano- and macroscale, with principles of scanning probe microscopy serving as a basis for the »Sensing Knife«, recognizing, mapping, and capable of cutting internal interfaces: small molecules such as water or ethanol can recognize interfaces between different material domains, wet them, and thereby possibly cut the interactions between them, as observed in two dimensions over an atomically flat substrate such as muscovite mica. Additionally, 2D carbon-based nanostructures of graphene were utilized as templates for attaching hyperbranched polyglycerol nanoparticles in a 2D cross-link. These were later cut and exfoliated from the graphene template for use as viral inhibitors. Their sulfated variants were shown to be capable of interacting with, and inhibiting, Covid-19 viral particles. In addition, it was demonstrated that the inhibition of cell infection can be independent of viral mutations, as the interaction is mainly physical rather than a chemical recognition. Furthermore, a macroscopic »Sensing Knife« has been explored and physically prototyped as an instrument that is to be further developed into an interface between materials, machines, and humans for simultaneous recognition of tissue and its separation.

These understandings of cutting and haptics have been further enhanced through the cooperation with weißensee school of art and design on »HyperHaptics« and by the participation of engineering and design students from Telecom SudParis and the École Supérieure d'Art et de Design in Reims in the context of a data visualization research project entitled »Brain Roads«. This project emerged from the »Adaptive Digital Twin«, which developed visual representations and interactive tools for exploring the white matter of the human brain.

Cutting's overall future goal is to overcome the distinction between the analog and the digital in our scenarios, as described in a joint article that introduced the new concept of network-based neurosurgery as a future application scenario for the »Adaptive Digital Twin«.



Adaptive Digital Twin: Underlying architecture of the structural-functional relationship. The selected fiber bundles are relevant for cognitive domains such as language and motor functions. The glioma is colored in bright green. Visualization by Lucius Fekonja



Sketching Brains. An Ethnographic Participant Exhibition at the Neurosurgery Department of Charité. Drawing by Maxime Le Calvé

# Selected outcomes

## Publications

Ribault, P. ed. 2022. *Design, Gestaltung, Formatività. Philosophies of Making*. Basel: Birkhäuser.

Fekonja, L. S., Wang, Z., Cacciola, A., Roine, T., Aydogan, D. B., Mewes, D., Vellmer, S., Vajkoczy, P., Picht, T. 2022. »Network Analysis Shows Decreased Ipsilesional Structural Connectivity in Glioma Patients.« In *Communications Biology*, 5: 258.

Gholami, M. F., Guiducci, L., Jany, S., Razghandi, K. 2022 »Rethinking Active Matter: Current Developments in Active Materials: What Is Activity? An Introduction.« In *Active Materials*, edited by Fratzl, P., Friedman, M., Krauthausen, K., Schöffner, W. Berlin, Boston: De Gruyter, 191-222.

Picht, T., Le Calvé, M., Tomasello, R., Fekonja, L., Gholami, M. F., Bruhn, M., Zwick, C., Rabe, J. P., Müller-Birn, C., Vajkoczy, P., Sauer, I. M., Zachow, S., Nyakatura, J. A., Ribault, P., Pulvermüller, F. 2021. »Letter: A Note on Neurosurgical Resection and Why We Need to Rethink Cutting.« In *Neurosurgery*, E289-E291.

Pulvermüller, F., Tomasello, R., Henningsen-Schomers, M. R., Wennekers, T. 2021. »Biological Constraints on Neural Network Models of Cognitive Function.« In *Nature Reviews Neuroscience*, 22(8): 488-502.

Mohammadifar, E., Ahmadi, V., Gholami, M. F., Oehrl, A., Kolyvushko, O., Nie, C., Donskyi, I. S., Herziger, S., Radnik, J., Ludwig, K., Böttcher, C., Rabe, J. P., Osterrieder, K., Azab, W., Haag, R., Adeli, M. 2021. »Graphene-Assisted Synthesis of 2D Polyglycerols as Innovative Platforms for Multivalent Virus Interactions.« In *Advanced Functional Materials*, 31: 2009003.

Zwick, C., Glaser, J., Rasehorn, F. (supervision), in collaboration with eLAB (led by Groll, F.), Bau, O. (computer science), van Brummelen, P. (textile and surface design), Le Calvé, M. (anthropology), Wiesener, H., Leask, Y., Erdöl, I. eds. 2021. *HyperHaptics - Oscillating between Physical and Virtual Tactility*. weißensee school of art and design berlin: HyperHaptics - Embodied Interaction (1) with contributions from Cisse, A., Gigi, N., Henßler, F., Kayser, T., Kim, M., Ruppert, A., Schmidt, J., Soravito De Franceschi, M., Zhang, R.

Rodrigues, L., Nyakatura, J. A., Zachow, S., Israel, J. H. 2022. »An Immersive Virtual Paleontology Application.« 13th International Conference on Human Haptic Sensing and Touch Enabled Computer Applications, EuroHaptics 2022. Springer, 478-481.

## Exhibits

Fekonja, L., Picht, T., Rasehorn, F. *Adaptive Digital Twin*. Exhibition. Cluster of Excellence »Matters of Activity«, Humboldt-Universität zu Berlin. Humboldt Labor, Humboldt Forum Berlin. Since 21 July 2020.

Gholami, M. F., Kim, Y., Le Calvé, M. with Espinoza, N. (sound artist) »Haptic Hanbok in the Virtual Reality Setup and the Concept of Virtual Sensing Knife in Virtual Cutting Floor.« At the exhibition: *Stretching Materialities - Hidden Activities in Objects and Spaces*. Tieranatomisches Theater, Humboldt-Universität zu Berlin. 17 September 2021-4 March 2022.

PROJECTS

# Material Form Function

From a historical-genealogical perspective, modern culture and technology have been extensively built on passivated materials, such as concrete, steel, plywood, and glass. Modern techniques of material passivation account for the exhausting consumption of resources and energy – contributing heavily to the ecological crises of today. Against this paradigm, the project’s interdisciplinary exploration of the inherent self-activity of (bio)materials operates as a critical intervention aimed at exploring novel modes of technicity and making: for the imagination of more sustainable futures and for a new culture of the material.

The project Material Form Function gathers experts from biology, engineering, surgery, design, architecture, and the humanities to explore material systems where micro- and macroscopic geometries and their associated properties interact at diverse structural levels to engender emergent (and often unexpected) behaviors/functions, react to their context, and can evolve over time. Leaving behind the hylomorphic schema of materiality, which perceives matter as a passive, acontextual, isomorphic substance, our interdisciplinary inquiry studies, interacts, and designs with active materials.

Material activity and bioinspiration are studied in the context of the current ecological emergency, questioning the logics of waste and cycles. The project’s aim is to develop a new theory and practice of design in which the strategies, tools, representations and research methods, functional performances, and future applications are a necessary consequence of engaging with active materials. Taking inspiration from biological materials, which integrate activity and matter, Material Form Function has built a strong connection between the natural sciences and design disciplines, resulting in different research strands. These research strands are not isolated, but vigorously intertwined, mutually informing one another across the disciplines, and highly collaborative. By combining methods from the natural sciences, design, and the humanities, the project seeks to advance the understanding of structure-function relationships in active material systems that can respond to, interact with, or adapt to, their environments.

#### Principal Investigators

Claudia Blümle – Art & Visual History  
 Karola Dierichs – Architecture  
 Michaela Eder – Materials Science  
 Myfanwy Evans – Mathematics  
 Peter Fratzl – Materials Sciences  
 Claudia Mareis – Design & Design Research  
 John Nyakatura – Biology  
 Konrad Polthier – Mathematics  
 Johann Pratschke – Surgery  
 Patricia Ribault – Gestaltung  
 Christiane Sauer – Architecture  
 Igor M. Sauer – Medicine  
 Robert Stock – Cultural History & Theory  
 Christof Windgätter – Media Theory

#### Cluster Professorships

Moritz Queisner – Digital Health & Media Studies

#### Research Associates

Lorenzo Guiducci – Materials Science  
 Léa Perraudin – Media Theory  
 Khashayar Razghandi – Materials Science & Engineering  
 Iva Rešetar – Architecture  
 Mareike Stoll – Comparative Literature, Art History & Design  
 Emile de Visscher – Design, Engineering & Materials Science

#### Pre-Doctoral Researchers

Pelin Asa – Civil Engineering  
 Frank Bauer – Architecture  
 Johanna Hehemeyer-Cürten – Fashion & Textile Design  
 Rahel Kesselring – Cultural History and Theory & Scenography  
 Maxie Schneider – Architecture & Design  
 Rasa Weber – Experimental Design  
 Charlett Wenig – Material & Production Design  
 Binru Yang – Lightweight Engineering

#### Associated Investigators

Cécile Bidan – Materials Science & Biophysics  
 Michaela Büsse – Design Anthropology  
 Mason Dean – Zoology & Biological Materials  
 Kora Kimpel – Interface & Interaction Design  
 Jörg Petruschat – Theory & History of Design  
 Marie Weinhart – Chemistry

#### Associated Members

Thomas Auer – Architecture  
 Claudia Banz – Curator for Design  
 Samuel Bianchini – Art & Design  
 Lennart Eigen – Zoology & Neuroscience  
 Anke Gruendel – Political Science  
 Leonie Häsler – Cultural History & Theory  
 Lucy Norris – Social Anthropology  
 Emanuele Quinz – Art & Design Historian  
 Diego Serra – Biology  
 James C. Weaver – Zoology & Materials Sciences

#### Alumni

Felix Gerloff – Design  
 Fariba Noorzadeh – Computer Science  
 Friedrich Reppe – Wood Sciences  
 Heidi Jalkh – Experimental Design

## Research (2019–2022)

During the course of the last three years, the project established new networks of experts through dedicated symposia (»Times of Waste – Handling Matter« at the Kunstgewerbemuseum, »Material Trajectories – Designing with Care«, annual conference of the German Society for Design Theory and Research), new teaching formats (»Scaling Nature« and »Scaling Fiber« at weißensee school of art and design), international collaborations and events for performative research (»Behavioral Matter« and »Dissect« events with the École nationale supérieure des Arts Décoratifs in Paris), design research workshops (»Material Negotiations: Practices of Biodesign«, »The Design Turn: Rehearsing Futures«), as well as academic lecture series (»Dis/Entangling Perspectives in Material Research«, »Dis/Entangling Material Futures«, and »Interdependence of Structure and Function in Biological Materials«).

Project participants have studied biological materials based on fibers, such as bacterial biofilms, wild silk cocoons, and timber as well as mineralized tesseræ (tessellated materials systems, for which an open-access online archive has been developed) as exemplary cases of materials in which 3D arrangements of

1D and 2D building blocks are used to obtain multiple functions. In addition, they have explored vascular structures found in extracellular matrices of organs and their regenerative role in the natural sciences and design (for instance, in the context of engineered organs).

A highlight of the joint project work was the exhibition project »Design Lab #13. Material Legacies« at the Kunstgewerbemuseum. By examining shape-shifting surfaces, phase-shifting textiles, and the processes of calcification, mineralization, and sedimentation, all the exhibits were considered within their sociocultural, economic, and political context. They focused on questions such as: How can we make better use of leftover materials? What can we learn from transferring biological processes to the processing of materials? What do materials and artifacts teach us about our relationship with the environment?

During the first research period, engineering, materials science, and design were at the center stage of the project. For the coming years, Material Form Function intends to leverage the unique interdisciplinary opportunity within the Cluster through an epistemological assessment conducted by the humanities and other disciplines in order to situate and deepen questions of materiality and making. The project plans to strengthen critical and historical approaches from the humanities, to systematize its interdisciplinary methodology and communicate it to a broader public, and to work toward application-oriented goals and outcomes.

## Selected outcomes

### Publications

Mareis, C., Rottmann, M. 2020. *Entwerfen mit System*. Studienhefte Problemorientiertes Design, 10, Hamburg: Adocs.

Mareis, C., Greiner-Petter, M., Renner, M. eds. 2022. *Critical by Design? Genealogies, Practices, Positions*. Bielefeld: transcript.

Ribault, P. ed. 2022. *Design, Gestaltung, Formatività. Philosophies of Making*. Basel: Birkhäuser.

Burchert, L., Rešetar, I. eds. 2021. *Atem / Breath: Gestalterische, ökologische und soziale Dimensionen / Morphological, Ecological and Social Dimensions*. Proceedings of the conference »Atem (Breath)« at the Department of Art and Visual History, Humboldt-Universität zu Berlin, 11–13 September 2019. Berlin/Boston: De Gruyter.

Eder, M., Schöffner, W., Burgert, I., Fratzl, P. 2020. »Wood and the Activity of Dead Tissue.« In *Advanced Materials*, 2001412.

Fratzl, P., Sauer, C., Razghandi, K. 2022. »Editorial for the Special Issue: Bioinspired Architectural and Architected Materials.« In *Bioinspiration & Biomimetics*, 17: 040401.

### Exhibition

Büsse, M. (curator), de Visscher, E. (curator), Dean, M., Dierichs, K., Eder, M., Eigen, L., Guiducci, L., Hehemeyer-Cürten, J., Jalkh, H., Kycia, A., Mareis, C., Nyakatura, J. A., Rasehorn, F., Rešetar, I., Ribault, P., Sauer, C., Sauer, I., Schneider, M., Stock, R., Shone, J., Wenig, C. *Design Lab #13. Material Legacies*. Exhibition. Cluster of Excellence »Matters of Activity«, Humboldt-Universität zu Berlin. Kunstgewerbemuseum Berlin. Funded by the Cluster of Excellence »Matters of Activity« and the Prussian Cultural Heritage Board of Trustees. 4 November 2022–26 February 2023.

### Design Project

Rasehorn, F., Ciecierska-Holmes, J., Rosenthal, N., Dean, M., Eigen, L., Nyakatura, J. A., Le, M.-L. V., Yang, B. 2022. *The Tessellation Archive*. Design project. weißensee school of art and design berlin, Max Planck Institute of Colloids and Interfaces, Humboldt-Universität zu Berlin: Comparative Zoology, Cluster of Excellence »Matters of Activity«. Since 1 June 2022.

### Events

Werner, K., Tikka, E., Nyakatura, J. A., Rasehorn, F., Vaish, A., Perraudin, L., Müller, M., Nestler, A., Bullermann, E. »What Is the Future Made Of? A Speculative Workshop about Bio-Inspired Design.« Museum für Naturkunde Berlin, Berlin Science Week. »CollActive Materials«. Cluster of Excellence »Matters of Activity«, Humboldt-Universität zu Berlin. 5 November 2022.

Quinz, E., Ribault, P. (moderators), Saraceno, T. (co-organizer), Chiaramonte, X., Hengge, R., Jäger, P., Jarry, A., Jordan, A., Müller, M. (guests). »Dissect« – *An Artistic Research on a More Equal Balance of Human- Techno- and Biodiversity. Discussion on Tomás Saraceno's Spiders*. Tieranatomisches Theater, Humboldt-Universität zu Berlin. Berlin Science Week, 4 November 2022.

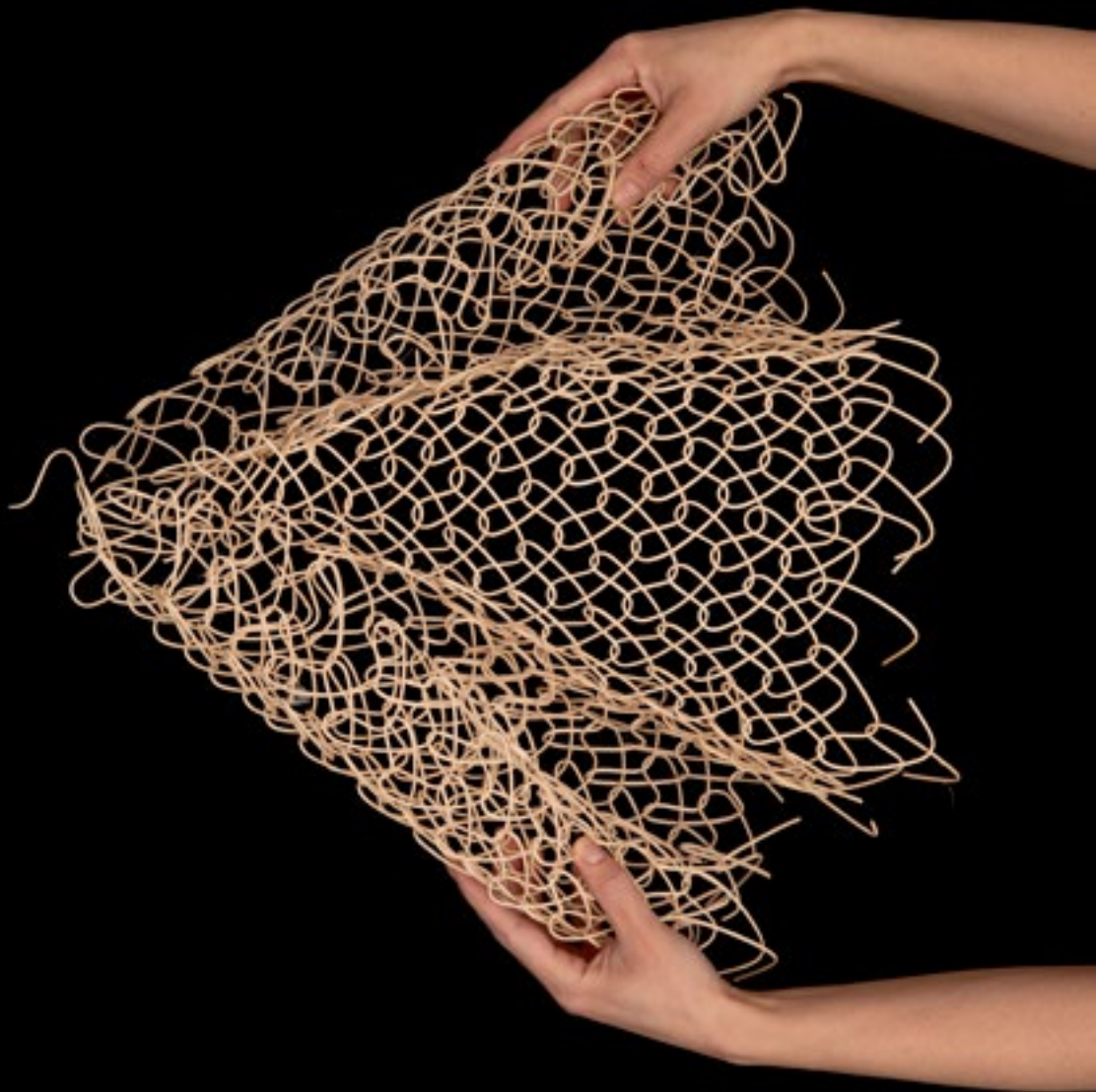


Hanging paper bridge made of approximately ten thousand A4 sheets held together by friction. Design and research: Lorenzo Guiducci, Maxie Schneider, Jojo Shone and Christiane Sauer



Exhibition view »Material Legacies«, Project »Architectural Yarns« and Installation »Yarns as Mixtures« by Iva Rešetar, Christiane Sauer, Jojo Shone and Maxie Schneider, Kunstgewerbemuseum Berlin, 2022

PROJECTS



# Object Space Agency

The researchers of Object Space Agency examine the relationships of active materials in the sphere of objects, persons, and architectural structures. Material objects appear to be temporally and spatially at once stable and changeable.

The inherent activity of matter is usually not immediately visible – it is hidden within, revealed by measurements, or becomes apparent only in interpretation. Activity manifests itself equally in structural, cultural, and semiotic dimensions. By further shifting the focus from objects to the materiality of spatial production and the spatial activity of matter, project researchers are finding ways to resensitize human perception and understanding of the built, grown, and preserved (extended) environment. Exhibitions and collections today are faced with the challenge of dealing not only with immobilized objects, but also with the various dimensions of their activity.

To comprehend the inseparability of human beings from their environment, experiences beyond the human are to be imagined. Creating a new habitat of active architectures is a negotiation between conservation, regeneration, and innovation. To conceive »matter as a condensation of responsibility«, new perspectives of processes are needed for innovation. What perspectives do nonhuman actors take on, and what might an exhibition dominated by bacteria, fungi, or particles look like? How can new experiences unfold aesthetically from material, biological, human, and ecological activities? What impact does the internal activity of materials have on ways of handling, exhibiting, or collecting in museums? Environment and objects, museum space and curation take a look at the conditions of their own creation and experiment with new material structures and configurations.

The project's concept is that an exhibition becomes an environment for research practices by bringing visitors, curators, researchers, objects, spaces, and activities into an integrative context. Exhibitions are understood as an academic research methodology rather than as merely a presentation of results. Thus, diagonal sciences as a theory of design and scientific research now include exhibiting and interrelating research, design, and publicly providing a basis for transdisciplinary research that includes stakeholders from society, starting with searching for a research question.

#### Principal Investigators

Claudia Blümle – Art & Visual History  
 Karola Dierichs – Architecture  
 Finn Geipel – Architecture  
 Christian Kassung – Cultural History & Theory  
 Sharon Macdonald – Social Anthropology  
 Thomas Ness – Design  
 Jörg Niewöhner – Social Anthropology  
 Christine Sauer – Architecture & Design  
 Wolfgang Schäffner – Cultural History & Theory  
 Jürgen Sieck – Computer Science  
 Matthias Staudacher – Mathematics & Physics  
 Sabine Thümmler – Art & Image History  
 Daniel Tyradellis – Philosophy  
 Christof Windgätter – Media Theory  
 Carola Zwick – Design

#### Research Associates

Philipp Kaspar Heimann – Art & Visual History  
 Maxime Le Calvé – Social Anthropology  
 Natalija Miodragović – Architecture  
 Nina Samuel – Art & Visual History  
 Christian Stein – Computer Science & Literature  
 Mareike Stoll – Comparative Literature, Art History & Design  
 Hanna Wiesener – Design  
 Clemens Winkler – Design Research

#### Pre-Doctoral Researchers

Dimitra Almpani-Lekka – Architecture  
 Yoonha Kim – Fashion Design & Anthropology  
 Babette Werner – Art & Visual History

#### Associated Investigators

Vera Meyer – Microbiology  
 Jörg Petruschat – Theory & History of Design  
 Chris Salter – Computer-based Art  
 Friedrich von Bose – Exhibitions & Social Anthropology

#### Associated Members

Flavia Caviezel – New Materialism, Political Ecology & Sensory Ethnography  
 Martin Grossmann – Art & Design  
 Thomas Helbig – Fine Arts, Art History & Philosophy  
 Anna Kubelík – Art, Design & Architecture  
 Chloé Lee – Fine Arts  
 Thomas Lilge – Philosophy & Theatre Science  
 Nelli Singer – Textile & Surface Design  
 Daniel Suarez – Architecture

## Research (2019–2022)

With the exhibition »Stretching Materialities«, new exhibition formats were developed that make visible the interweaving of the exhibits and visitors as agents through the activity of the materials. In this sense, the visitors were transformed from external observers into actors and cocreators within the exhibition. The exhibition evolved further through the influence of the visitors, time, and environment. A digital round trip through the exhibition as it was being prepared provided an additional dimension for visitor engagement. The »Stretching Senses School – VR Worlding for Planetary Emergency« further enhanced the cocreative nature of the research. The »Active Curtain« in the entrance area of the Humboldt Lab in the Humboldt Forum comprises various interactive/reactive and translucent elements made of bacterially generated and plant cellulose. These elements react to the environment and visitors without any conventional mechanical devices. Workshops on clouds and air, such as »Luft« at »Macht Natur«, underlined the implications of air as a responsive environment with an impact on the biosphere. Together with the Cluster's science communication team, the Virtual Cluster Space was created to make the experience of researching online more vivid and interactive. Responding to the pressing crisis of isolation during the pandemic, the Singleton #WirBleibenZuHause (#StayAtHome) app for tackling the crisis through play was codeveloped with gamelab.berlin and selected as a solution enabler for »WirVsVirus« (#UsVsVirus) at the #WirVsVirus hackathon organized by the German federal government. The Mein Objekt (My Object) app provides



games for knowledge transfers in museums. The app enables an interactive and entertaining chat dialogue between the visitor on their smartphone and the museum objects, which are no longer passive behind a showcase. The VR experience »PAAR« explored new ways of performing between digital and analog spaces.

The interactive VR installation »Die Umgebung der Wörter – Ausstellung eines Romans« invited visitors to explore Höllerer's novel »Die Elefantenuhr« in an immersive exhibition space. Unique collages were created by AI based on the visitor's activity, raising the question of who is the owner of the image created.

In the coming years, Object Space Agency will focus on the interweaving of nature, history, and culture with the agency of objects and spaces as interactive environments as well as on exhibiting as a research method in its own right.

## Selected outcomes

### Publications

Blümle, C., Lazardzig, J. 2022. »Foyer BRD. Zum Verhältnis von Theaterbau, Kunst und Öffentlichkeit in der Nachkriegszeit.« In *Zoltán Kemény. Das Raumkunstwerk für die Städtischen Bühnen in Frankfurt am Main*, edited by Oswald, P. Berlin: Deutscher Kunstverlag, 28–45.

Samuel, N., Sattler, F. eds. 2022. *Museale Reste. Bildwelten des Wissens*, 18. Berlin: De Gruyter.

Winkler, C. 2020. »Per-Forming Clouds – Materielle Dynamiken als Kommunikationsmodelle.« In *Matters of Communication – Formen und Materialitäten gestalteter Kommunikation*, edited by Foraita, S., Herlo, B., Vogelsang, A. Bielefeld: transcript, 206–212.

### Exhibitions/Media

Blümle, C., Stein, C., von Herrmann, H.-C.: »Die Umgebung der Wörter – Ausstellung eines Romans« for the exhibition *Sprache im technischen Zeitalter*. Technische Universität Berlin and Berlin University of the Arts. 17 November 2022–4 February 2023.

Stein, C., Lave, C. *PAAR. 360° virtual reality dance, performance and film*. Video, 2022.

Winkler, C., Blümle, C. (project leaders, curatorial leaders), Kim, Y., Le Calvé, M., Miodragović, N., Samuel, N., Stein, C. (concept, curators), Trabant, M.-L., Ladik, L. (project assistants). *Stretching Materialities – Hidden Activities in Objects and Spaces*. Exhibition. Cluster of Excellence »Matters of Activity«, Humboldt-Universität zu Berlin. Tieranatomisches Theater, Berlin. 16 September 2021–4 March 2022.

Sauer, C. (project leader), Miodragović, N. (project leader, designer), Beyer, B. (designer), Rešetar, I. (designer), Suarez, D. (designer, video producer), Singer, N. (designer), Hengge, R. (microbiologist), Hathroubi, S. (microbiologist), Eder, M. (materials scientist), Bidan, C. (materials scientist). »Active Curtain.« Humboldt Lab, Humboldt Forum Berlin. Since 29 April 2021.

Le Calvé, M., Miodragović, N., Samuel, N., Stein, C., Winkler, C. *TA Tour – eine virtuelle Ausstellung in 360-Grad-Aufnahmen*. Exhibition. Conception and implementation in collaboration with the research group Object Space Agency. Cluster of Excellence »Matters of Activity«, Humboldt-Universität zu Berlin. Since 1 June 2020.

Nestler, A., Schmidt, E., Stein, C., Trinkle, J., Wegener, F., Winkler, C. 2020. »Virtual Cluster Space.« Design project. Virtual since 11 November 2020.

### Conferences

Stein, C., Janke, J., Mosse, R., Tecklenburg, J. »Viral Theatres: Pandemic Past/Hybrid Futures.« Conference of the Cluster of Excellence »Matters of Activity«, Humboldt-Universität zu Berlin, Tieranatomisches Theater, Berlin, 28–30 April 2022.

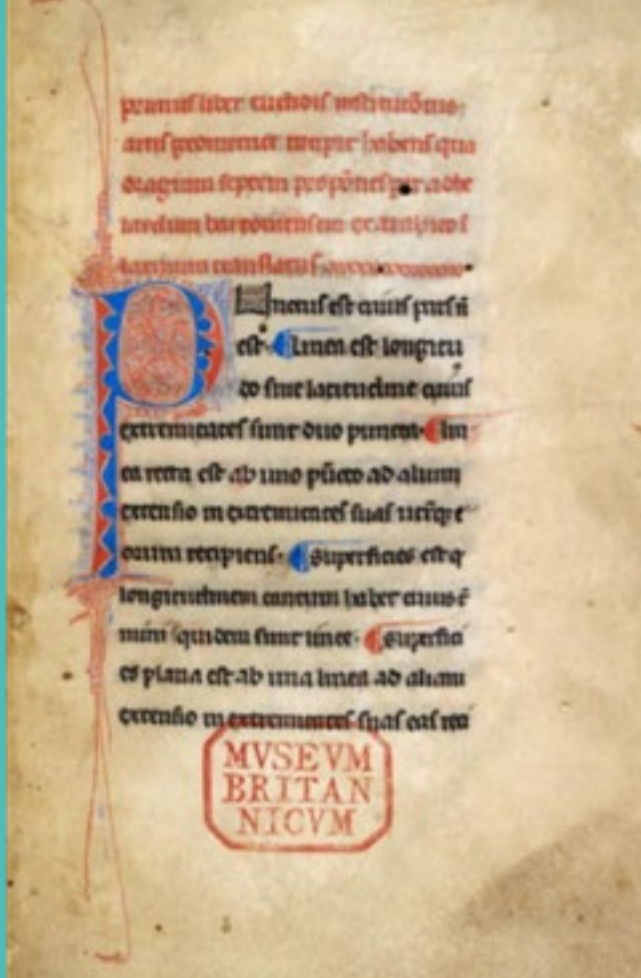
Stein, C., Drury, L., Mosse, R. The 25th Annual DRHA Conference »Digital Matters: Designing/Performing Agency for the Anthropocene.« Heilig-Geist Kapelle, Berlin. Organized by the Cluster of Excellence »Matters of Activity«, Humboldt-Universität zu Berlin, in cooperation with the Cluster of Excellence EXC 2020 »Temporal Communities: Doing Literature in a Global Perspective«, Freie Universität Berlin, and the practice-based research project »Viral Theatres«. 5–7 September 2021.



Collection of tracing ephemeral materiality in a timeline over four months of the exhibition »Stretching Materialities«, TA T, 2021.  
Photo: Estefania Ehresmann

Virtual reality dance performance and film »PAAR« at TA T, 2022

## PROJECTS



Euclid, *Elementa* (translated by Adelard of Bath), 1st half of the 14th century.  
A Catalog of the Harleian Manuscripts in the British Museum, 4 volumes  
(London, 1808-1812), III (1808), no. 5404

# Symbolic Material

The change of perspective from supposedly passive material to active matter that engenders symbolic processes according to its inherent structure provokes a shift in the traditional boundaries between nature and culture. Thus, other traditional opposites (body–mind, active–passive, material–symbolic) can also be rethought as changeable polarities. The project Symbolic Material investigates the material foundations of symbolic processes in interaction with the symbolic dimension of materials from the viewpoint of philosophy, the history of mathematics, physics, and neuroscience.

The fundamental concepts of the Cluster – matter, activity, symbol, analog code, among others – present themselves as tasks and promises at the same time. Used and understood differently in the individual disciplines, they are experimentally explored and reflectively developed as common categories. One of the inquiries that stands at the center of Symbolic Material concerns the intrinsic relationship between the material and the ›immaterial‹ as well as the different material processes of symbolization as they come into expression in different disciplines.

Symbolic Material's philosophical approach elaborates the epistemic framework of active matter, thus offering methods for dealing with concept formation and an analysis of terms that generate a transversal and integrative perspective for other disciplines and their historical dimension. This conceptual work is not the task of philosophically trained specialists alone. Our conceptualizations arise from material practices, but they also help to clarify them. In this view, the historical and systematic reconstruction and formation of terms and notions are at the core of the Cluster's genealogical analysis of active matter: understood above all as instruments of research, they are to be judged according to the practical consequences that follow from their use. This includes an understanding of their translatability, equivalencies, or ambiguities as well as an awareness of their connotations, metaphorical charges, immigration, and transfer of knowledge from various disciplines. The challenge is to provide a conceptual framework in a genealogical perspective that can make explicit the historicity of today's conceptual tools, fulfill the Cluster's interdisciplinary venture, and consistently prove itself in experimental practice and its material foundations.

#### Principal Investigators

Horst Bredekamp – Art & Visual History  
 Regine Hengge – Microbiology & Molecular Genetics  
 Claudia Mareis – Design & Design Research  
 Sabine Marienberg – Philosophy & Linguistics  
 John Nyakatura – Biology  
 Thomas Picht – Digital Neurosurgery  
 Friedemann Pulvermüller – Neuroscience, Linguistics & Psychology  
 Wolfgang Schäffner – Cultural History & Theory  
 Jürgen Sieck – Computer Science  
 Matthias Staudacher – Mathematics & Physics  
 Joseph Vogl – Literary Studies

#### Research Associates

Martin Müller – Cultural History & Theory  
 Kolja Thurner – Art & Visual History  
 Samo Tomšič – Philosophy  
 Stefan Zieme – History of Science & Knowledge

#### Pre-Doctoral Researchers

Frank Bauer – Architecture

#### Associated Investigators

Maria Luisa Catoni – Ancient Art History & Archaeology  
 Michael Friedmann – Mathematics & Philosophy  
 Christiane Heibach – Media Aesthetics  
 Malte Henningsen – Computer Science  
 Shintaro Miyazaki – Media & Cultural Studies  
 Jürgen Trabant – Linguistics  
 Richard Weinkamer – Materials Science

#### Associated Members

Kathrin Mira Amelung – Media & Culture Studies  
 Arthur Glenberg – Psychology  
 Luigi Grisoni – Neuropsychology  
 Joachim Krausse – Design Theory  
 Georg Toepfer – Biology & Philosophy

#### Alumni

Stefanie Meisgeier – Art & Visual History  
 Kay Usenbinz – Art & Visual History  
 Michael Droste – Computer Science  
 Paul Feigelfeld – Media Theory

## Research (2019–2022)

The idea of a fundamental symbolic dimension of materiality does not only refer to biology (genetic code, function) or to cultural techniques, but changes the very notion of physical matter itself. The project therefore worked on a material epistemology, aiming to provide an integrative conceptual approach for the Cluster as a whole by combining experimental research by the natural sciences and practice-based design strategies with the humanities' historical and theoretical analysis.

During the first research phase, members of Symbolic Material undertook extensive genealogical research on basic epistemological constellations of symbolic material, that is, on modes of essential fusion and interweaving of the symbolic and the material. This included theoretical and material genealogies of structures and instabilities, mathematical materials, geometric operations, material constraints of brain functions, art production, economy and affect, enjoyment and materialism, and active materials. Methodological and historical research was developed together with the project *Weaving*, especially in relation to the Cluster's core topic of activity in the anthology *Active Materials* (2021).

The genealogical analysis of analog code focused on three different strategies: 1) longue durée genealogies of material practices of Gestaltung in the arts (Michelangelo) and of geometric operations from European antiquity to the 20th century; 2) intercultural genealogies of analog-coded practices with an emphasis on Latin America and Africa; 3) analysis of active materials as intrinsically coded and thus

as analog hardware.

A close connection to an experimental epistemology was developed through the analysis of the material constraints of brain activity in collaboration with the project Cutting, initiating feedback between experimental modeling and neuro-surgical practice on the one hand and the conceptual ideas of symbolic material on the other. The different genealogical and critical strands were used as the interdisciplinary background for the development of the methodological approach of an integrated material epistemology. The project's work focused on a broad variety of theoretical approaches including semiotics, new structuralism, new materialism, the theory of embodiment, the analysis of material codes, dynamic structures, the emergence of intrinsic symbolic activity, plasticity, and adaptive design.

Contemplating economic, ecological, societal, and intercultural perspectives on the present crisis, the urgency of an analysis of active and symbolic material became evident: the epistemological approach made its implicit critical attitude explicit. In this way, a material epistemology is made visible as a transformation-oriented research practice that allows for responses to the contemporary challenges within different societal, scientific, or technological constellations.

For the coming years, Symbolic Material's objective is to further develop the conceptual framework that enables the convergence of all Cluster projects in terms of an integrative material epistemology of the divergent methodological approaches and their close and necessary interaction. How can symbolic structures emerge, be stabilized, transmitted, memorized, and put into dynamics within physical matter? The integrative material epistemology will thus pave the ground for a new theory of matter and material code.

Marienberg, S. 2021. »Bewegliche Denkungsart und Lebendigkeit der Rede im Versuch über eine akademische Frage.« In: ... sind noch in der Mache: Zur Bedeutung der Rhetorik in Hamanns Schriften. Acta des zwölften Internationalen Hamann-Kolloquiums in Heidelberg 2019, edited by Achermann, E., Reibold, J., Göttingen: Vandenhoeck & Ruprecht, 319–329.

Zieme, S. 2021. »Imagining the Heavens: Adam Elsheimer's Flight into Egypt and the Renaissance Night Sky.« In *Journal for the History of Knowledge*, 2 (1):1–18.

Bredenkamp, H., Schäffner, W. 2020. »Material Agencies.« In *Zeitschrift für Kunstgeschichte*, 83 (3), 300–309.

Mareis, C. 2019. »Die Zeitlichkeit des Entwerfens. Visuelle Prozessmodelle und ihre temporale Bedeutung.« In *Visuelle Zeitgestaltung*, edited by Blümle, C., Mareis, C., Windgätter, C. Bildwelten des Wissens. Kunsthistorisches Jahrbuch für Bildkritik, 15. Berlin/Boston: Akademie Verlag, 114–123.

Müller, M. 2019. »Universale Konstrukteure? Vom αὐτός des Lebendigen zur Affirmation der synthetischen Biologie als universale Ingenieurwissenschaft.« In *Standardisierung und Naturalisierung*, edited by Müller, M., Neubert, C. Schriftenreihe des Graduiertenkollegs »Automatismen«, 17. Paderborn: Wilhelm Fink, 233–243.

Schäffner, W. 2019. »Am Nullpunkt des Wissens. Platon mit Euklid.« In *Modell + Risiko. Historische Miniaturen zu dynamischen Epistemologien*, edited by Laqua, A., Löffelbein, P., Lorber, M. Wiesbaden: Harrassowitz Verlag, 36–45.

## Selected outcomes

### Publications

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**»As long as design is understood as transferring pre-conceived design ideas into matter, material still plays the role of a passive recipient. A thorough analysis of active material can direct us towards a new kind of design.«**

**Wolfgang Schäffner**  
Director

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