SFB 1357 (2019-2026)
Collaborative Research Center

MICROPLASTICS

Understanding the mechanisms and processes of biological effects, transport and formation:

From model to complex systems as a basis for new solutions

Spokesperson:
Prof. Dr. Christian Laforsch

Vize Spokesperson:
Prof. Dr. Andreas Greiner

Tackling microplastics in the environment

evidence-based policy recommendations on textile fibres, tire abrasion, and pellet loss

Kindly hosted by
Representation of the Free State of Bavaria to the European Union

EPA Network

SFB MIKROPLASTIK

An Initiative of the German Federal Ministry of Education and Research
Plastics in the Environment
sources • sinks • solutions

SPONSORED BY THE
Federal Ministry of Education and Research

FONA
Research for sustainability

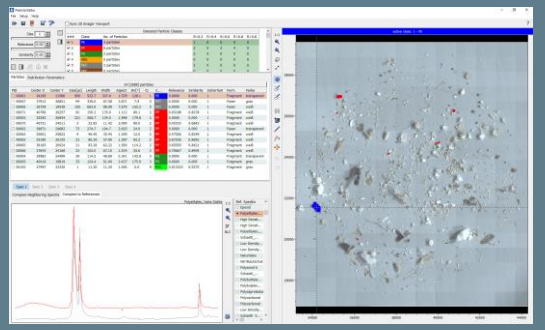
Representation of the Free State of Bavaria to the EU in Brussels
09 March 2023
09:30 - 15:00

Microplastics

Animal Ecology

UNIVERSITÄT BAYREUTH

Methods



Environmental contamination

Impact

International

limnoplast

HORIZON 2020 PAPILLONS

Plastic in Agricultural Production:
Impacts, Lifecycles and LONg-term Sustainability

PlasticsFatE

Plastics Fate and Effects in the Human Body

National

Collaborative Research Centre (SFB) 1357: Microplastics

microplastics@food CORNET

BabbA

Biologisch abbaubare Beutel in der Bioabfallverwertung

MIKOBO

Microplastics in organic fertilizers and their impact on agricultural soils

Why starting an Collaborative Research Center?

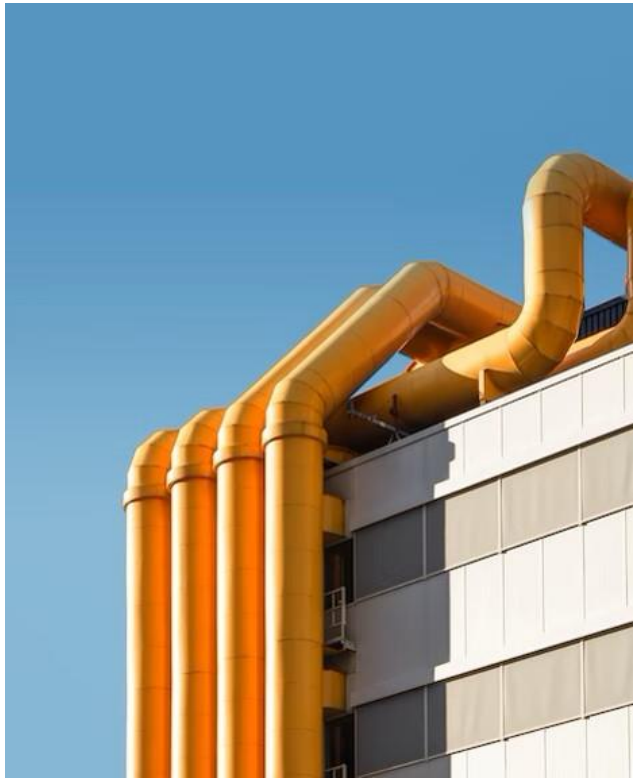


Foto: Victor auf Unsplash

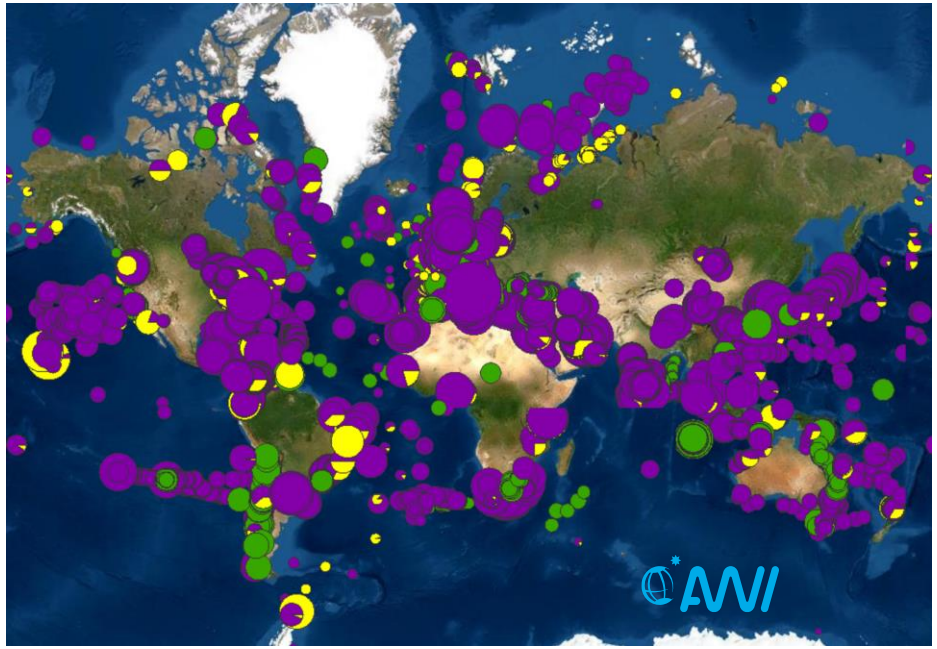
A problem solver turned into a problem

Why starting an Collaborative Research Center?

Foto: i-stock, Getty Images

Plastics pollution is a “wicked problem” that is highly interconnected to the economy, environment, and society

Why starting an Collaborative Research Center?



MP is a potential risk to the environment, economy and society

Science 2004

Current Issue First release papers Archive About Submit manuscript

Lost at Sea: Where Is All the Plastic?

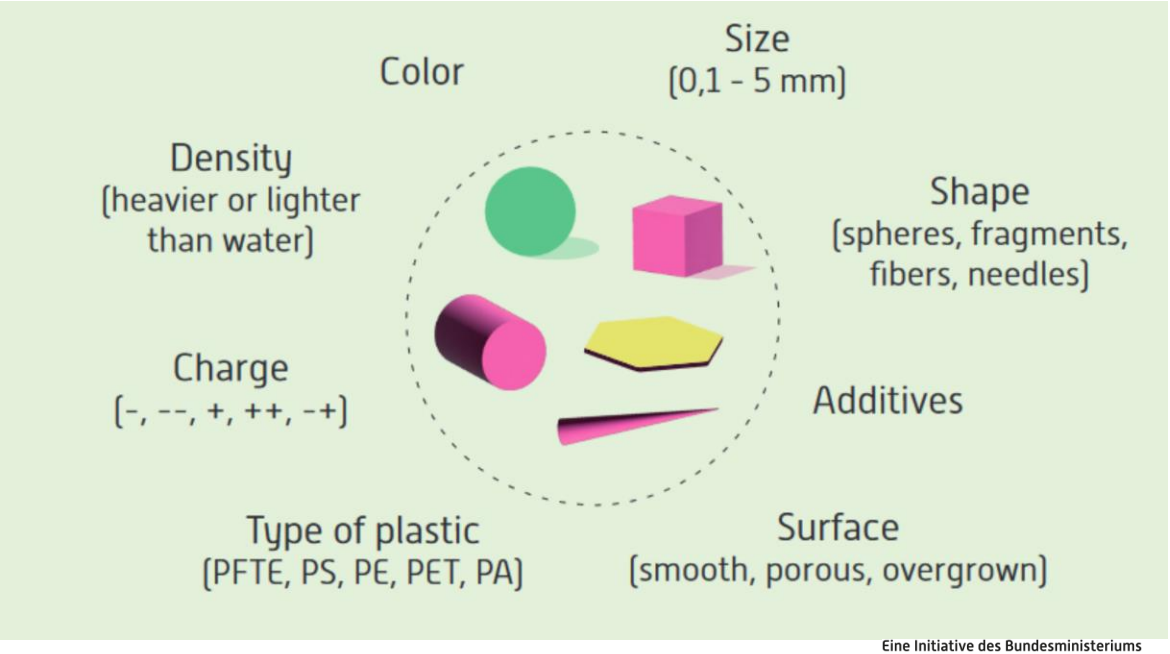
RICHARD C. THOMPSON, YLVA OLSEN, RICHARD P. MITCHELL, ANTHONY DAVIS, STEVEN J. ROWLAND, ANTHONY W. G. JOHN, DANIEL MCGONIGLE, AND ANDREA E. RUSSELL

After 19 years of intensive research: lot of progress is made - but many questions about the effects, transport in the environment and degradation are still largely unresolved.

Why?

Microplastics ≠ Microplastics

a diverse suite of contaminants



Eine Initiative des Bundesministeriums für Bildung und Forschung

Plastik in der Umwelt

Quellen • Senken • Lösungsansätze

Microplastics ≠ Microplastics

a diverse suite of contaminants

Foto: i-stock, Getty Images

textile fibres

tire abrasion

Foto: JOHN BEARBY IMAGES auf Unsplash

Foto: Sören Funk auf Unsplash

pellet loss

Mikroplastik ≠ Mikroplastik

Journal of Hazardous Materials 425 (2022) 127961

Contents lists available at ScienceDirect

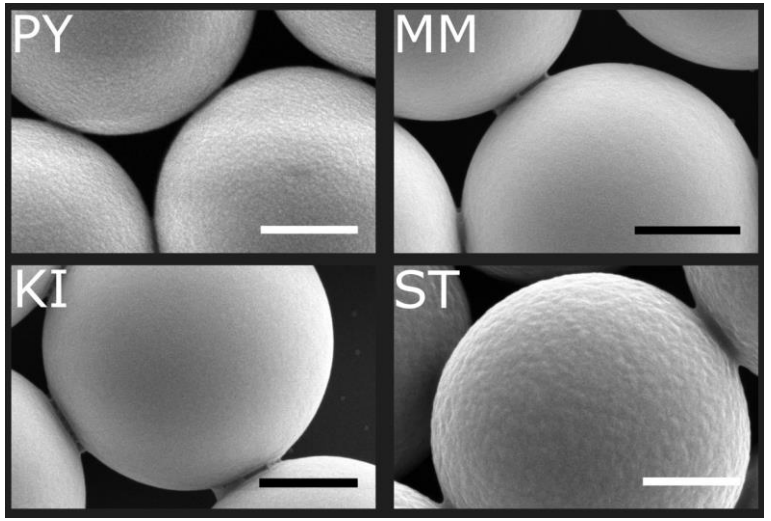
Journal of Hazardous Materials 2022

journal homepage: www.elsevier.com/locate/jhazmat

Research Paper

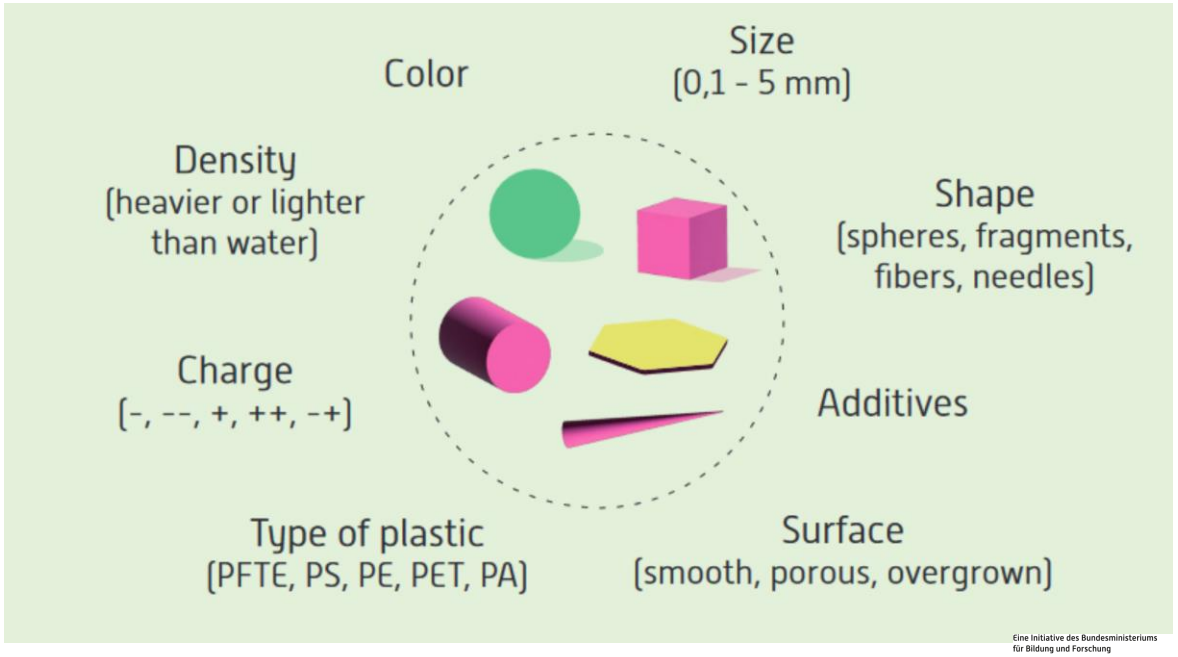
Supposedly identical microplastic particles substantially differ in their material properties influencing particle-cell interactions and cellular responses

A.F.R.M. Ramsperger [a,g,1], J. Jasinski [b,1], M. Völkl [c,1], T. Witzmann [d], M. Meinhart [e], V. Jérôme [c], W.P. Kretschmer [f], R. Freitag [c], J. Senker [e], A. Fery [d], H. Kress [g], T. Scheibel [b], C. Laforsch [a,*]



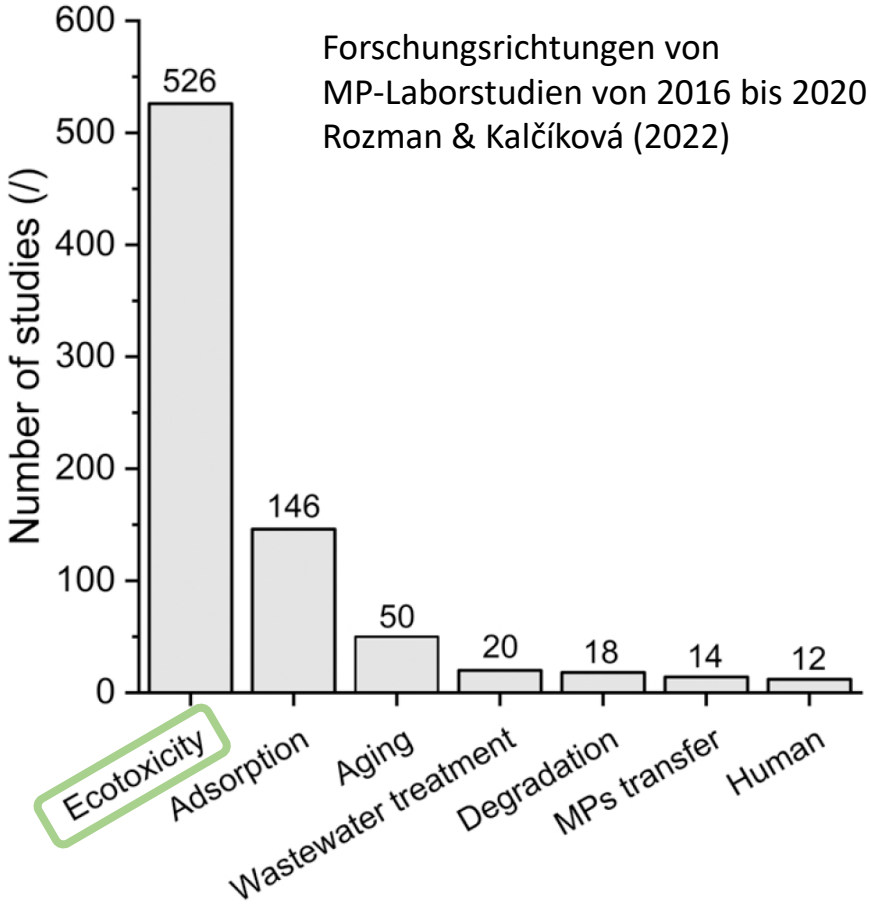
Microplastics ≠ Microplastics

a diverse suite of contaminants



➢ **Grand challenges**

Biological effects



Forschungsrichtungen von
MP-Laborstudien von 2016 bis 2020
Rozman & Kalčíková (2022)

Triebskorn et al. (2019) *"Lacking information on the exact* ***particle qualities*** *(…) poses a drawback."*

Stock et al. (2021) *"(…) all existing studies dealing with microplastic uptake and toxicity exclusively* ***used spherical, monodisperse model polystyrene particles****."*

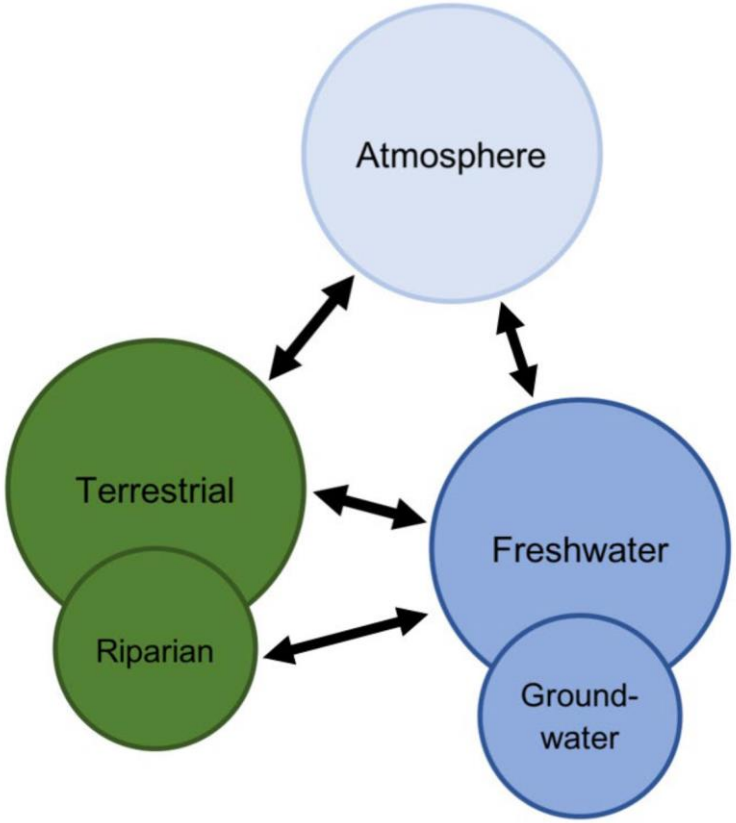
Rozman & Kalčíková (2022) *"(…) the majority of microplastic particles used are manufactured* ***spheres of polystyrene*** *(…),* ***did not characterize the particles used,*** *and that a minority of studies used* ***aged particles,*** *or used* ***natural particles as a control****."*

Hampton et al. (2022) *"For some characteristics, such as morphology and polymer type, more data are needed.* ***Other characteristics are not described or reported in the literature****."*

➢ **Fundamental understanding of effects as a function of particle properties**

Challenges

Transport & migration



& Interaction with Biota

Contents lists available at ScienceDirect

Science of the Total Environment **2021**

journal homepage: www.elsevier.com/locate/scitotenv

Review

The occurrence and transport of microplastics: The state of the science

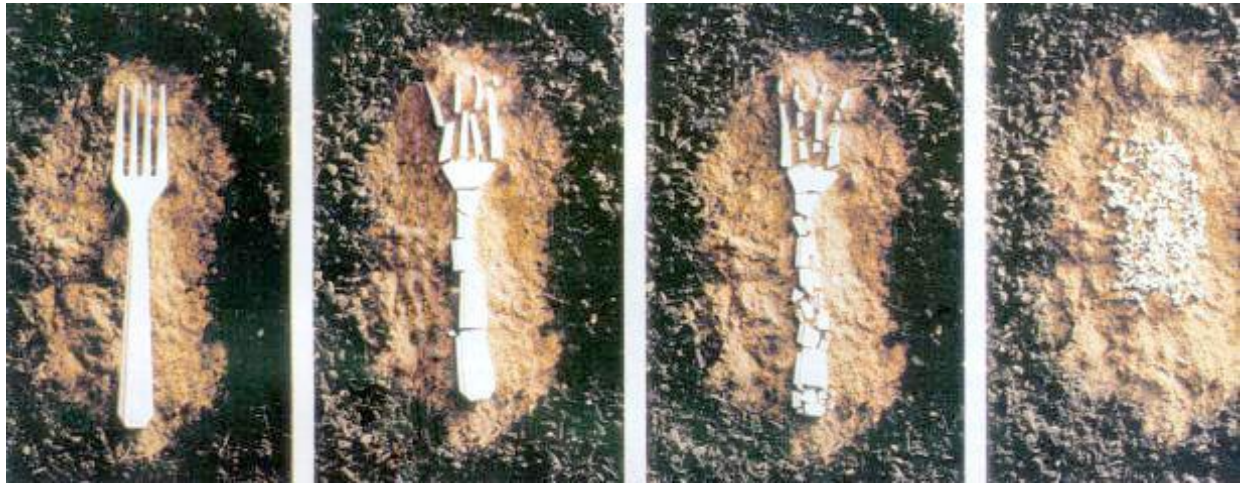
Fritz Petersen [a,*], Jason A. Hubbart [a,b]

[a] Institute of Water Security and Science, West Virginia University, 1194 Evansdale Drive, 3109 Agricultural Sciences Building, Morgantown, WV 26506, USA
[b] Schools of Agriculture and Food, and Natural Resources, Davis College of Agriculture, Natural Resources and Design, West Virginia University, 3109 Agricultural Sciences Building, Morgantown, WV 26506, USA

"Most MP transport processes, and environmental impacts remain poorly understood."

➢ **Fundamental understanding of the transport behavior as a function of particle properties**

Degradation



ELSEVIER

Environmental Pollution
Volume 274, 1 April 2021, 116554

2021

Review

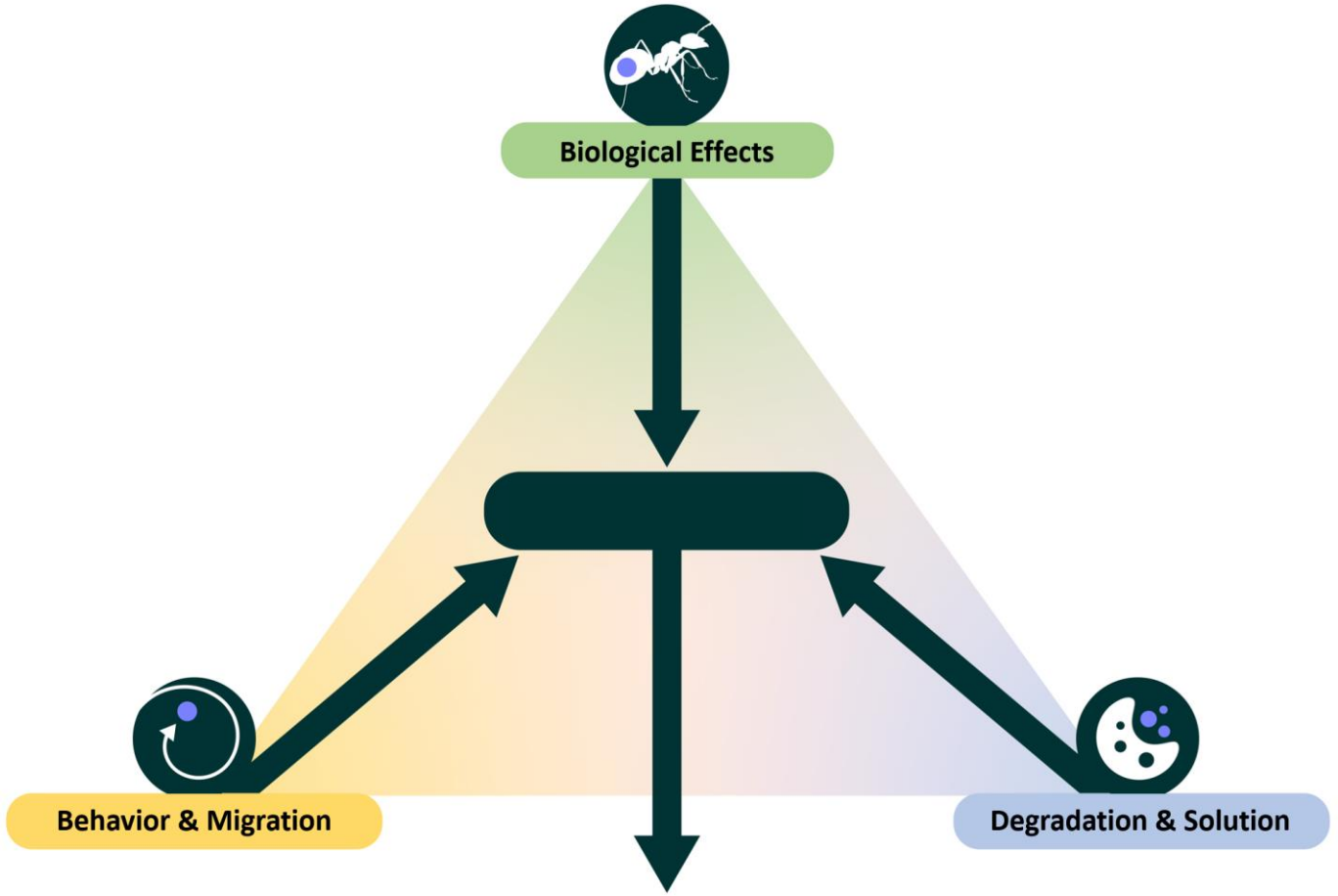
Understanding plastic degradation and microplastic formation in the environment: A review ☆

Kai Zhang [a, e], Amir Hossein Hamidian [b, d], Aleksandra Tubić [c], Yu Zhang [d], James K.H. Fang [e, f], Chenxi Wu [a] ✉, Paul K.S. Lam [e]

"Knowledge on the environmental degradation of plastics and the formation of microplastics is still limited."

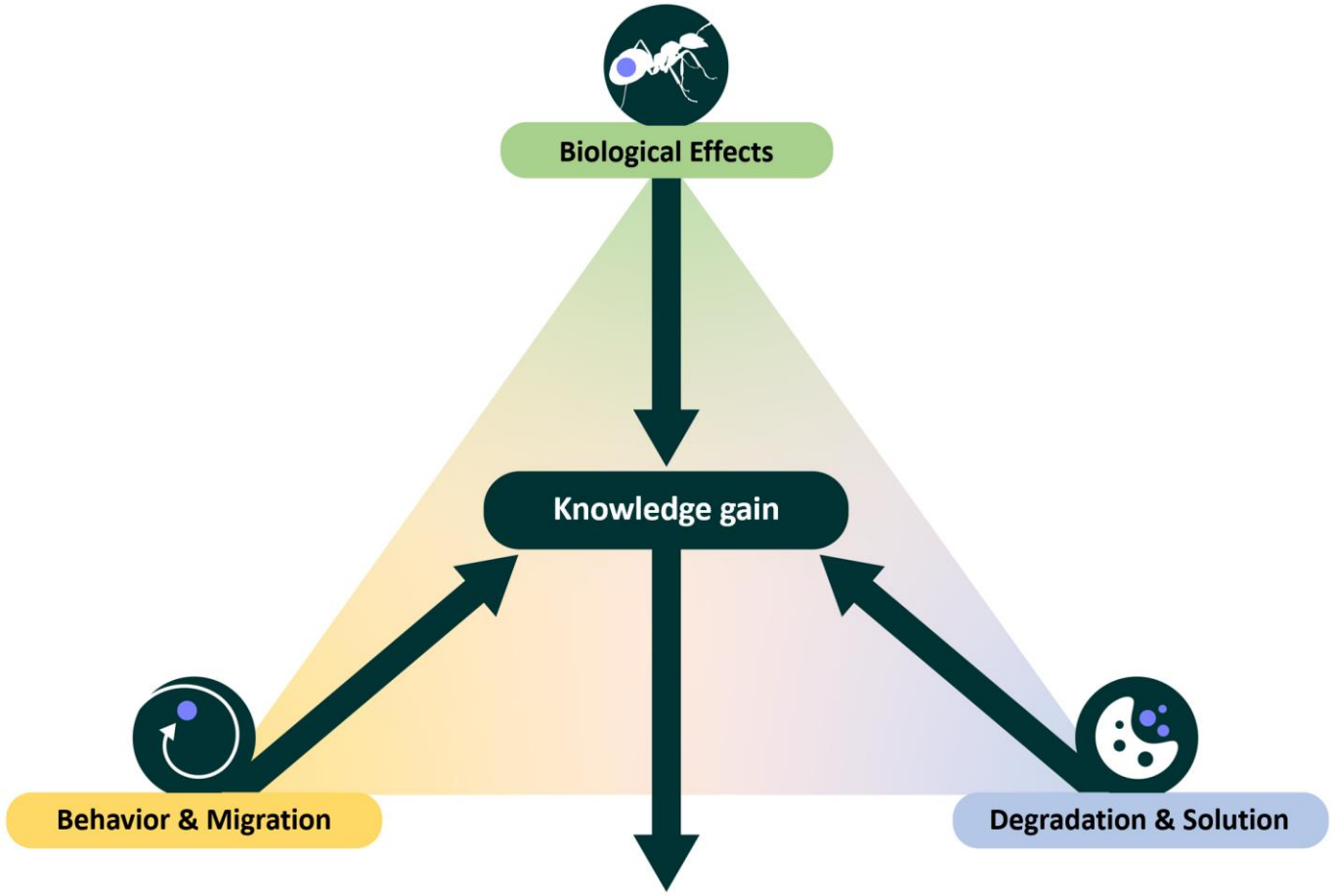
➢ **Fundamental understanding of degradation mechanisms as a function of particle properties**

Challenges



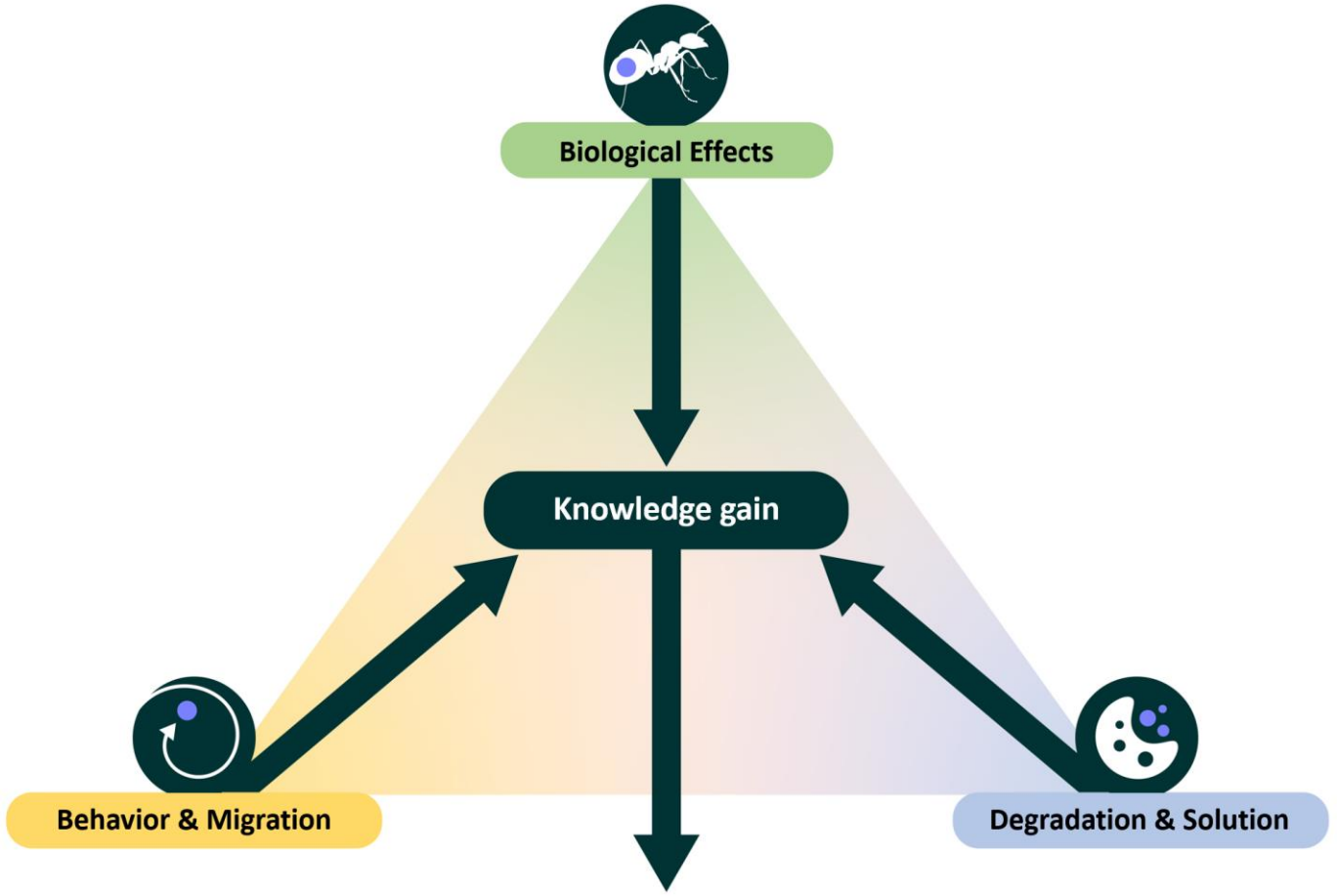
➢ **Grand challenges = project areas**

Joint knowledge gain



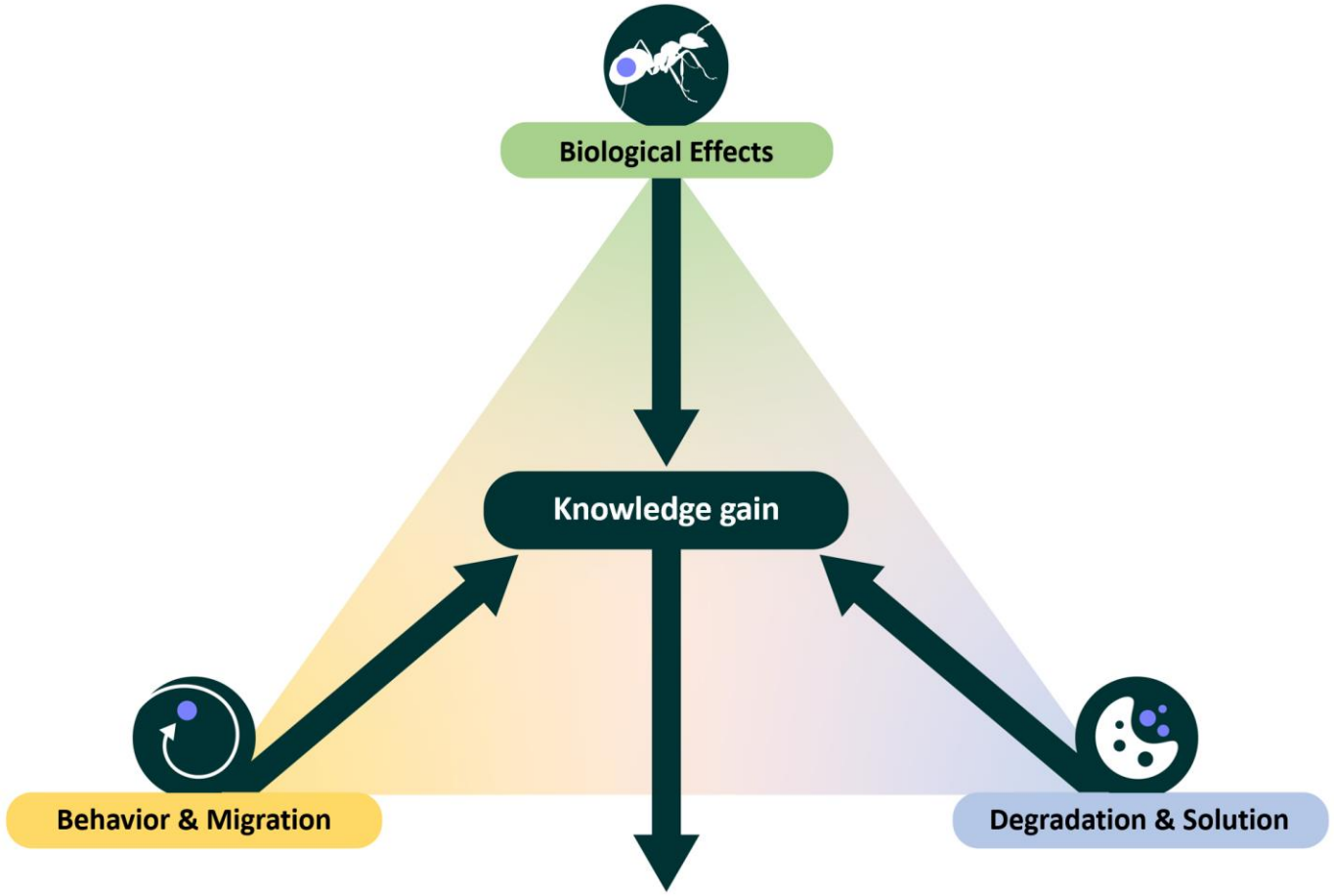
➢ **Knowledge gain = Environmentally relevant properties**

Basis



➢ **Assessment of environmental risks**

Basis

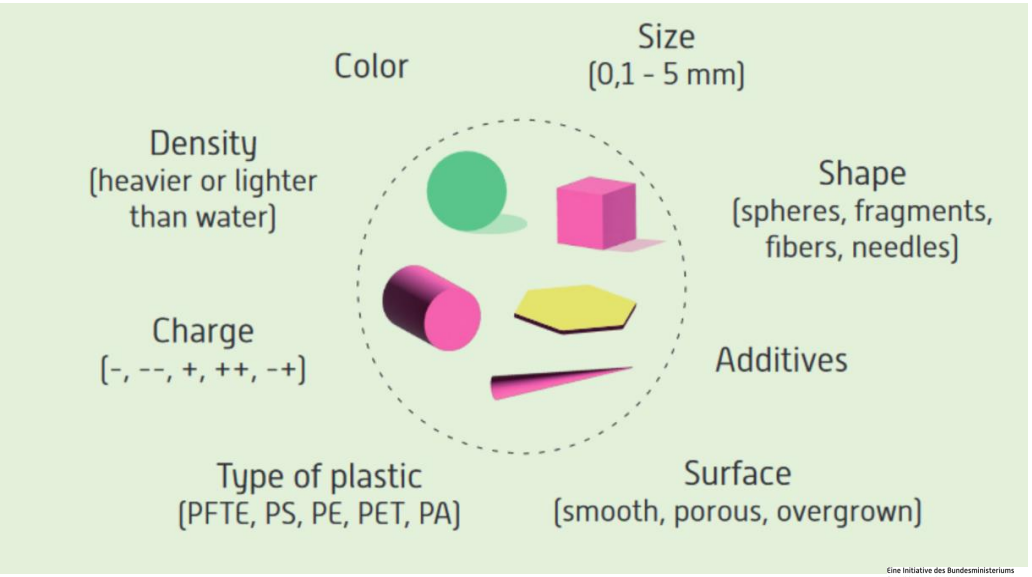


➢ **Development of new materials/solutions**

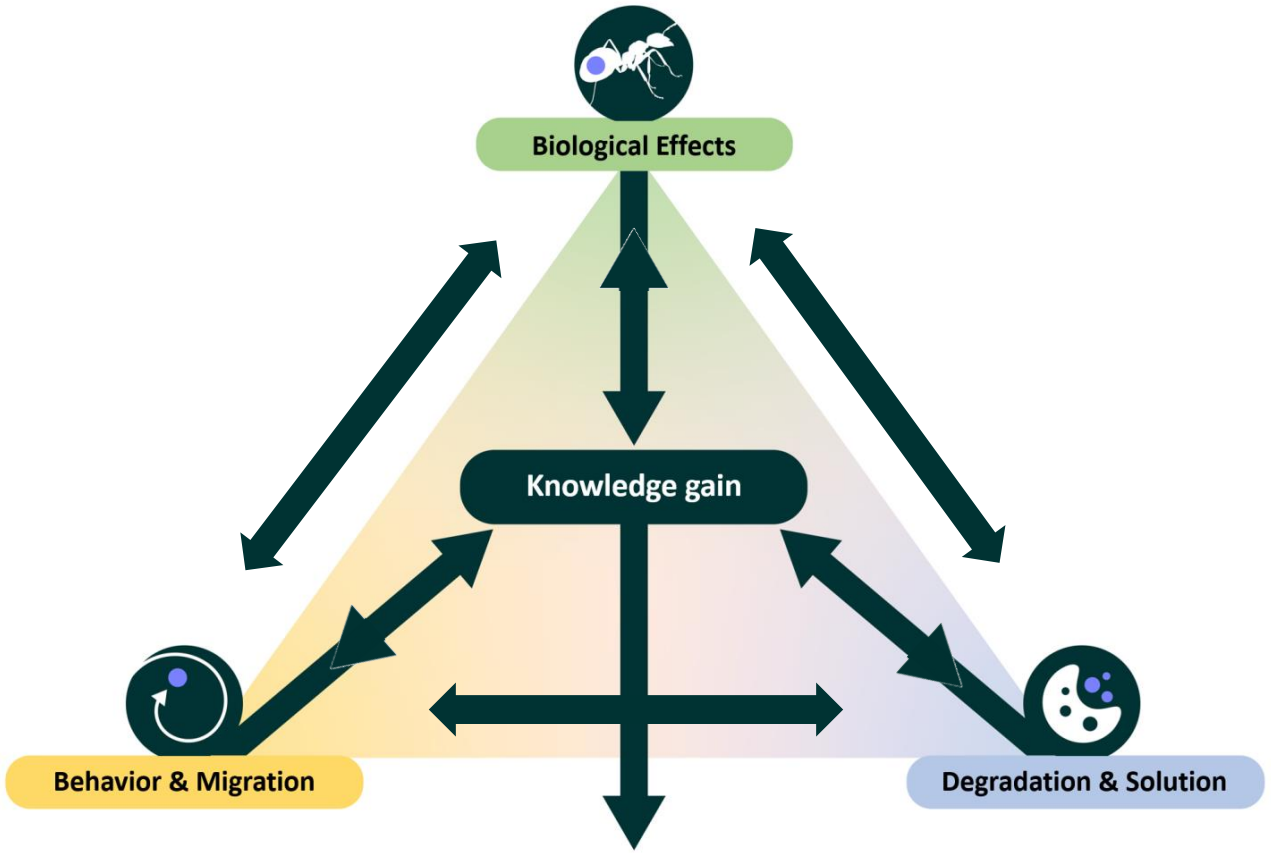
Challenges

➢ **Development of new materials/solutions**

Complex topic

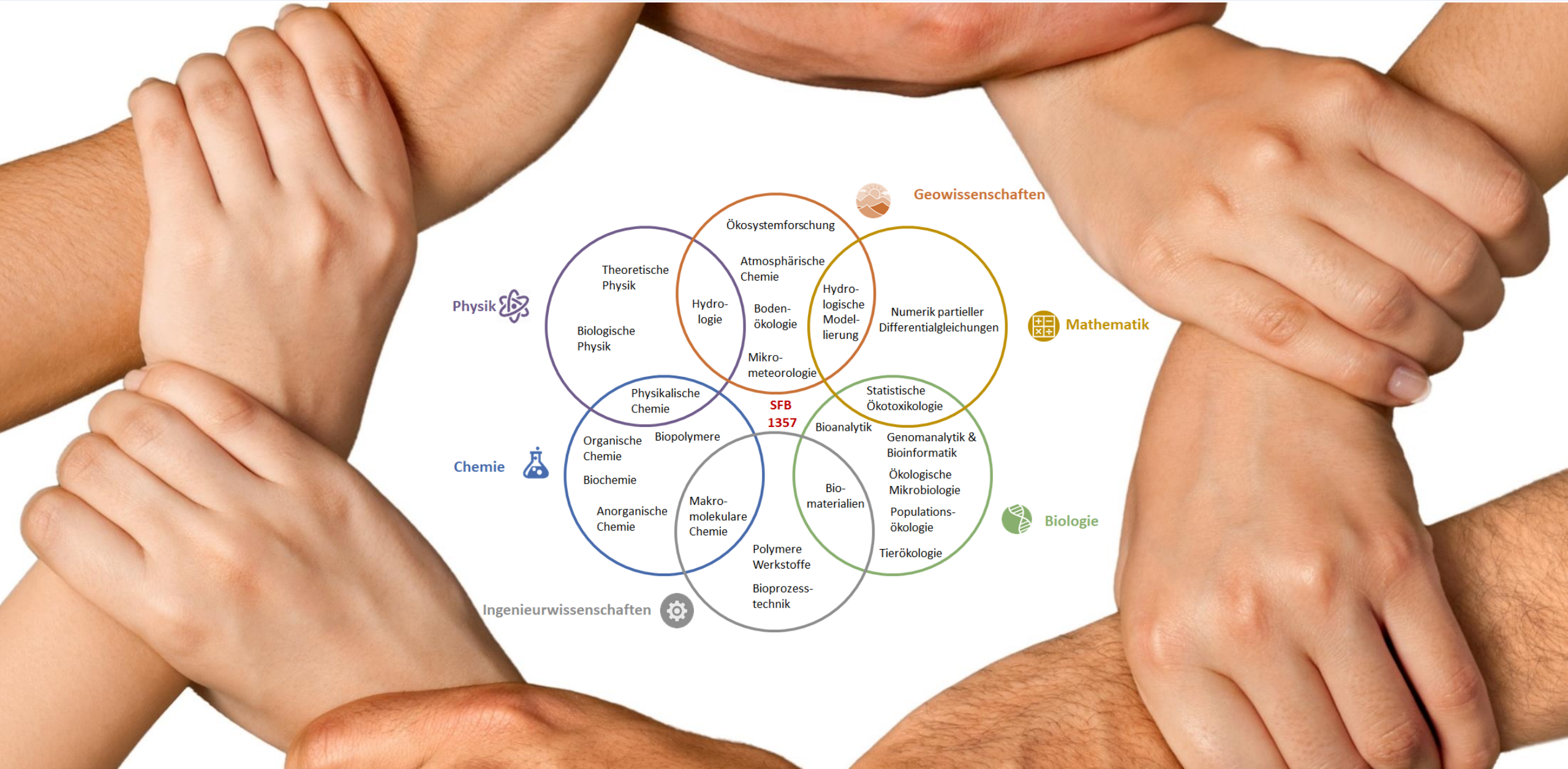


Eine Initiative des Bundesministeriums für Bildung und Forschung
Plastik in der Umwelt
Quellen • Senken • Lösungsansätze

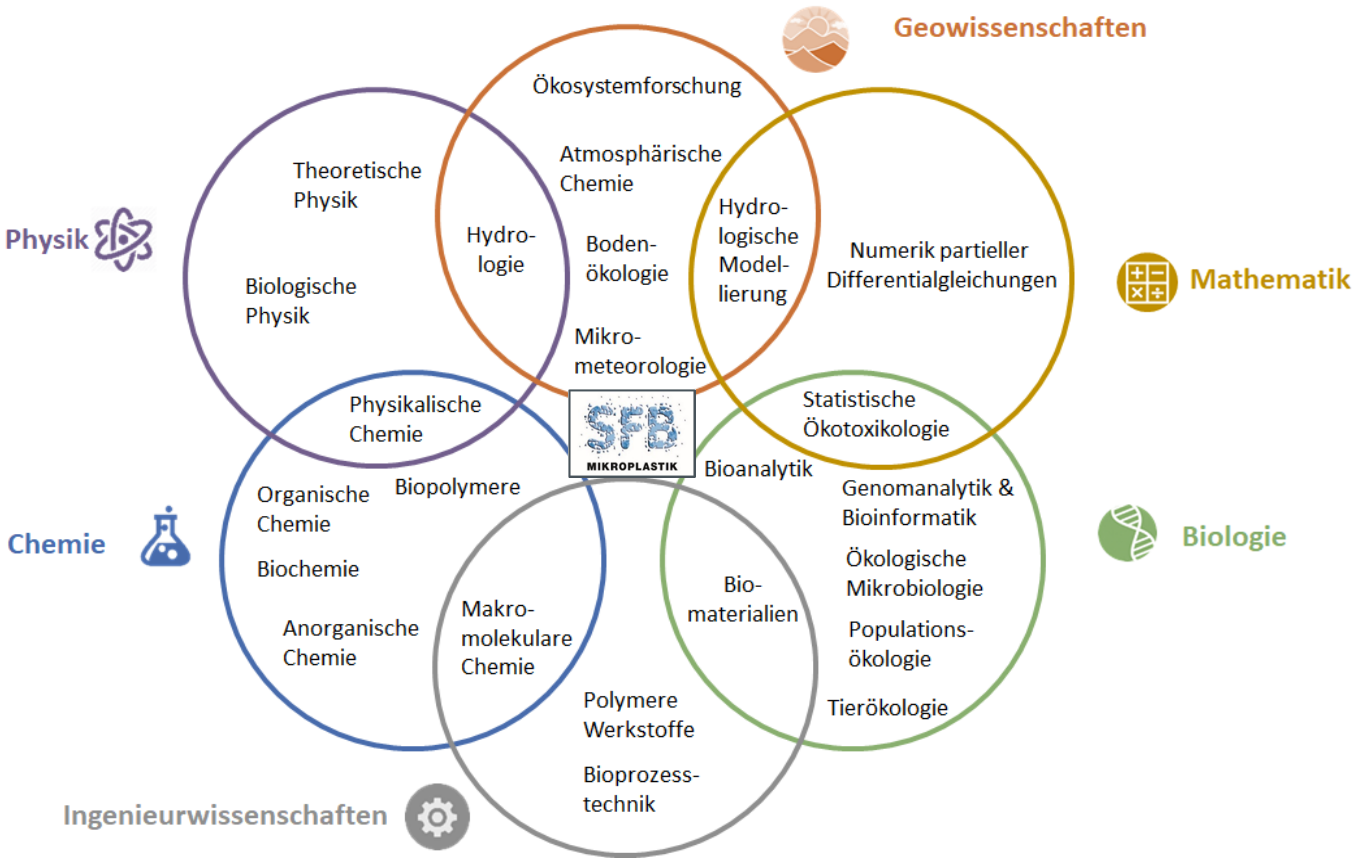


- **Understanding the interrelationships**
- **High degree of interdisciplinarity**

Interdisciplinary Team



Interdisciplinary expertise



DFG Deutsche Forschungsgemeinschaft

Collaborative Research Centre 1357

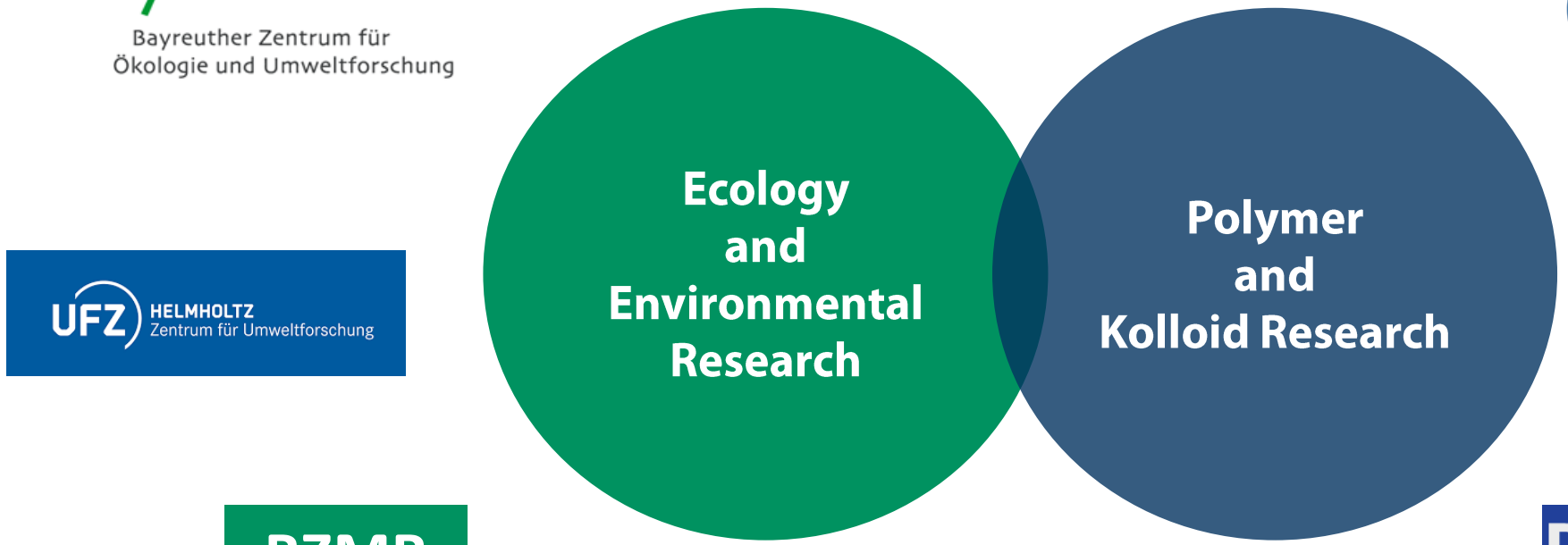
UNIVERSITÄT BAYREUTH

Over 160 scientists

Open for collaboration

https://www.sfb-mikroplastik.uni-bayreuth.de/en/

Interdisciplinary expertise



BZMB

Bayreuther Zentrum für Molekulare Biowissenschaften

NBNC

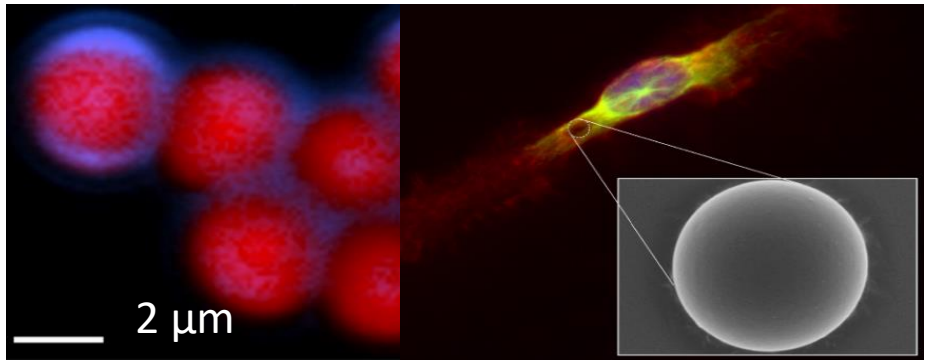
Nordbayerisches NMR-Zentrum

BZKG

Bayreuther Zentrum für Kolloide und Grenzflächen

(sublethal) effects: induced by the plastic material itself and not by particle exposure per se (use of natural reference particles mandatory)

besides size and morphology: eco-corona, aging, ζ-potential, additives and residual monomers play a decisive role for the effects



SCIENCE ADVANCES | RESEARCH ARTICLE

ENVIRONMENTAL STUDIES

Environmental exposure enhances the internalization of microplastic particles into cells

A. F. R. M. Ramsperger[1,2], V. K. B. Narayana[1], W. Gross[2], J. Mohanraj[3], M. Thelakkat[3], A. Greiner[4], H. Schmalz[4], H. Kress[2*†], C. Laforsch[1*†]

➢ detailed characterization of the physical and chemical properties of MP are essential for understanding the effects

Behavior und Migration

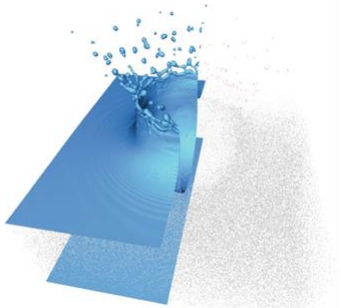
Rapid heteroaggregation with environmental particles (humic acids, ferric (oxy)hydroxide, aluminimium hydroxide) affects environmental behavior.

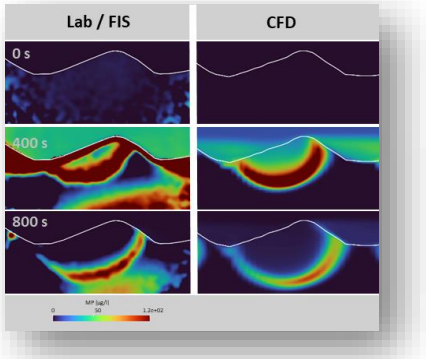
environmental behavior strongly depend on particle properties in air, water and soil

RESEARCH

Is transport of microplastics different from that of mineral dust? Results from idealized wind tunnel studies

Eike M Esders[1*], Sebastian Sittl[2], Inka Krammel[2], Wolfgang Babel[1,3], Georg Papastavrou[2] and Christoph K Thomas[1,3]





➢ detailed characterization of the physical and chemical properties of MP are essential for understanding behavior and migration

Degradation mechanisms and models for PS, PE, PP

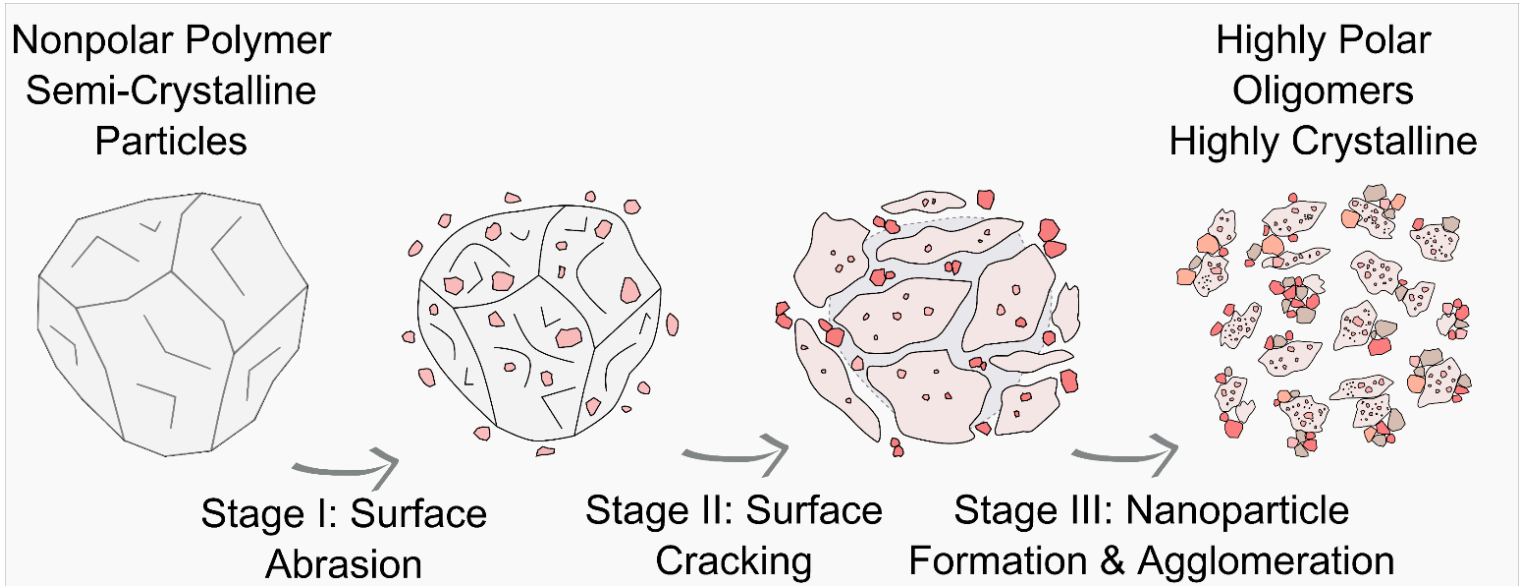
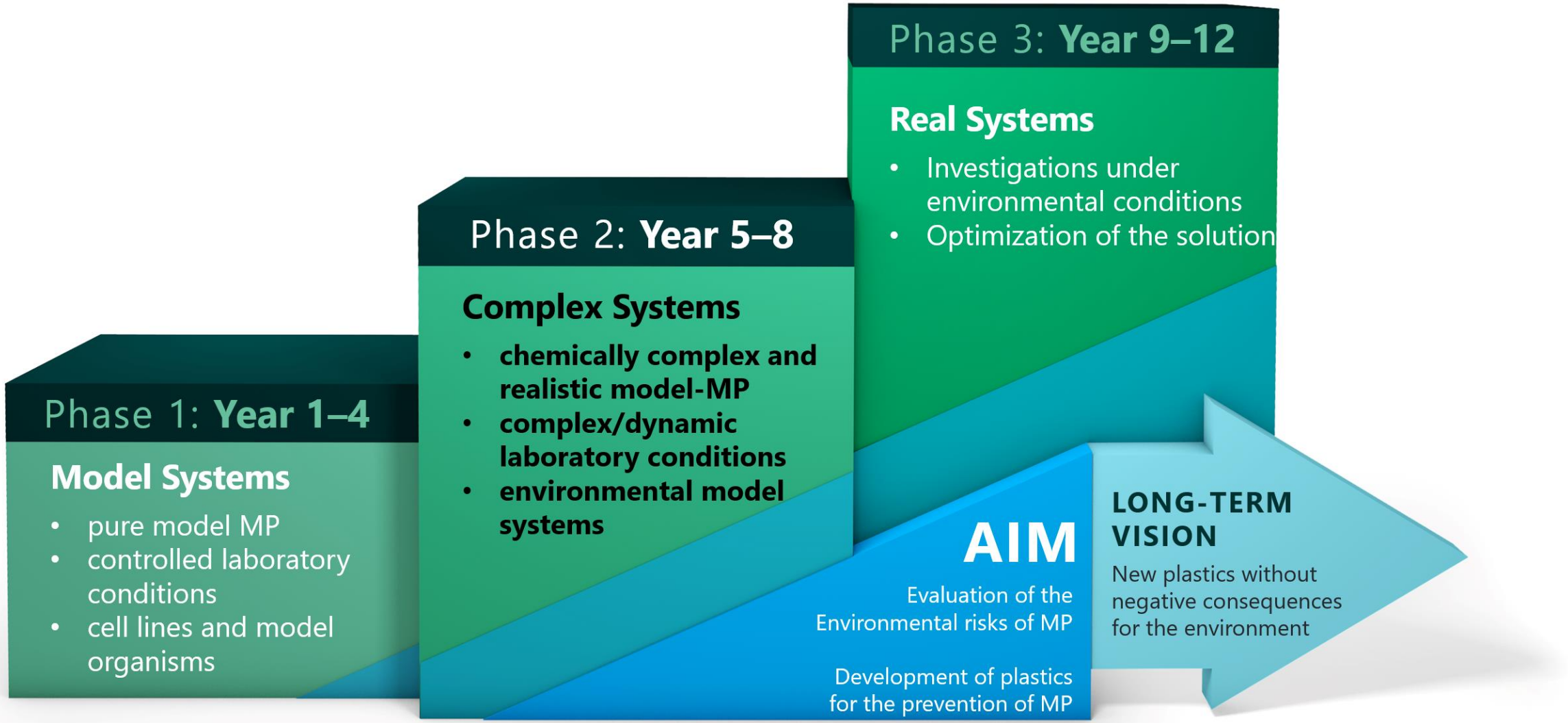


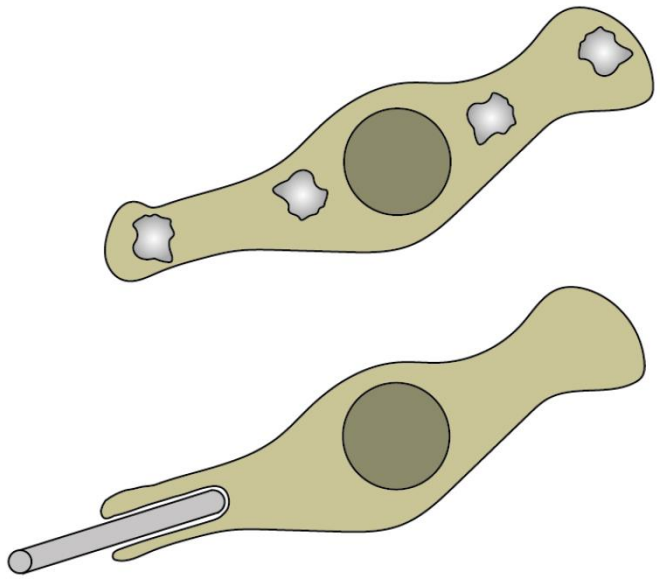
Foto: Sören Funk auf Unsplash

Focus 2. Phase

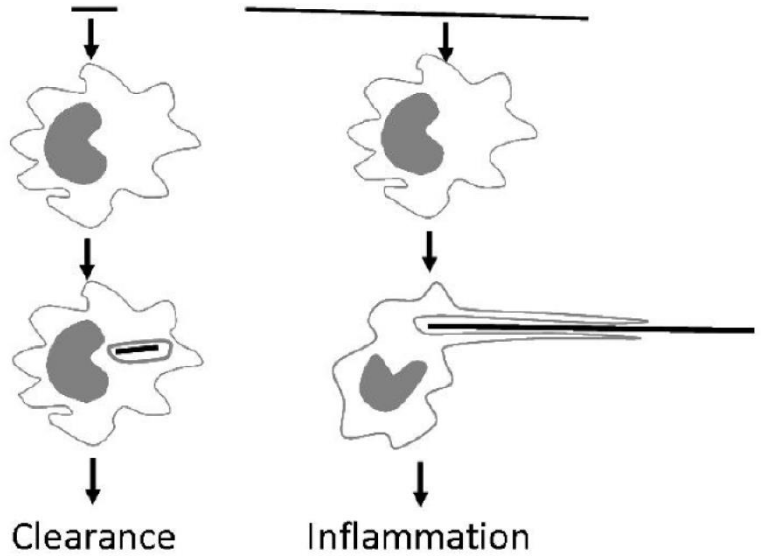


Focus 2. Phase

Foto: i-stock, Getty Images



Fiber toxicity paradigm:



Donaldson et al. 2010

Focus 2. Phase

Photo: Matthew Valentino / Unsplash.

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Beyond microplastics: Water soluble synthetic polymers exert sublethal adverse effects in the freshwater cladoceran *Daphnia magna*

Simona Mondellini [a,b], Matthias Schott [a,b], Martin G.J. Löder [a,b], Seema Agarwal [c], Andreas Greiner [c], Christian Laforsch [a,b,*]

Contents lists available at ScienceDirect

Ecotoxicology and Environmental Safety

journal homepage: www.elsevier.com/locate/ecoenv

Disentangling biological effects of primary nanoplastics from dispersion paints' additional compounds

Ann-Kathrin Müller [a], Julian Brehm [b], Matthias Völkl [c], Valérie Jérôme [c], Christian Laforsch [b,*], Ruth Freitag [c,*], Andreas Greiner [a,*]

Focus 2. Phase- ecological effects

sublethal effects: induced by the plastic material itself and not by particle exposure per se
(use of natural reference particles mandatory)

www.nature.com/scientificreports

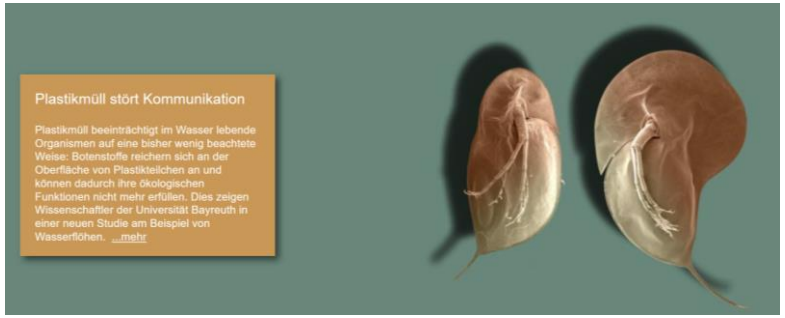
SCIENTIFIC REPORTS

OPEN

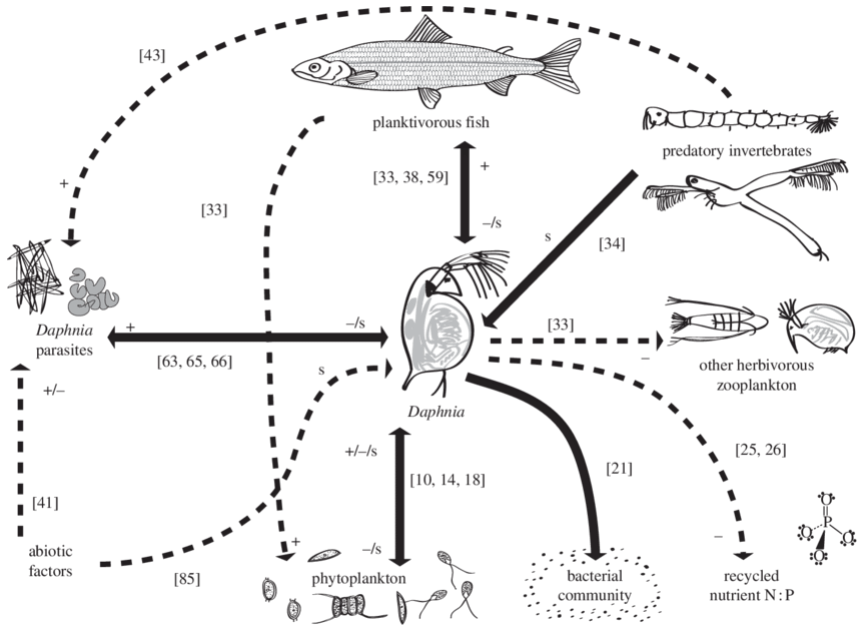
Plastic waste interferes with chemical communication in aquatic ecosystems

Received: 27 September 2018

B. Trotter, A. F. R. M. Ramsperger, P. Raab, J. Haberstroh & C. Laforsch

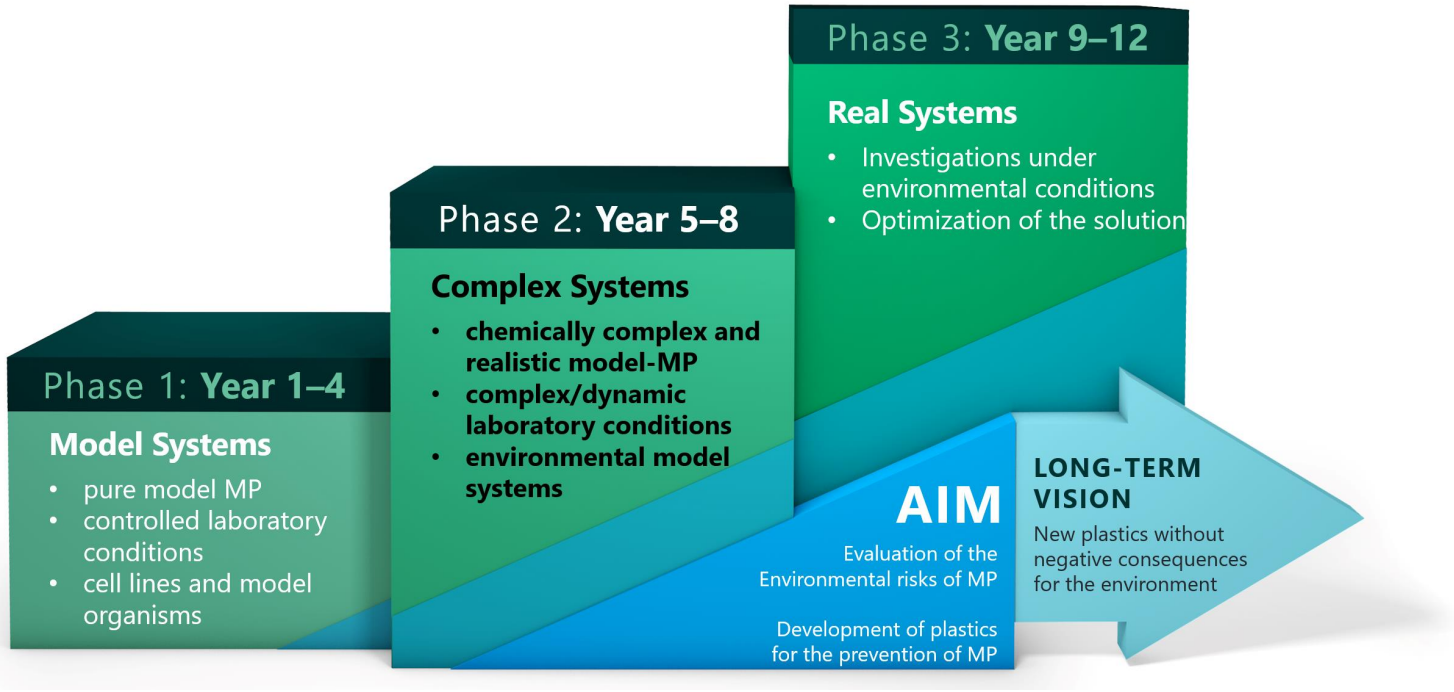


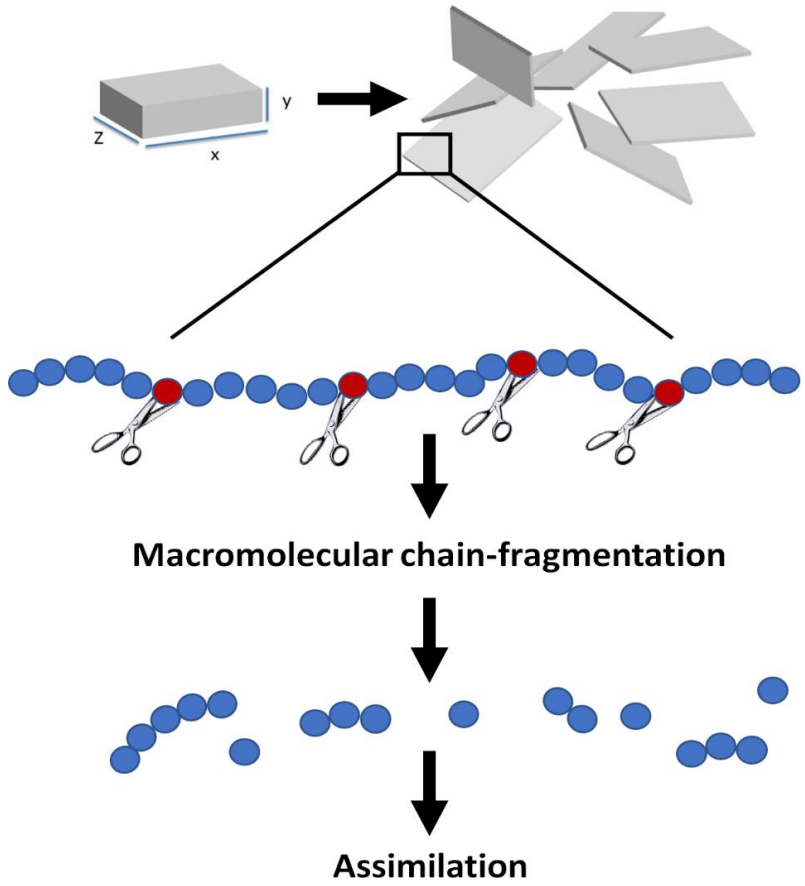
Biotic interactions



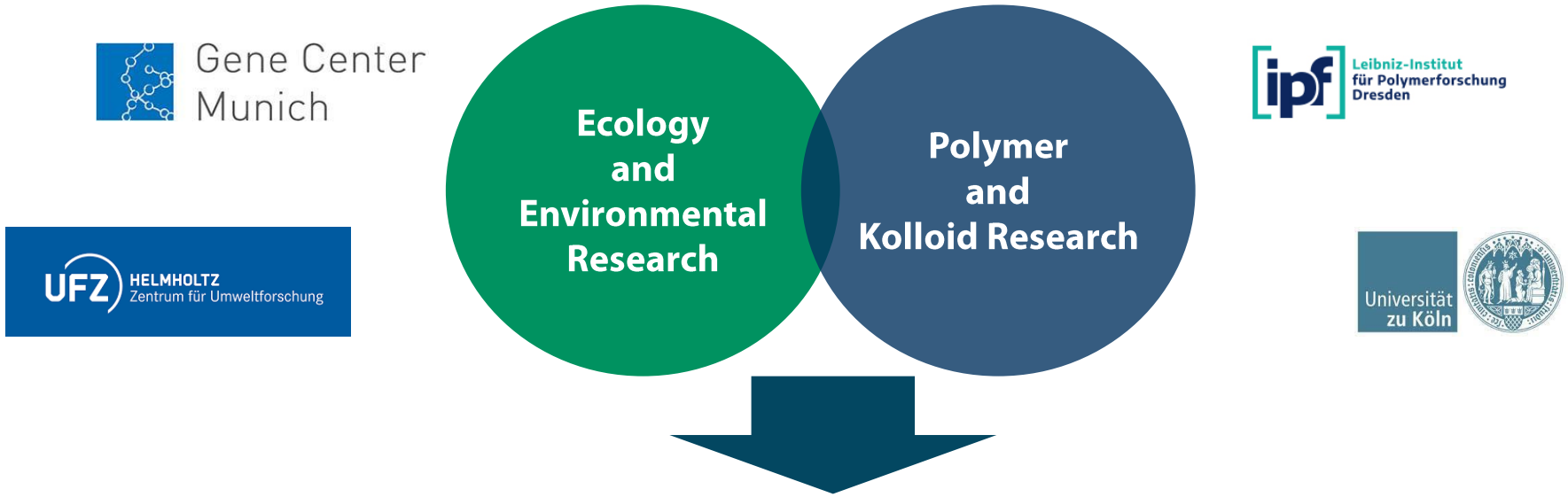
Minor et al. 2010

Focus 2. Phase- need for solutions and novel polymers





Complexity of the topic requires close and well-networked cooperation



Interdisciplinary Center for microplastics research

- **"Nucleus" for national and international cooperation – open for collaboration**
- **SFB 1357 as a pioneer for further initiatives and innovations**

Thank you

Eine Initiative des Bundesministeriums für Bildung und Forschung

Plastik in der Umwelt

Quellen • Senken • Lösungsansätze

christian.laforsch@uni-bayreuth.de

https://www.sfb-mikroplastik.uni-bayreuth.de/en/index.html