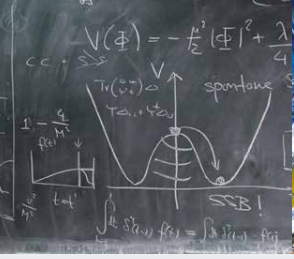


THE SEARCH FOR NEW PHYSICS

PRISMA+

Cluster of Excellence

Precision Physics, Fundamental Interactions and Structure of Matter

WHAT IS THE NATURE OF DARK MATTER?

WHY DOES THE UNIVERSE CONTAIN SO MUCH MORE MATTER THAN ANTIMATTER?

DO NEW PARTICLES OR NEW FORCES EXIST?

WHAT LIES BEYOND THE STANDARD MODEL?

CURIOSITY IS OUR BUSINESS – HOW ABOUT YOU?

The Standard Model of particle physics describes with impressive accuracy the properties of the known constituents of matter. Despite its huge success, it leaves some fundamental questions unanswered. Furthermore, there are findings that provide initial hints for the existence of new particles and fundamental forces beyond the Standard Model.

A key objective of **PRISMA+** is the search for "New Physics". Therefore, we focus on increasingly precise measurements: The construction of the new accelerator MESA will allow for experiments with unprecedented accuracy. Another research theme is the weakly interacting universe and the exploration of the mysterious dark matter and the enigmatic neutrinos.

Johannes Gutenberg University Mainz has a long-standing experience in the construction and operation of large particle accelerators and modern experimental facilities. However, answering the fundamental questions of physics is a major goal of a community-wide effort, which involves an international network of large-scale experiments, thus exporting Mainz technology and knowledge all over the world.

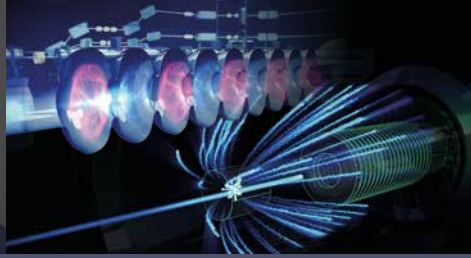
Although our current possibilities are very different from those of earlier researchers, we are driven by the same curiosity: understanding how nature works at the most fundamental level.

Prof. Dr.
Matthias Neubert

Prof. Dr.
Hartmut Wittig

Spokespersons
PRISMA+ Cluster of Excellence

Prof. Dr. Achim Denig

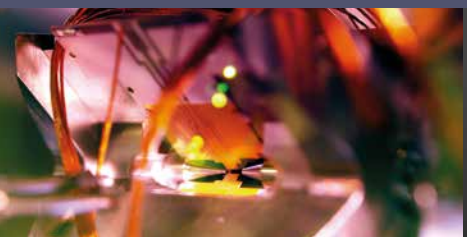


USING MESA FOR EXTREMELY PRECISE MEASUREMENTS

The extraordinary high intensity of MESA provides the basis for high-precision measurements of natural constants and of the structure of subatomic particles. After all, the focus of our work is related to the great mysteries of the universe, such as the mysterious dark matter.

PRECISION PHYSICS AT THE LOW-ENERGY FRONTIER

We place the Standard Model under scrutiny with our experiments. For this purpose, we need increasingly sophisticated technologies, which we successfully develop in Mainz. We create exotic atoms or trap particles so we can study them more closely than ever before.



Prof. Dr. Randolf Pohl

Prof. Dr. Michael Wurm

EXPLORING THE WEAKLY INTERACTING UNIVERSE

Neutrinos are ghost particles not easy to detect. Every second, millions of them penetrate our bodies without us ever noticing. However, we can catch them with our extremely massive detectors, providing us with an undisguised view on the processes in the sun's core. Maybe neutrinos are close cousins of the mysterious particles making up dark matter?

PHYSICS AT HIGH-ENERGY ACCELERATORS

As part of a large research community, we work at huge particle accelerators all over the world, allowing us to investigate what happened in the early universe and how this affected its evolution. For example, with the ATLAS detector at CERN we are studying the Higgs particle, which we co-discovered, and with neutrino experiments in the US we want to understand why the universe contains so much more matter than antimatter.

Prof. Dr. Volker Büscher

Prof. Dr. Stefan Weinzierl

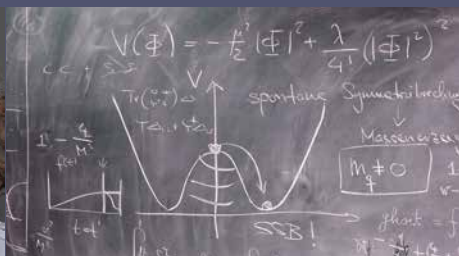
THEORY AND PHENOMENOLOGY OF FUNDAMENTAL INTERACTIONS

I am working to better explain the inner structure of surrounding matter, using the methods of theoretical physics. We carry out our calculations with enormous computers and in doing so, deliver important theoretical contributions to the main research objectives of our colleagues who do experimental work.

MAINZ INSTITUTE FOR THEORETICAL PHYSICS (MITP)

Does physics only take place in the lab? Far from it! Together with physicists all over the world, we are continually developing the theoretical foundations of our field. And our work is rewarded. For example, the theory predicting the Higgs particle has since been confirmed, showing how tightly theory and experiments are interwoven at PRISMA+.

Prof. Dr. Sonia Bacca



Prof. Dr. Uwe Oberlack

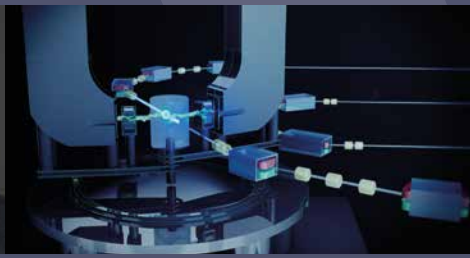
DETECTOR LAB

In the PRISMA+ Detector Lab, we share resources and expertise to develop innovative detectors and electronics across disciplines. This allows us to build highly sophisticated and sometimes large components, which are then used in experiments all over the world, increasing the visibility of the cluster here in Mainz.

ELECTRON ACCELERATOR MESA

We are already working at the highest level with the MAMI electron accelerator. With MESA we will explore the possibilities offered by the recently established Energy-Recovery-Linac (ERL) accelerator technology, allowing us to carry out precision experiments which, up until now, were unthinkable.

Prof. Dr. Kurt Aulenbacher



SHARING KNOWLEDGE

Regardless of age or level of knowledge, PRISMA+ offers all those interested in fundamental research in physics the opportunity to take part in current research projects. We bring our research to the stage and to the general public. With a "PRISMA+ Internship", outstanding bachelor and master graduates can quickly gain insight into highly interesting, ongoing research projects. Students and doctoral candidates will find themselves in an excellent training environment.

CREATING PROSPECTS

» The value of equal opportunities is firmly anchored as a strategic objective at PRISMA+. Through the established Irène Joliot-Curie Programme, we are able to give women many offers for support during all phases of their academic career. We want to encourage more young female scientists to forge a career path in these fields. «

Prof. Dr.
Concettina Sfienti

PROMOTING DEVELOPMENT

With the Mainz Physics Academy (MPA), we want to build a bridge between the outstanding research at PRISMA+ and academic teaching. In the future, all measures for graduate training and support of young scientists will be brought together under one umbrella. Additional offers for career development also play an important role.

Students often ask me what I find so interesting about the many technical details of my work. I encourage them to see the world behind technology. Building devices with screwdrivers and soldering irons, developing measuring instruments and using them to investigate things that no one else has ever seen before – it is absolutely fascinating. Here at PRISMA+ we have made it our goal to get more young people interested in this exciting work.

Prof. Dr. Matthias Schott

FACTS AND FIGURES

Funding period:
2019 – 2025 (second funding period)

Funding amount:
EUR 52 million

Institutes involved:
Institute of Physics, JGU | Institute of Nuclear Physics, JGU | Institute of Nuclear Chemistry, JGU | Helmholtz Institute Mainz (HIM)

Staff:
49 senior researchers,
about 180 doctoral candidates, about 100 postdoctoral researchers,
10 new research groups since 2012

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