

ExtreMe Matter Institute EMMI



www.gsi.de/emmi



EMMI

- founded in 2008 in framework of Helmholtz Alliance (2008 - 2015)
Cosmic Matter in the Laboratory

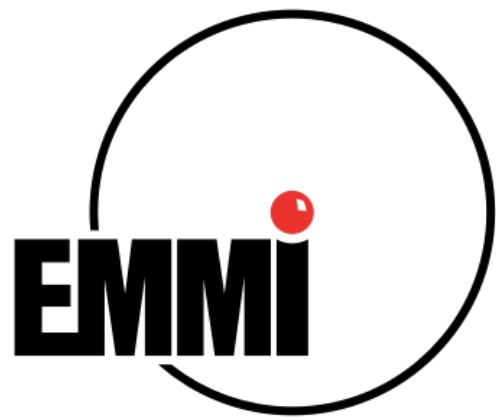


Alliance on Cosmic Matter
in the Laboratory

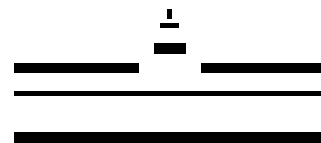
- now continued as part of GSI:
taking the momentum of the alliance into the future
- annual budget of 500 kEuro

EMMI Partner Institutions

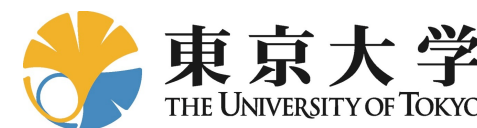
- GSI Helmholtz Centre for Heavy Ion Research
- Forschungszentrum Jülich
- Technische Universität Darmstadt
- Goethe-Universität Frankfurt
- Ruprecht-Karls-Universität Heidelberg
- Universität Münster
- Max-Planck-Institut für Kernphysik (MPIK), Heidelberg
- FIAS Frankfurt Institute for Advanced Studies
- Université VI (Pierre et Marie Curie), Paris
- Lawrence Berkeley National Laboratory, Berkeley
- Joint Institute for Nuclear Astrophysics (JINA)
- University of Tokyo
- RIKEN, Saitama



... and its Partners



WESTFÄLISCHE
WILHELMS-UNIVERSITÄT
MÜNSTER



UNIVERSITÄT
HEIDELBERG
ZUKUNFT
SEIT 1386



TECHNISCHE
UNIVERSITÄT
DARMSTADT

Organisation

13 Partner Institutions

Management:

Scientific Director: Peter Braun-Munzinger

Scientific Coordinator: Carlo Ewerz

+ administrative support

31 further experts as **Associated Partners**

Steering Committee (representatives of Partners)

as main steering body

Scientific Advisory Committee (9 external experts)

Main Research Areas of EMMI

Matter under extreme conditions of temperature, density and pressure, in particular

- quark-gluon plasma, phase diagram of strongly interacting matter, and hadron physics
- structure and dynamics of neutron-rich systems from the laboratory to the stars
- plasma physics
- atomic physics and ultracold gases

... and related topics

Aim:

bringing together the best minds from these communities

Emergence of common concepts

Common structures and underlying theoretical concepts for these strongly coupled systems, for example

- from BEC to BCS
- from QGP to ultracold Fermi gases
- from conformal field theory to QCD via black holes (AdS/CFT)
- from neutron star matter to strongly coupled electromagnetic plasmas
- hydrodynamics, turbulence, ...
- ...

Goals

central goal of EMMI:

act as think tank & provide intellectual environment
for extreme matter research (at GSI and beyond)

aiming at:

- interdisciplinary scientific events of highest quality
- strong promotion of early-career researchers
- network among two Helmholtz centres and
eleven top national and international laboratories and
universities

EMMI Scientists

- more than 100 senior researchers participating in EMMI, more than 400 scientists in total
- 14 new positions (professorships / tenured) created by partners:
 - 10 at TUD, F, MPI-K, MS, HD, LBNL
 - 4 EMMI Fellow positions at GSI
- EMMI PhD students associated with surrounding graduate schools (H-QM, HGS-HIRe, HGSFP)

EMMI Programs

- EMMI Workshops
- EMMI Programs
- EMMI Rapid Reaction Task Force meetings (RRTFs)
- joint workshops with ECT* Trento



- Visiting Professor program
- Visiting Researcher program

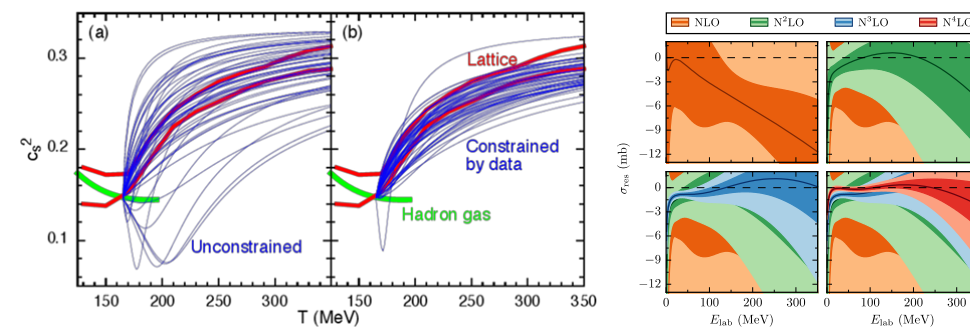
Interdisciplinary Events: examples

ExtreMe Matter Institute EMMI

EMMI Workshop

Uncertainty Quantification at the Extremes (ISNET-6)

GSI, Darmstadt, Germany
October 8-12, 2018



Goals

- Facilitate cross communication, fertilization, and collaboration on statistical applications among the nuclear sub-fields
- Provide the opportunity for nuclear physicists unfamiliar with Bayesian methods to start applying them to new problems
- Learn from experts about innovative and advanced uses of Bayesian statistics, and best practices in applying them
- Learn about advanced computational tools and methods
- Critically examine the application of Bayesian and frequentist methods to particular physics problems in the subfields

Information

www.gsi.de/emmi/workshops

Organizers

Dick Furnstahl, Ohio State U.
David Ireland, U. Glasgow
Daniel Phillips, Ohio U.
Ian Vernon, Durham U.

More about EMMI

www.gsi.de/emmi

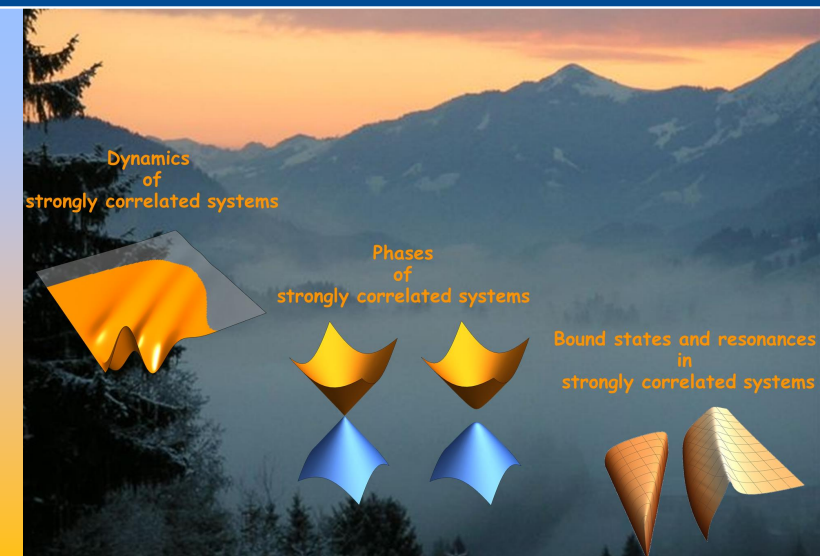


ExtreMe Matter Institute EMMI

EMMI Workshop

Functional Methods in Strongly Correlated Systems

Darmstädter Haus, Hirschegg, Austria
March 31 - April 6, 2019



Speakers:

Laura Classen (Brookhaven National Lab & University of Minnesota)
Sebastian Diehl (University of Cologne)
Joaquin Drut (UNC Chapel Hill)
Nicolas Dupuis (Université Pierre et Marie Curie)
Stefan Flörchinger (Heidelberg University)
Kenji Fukushima (Tokyo University)
Daniel Litim (University of Sussex)
Hans-Werner Hammer (TU Darmstadt)
Urko Reinosa (CPHT, Ecole Polytechnique)
Fabian Rennecke (Brookhaven National Lab)
Michael Scherer (University of Cologne)
Malo Tarpin (Université Grenoble Alpes & Heidelberg University)
Ralf-Arno Tripolt (Goethe University Frankfurt)
Corbinian Wellenhofer (TU Darmstadt)
Nicolas Wink (Heidelberg University)

Information:

www.gsi.de/emmi/workshops

Organizers:

Jens Braun
Michael Buballa
Stefan Flörchinger
Jan M. Pawłowski
Dirk H. Rischke
Bernd-Jochen Schaefer
Lorenz von Smekal

Registration Deadline:

February 28th, 2019

More about EMMI:

www.gsi.de/emmi



Interdisciplinary Events: examples

Helmholtz Alliance
Extremes of Density and Temperature: Cosmic Matter in the Laboratory

ExtreMe Matter Institute EMMI

Relaxation, Turbulence, and Non-Equilibrium Dynamics of Matter Fields
— From Quantum Fluids to High-Energy Physics —

RETUNE

Internationales Wissenschaftsforum, Universität Heidelberg
June 21-24, 2012

Speakers

Alberto Amo (Paris)	Kerson Huang (Cambridge, MA/Singapore)
Brian Anderson (Tucson)	Jonathan Keeling (St. Andrews)
Vanderlei Bagnato (Sao Carlos)	Larry McLerran (Brookhaven)
Carlo Barenghi (Newcastle)	Sergey Nazarenko (Warwick)
Jürgen Berges (Heidelberg)	Boris Nowak (Heidelberg)
Natalia Berloff (Cambridge)	Anton Rebhan (Wien)
Jean-Paul Blaizot (Saclay)	Jörg Schmiedmayer (Wien)
Elena Bratkovskaya (Frankfurt)	Gora Shlyapnikov (Orsay)
Matthew Davis (Queensland)	Johanna Stachel (Heidelberg)
Sergey Demokritov (Münster)	Igor Tkachev (Moscow)
Vladimir Eltsov (Aalto)	Makoto Tsubota (Osaka)
Gregory Falkovich (Rehovot)	Joe Vinen (Birmingham)
Kenji Fukushima (Keio)	Christof Wetterich (Heidelberg)
Andrei Golov (Manchester)	Michael Wouters (Antwerpen)
Ulrich Heinz (Columbus)	

International Scientific Advisory Committee

Carlo Barenghi (Newcastle)
Jürgen Berges (Heidelberg)
Larry McLerran (Brookhaven)
Makoto Tsubota (Osaka)

Organizing Committee

Natalia Berloff (Cambridge)
Thomas Gasenzer (Heidelberg)
Jan M. Pawłowski (Heidelberg)

Topics

Relaxation dynamics of classical matter fields
Dynamical evolution of quenched systems
Dynamics and relaxation of driven systems to non-equilibrium steady states

in the realms of:


Ultracold Atomic Gases
Superfluid Helium
Condensates in Solid-State Systems
Heavy-Ion Collisions and the Quark-Gluon Plasma
Cosmic Inflation and Reheating

Information

<http://www.thphys.uni-heidelberg.de/~smp/RETUNE2012>

More about EMMI

www.gsi.de/emmi

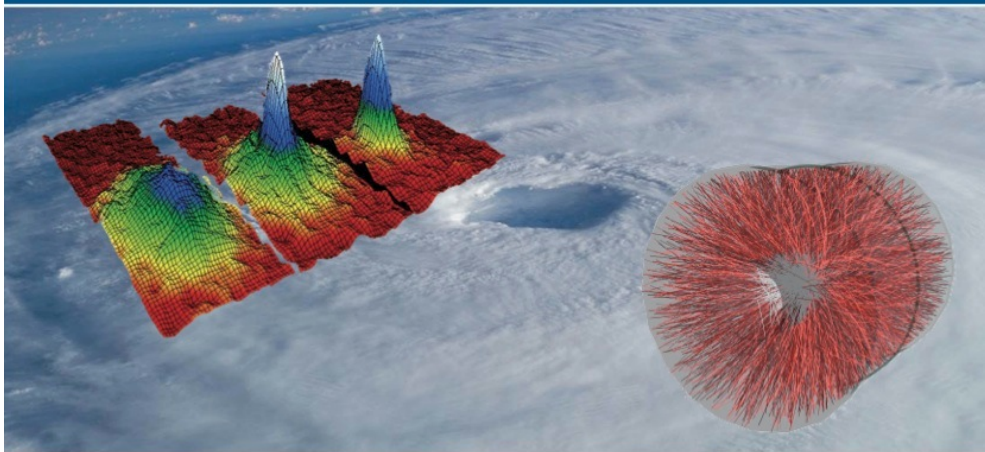


Helmholtz Alliance
Extremes of Density and Temperature: Cosmic Matter in the Laboratory

ExtreMe Matter Institute EMMI

Quark-Gluon Plasma meets Cold Atoms - Episode III

Workshop at Waldemar-Petersen-Haus
Hirschegg, Austria
August 25 - 31, 2012



Lecturers

Jens Braun, TU Darmstadt
Peter Braun-Munzinger, EMMI, GSI
Kenji Fukushima, Keio University
Thomas Gasenzer, Heidelberg University
Larry McLerran, Brookhaven National Lab
Thomas Schäfer, North Carolina State University
Florian Schreck, Innsbruck University & IQOQI
Achim Schwenk, EMMI, TU Darmstadt
Lorenz von Smekal, TU Darmstadt
Johanna Stachel, Heidelberg University
Michael Thies, Erlangen University
John Thomas, North Carolina State University

Organizers

Michael Buballa
Selim Jochim
Jan M. Pawłowski
Dirk Rischke

Registration deadline

July 15th, 2012

Registration and further information

<http://www.aix.gsi.de/conferences/emmi/QGPmCA2012>

More about EMMI

www.gsi.de/emmi

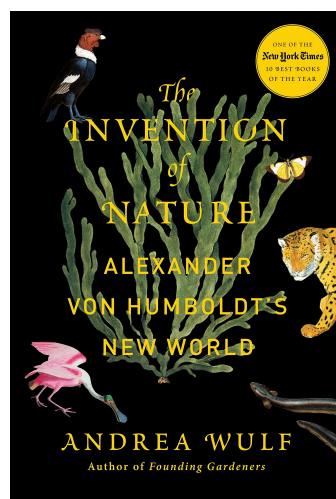
EMMI RRTFs

- concentrate on focussed problem in intense discussion
- 15 - 25 expert participants
- aim: summary of results, optimally with publication on arXiv and/or in journal

EMMI RRTFs

RRTF concept goes back to **Alexander von Humboldt**:

*Humboldt was revolutionizing the sciences. In September 1828 he invited hundreds of scientists from across Germany and Europe to attend a conference in Berlin. Unlike previous such meetings at which scientists had endlessly presented papers about their own work, Humboldt put together a very different program. **Rather than being talked at, he wanted to the scientists to talk with each other.** [...] ‘Without a diversity of opinion, the discovery of truth is impossible’, he reminded them in his opening speech.*



in Andrea Wulf, *The Invention of Nature*, 2016

EMMI RRTFs: examples

- Thermalization in a Nonabelian Plasma (2011)
- Quark Matter in Compact Stars (2013)
- Direct-Photon Flow Puzzle (2014)
- Non-Exponential Two-Body Weak Decays (2014)
- Resonances in QCD (2015)
- Extraction of heavy-flavor transport coefficients in QCD Matter (2016)
- The physics of neutron star mergers (2018)
- Electromagnetic Structure of Strange Baryons (2018)
- Direct reactions and nuclear structure (2018)
- Space-time structure of jet quenching: theory and experiment (2019)

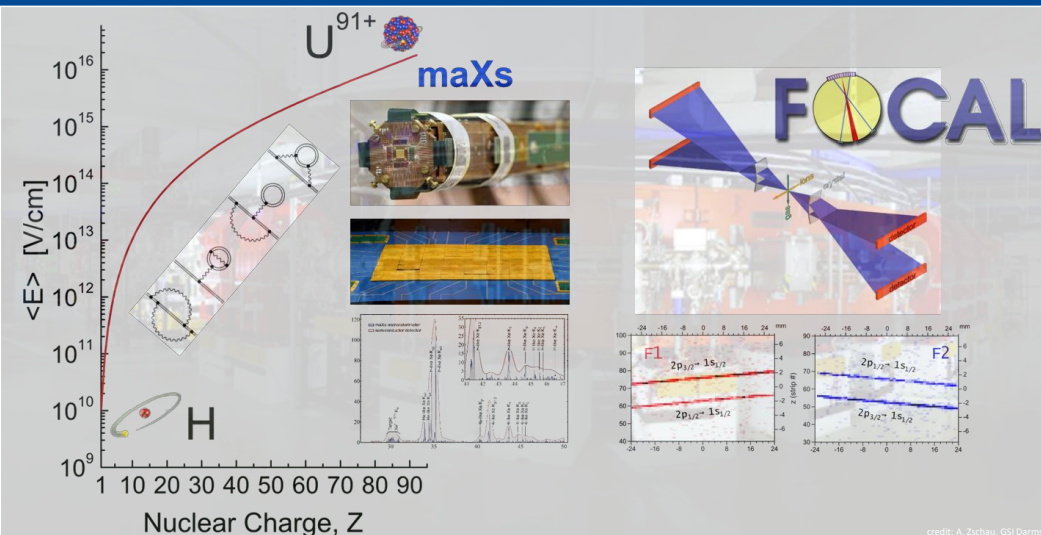
Recent RRTFs

ExtreMe Matter Institute EMMI

EMMI Rapid Reaction Task Force

1s Lamb shift in heavy H-like ions: towards an accuracy of <1 eV

Rosensäle, Jena, Germany
September 17-19, 2018



Topics

- High-resolution X-ray microcalorimeters and crystal spectrometers
- Precision X-ray spectroscopy of stored and cooled heavy highly-charged ions
- Bound-state QED

Information

www.gsi.de/emmi/rrtf

Organizers

Alexandre Gumberidze (GSI, U Frankfurt)
Yuri Litvinov (GSI, U Heidelberg)
Günter Weber (HI Jena)
Thomas Stöhlker (HI Jena, GSI, U Jena)

More about EMMI

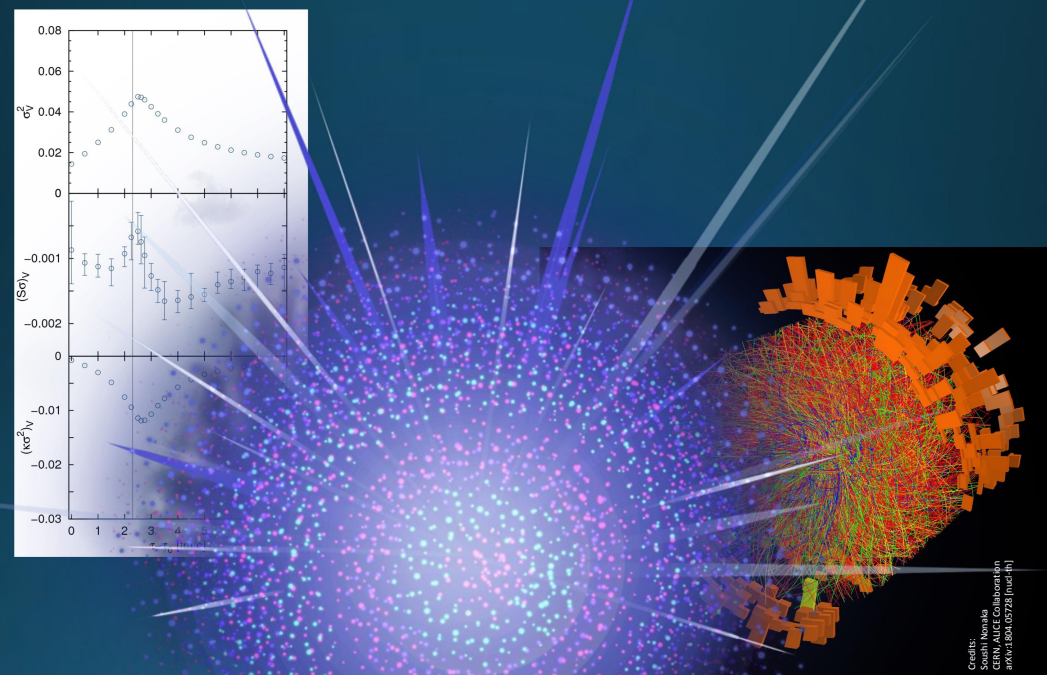
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ExtreMe Matter Institute EMMI

EMMI RRTF

Dynamics of critical fluctuations: theory – phenomenology – heavy-ion collisions

GSI, Darmstadt, Germany
April 8-12, 2019



Topics:

- dynamical modelling of critical fluctuations in QCD
- coupling of the critical dynamics to the bulk evolution in HIC
- proper treatment of the order parameter(s) in and out of the scaling region
- experimental observables and challenges
- connection with cold atomic gases at phase transitions

Information:

www.gsi.de/emmi/workshops

Organizers:

Marcus Bluhm, Subatech
Alexander Kalweit, CERN
Marlene Nahrgang, Subatech

More about EMMI:

www.gsi.de/emmi

ExtreMe Matter Institute EMMI

Call for Proposals

EMMI Workshops, Programs, Rapid Reaction Task Forces

The ExtreMe Matter Institute EMMI invites proposals for workshops, programs, and Rapid Reaction Task Forces in the research areas of EMMI:

- quark gluon plasma, phase diagram of strongly interacting matter, and hadron physics
- structure and dynamics of neutron-rich systems
- electromagnetic plasmas of high energy density
- ultracold quantum gases and extreme states in atomic physics

all understood in a broad sense.

Further information at www.gsi.de/emmi

