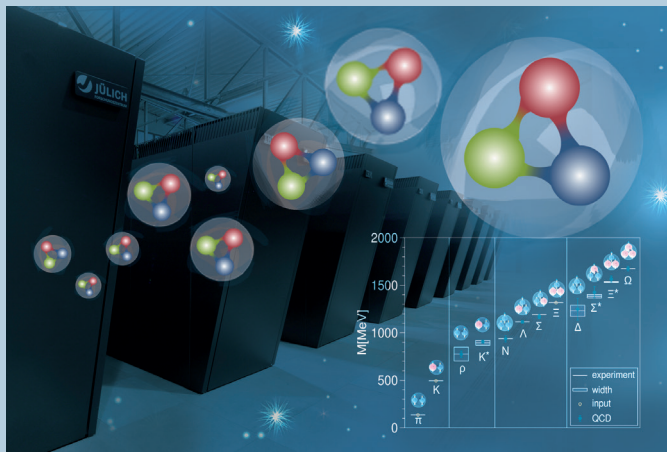# JÜLICH
FORSCHUNGSZENTRUM

Simulation Laboratory Nuclear and Particle Physics
with CaSToRC, The Cyprus Institute and DESY, Zeuthen

Research on
- Particle physics, thermodynamics
- Nuclear physics
- Algorithms with Exascale perspective
- Optimized software and libraries

Community Support
- Workshops and schools
- Provide highly optimized software and libraries
- Collaboration with user groups

Physics Research

Particle Physics:
- Standard Model and χPT parameters from ab-initio simulations
- Phenomenology from lattice simulations of QCD + QED
- Equation of state
- Influence of external magnetic fields
- Phenomenology of the phase transition region
- Comparisons with different lattice actions
- Simulations with finite chemical potential

Nuclear Physics:
- Phenomenological properties of the nucleon
- Nuclear potentials from Lattice QCD simulations

Highlight
**Ab initio calculation of the neutron-proton mass difference
Science, 347 (2015), 1452**
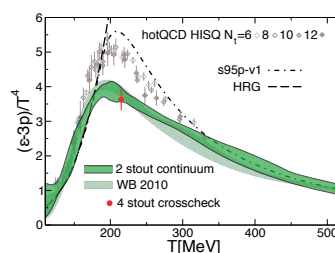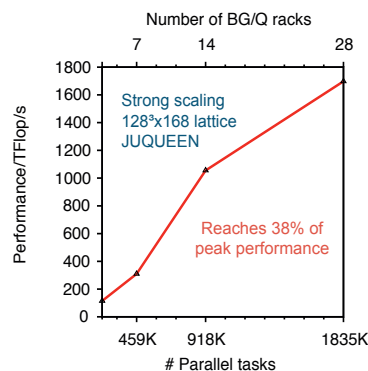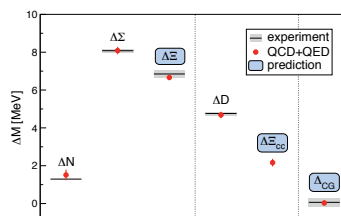
HPC Research and Development
- Algorithms for massively parallel supercomputers
- Multilevel methods
- Highly scalable implementations (up to 1,835,008 BGQ threads)
- Kernel identification and low level (assembly, intrinsics) optimization
- Custom-tailored low-level communication libraries
- Exascale research and co-development with HPC hardware vendors

Community Support
- Workshops and schools ("Lattice Practices")
- Optimized implementations
- Data repositories (ILDG, DESY)

Collaboration partners
CaSToRC, DESY, BUW, RU, CNRS, MIT, ELTE, LLNL

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