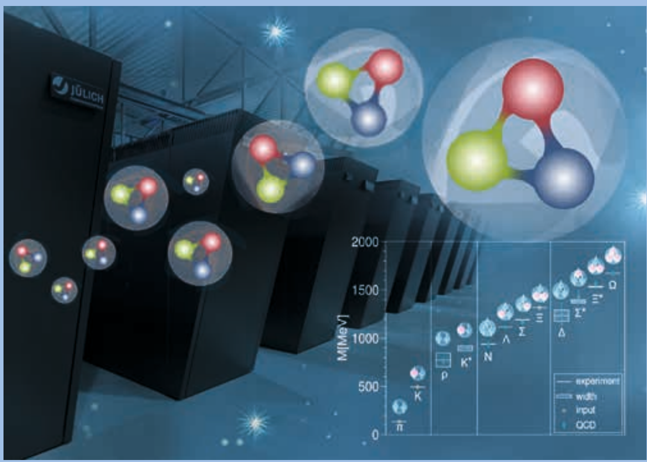
JÜLICH Forschungszentrum | JÜLICH SUPERCOMPUTING CENTRE

SIMULATION AND DATA LABORATORY NUMERICAL QUANTUM FIELD THEORY

FROM FEMTOVERSE TO EXASCALE: STRONG CORRELATION AND SCALING



Research on numerical field theory

- Particle physics, nuclear physics
- Carbon nanosystems
- Algorithms with exascale perspective
- Optimized software and libraries

Community support

- User training: lectures, workshops and schools
- Collaboration with user groups
- Data management and analysis tools

Numerical field theory

Particle physics:

- Standard model and χPT parameters from ab initio simulations
- Phenomenology from lattice simulations of QCD + QED
- Resonances and scattering

Nuclear physics:

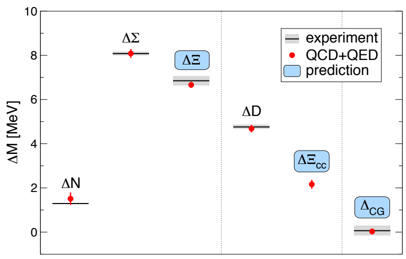
- Phenomenological properties of the nucleon
- Nuclear potentials from lattice QCD simulations

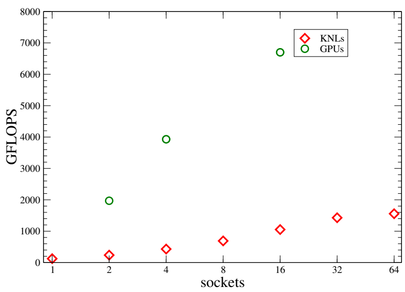
Carbon nanosystems:

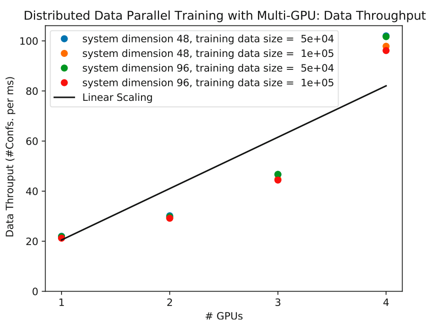
- Graphene, nanotubes
- Hubbard, phenomenological potentials
- Machine learning methods addressing "sign problem"

Highlight

Ab initio calculation of the neutron-proton mass difference Science, 347 (2015), 1452







HPC research and development

- Algorithms for modular and heterogeneous supercomputers
- Multilevel methods
- Highly scalable implementations
- 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")
- Lectures (Bonn, Wuppertal)
- Optimized implementations
- Data repositories (ILDG, DESY, PUNCH4NFDI)

Collaboration partners

- CaSToRC, DESY, Bonn, BUW, Mainz, RU, Rome, MIT, BNL, SUNY, UA, NMSU, UMD

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