# Wigner Heavy-ion Research Group

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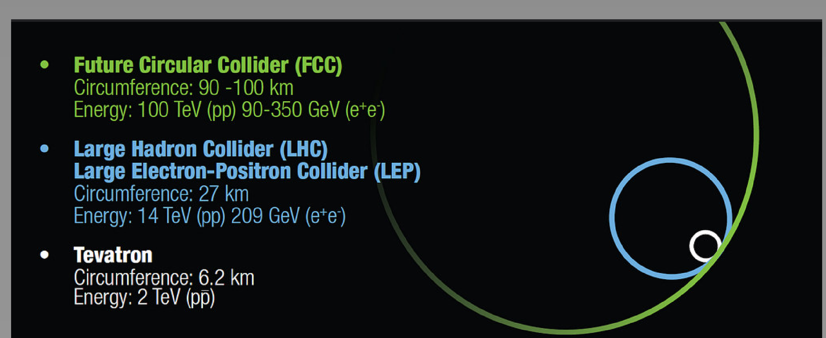
## Highlights from our Recent Results & Achievements

*Supports: NKFIH OTKA K120660, K104260, K116197, K109462, K123815 UKRAINIAN–HUNGARIAN MTA-UA NKM-81/2016, CHINESE–HUNGARIAN TET_12_CN_D0524D1E, CERN ALICE experiment, and COST actions: NewCompStar (MP1304), THOR (CA15213), PHAROS (CA16214).*

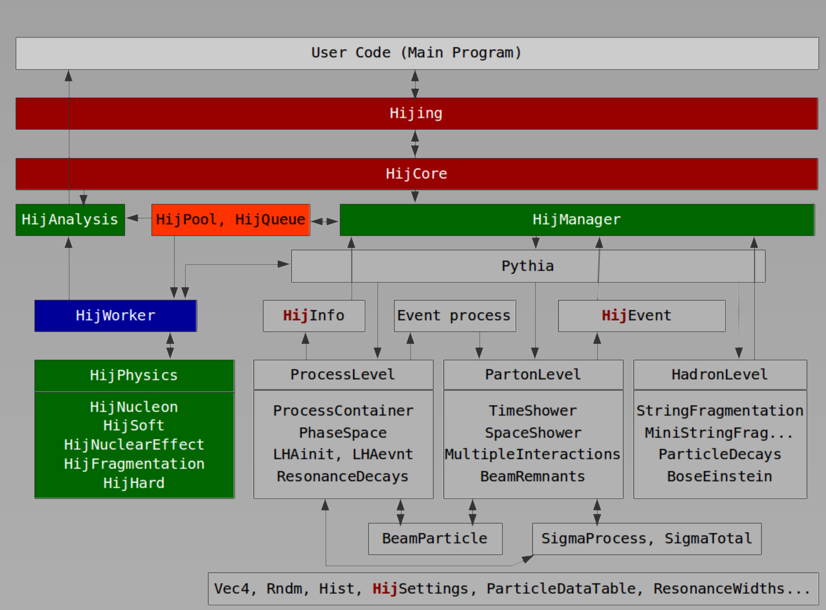
### HEP Software Development

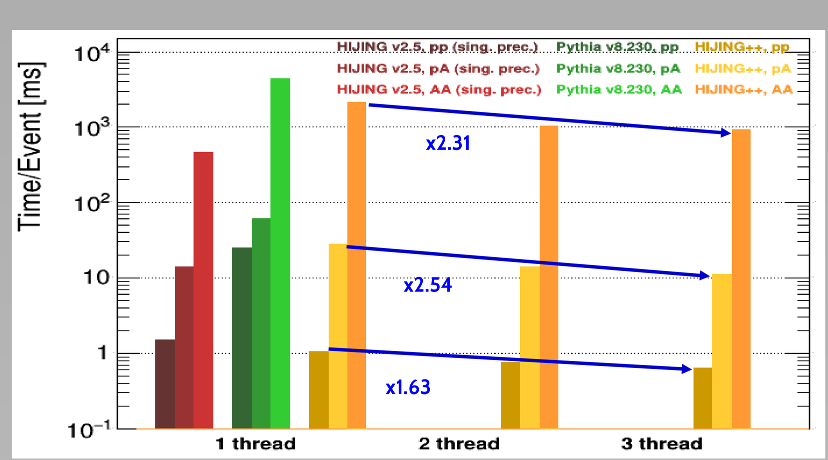
Future higher-and-higher energy particle accelerators and more-and-more accurate measurements require large-scale, computing and faster (parallel) simulations.

The future of the high-energy physics (HEP) is strongly connected to the future-planned accelerators: NICA (Dubna, Russia), eRHIC (BNL, USA), FAIR/GSI (Darmstadt, Germany), FCC (CERN, Geneva, Swiss).




HIJING++ is new, C++ version of the original HIJING, the Heavy-Ion Jet INteraction Generator code written in FORTRAN in the mid-80s. This Monte Carlo event generator code contains both the soft and hard physics in high-energy heavy ion collisions. The upgraded version of this is modular and runs faster due to the applied parallel programming techniques.

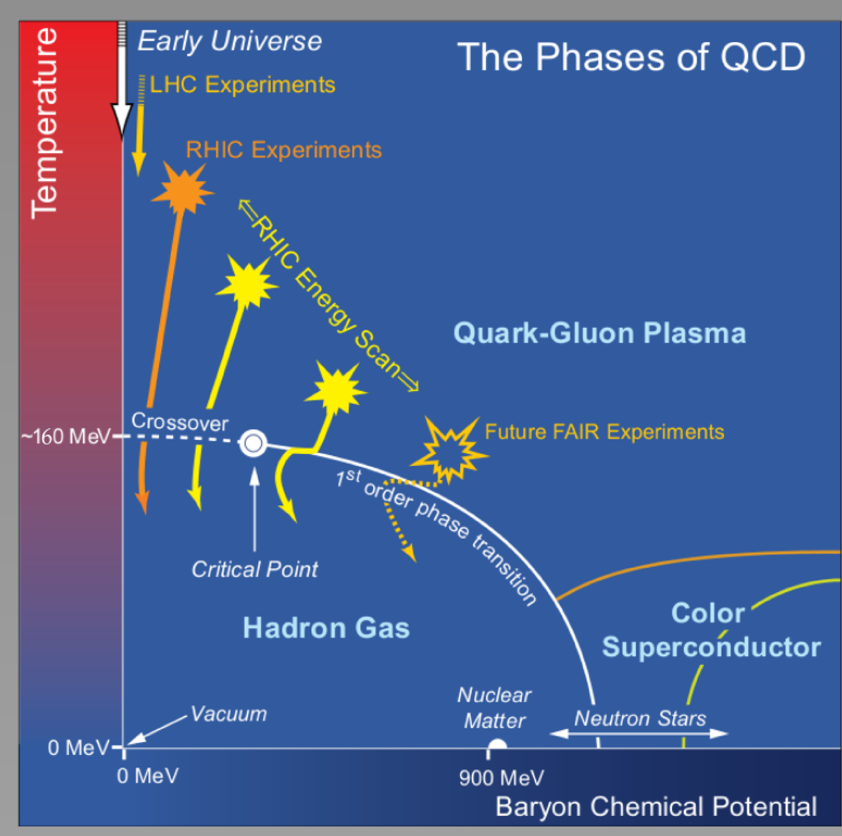


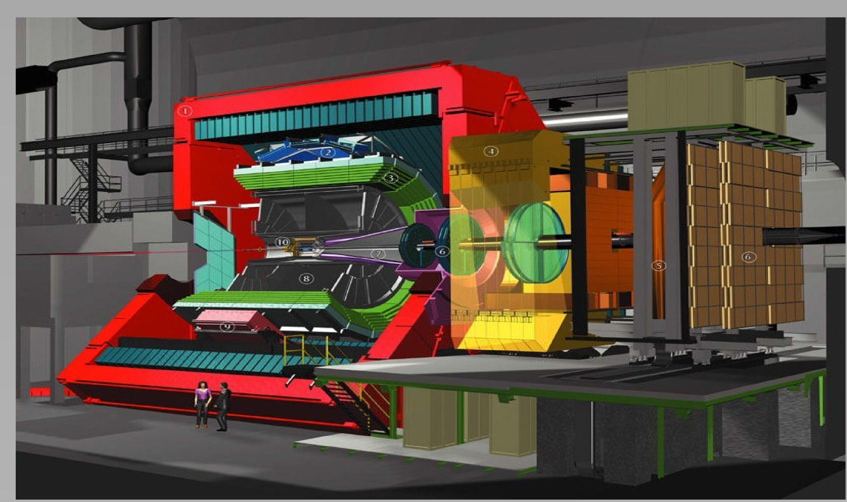

We also develop a BUU theory based (Boltzmann–Uehling–Uhlenbeck) transport code for lower energy collisions with novel potentials for vector mesons.

### Theory & Experiment

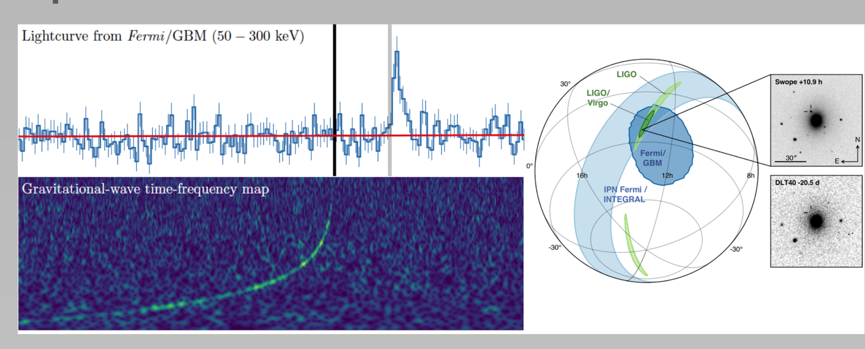
High-energy heavy ion collisions are the tools to explore the phases of strongly interacting matter, especially at the early stage of the hot and dense Universe. The measurements of compact star observables and the modeling of their interior is the way to explore the superdense cold nuclear matter phase. Our group participate in both activities, developing novel theoretical models & simulations.




A new theoretical development is the non-extensive statistical physics – a new and promising tool to investigate the identified hadron spectra measured in high-energy collisions. The Tsallis–Pareto formalism provide more information on hadronization at microscopical level. This can be also measured by CERN ALICE.

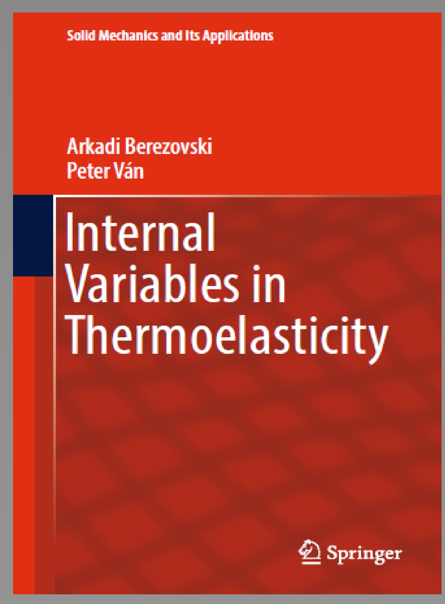


The effective non-linear sigma model and the Functional Renormalization Group method are to test the inner superdense matter of neutron stars.



### Education

Our Research Group makes a lot of effort for the next generation of physicists by publishing textbooks. During the last five years we have published three textbooks.




The most recent book by Péter Ván, describes an effective method for modeling advanced materials like polymers, composite materials and biomaterials, which are, as a rule, inhomogeneous. The thermoelastic theory with internal variables presented here provides a general framework for predicting a material's reaction to external loading. The basic physical principles provide the primary theoretical information, including the evolution equations of the internal variables.

The cornerstones of this framework are the material representation of continuum mechanics, a weak non-locality, a non-zero extra entropy flux, and a consecutive employment of the dissipation inequality. Examples of thermoelastic phenomena are provided, accompanied by detailed procedures demonstrating how to simulate them.

**Further books from our group are:**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