# Review of the project STAR: Proposal for Extension of JINR Participation

The JINR group has been participating in the STAR experiment since 1993. The collaboration has long history and many scientific achievements. The requested prolongation focuses on the following physics tasks:

1. In 2018-2019

* Study of isobaric collisions (96Ru-96Ru and 96Zr-96Zr) to clarify the role of the magnetic field in the charge separation measurements;
* Improved measurement of the Lambda and Anti-Lambda polarization to further investigate the creation of vortical fluid in Au-Au collisions;
* Au-Au collisions in fixed target mode to cover the energy range 3.0 to 7.7 GeV. Studies of NCQ scaling of elliptic flow, balance function, strange particle production.

1. In 2019-2021: Beam Energy Scan II (BES-II) program

* Search for the Critical Point: fluctuation of event-by-event multiplicities studying the net-proton kurtosis as function of energy;
* Search for First Order Phase Boundary: measurement of baryon directed flow;
* Elliptic flow of ϕ-mesons and its scaling with the number of constituent quarks;
* Low mass di-lepton measurements: thermal radiation, broadening of the ρ width;
* Measurement of transverse momentum spectra and their medium modification.

**The JINR Group plans to participate in the following activities:**

1. Participation in the STAR runs
   * Support, maintenance and operation of End Cap EMC;
   * Participation in assembly and testing of Event Plane Detector;
   * Development of new statistical method for particle identification in data analysis;
   * Participation in data taking and data analysis for BES-II.
2. Global polarization study
   * Participation in data analysis of global polarization (isobaric nuclei, high statistic measurement at 27 GeV, BES-II measurements);
   * Comparison of the polarization of Lambda hyperons in collisions of the ruthenium and zirconium nuclei. Studies of rapidity dependence of Λ hyperon polarization and possibility to measure Ξ hyperon polarization. Attempt to distinguish the “vortex” model from model associated with the magnetic field effects.
3. Scaling and fractal structure study
   * Analysis of scaling properties and the fractal structure of nucleus-nucleus collisions to search for signatures of phase transition and the critical point in nuclear matter.
   * Fractal analysis of nucleus-nucleus collisions on event-by-event basis and selection of events according to the fractal dimensions;
   * Measure the model parameters of self-similarity (“heat capacity” and fractal dimensions) of charged hadron production (z-scaling) and study their discontinuities and correlations as indications of critical phenomena in the nuclear matter.
   * Explore the new cumulative kinematical region of hadron production at high transverse momenta.
4. STAR–JINR GRID
   * Using GRID technologies for processing data from the STAR facility at JINR computer cluster we plan to convert over a million of files from MicroDST to the new compact analysis format PicoDST in 2019–2021.

**The reviews of the referees M. Hnatič and V.P.Ladygin are positive and support the extension of the program.** They note that the physical program proposed in the project is well grounded and its implementation is unquestionable. The experience of staff involved in the experiment STAR, is extremely important for preparation of new heavy-ion physics projects JINR – MPD / NICA. The resources required for the STAR project (JINR participation) in 2019-2021 are reasonable.

**I completely agree with the opinion of both referees and propose to extend the JINR participation in the STAR experiment in 2019-2021**. At the same time I have the following remarks, partially based on the observations of the two reviews:

* There are many experienced senior physicists in the JINR group, however the involvement of young researchers is not discussed in the project;
* The synergies between the STAR project and the NICA activities are not covered at all;
* The participation in conferences is highly non-uniform between the members of the group and the fraction of major heavy-ion events in the list is low.

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