

## MTA Wigner FK, RMI, Femtoscopy Research Group

T. Csörgő, A. Ster, F. J. Nemes, D. Lucsányi<sup>#</sup> (CERN,BME), G. Kasza (ELTE), D. Kincses<sup>#</sup> (ELTE) J. Sziklai\*.

(\*): Listed at the Hadron Physics Research Group, retired during 2017

The Femtoscopy Research Group is actively participating in **theoretical** research and in experimental research in the **PHENIX** experiment at the RHIC accelerator, Brookhaven National Laboratory and in the **TOTEM** experiment at Large Hadron Collider (LHC) at CERN. We have achieved important breakthroughs in each research direction during 2017:

In our **theoretical femtoscopy related research**, we have discovered

- new families of exact solutions of 1+3 dimensional, rotating, multi-component, non-relativistic fireball hydrodynamics
- new families of exact solutions of accelerating 1+1 dimensional, relativistic perfect fluid hydrodynamics with realistic equations of state
- new families of perturbative solutions of accelerating, viscous 1+1 dimensional relativistic viscous hydrodynamics.

During the academic year we have organized and participated in an extremely large number of conferences where most of these new results were presented, and we started to write-up these results in conference proceedings and manuscripts submitted for a publication. We expect that most of the new solutions will be published subsequently during 2018.

In our **TOTEM related femtoscopy research**, we have discovered

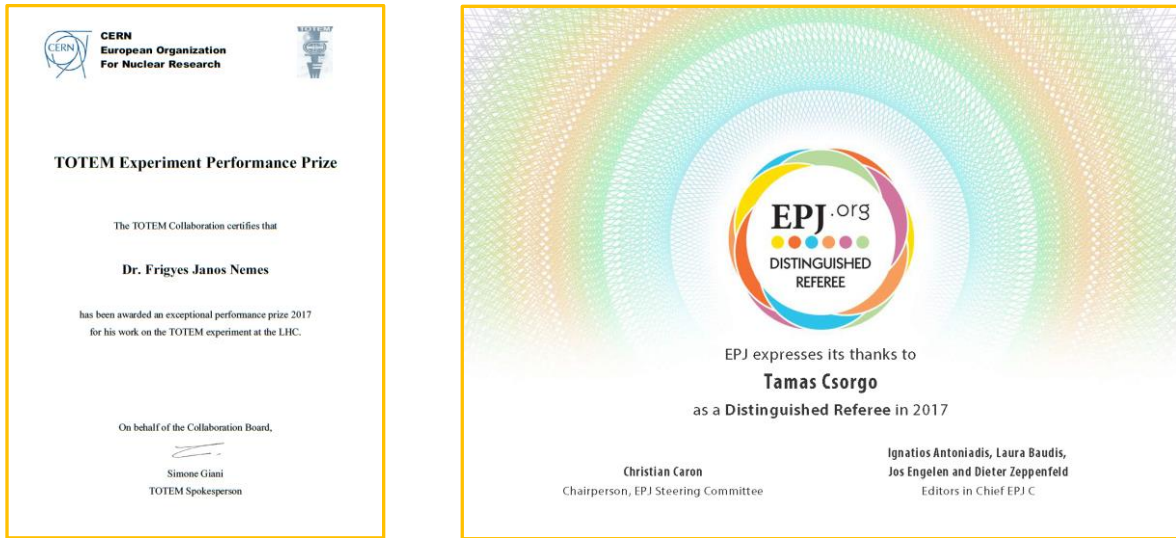
- new structures in the excitation function of the total cross section, the rho and the B parameter of elastic proton-proton scattering. This result is interpreted as the discovery of the Odderon (or vector glueball, a 3-gluon bound state). The preprint is finished in December 2017, publication is expected during 2018.

In our **PHENIX related femtoscopy research**, we have discovered

- that d+Au collisions and 3He+Au collisions feature perfect fluid properties down to as low nucleon-nucleon center of mass energies as 19.6 GeV. T. Csörgő acted as the Chair of the Internal Review Committee on this publication.
- in 0-30% Au+Au collision at 200 GeV, the shape of the Bose-Einstein correlation function is significantly different from the usual Gaussian shape. The Levy form however describes the data, opening a new series of papers. The manuscript was submitted for a publication and several Levy related Bose-Einstein correlation measurements were presented by members of the Hungarian PHENIX group at conferences during 2017, with publications to appear in 2018.

### Grants:

- Hungarian Academy of Sciences - Ukrainian Academy of Science bilateral grant NKM-082/2016
- Hungarian Academy of Sciences - Ukrainian Academy of Science bilateral grant NKM-092/2017
- Hungarian Academy of Sciences – Grant for the Organization of the BGL 2017 conference
- Participation, NKTIH FK 123842 and FK 123959 grants (PI: M. Csanád, ELTE & A. László, Wigner)
- Participation in EFOP EFOP 3.6.1-16-2016-00001 grant (PI: Papp József, EKE)



**Figure 1.** Two of four awards received in 2017. Left: TOTEM Experiment Performance Prize awarded to Dr. F. Nemes, on behalf of the TOTEM Collaboration Board by Prof. S. Giani, Spokesperson of the TOTEM experiment at CERN LHC. Right: EPJ Distinguished Referee Award by the Chair of the Steering Committee and the Editors in Chief of European Physics Journal (EPJ) C, to T. Csörgő, MAE.

#### International cooperations:

- **PHENIX** Collaboration (BNL, Upton, NY, USA):
- **Brookhaven National Laboratory**, USA, Memorandum of Understanding between the **PHENIX** Experiment and KFKI representing the PHENIX-Hungary team (Hungarian Principal Investigator: M. Csanád (ELTE), participants in 2017: T. Csörgő, G. Kasza, D. Kincses, A. Ster, J. Sziklai)
- **TOTEM** Collaboration (CERN LHC, Svájc). (Hungarian Principal Investigator: T. Csörgő, other participants in 2017: D. Lucsányi, F. Nemes, J. Sziklai)
- **CERN**, Memorandum of Understanding for Collaboration in the Construction of the **TOTEM** detector and Memorandum of Understanding for the Maintenance and Operation of the TOTEM detector at LHC (Hungarian Principal Investigator T. Csörgő, other participants from Wigner in 2017: F. Nemes, J. Sziklai, D. Lucsányi). During 2017 this membership lead us to participation in the CMS-TOTEM Precision Proton Spectrometer or **CT-PPS project**.
- **Bogoliubov Institute for Theoretical Physics** (Kiev, Ukraine): bilateral grants NKM-082/2016 and NKM-092/2017 . Hungarian PI : T. Csörgő, Ukrainian PI: D. Anchiskin
- **Lund University** (Lund, Sweden) – Wigner RCP, Memorandum of Understanding on bilateral international collaboration (T. Csörgő, A. Ster, L. Lönnblad (Lund), G. Gustafson (Lund))
- **State University of New York at Stony Brook** (Stony Brook, NY, USA) – Wigner RCP, Memorandum of Understanding on bilateral international collaboration (T. Csörgő, R. Lacey (SUNY SB)). Participant in this collaboration: D. Kincses.