

NA61



András László

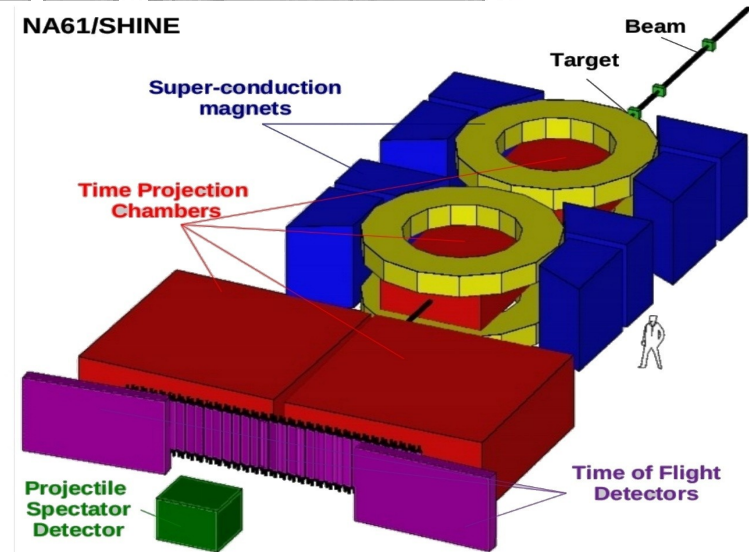
Wigner RCP, Budapest



Outline

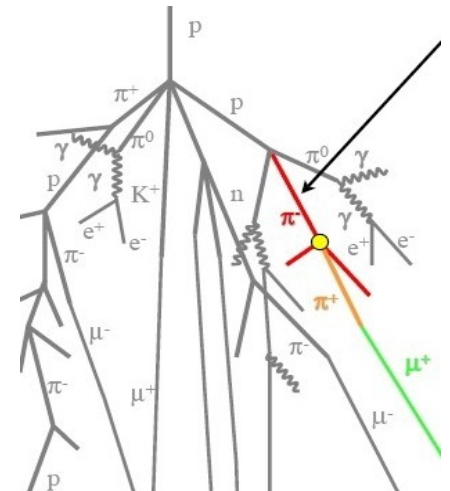
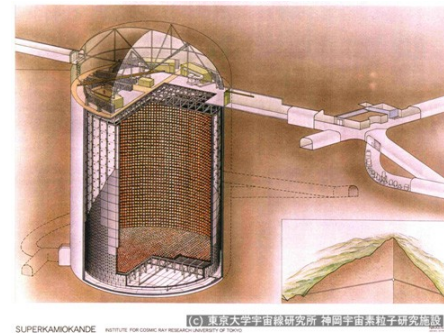
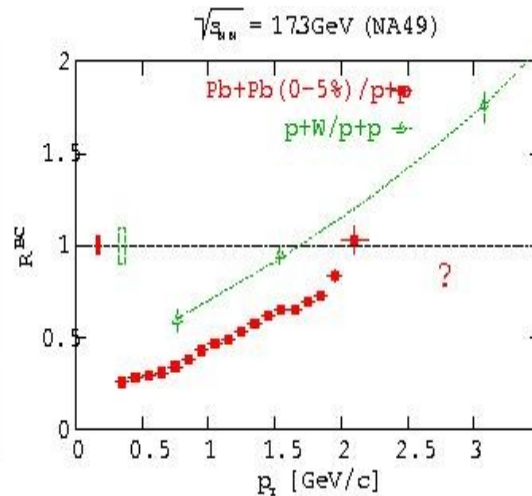
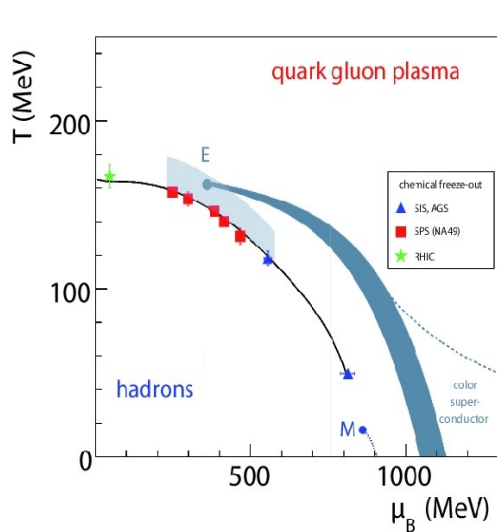
- NA61/SHINE experiment
- Hungarian participation in NA61/SHINE
- Resources
- Summary

*SHINE: SPS Hheavy-Ion and
Neutrino Experiment*



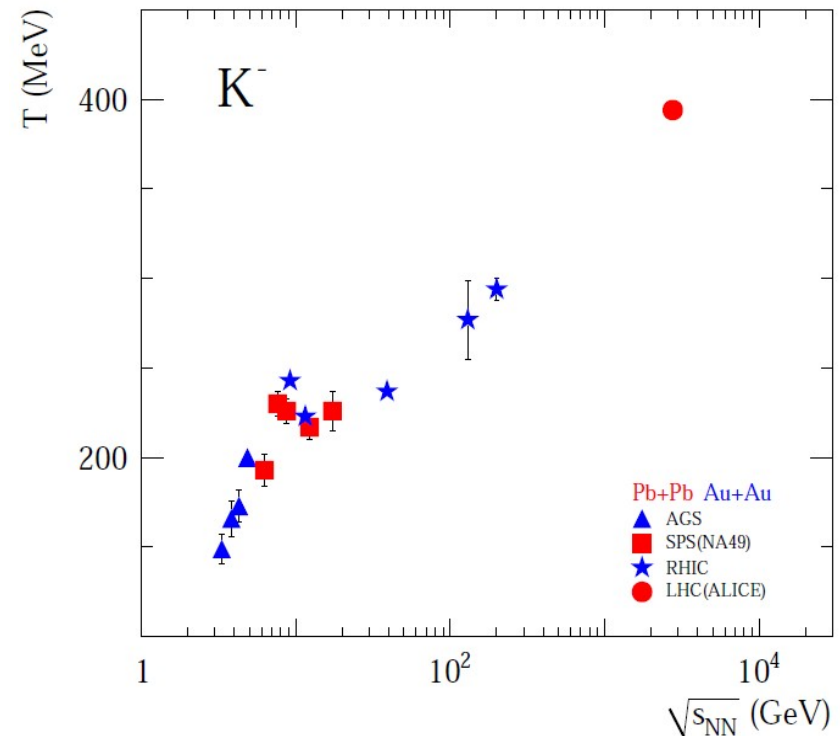
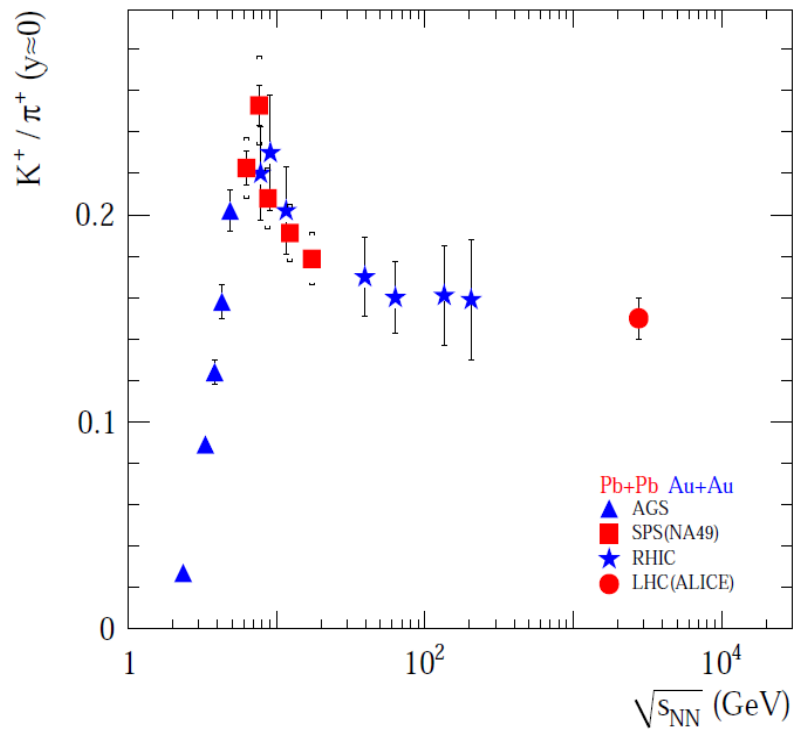
NA61/SHINE experiment

- NA61 is a large acceptance hadron spectrometer experiment at the CERN SPS. Main tracking components: 40m³ TPC system.
- Main physics goals are to measure:
 - Hadronic spectra and fluctuations in A+A for studying Onset of Deconfinement and searching for Critical Point in strong interactions, intermediate p_T physics in p+p, p+A, A+A
 - Reference hadron spectra in p+C for T2K experiment
 - Reference hadron spectra in π^- +C for the Pierre Auger Obs.



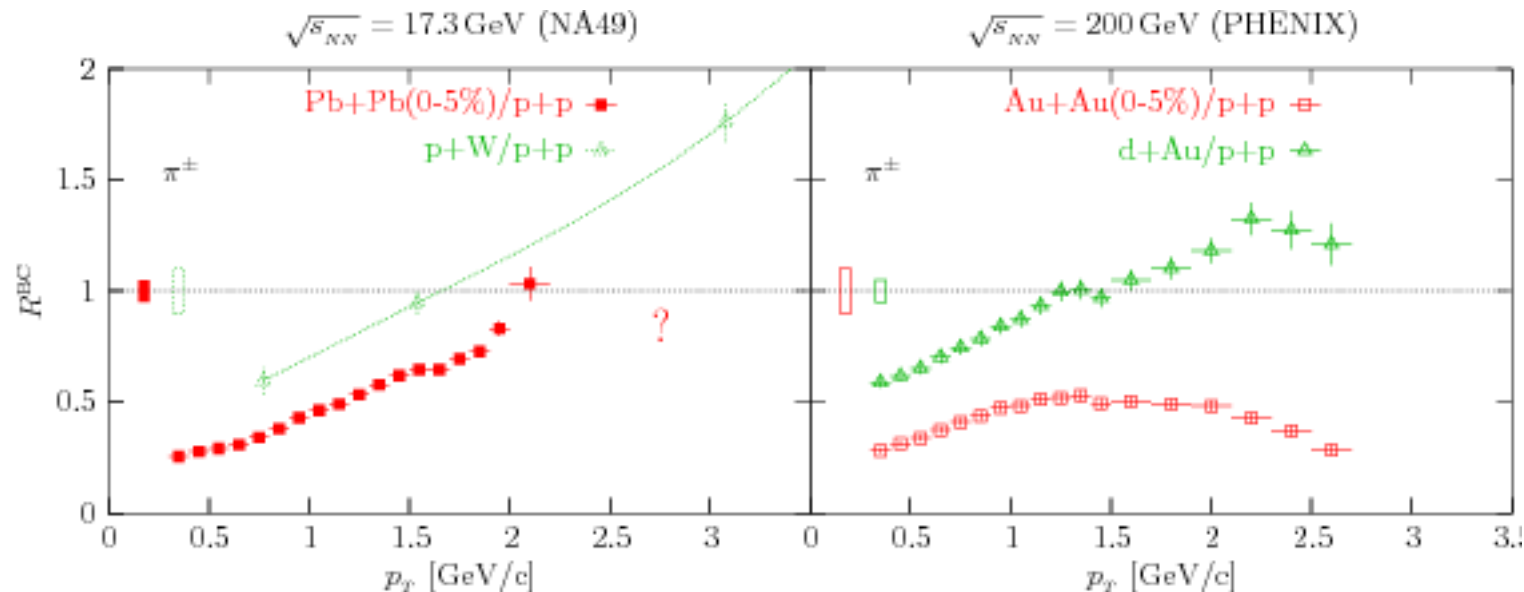
HI physics and NA61/SHINE

- Change of energy dependence of hadronic observables around SPS energies in A+A.



- Compatible explanation: decrease of strangeness carrier masses, decrease of number of strange to non-strange degrees of freedom.
- Compatible explanation: constant temperature and pressure in mixed phase. (Onset of deconfinement)
- Lattice QCD indicates existence of a critical point of strongly interacting matter at freeze-out temperatures foreseen to be accessible around SPS energies.
- NA61 is searching for CP and is studying OoD by performing an E—A scan program with moderate statistics.

- Medium effects in A+A: energy dependence of R_{AA} (nucl. mod. fact.)
 - Strong intermediate / high p_T hadron suppression seen at RHIC and LHC energies
 - Strong energy dependence of this effect toward SPS energies is expected



Phys.Rev. C77 034906

Phys.Rev. C69 034910, C74 024904

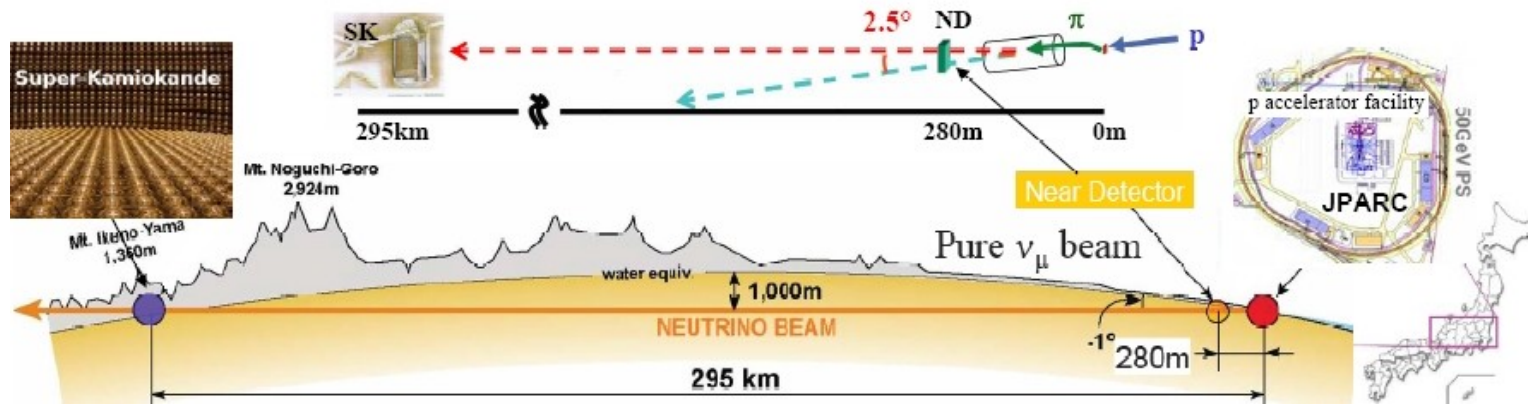
- NA49 measured R_{AA} at SPS energies but not to sufficiently high p_T . NA49 measured R_{CP} and sees suppression.

- Strong high p_T suppression seen in R_{AA} at RHIC and LHC energies.

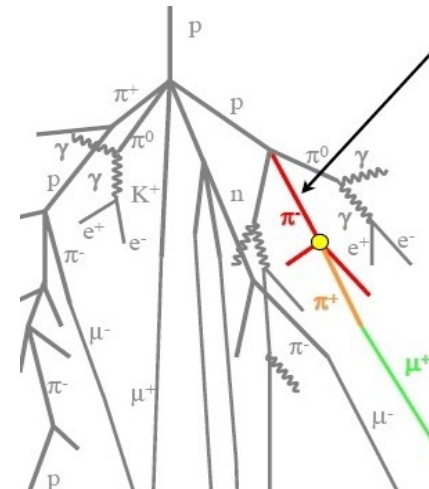
- NA61 is completing R_{AA} measurements by the high statistics p+p and p+Pb data.

Neutrino and CR physics

- In neutrino beam experiments, such as T2K, mesons are produced with a proton beam on a production target. Neutrinos are produced from decay of mesons. Precise knowledge is needed on the meson production cross section differentiated in momentum space. NA61 provides these p+A reference spectra.



- In large coverage cosmic ray observatories, such as Pierre Auger Observatory, the modelling of cosmic air showers is most sensitive to π^\pm/K^\pm production in $\pi^\pm/K^\pm + \text{air}$ nucleus collisions. NA61 provides precise π^\pm/K^\pm spectra in $\pi^\pm/K^\pm + \text{C}$ collisions.

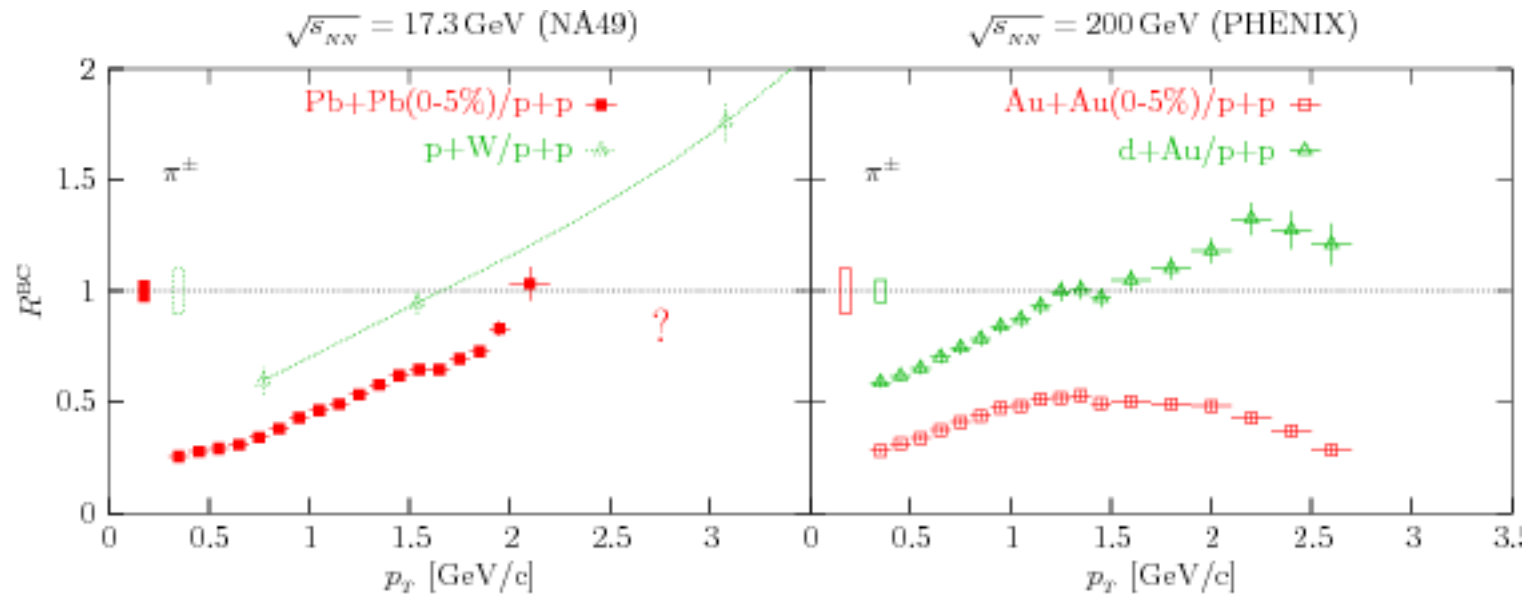


Hungarian participation in NA61/SHINE

- A Hungarian group is present in NA61 since its proposal.
 - Main interest is p+p and p+A physics, with a special emphasis on understanding A+A medium effects using intermediate p_T hadron spectra in p+p and p+A.
 - Members:
 - Zoltán Fodor (senior physicist)
 - Tivadar Kiss (electronic engineer)
 - András László (physicist, recent CERN fellow at NA61)
 - Krisztina Márton (PhD student in physics)
 - Tamás Tölyhi (electronic engineer)
 - György Vesztergombi (senior physicist)
- All members are from Wigner RCP, Budapest.
- Close collaboration with REGARD group in Wigner RCP:
 - Dezső Varga (senior physicist, former CERN fellow at NA49)
 - Gábor Kiss (PhD student in physics)

Contributions of Hungarian group in NA61/SHINE

- p+p, p+A physics part in EOI, LOI, Proposal

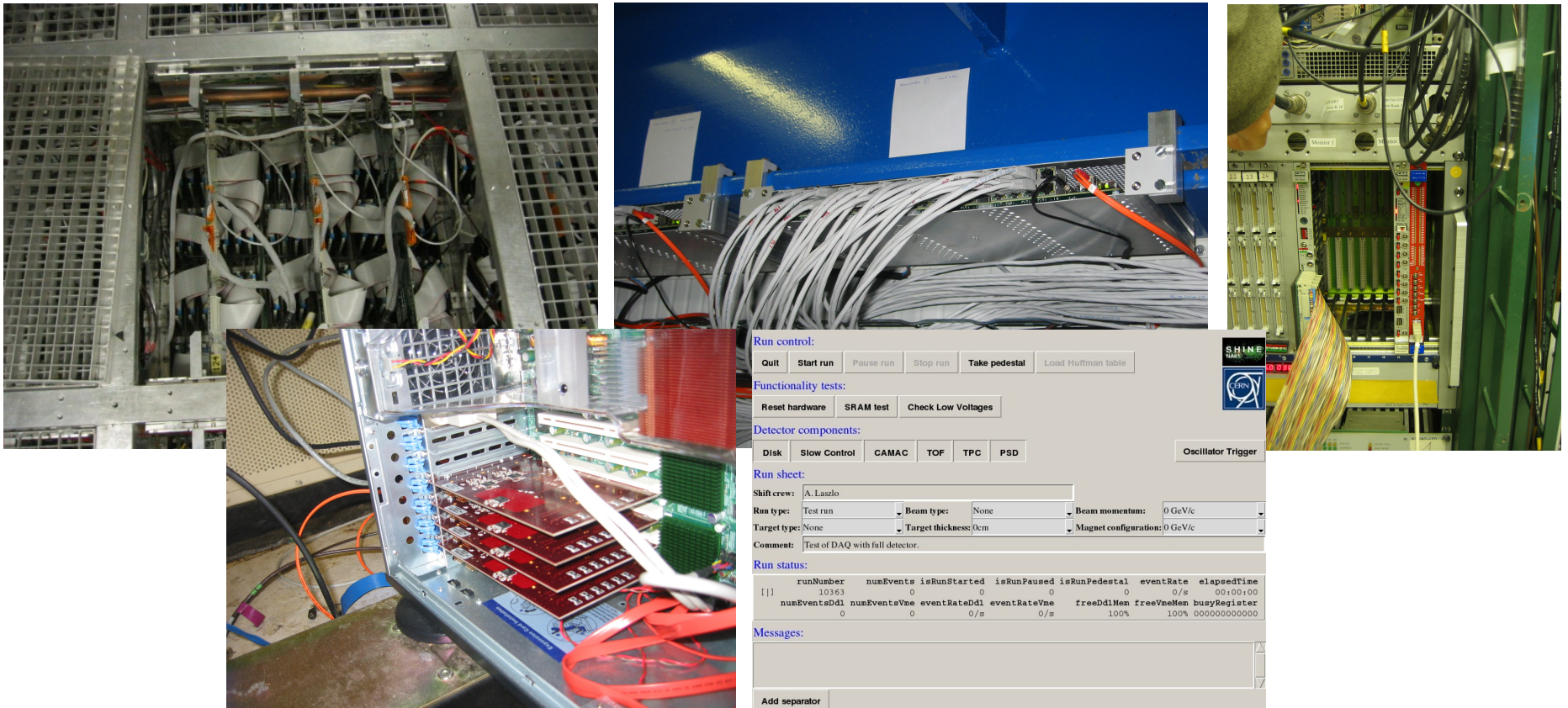


Main research interest is study of the energy dependence of nucl.mod.fact. around top SPS energies.

Experimental setup could provide quantitative information on medium effects in A+A via p+p and centrality differentiated p+A interaction data.

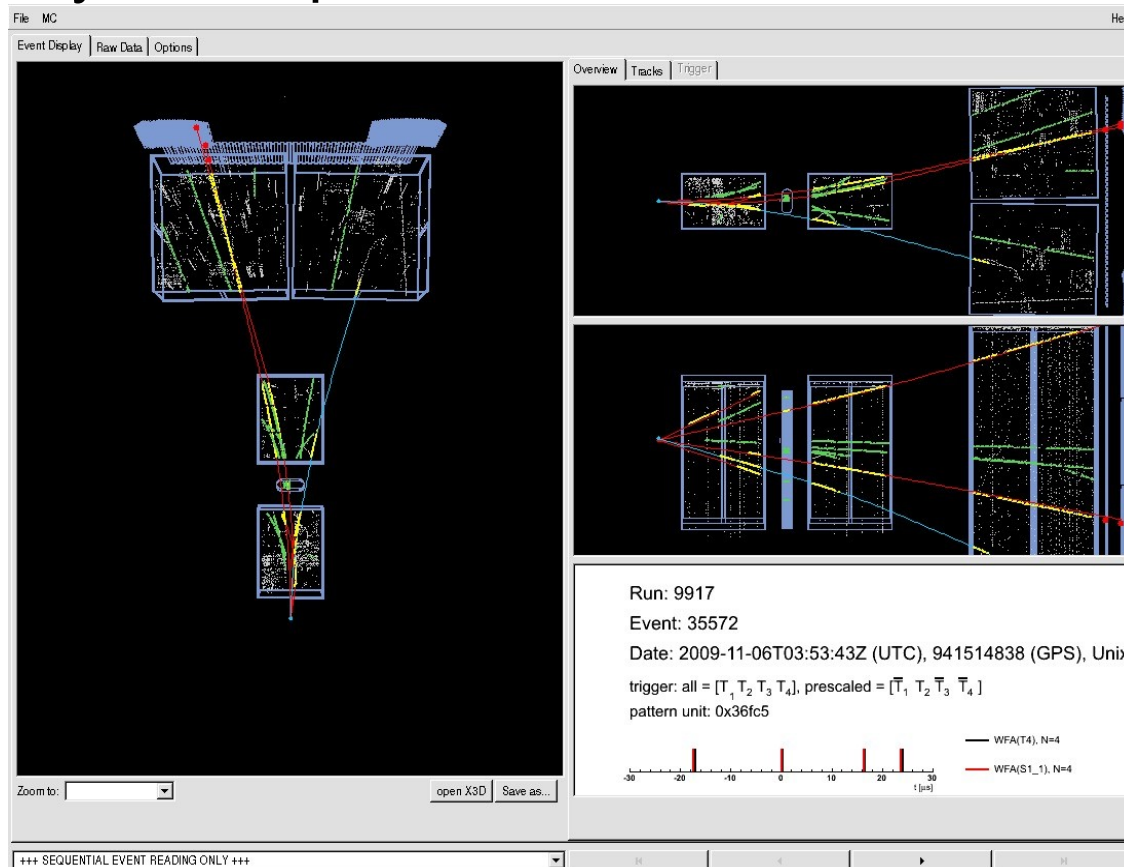
p+p already recorded (40M), half of planned p+Pb (12M).

- Development, building and maintenance of DAQ:
 - readout electronics, firmware, software for TPC system
 - full Central DAQ software, and all the other online software



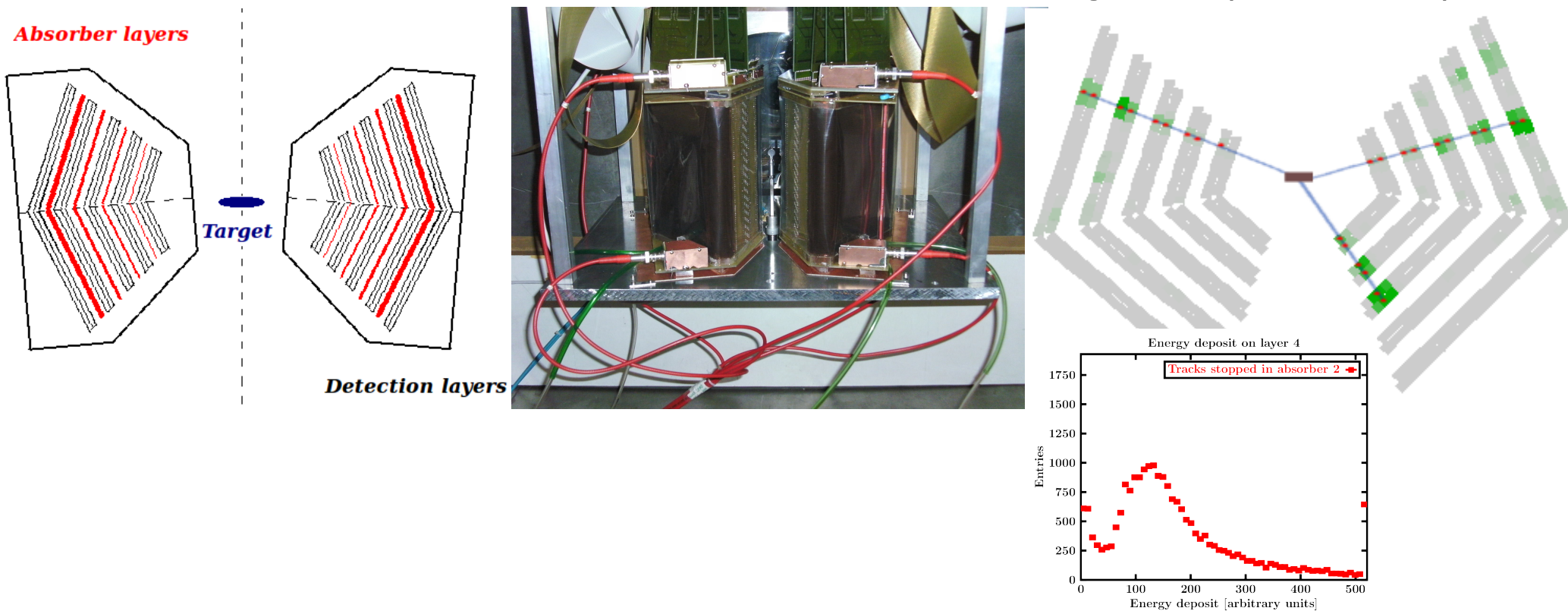
~200k pads, ~50MByte/event before electronic compression,
 ~80Hz event rate, DDL based data transmission

- Development of the offline software:
 - initiation of the Shine offline software upgrade project
 - key developer of the Shine offline software



Main responsibilities: raw data decoding, detector description, tracking and reco modules for new apparatus.

- Development of detector for centrality determination in p+A:
 - proposing, prototyping, building of LMPD detector
 - in close collaboration with REGARD R&D group (Budapest)



Counting slow (50-250MeV/c) protons from breakup of nucleus.
 Based on simultaneous range and energy loss measurement.
 In production for the 12M p+Pb physics data in 2012.

- Responsibilities within the experiment:
 - detector coordinator and on-call expert: Zoltán Fodor
 - DAQ/online coordinator and on-call expert: András László
 - offline software expert: A.László
 - operation of LMPD: Krisztina Márton, Dezső Varga, A.László
 - safety responsible: Zoltán Fodor
 - contact person: A.László
 - deputy chair in Collab.Board: György Vesztergombi
 - member in Phys.Board: A.László
 - etc.

Resources

Former funding grants:

- OTKA 68506: 60kEuro, over 4 years (mainly NA61 DAQ).
- OTKA 79840: 10kEuro, over 3 years (mainly NA61 running).
(OTKA: Hungarian Scientific Research Fund)

- LMPD development was supported also from the R&D specific grant NFÜ 77815.

Summary

- NA61 is a unique hadron spectrometer facility to study strongly interacting matter in the region of onset of deconfinement and close to the critical point (fixed-target SPS energies).
- Hungarian group is strongly present in NA61 with key contributions to the experiment. Main interest is measurement of p+p and p+A spectra up to intermediate p_T range. The group has large number of responsibilities within the collaboration.