

Status of High Energy Physics in Slovakia

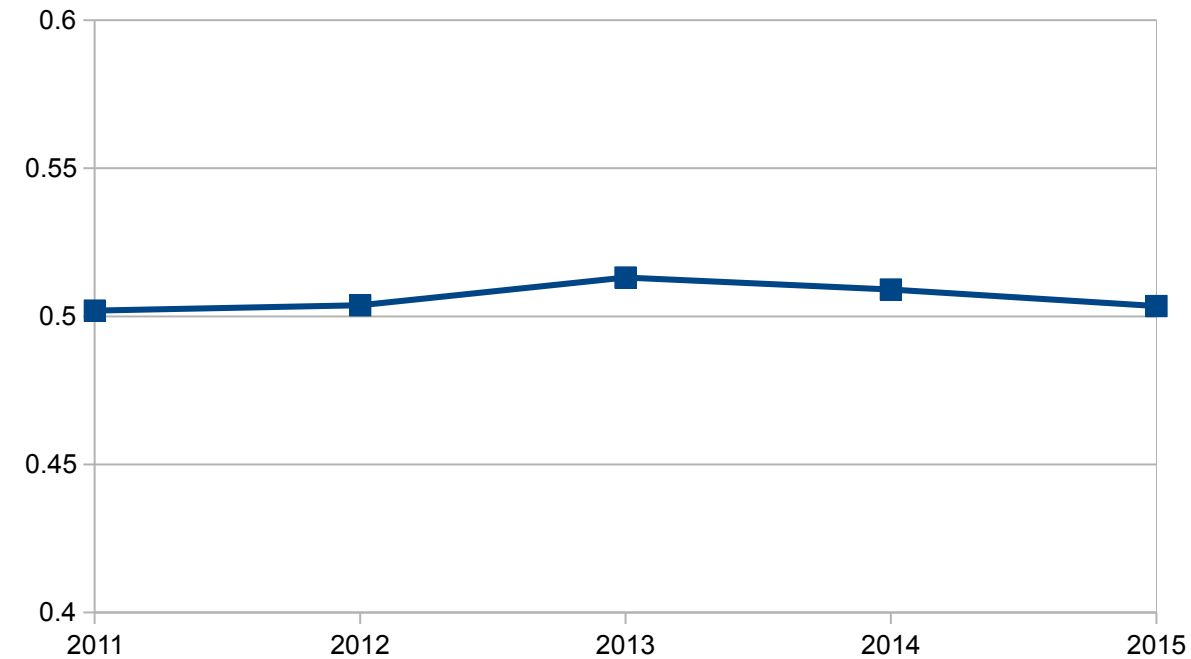
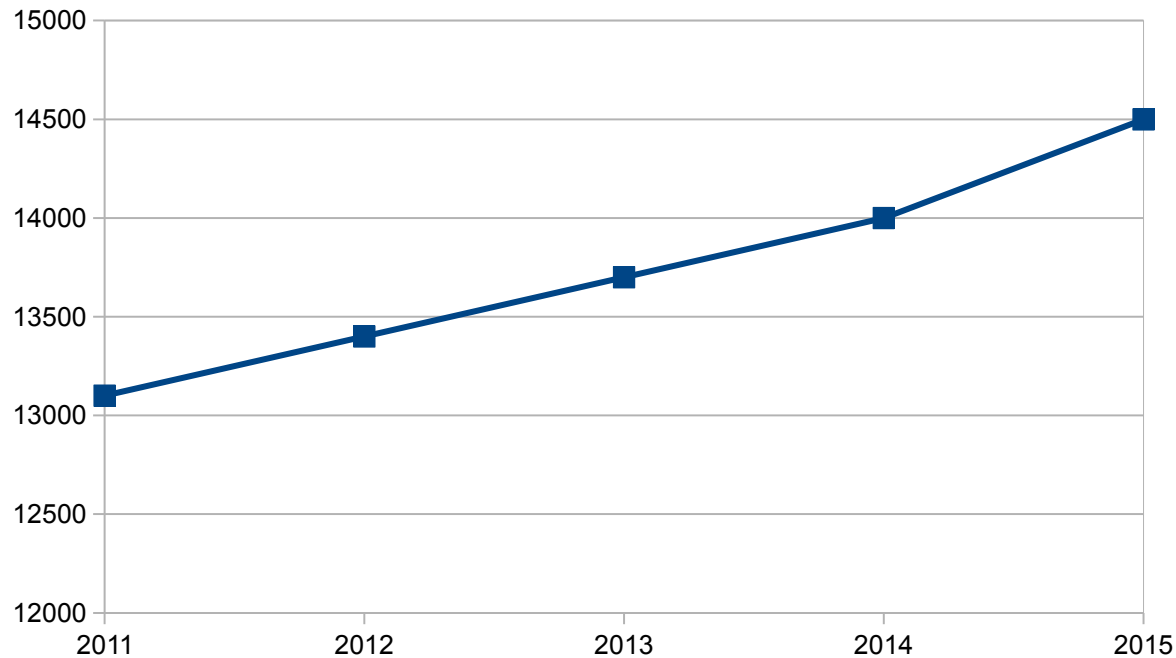
ECFA Midterm Report 2016

Pavol Stríženec

(on behalf of Boris Tomášik, previous PECFA member)

Slovak Republic

- Population 5,4 million
- Area 49 000 km²
- GDP per capita 14 394 € (data from 2015), 50% of EU28 average



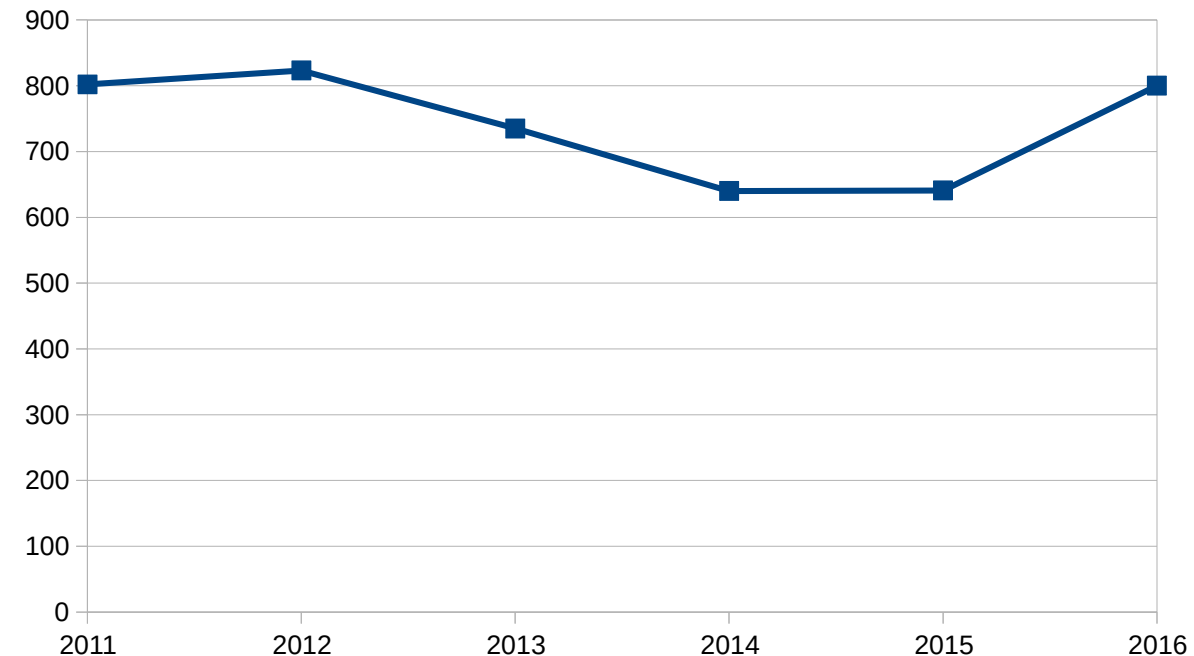
Science and Higher Education in Slovakia

- Slovak Academy of Sciences (own chapter in state budget)
- Universities:
 - 20 public universities
 - 3 state universities (army, police, healthcare)
 - 15 private colleges
- Basic research limited to very few universities

Financing of HEP: state budget

CERN membership fee

- (5.5 MCHF)
- Financing of CERN-related activities
 - budget distributed by the Committee for Slovakia-CERN Collaboration (scientists + ministry officials)
- total sum per year in kEUR shown on graph, contains:
 - M&O, upgrades, running costs for experiments
 - Contribution to theoretical physics
 - Outreach activities
 - Running 2 WLCG clusters (Tier-2)



Financing of HEP: research grants

- APVV – Research and Development Agency
 - in general, grants up to 250 k€/year and 4 years
 - competitive funding, general calls to all sciences
 - Examples of supported groups:
 - Nuclear structure group at IoP SAS Bratislava, in 2011, 2015
 - Nuclear structure group and neutrinos at Comenius University, in 2011 and 2015
- VEGA – Science Grant Agency
 - Smaller grants, of the order 10 k€/year, up to 3 years
 - Competitive funding, general calls for all sciences
 - Examples of supported groups:
 - ALICE (DAQ R&D)
 - Nuclear structure group at Comenius University

HEP Geography in Slovakia

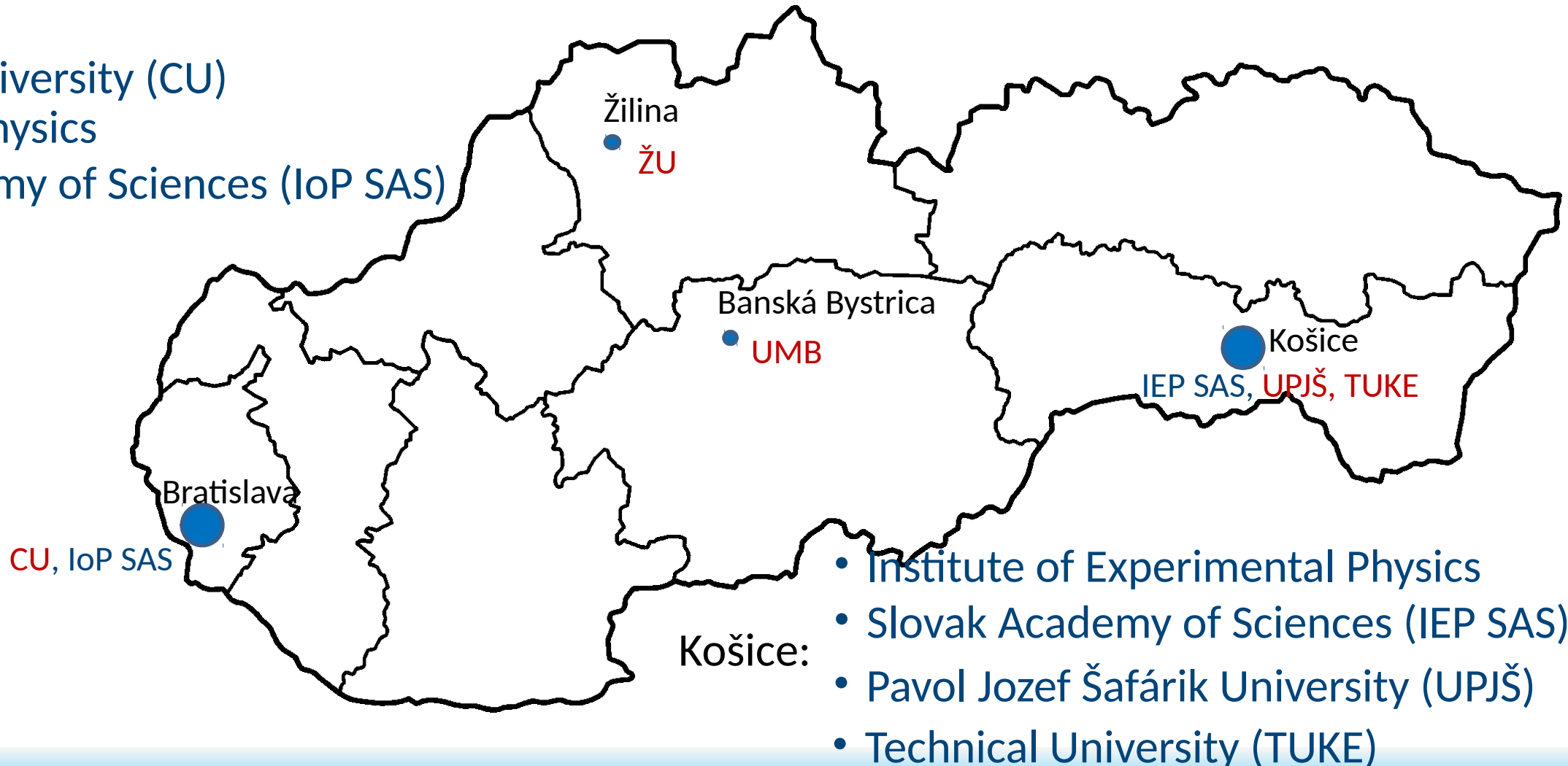
Žilina: • University of Žilina (ŽU)

Banská Bystrica:

• Matej Bel University (UMB)

Bratislava:

- Comenius University (CU)
- Institute of Physics
Slovak Academy of Sciences (IoP SAS)



Košice:

- Institute of Experimental Physics
- Slovak Academy of Sciences (IEP SAS)
- Pavol Jozef Šafárik University (UPJŠ)
- Technical University (TUKE)

Involvement in Projects/Collaborations

ATLAS

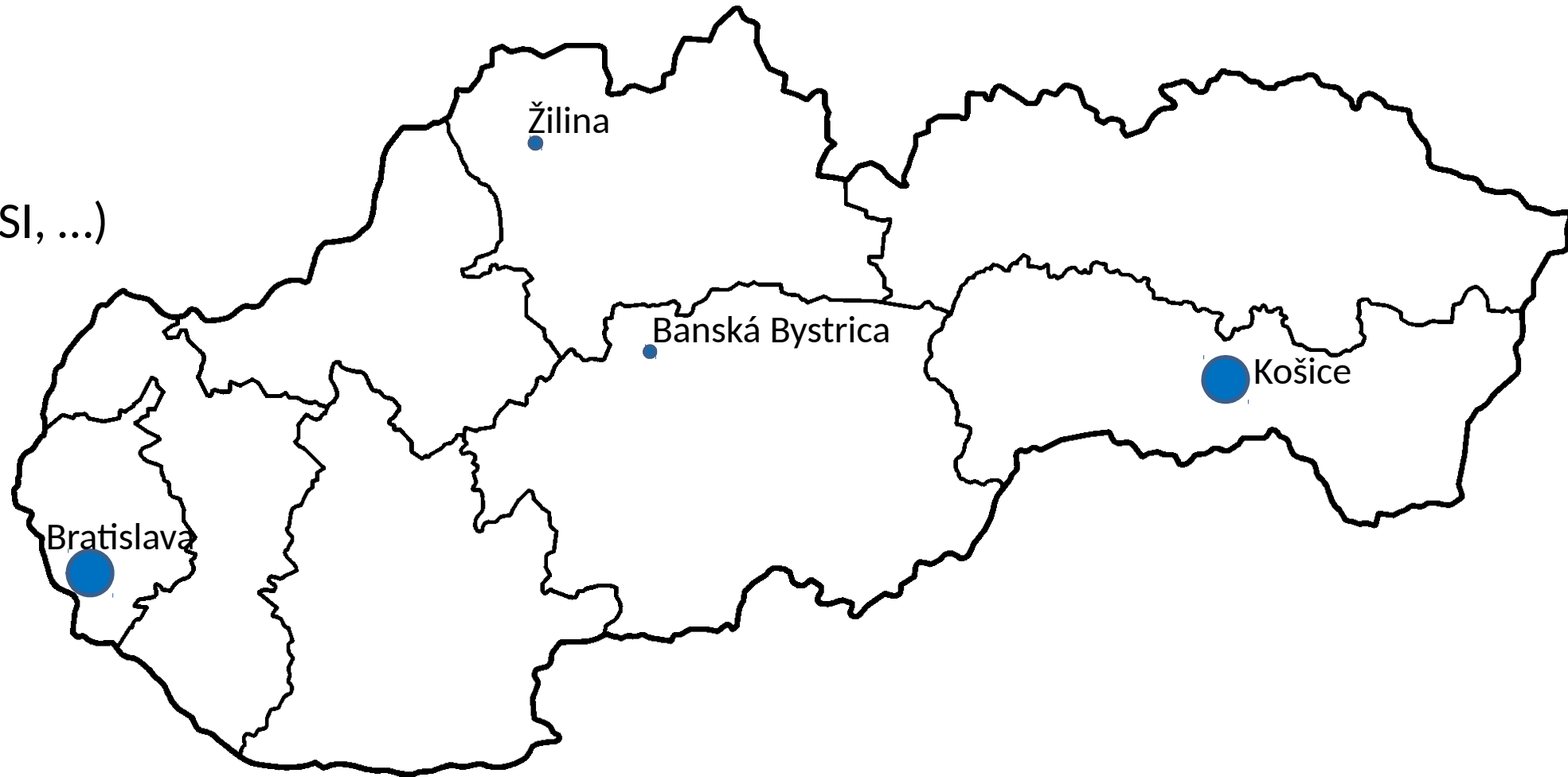
ALICE

Nuclear structure
(ISOLDE, GANIL, GSI, ...)

NA62

SuperFRS

Baykal/JUNO/
SuperNEMO



Comenius University – ATLAS

3 seniors, 3 juniors, 2 technicians, 7 PhD. students, 28 students

- Topics:
 - Top quark physics in pp collisions
 - Bose-Einstein correlations in pp collisions
- Key results:
 - Measurement of the top quark charge in pp collisions at $\sqrt{s} = 7$ TeV
 - Two-particle Bose-Einstein correlations in pp collisions at $\sqrt{s} = 0.9$ and 7 TeV
- Since 2013: 19 talks for collaboration, 14 proceedings, 6 internal notes
- Responsibility: Data Quality Control for the TileCal
- Local ATLAS farm, Tier 2 together with Košice

Comenius University – ALICE

4 seniors, 1 junior, 1 technician, 1 PhD. Student, 1 student

- Topics
 - Mid-rapidity anti-baryon to baryon ratio in Pb-Pb and p--Pb collisions
 - Production of anti-nucleons and nucleons
- Responsibilities
 - TPC upgrade: measurements of ion mobility, new detector lab built
 - World LHC Computing Grid
 - Aliroot
- Key results:
 - 2 papers of the collaboration
 - 2 talks for the collaboration, 1 poster

Comenius University – FRS and SuperFRS *Bratislava*

All members are also members of Comenius University – ALICE

4 seniors, 1 technician

- Topics:

- Study of exotic nuclei (mainly halo nuclei) on the Fragment Separator FRS
- Study of new magic numbers near the neutron drip-line on the FRS

- Responsibilities

- tracking by the TPC detectors (including electronics a software) produced and maintained by the group in many experiments on the FRS
- R&D of new position sensitive detectors for the Super FRS in the FAIR facility
- Development and testing of the Twin TPC detector proposed by the group as a basic detector for the Super FRS

- Results

- 12 papers
- 3 talks for the collaboration

Comenius University – NA62

3 seniors, 1 junior, 3 PhD. students, 4 students

- Topics: rare K decays as indication for BSM physics
- Participation in software development for:
 - LTU board
 - TDAQ STRAW detector
 - MUV3 muon trigger
- Theoretical guidance for the experiment
- Key results:
 - Measurement of Neutral Pion Transition Form Factor
 - Left-Left Squark Mixing, K^+ to $\pi^+\nu$ $\bar{\nu}$ and Minimal Supersymmetry with large $\tan\beta$ (theoretical paper)

Comenius University - Neutrinos

2 senior, 3 juniors, 2 PhD students

- Strong theoretical activity – support to a few collaborations
- Participation to NEMO3, SuperNEMO, ECHo, TGV, Baykal GVD, observer in JUNO – also contribute workforce in experimental activities

Comenius U – Nuclear structure and reactions

1 senior, 1 junior (leave of absence), 2 PhD students, 4 students

- Topics:

- Nuclear reactions with production of heavy and superheavy nuclei
- Delayed fission after beta decay
- Decay spectroscopy and nuclear structure of heavy nuclei

- Participation in experiments at GANIL, GSI-SHIP

- Key results:

- Confirmed synthesis of nuclide 116
- Measurement of the first ionization potential of astatine
- alpha decay of the very neutron-deficient isotopes $^{197-199}\text{Fr}$

- Responsibility: analysis software for detection system MoDSS (use at GANIL and GSI)

Institute of Physics, SAS – Nuclear structure

7 seniors, 3 juniors, 1 technician, 4 PhD students, 5 students

- Structure of heavy nuclei studied with the help of beta decay (ISOLDE) and in-beam spectroscopy (Jyväskylä, iTHEMBA Labs)
- Leading group (includes spokesperson) for: IS521 (CERN), IS581 (CERN), S17 (Jyväskylä), JR115 (Jyväskylä), PR235 (iThemba Labs, ZA),
- Key results:
 - Construction of high-vacuum transport system for isotope samples TATRA, successful use at ISOLDE, MoU about construction of a copy at iTHEMBA
 - First observation of strongly coupled rotation band with zero alignment in other region than actinides (in ^{177}Au)
 - New methodology of construction of decay schemes for isotopes with high density of states

Institute of Experimental Physics - ATLAS

Košice

4 seniors, 1 junior, 4 technicians (shared with ALICE), 2 students

- Topics:

- Charge asymmetry in t-tbar and production mechanism of t-tbar
- Top quark mass determination in dilepton channel with the help of KIN method

- Leadership roles:

- Coordinator for electronic calibration for LAr calorimetry
- Chair of "ATLAS Computing Speakers Committee", 2015-2016
- Since 2012 coordinator for "LAr software and Data Preparation"

- Key responsibilities:

- Electronic calibration, monitoring and data quality for LAr calorimetry
- Development of electronics for the upgrade of LAr calorimetry
- Preparation of forward-backward calorimetry for hi-lumi
- Participation in the Proposal to Measure Radiation Field Characteristics Luminosity and Induced Radioactivity with TIMEPIX Devices

- Main original results:

- 11 internal documents of the collaboration, 1 talk for the collaboration

Institute of Experimental Physics – ALICE

Košice

2 seniors (1 emeritus), 5 juniors, 4 technicians (shared with ATLAS)

- Topics:

- Strange baryon production in pp, pPb, and PbPb collisions
- Production of resonances

- Responsibilities:

- Luminosity monitoring
- maintenance and modernization of the Central Trigger Processor
- measurements for ITS upgrade
- Off-line: contributions to the physics analysis software (ROOT, AliROOT)

Most important results:

- Study of the strangeness production at LHC:
 - development of an analysis code independent for the the cross-check of the mainstream analysis of the strangeness production in p-Pb collisions:
 - systematic effects due to misidentification of Ξ and Ω
 - investigation and understanding of various sources of background
 - debugging the mainstream analysis code
 - improving precision and robustness of the results on multi-strange production
 - analysis of the Λ of K_s^0 production in p-p collisions at 13 TeV (ongoing effort)

3 seniors, 5 PhD students, 6 students

- Topics:

- Hyperon and K^0 production in pp and PbPb
- Nuclear modification factor for multistrange hyperons
- study of the V0-charged particle correlations (where V0 is Λ or K^0_s)

- Main results:

- multiplicity dependence of the strange particle production in Pb-Pb collisions at
- $\sqrt{s_{NN}} = 5.02$ TeV (together with IEP SAS)
- K^0 s and Lambda Production in Pb-Pb Collisions at $\sqrt{s_{NN}} = 2.76$ TeV; anomalous baryon production
- 1 talk for collaboration, 2 posters, 2 proceedings, 4 analysis notes

- Responsibilities:

- Software for Central Trigger Processor
- Exclusive responsibility for Trigger Data Quality Monitoring
- Analysis software

Technical University, Košice – ALICE

2 Seniors, 1 Juniors, 6 PhD. Students, 5 Students

- Inner Tracker System innovation, focused on Pixel Detector
 - Steering of the pixel detector
 - Development of a Hybrid Integrated Circuit for data collection and processing from the ALICE detector
 - Development of program modules for ALICE Detector Control System
- Member of ALICE Collaboration since 2014

Theoretical physics

- Heavy-ion and hot matter phenomenology
 - (Banská Bystrica, Žilina, Bratislava IoP)
 - Grant Holder for COST Action CA15213
- Neutrino phenomenology (Comenius University)
- Hadronic interactions at high energies (IEP Košice)
- BSM in connection with rare kaon decays (Comenius University)
- Light-cone quantization (Bratislava IoP)
- BSM top-BESS models (Žilina)

Outreach

- International Particle Physics Masterclasses
 - Flagship project with satellite events to feed the interest
 - Typically 7 universities and 300 participants annually
- Cascade projects
 - Teams of middle-school pupils prepare presentations on specified topics
 - Presentations done in their schools and recorded
 - Based on recorded presentations the best teams are selected by jury
 - Very wide coverage directly in the schools
- Web portal www.svetcastic.sk
Communication platform for public, teachers, journalists, scientists,...