

Accelerator R&D in Slovakia 2011 – 2018

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Lecture overview

- Existing research accelerator facilities in Slovakia a brief list
 - BIONT, Inc. Bratislava, PET center
 - Electron accelerator at the Slovak Medical University in Trenčín
 - Slovakion at the Slovak University of Technology in Trnava
 - Pelletron at the Comenius University in Bratislava
 - Pelletron at the Slovak Academy of Sciences in Piešťany
- Most significant international collaborations
 - Joint Institute for Nuclear Research in Dubna, Russian Federation
 - CERN Accelerator School in Slovakia on ion sources, 2012
 - GSI Darmstadt & FAIR
 - Others see dedicated lectures
- Accelerator R&D projects
 - Development of rotating gantries
 - Activation studies for high-power future accelerators (FAIR)
- Summary and conclusions



CYCLONE 18/9 at BIONT, Inc. Bratislava PET center

Isochronous cyclotron 18 MeV protons 9 MeV deuterons internal ion source 7 target ports 1 external beamline







- Beam power: 1 kW
- ✤ Beam energy: (3.6 6.2) MeV
- ✤ Beam repetition rate: 5 -240 Hz
- Beam diameter at window: 11 mm
- Scanning: 40 cm, 45 cm, 50 cm
- Scanning frequency: 0.25 5 Hz
- Conveyor velocity: 0.1 100 mm/s
- Three modes of irradiation:
 - ✤ static
 - ✤ in-line
 - rotational irradiation

6 MV Tandetron at the University Science Park "Slovakion" of the Slovak University of Technology in Trnava:

• Standard IBA and implantation techniques





3 MV Pelletron, Comenius University, Bratislava

- AMS
- Nuclear physics
- Analysis of environmental samples

2 MV Tandetron, Slovak Academy of Sciences, Piešťany

- Neutron physics
- Stellar reactions
- Opening day: 24.05.2018



Collaboration with the Joint Institute for Nuclear Research in Dubna, RF

- Regular exchange of experts between Slovakia and RF (several tens of people every year):
 - Short visits (2 weeks); Visits (3 months); Long-term stays (several years)
- Some projects are related to the accelerator R&D

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Reactive magnetron sputtering of N-doped carbon thin films on quartz glass for transmission photocathode applications

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The CERN Accelerator School and The Slovak University of Technology will organise a course on

Ion Sources

29 May - 8 June, 2012 | HOTEL SENEC, Senec, Slovakia













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An ion-optical design study of a carbon-ion rotating gantry with a superconducting final bending magnet



INUCLEAR INSTRUMENTS & METHODS

> IN PHYSICS RESEARCH

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lon species	Copper		Stainless steel	
	Energy [MeV/u]	Range [mm]	Energy [MeV/u]	Range [mm]
238-U	500	5.34	500	6.28
	950	13.2	950	14.4
40-Ar	500	22.91		
	1000	63.35		

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Residual activity induced by heavy ions and beam-loss criteria for heavy-ion accelerators

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Depth profiling of residual activity of ²³⁷U fragments as a range verification technique for ²³⁸U primary ion beam

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Radiation damage studies of soft magnetic metallic glasses irradiated with high-energy heavy ions

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Some statistics and summary				
CERN Accelerator School	2012	69 participants; more than 25 nationalities; 3 people from the STU employed in the local organizing committee		
JINR Dubna collaboration	regular	Several tens of experts exchange per year; small fraction devoted to accelerator R&D		
Gantry development	regular	About 2-3 people per year; 1 supervisor, 2 students (diploma, PhD); GSI Darmstadt, STU, PSI (1 stay), MedAustron – to be started in June 2018; SAIA support in collaboration with PSI Villigen		
Activation studies	till 2015	FAIR, GSI Darmstadt, bilateral agreement or informal collaboration, sample exchange, INTAS (FP) collaboration (before 2012), ≈ 5 STU team- members		
Educational project KEGA	2012-2014	Development of accelerator physics course at STU in Bratislava; 3 years, 11 team-members from STU		
MedTech	till 2017	Accelerator physics course at the UAS Wiener Neustadt, 1 external lecturer from Slovakia		

SOME MAJOR PROBLEMS

•WRONG strategy of financing educational institutions according to the NUMBER of students

- general decrease of the quality of education (acquiring of an academic degree becomes less demanding, the teachers are forced to be more "tolerant")
 - students' background in physics and mathematics becomes not satisfactory for sophisticated disciplines like accelerator physics, solid-state physics, HEP, etc.;
 - students prefer studying less demanding disciplines or the same disciplines at universities having lower reputation;
 - on the other hand, the most talented and ambitious students are not content with the level of education they can obtain in Slovakia and go abroad (e.g. Czech republic);
- Supporting few but excellent students is rather inefficient