

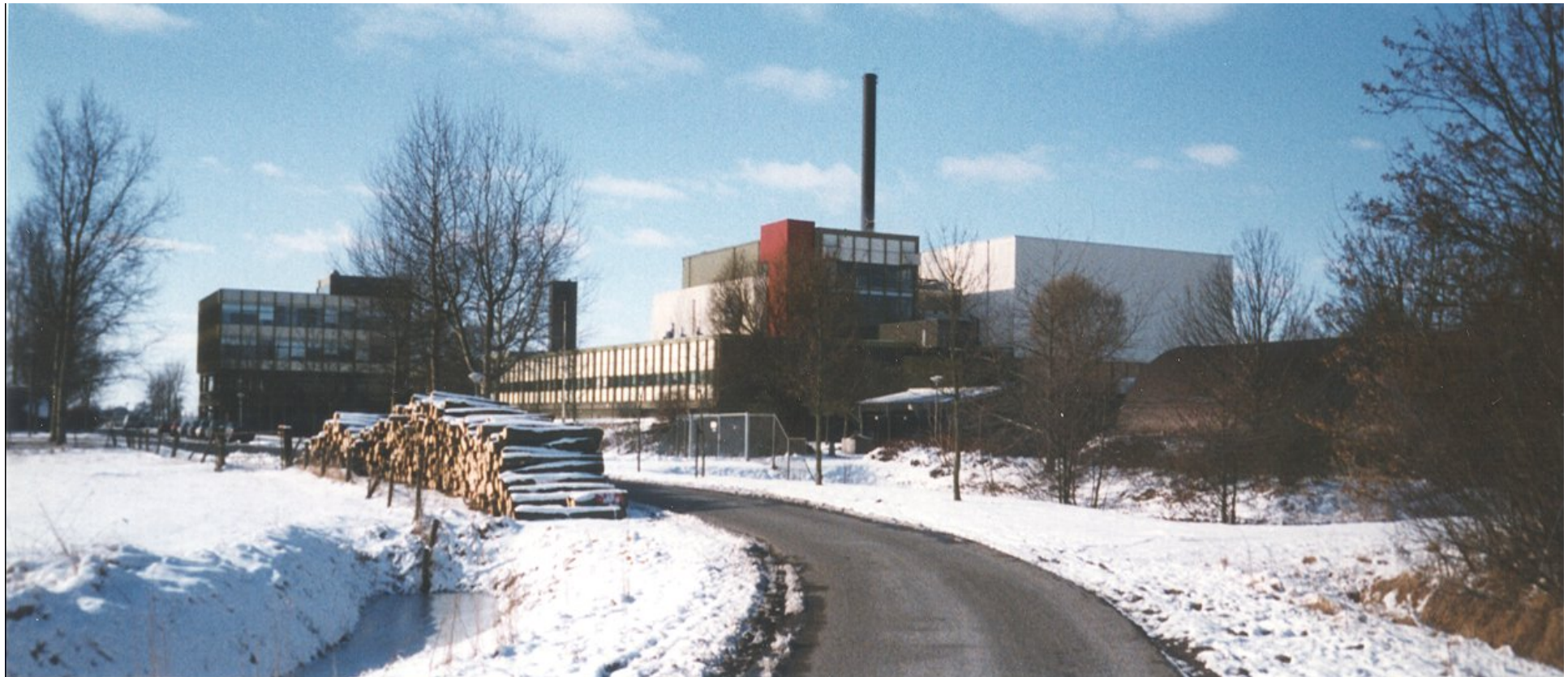


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ENSAR TNA RuG/KVI

ENSAR Town Meeting – 17-20 June 2013, Warsaw, Poland

Peter Dendooven – dendooven@kvi.nl



The AGOR accelerator

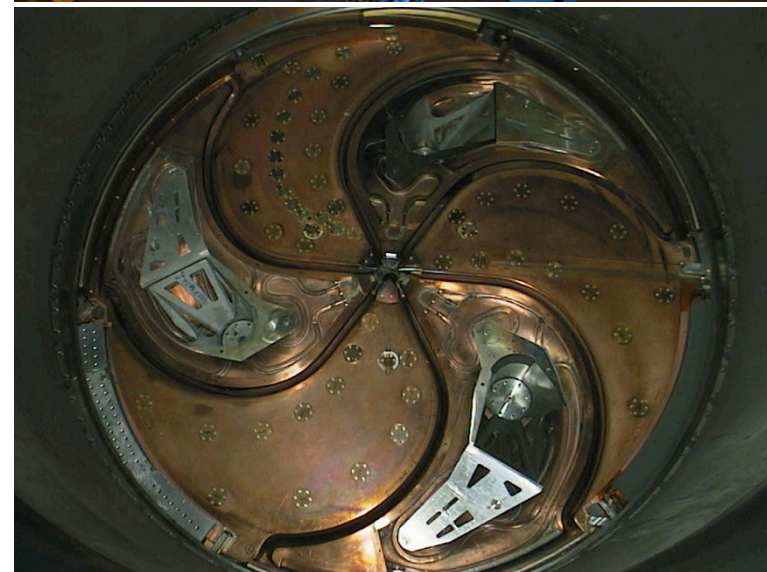
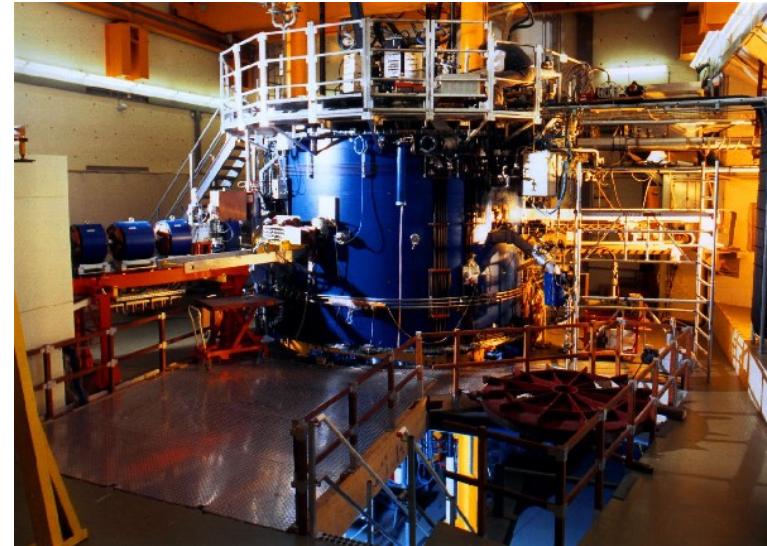


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<http://www.rug.nl/kvi/facilities/agor/>

- asynchronous cyclotron
- $K = 600 \text{ MeV/u}$
- superconducting $B = 1.7 - 4.1 \text{ T}$
- $\nu_{\text{RF}} = 24 - 62 \text{ MHz}$



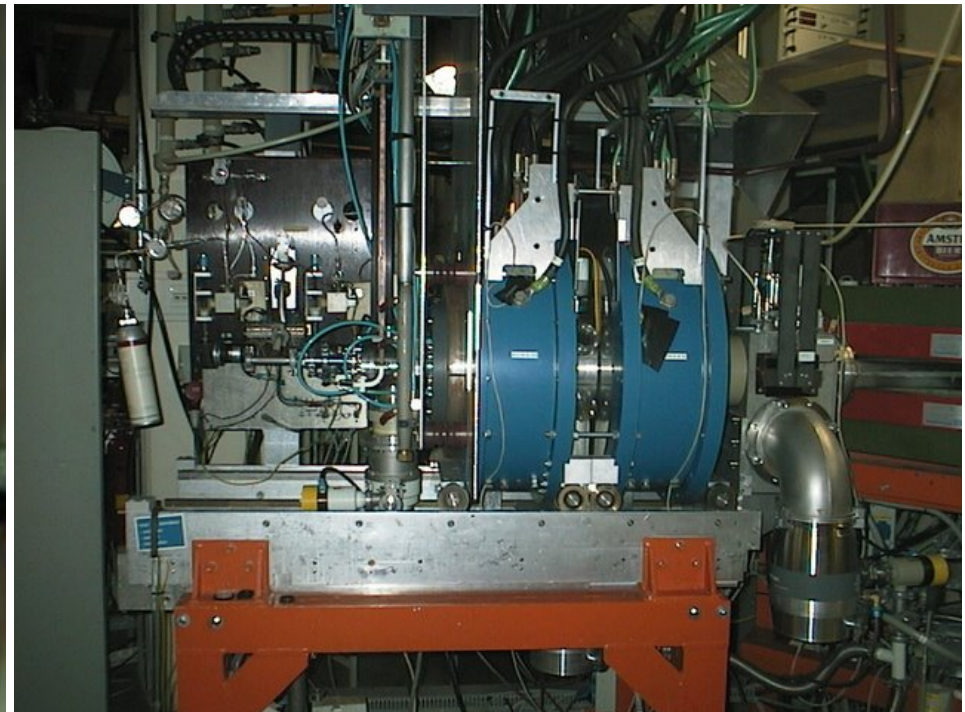
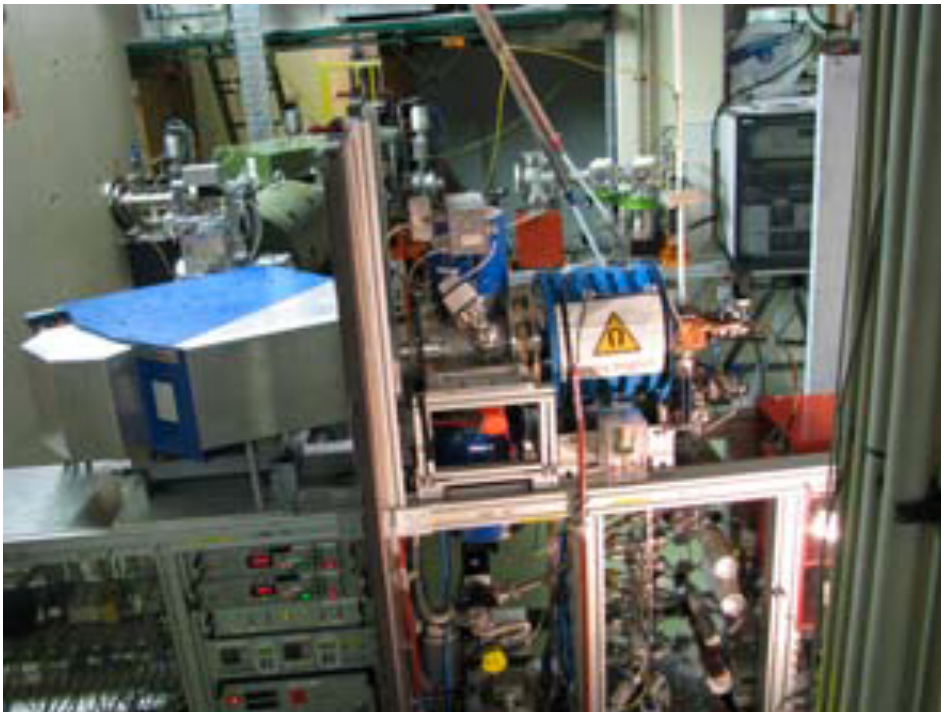
The AGOR ion sources



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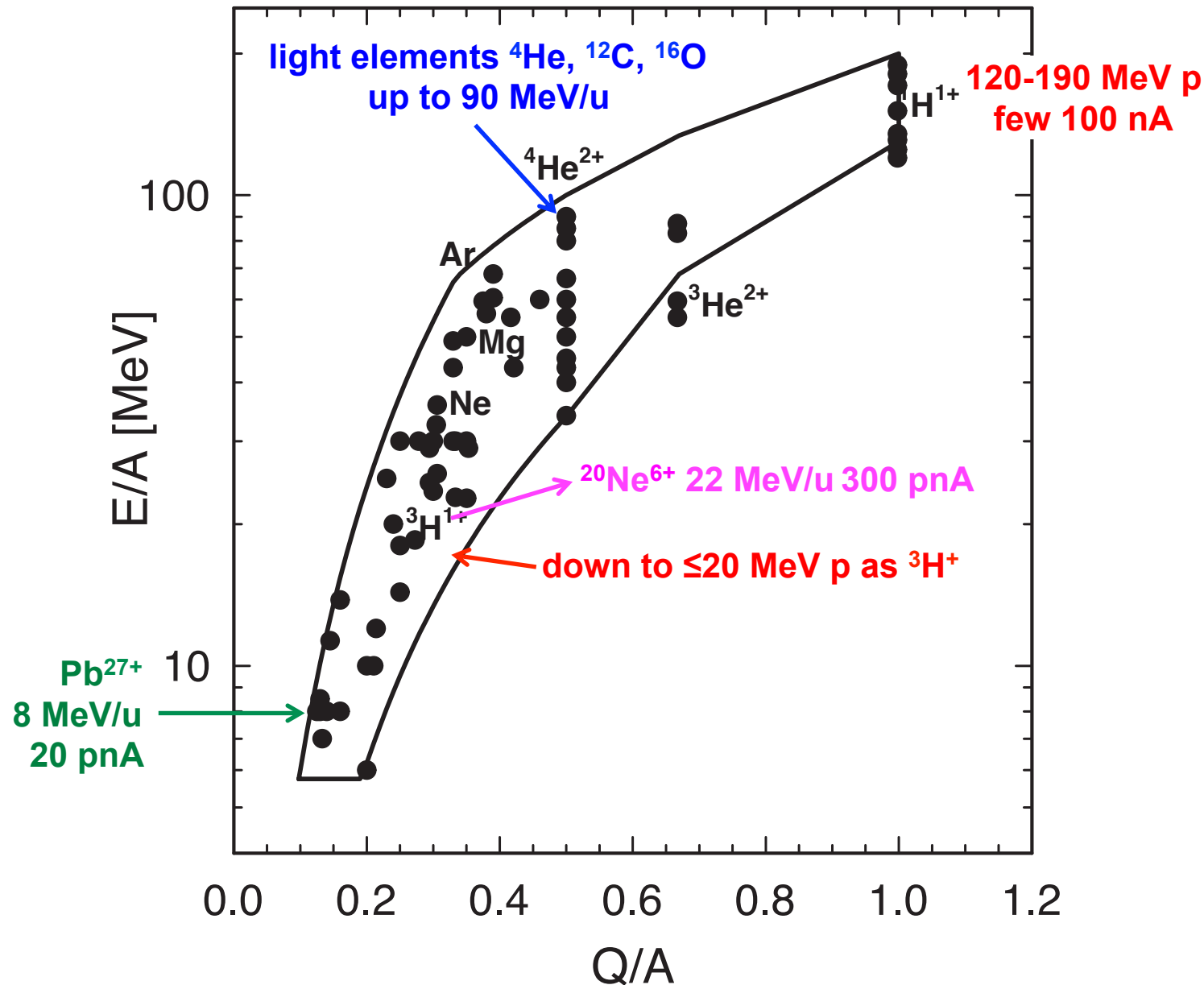
- **multicusp ion source:** hydrogen, deuterium, helium
- **ECR sources**
 - **14 GHz KVI-AECR**
production of highly-charged metal ions (e.g. Pb^{27+})
 - **14 GHz SUPERNANOAN**
gaseous elements (e.g. Ne^{6+})



Operating diagram / beams produced



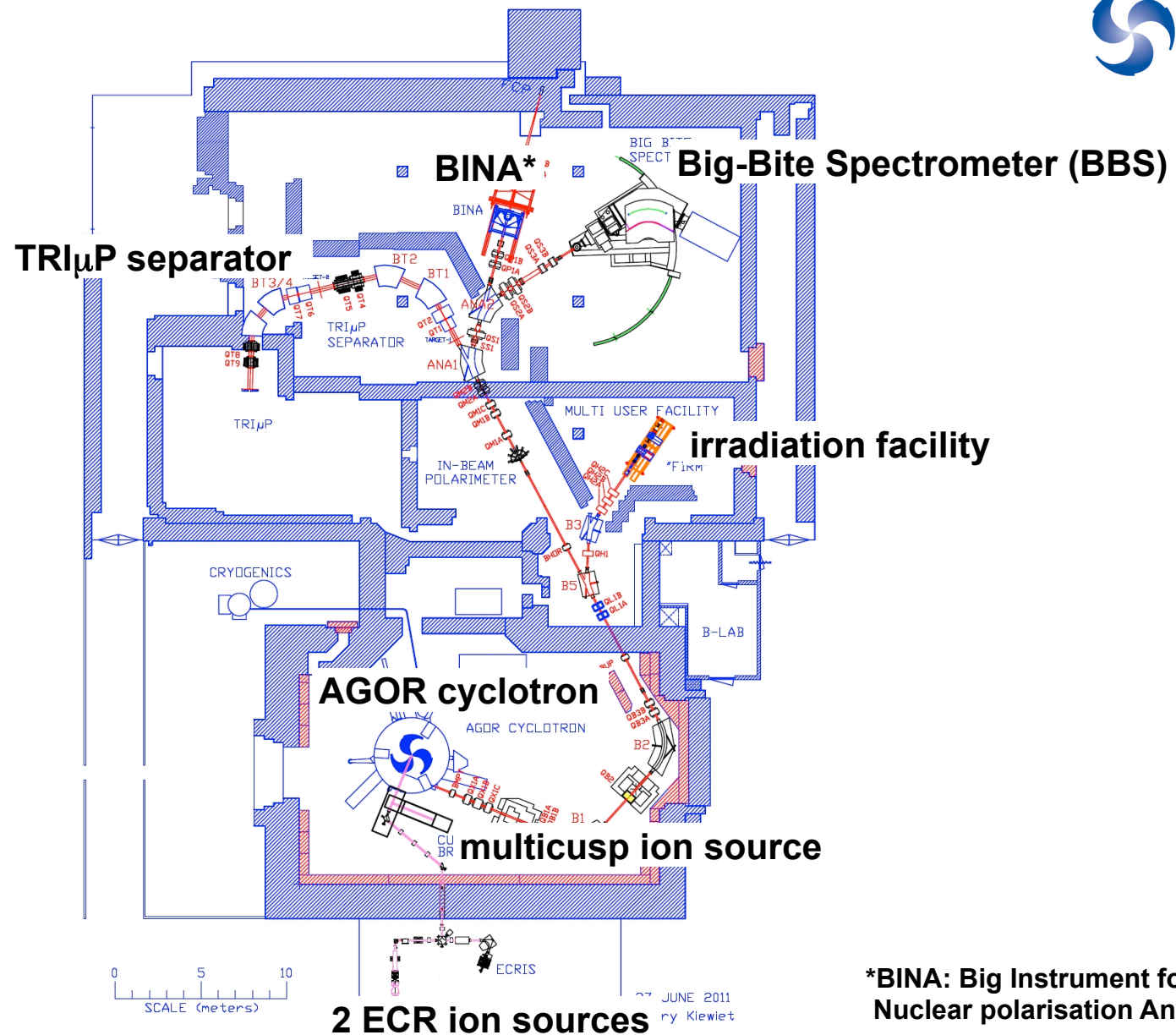
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The beam-line layout (2011)



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*BINA: Big Instrument for
Nuclear polarisation Analysis



T29

Radiation hardness of avalanche photodiodes, radiation damage and defect studies in PWO crystals, and hadron response of inorganic scintillating fibers

developments for the electromagnetic calorimeter for PANDA at FAIR and an innovative detector concept based on inorganic scintillating fibers

Spokesperson: **Rainer Novotny** (University Giessen)

Institutes: University Giessen

University Bochum

GSI

University Frankfurt

Belarus State University Minsk

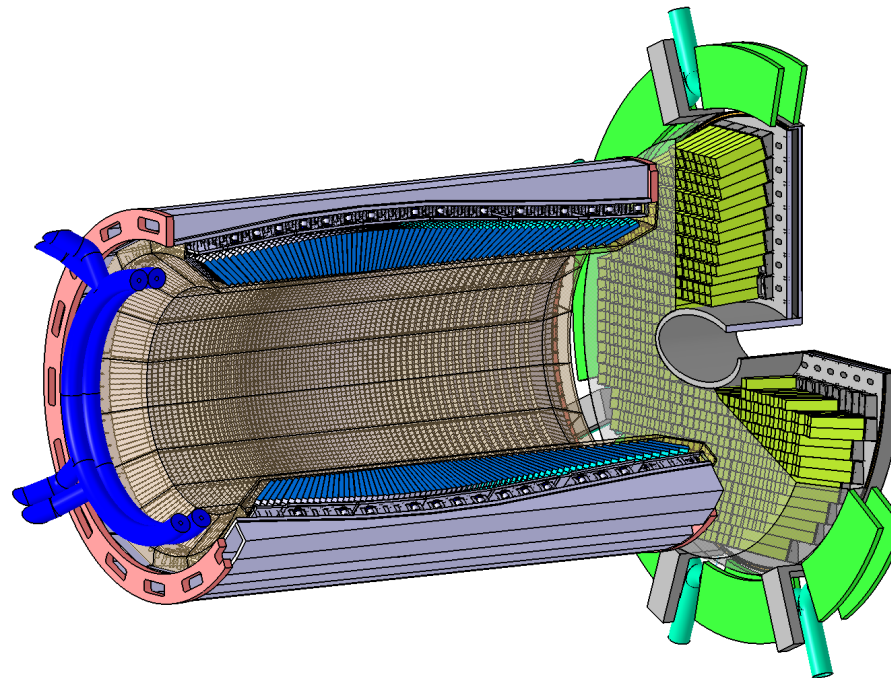
KVI

KVI beam line: irradiation facility

T29

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http://www-panda.gsi.de/html/det/emc/emc_new.png

T30

Experiments for real time in-vivo dosimetry for ion therapy

characterization and optimization of a Compton camera and a state-of-the-art time-of-flight positron emission tomography device for in-vivo dose delivery verification for proton/heavy ion therapy

Spokesperson: **Fine Fiedler** (Helmholtz Zentrum Dresden Rossendorf)

Institutes: Helmholtz Zentrum Dresden Rossendorf

TU Dresden

Oncoray Dresden

TU Delft

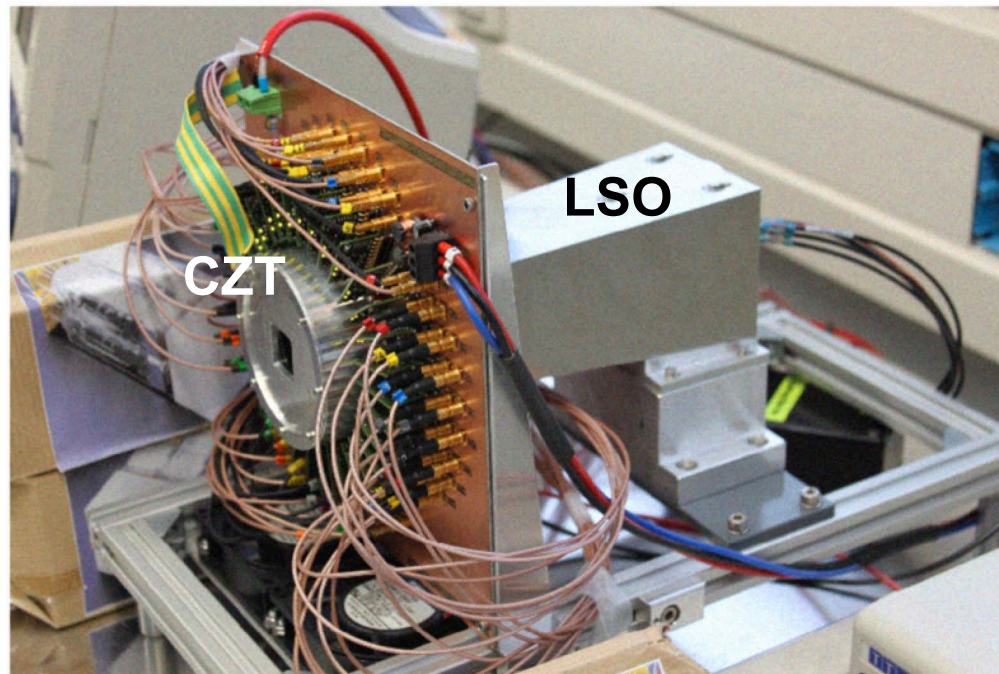
KVI

KVI beam line: irradiation facility

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T. Kormoll et al., 2011 IEEE Nucl Sci Symp Conf Rec MIC15.S-278



F18

Dynamics of three- and four-nucleon systems studied in the elastic scattering and breakup reactions

extension of the data basis for investigations of various aspects of three- and four-nucleon system dynamics: differential cross sections for elastic scattering and breakup: $d+p \rightarrow d+p$, $d+p \rightarrow p+p+n$, $d+d \rightarrow d+d$, $d+d \rightarrow d+p+n$

Spokespersons: **Stanislaw Kistryn** (Jagiellonian University, Kraków)
Elzbieta Stephan (University of Silesia, Katowice)

Institutes: Jagiellonian University, Kraków
University of Silesia
Institute of Nuclear Physics PAN, Kraków
KVI

KVI beam line: BINA (Big Instrument for Nuclear polarisation Analysis)
 LH_2 and LD_2 targets

ENSAR-supported experiments



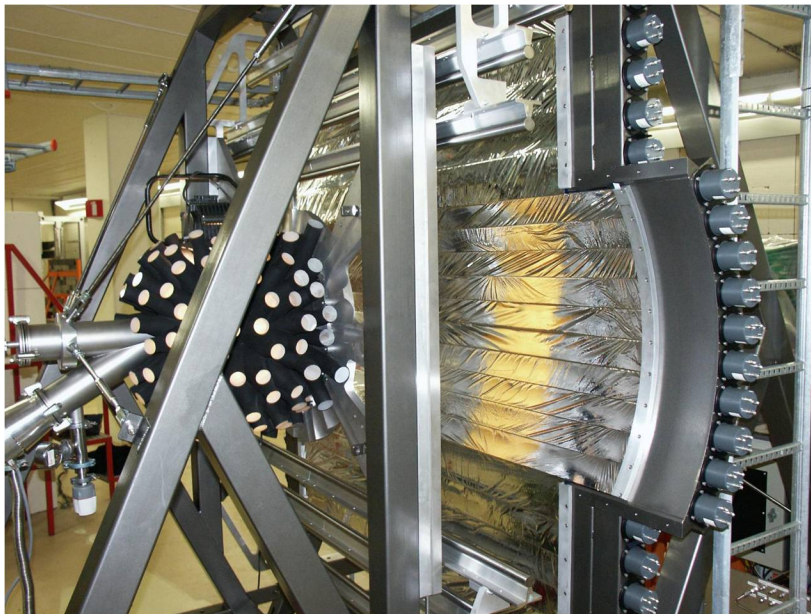
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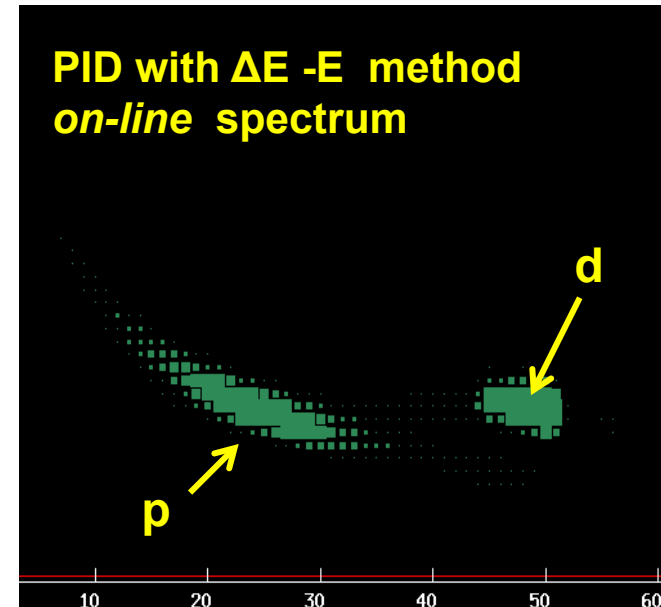
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<http://zfj.if.uj.edu.pl/FewBodyExp/wp-content/uploads/2012/01/wall-and-ball.jpg>



N. Kalantar-Nayestanaki, priv. comm.

ENSAR-supported experiments



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P20

β -delayed α -decay study of ^{16}N using the implantation method

to extract information relevant for the determination of the reaction rate of the very important $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$ reaction, a key reaction in helium burning

Spokesperson: **Hans Fynbo** (University of Aarhus)

Institutes: University of Aarhus

Institute of the Structure of Matter, Madrid

Chalmers University of Technology, Gothenburg

KU Leuven

TRIUMF

KVI

KVI beam line: TRl μ P separator

ENSAR-supported experiments



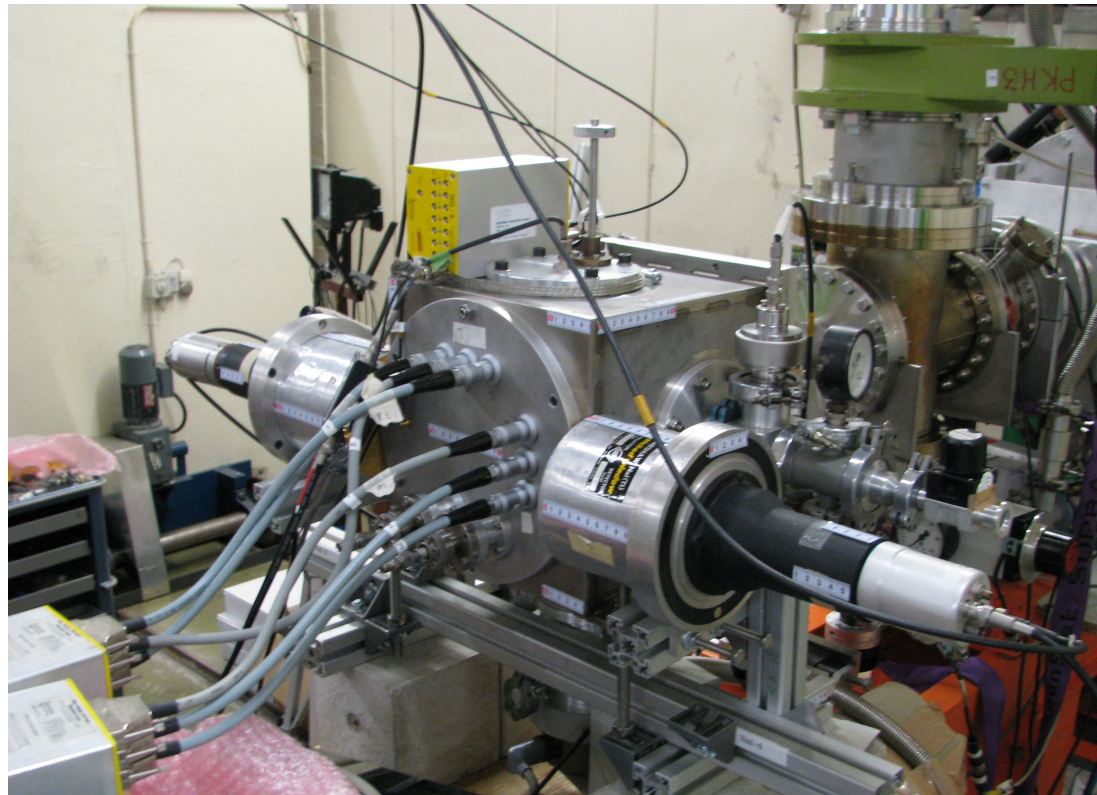
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H. Fynbo, priv. comm.

S58

Study of electric dipole strength below the particle threshold in $(p,p'\gamma)$ experiments

medium energy proton scattering (isovector probe) to give a deeper insight into the structure of the Pygmy Dipole Resonance and to help interpret the splitting of this resonance

Spokesperson: Andreas Zilges (University of Cologne)
Deniz Savran (TU Darmstadt)

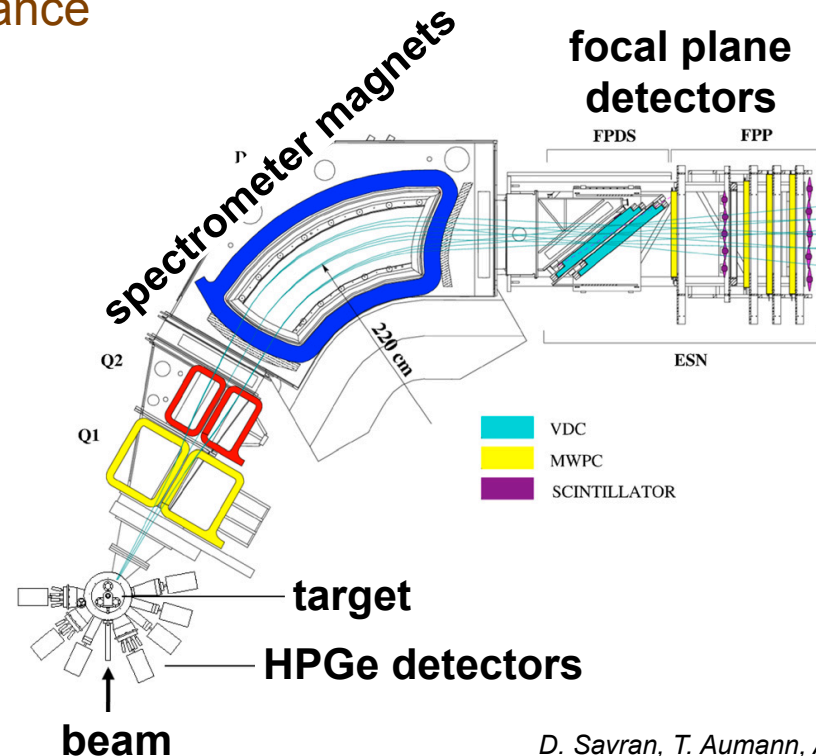
Institutes: University of Cologne
TU Darmstadt
GSI
Jožef Stefan Institute Ljubljana

KVI beam line: Big-Bite Spectrometer
substantial technical support from KVI

S58

Study of electric dipole strength below the particle threshold in $(p,p'\gamma)$ experiments

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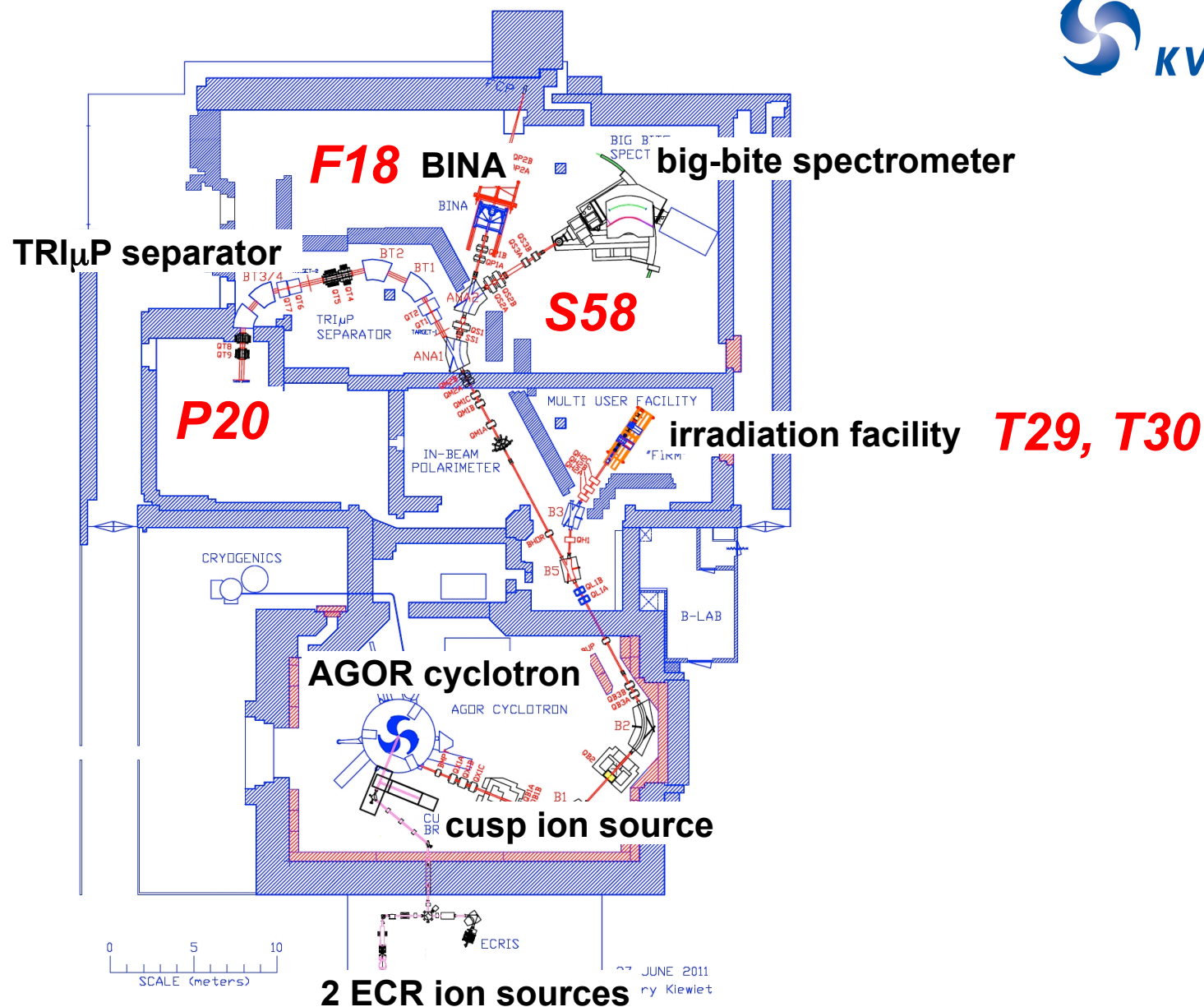
Big-Bite Spectrometer detects the scattered protons in coincidence with the gamma rays

D. Savran, T. Aumann, A. Zilges, Prog Part Nucl Phys 70 (2013) 210

Location TNA experiments



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beam time distribution (in 8-hour shifts)

experiment	2011	2012	2013*	total
T29	5	2		7
T30	4	4	12	20
F18	22			22
P20		7	13	20
S58		31		31
total	31	44	25	100

**planned*

ENSAR TNA RuG/KVI summary



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- 5 experiments supported
- all KVI beam lines used
- wide variety of research topics:
 - nuclear structure
 - hadron physics
 - nuclear astrophysics
 - proton radiotherapy



status mid-2013:

- support beam hours is exhausted
- support travel and subsistence not exhausted