Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin
Nationales Metrologieinstitut

Neutron and Ion Beams at the PTB Ion Accelerator Facility PIAF

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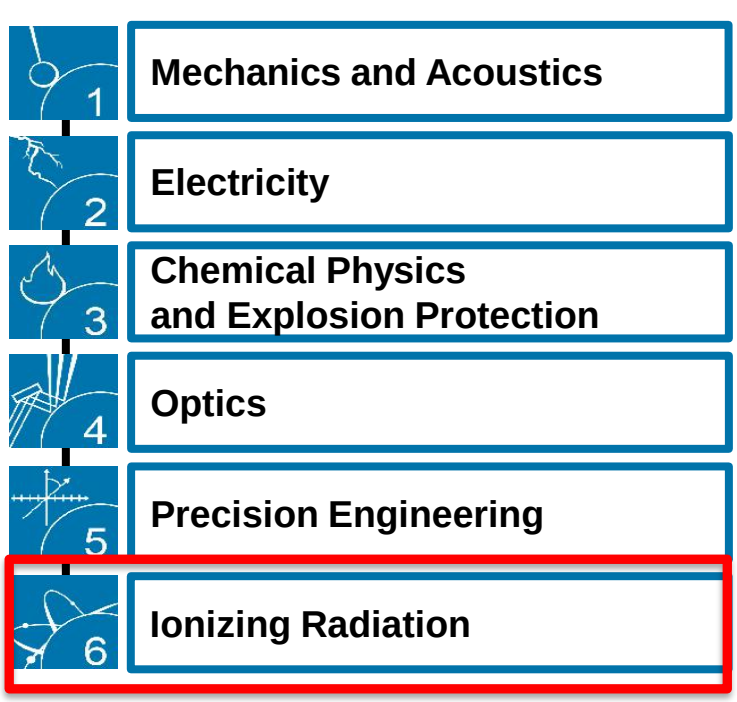
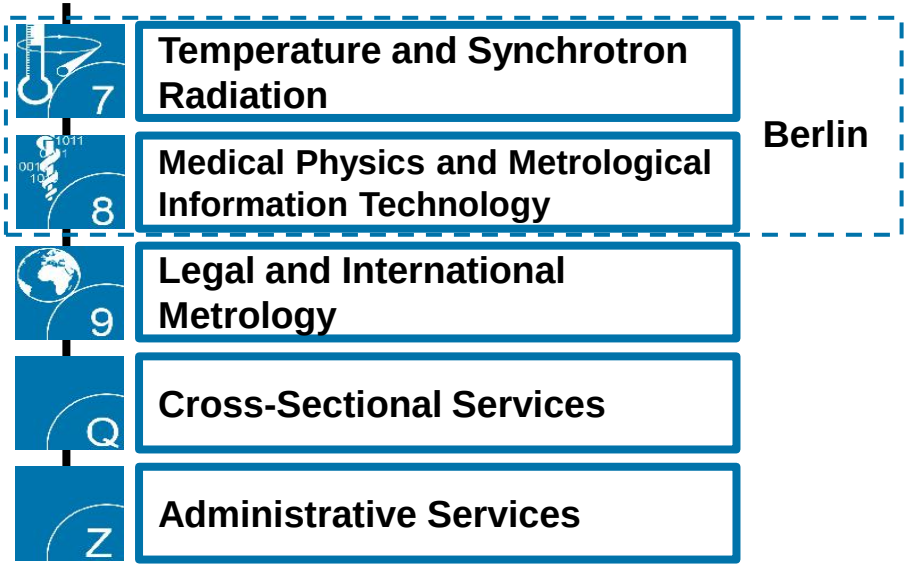
PTB: The National Metrology Institute of Germany

- Founded 1887
- Federal Authority at the BMWi (Ministry of Economy)
- About 2000 staff members in Braunschweig and Berlin
- Mission: Correct, quality-assured measurements for economy, societ and science

  Traceability to the SI via national standards





Neutron Radiation Department of PTB

Our objectives:

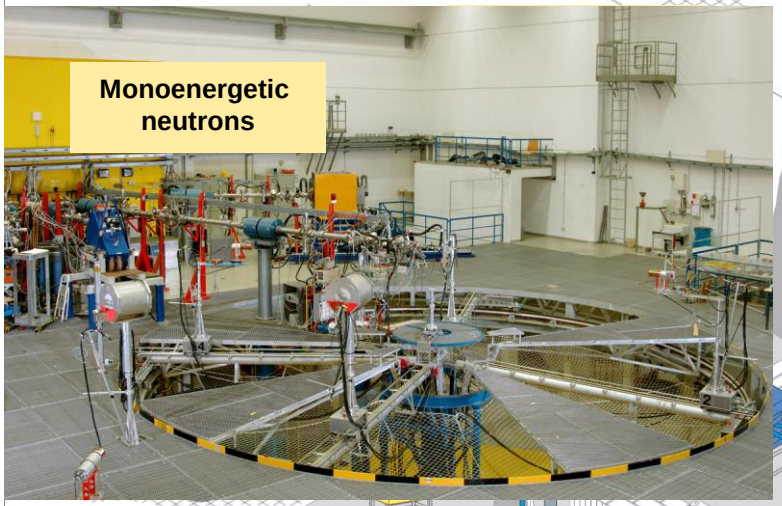
- Neutron Physics: Metrology, spectrometry and dosimetry of neutron radiation, nuclear data
- Characterization and calibration of neutron detectors
- Measurements in nuclear industry, at medical centres, in environment
- Support of fundamental research, science and industry

For traceable measurements of neutron radiation, we provide

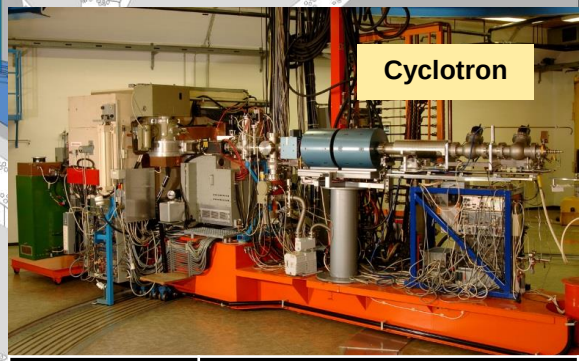
- Neutron reference fields (mono-energetic, sources, thermal)
- Neutron detectors
- Methods of data analysis

⇒ Main contribution to ChETEC: TA

PTB Ion Accelerator Facility (PIAF)

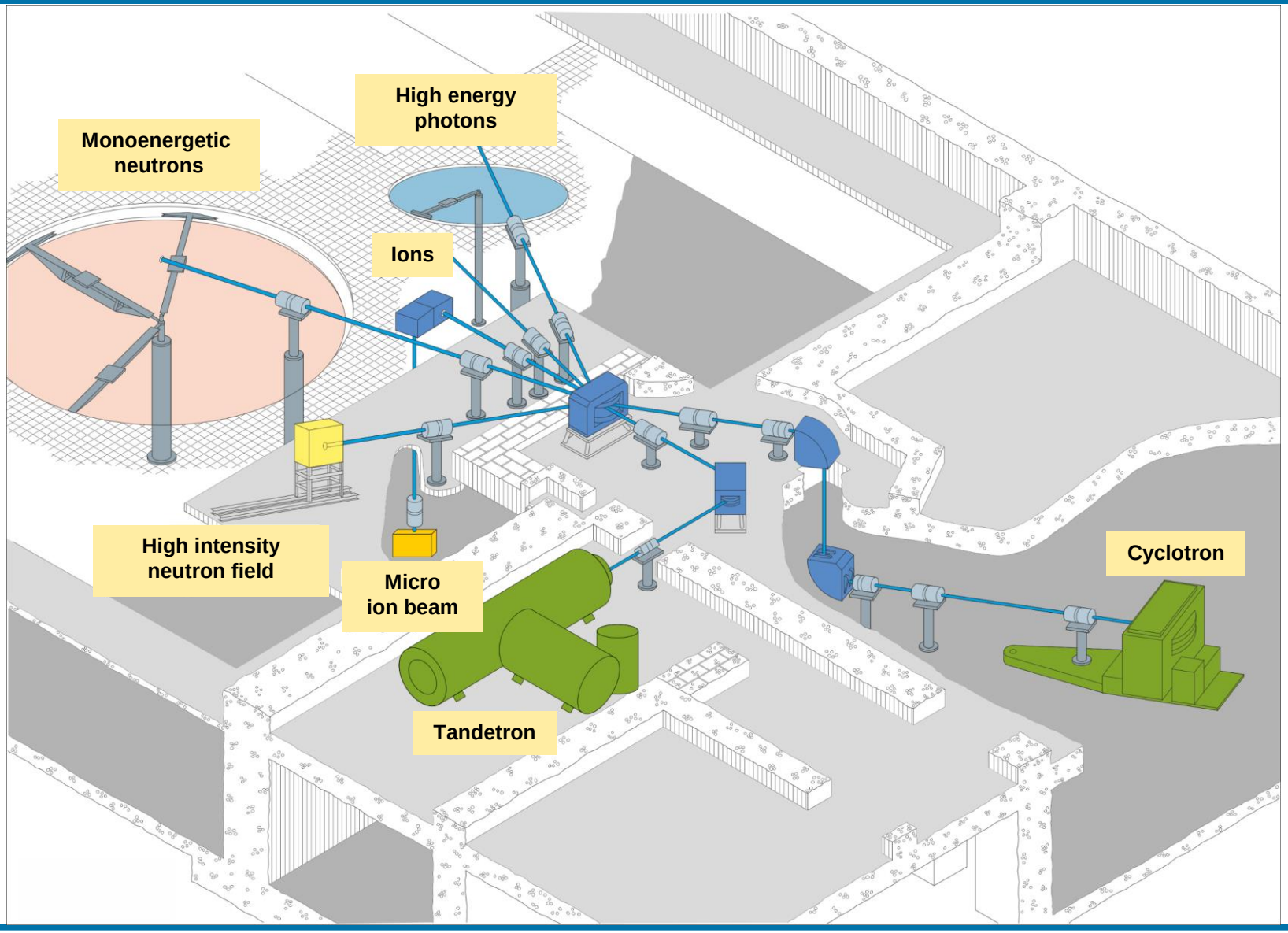


Ions	Energy range
p	0.2 MeV – 4 MeV
d	0.2 MeV – 4 MeV
^{4}He	0.4 MeV – 6 MeV

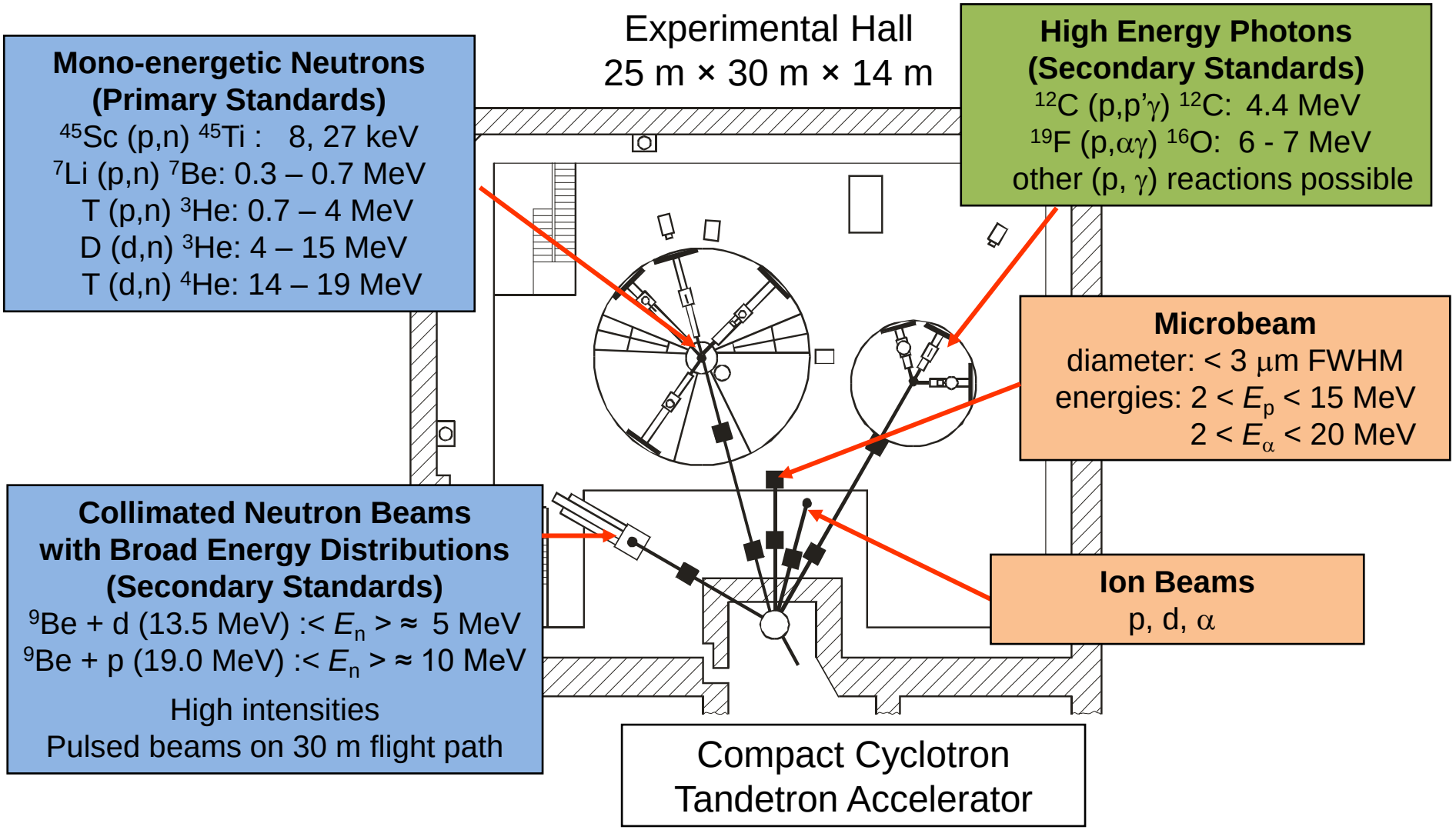


Ions	Energy range
p	4 MeV – 19 MeV
d	4 MeV – 13.5 MeV
^{4}He	8 MeV – 26 MeV

PTB Ion Accelerator Facility (PIAF)



Neutron, Photon and Ion Beams at PIAF



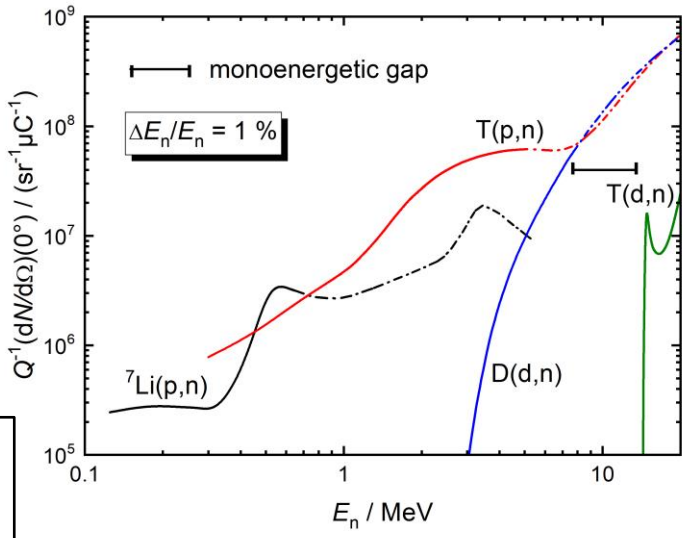
Monoenergetic Neutron Fields

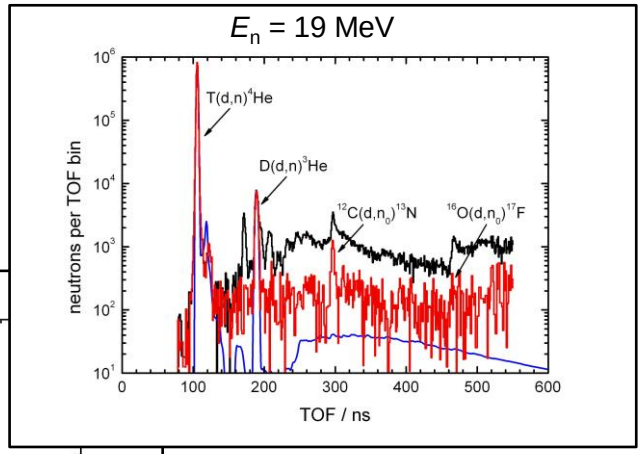
$E_n(0°)$ = 140 keV – 8 MeV, 14 MeV – 19 MeV

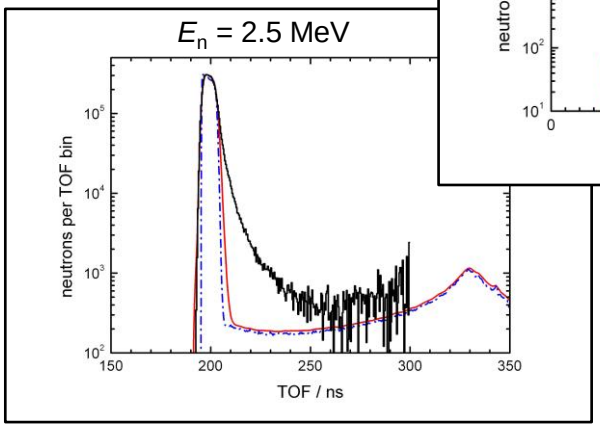
'Open' geometry: $(dN/d\Omega)(\Theta_n)$, $E_n(\Theta_n)$

Neutron energy distribution:

- FWHM of the mon. peak: 2-10 %
- Direct + scattered neutrons: 2-6 %
- Parasitic neutrons above 14.8 MeV: blank targets!







Neutron yield depends on:

- Target thickness
- Heat load: T(Ti) targets!
- Target stability: Li targets

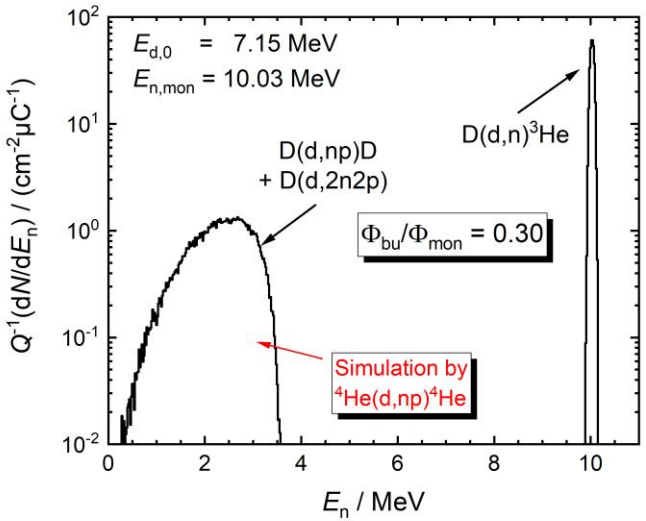
Quasi-Monoenergetic and 'White' Neutrons

QMN neutrons from D+d using cyclotron beams:

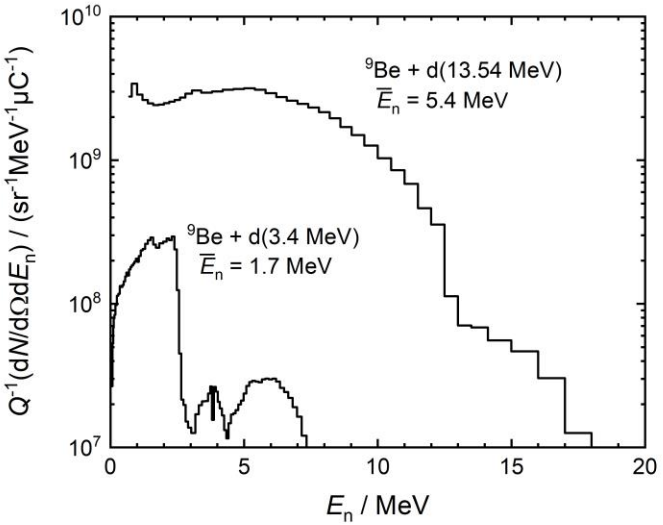
$D(d,n)^3He$ + D(d,np)D + D(d,2n2p) for E_d > 4.45 MeV

Simulation of deuteron breakup by $^4He(d,np)^4He$:

⇒ virtually mon. neutrons by subtraction in the gap region (8 – 14 MeV)!

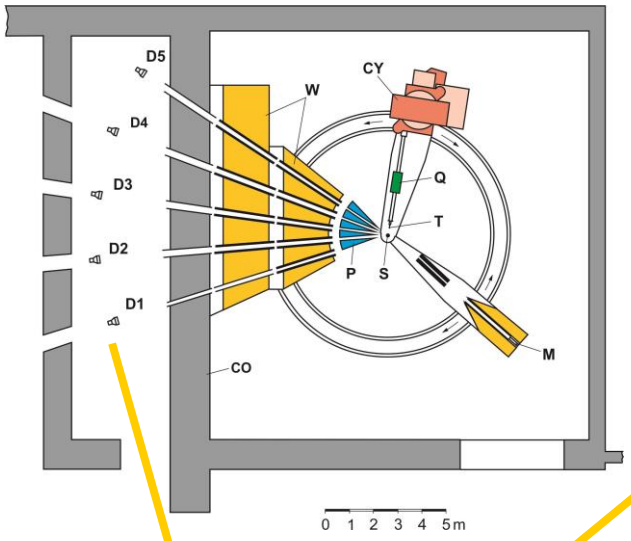


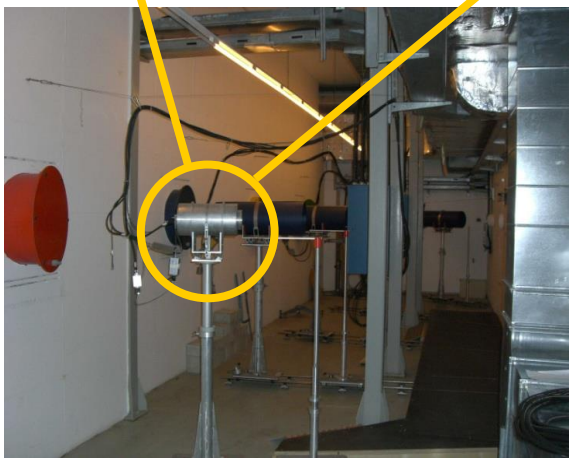
Collimated high-intensity 'white' beams:



Be+d beams: $\varphi < 10^8$ cm^{-2}s^{-1} at 80 cm

‘White’ Neutron Beams for Detector Studies





(Quasi-)monoenergetic and ‘white’ neutron sources at the TOF spectrometer:

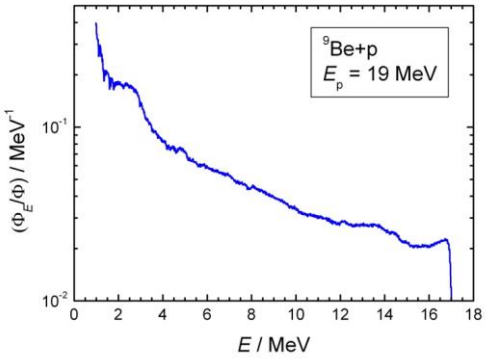
D(d,n), ^{15}N(p,n), ...

^{9}Be + p(19 MeV), ^{9}Be + d(13 MeV

Energy selection via TOF

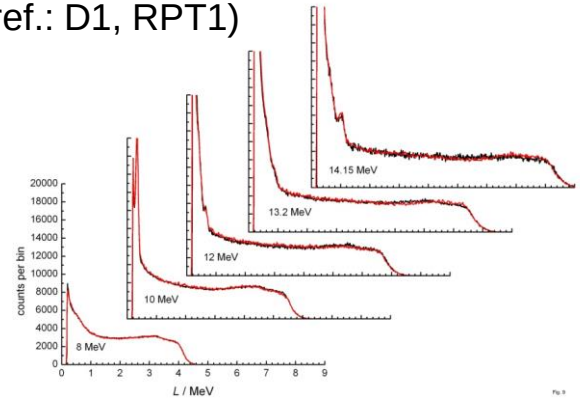
Flight paths: 11 m - 30 m

Ref: D1, RPT1



Detector development:

- Light yield (Quenching)
- Efficiency (ref.: D1, RPT1)
- …



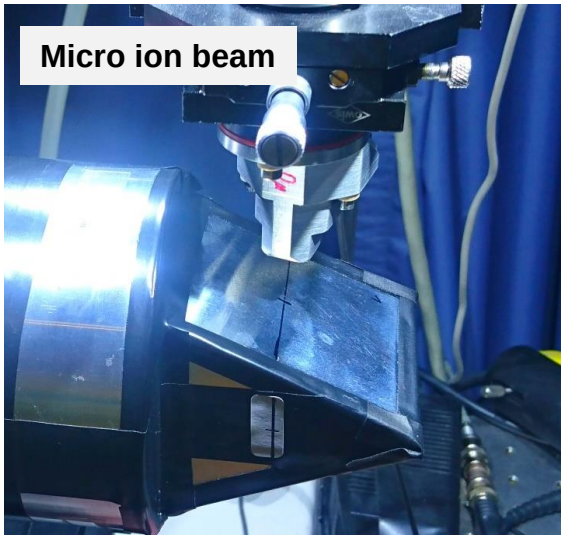
Light Ion Beams

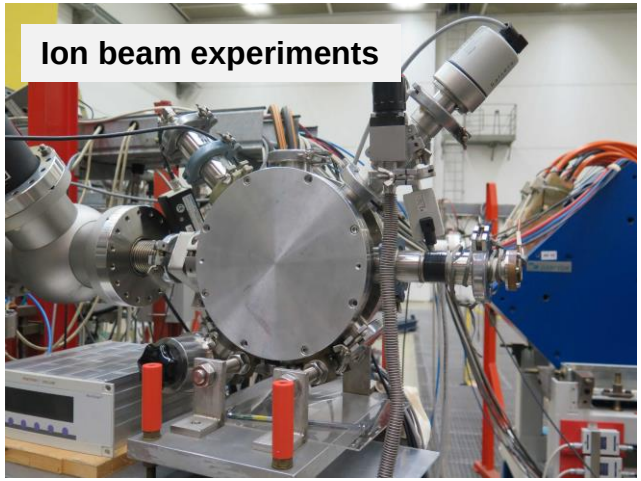
Focused beams for cross section measurements

- Activation cross section
- DX data for neutron sources
- Target production: $E_p < 19$ MeV, $E_\alpha < 26$ MeV!

Micro-ion beam for detector studies

Detectors: HPGe, BC501, ^{7}LiGlas, CLYC, $CeBr_3$, …





Info: www.ptb.de/cms/en/ptb/fachabteilungen/abt6/fb-64.html

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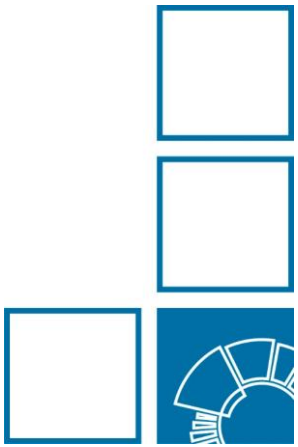

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