

Detectors for Nuclear Astrophysics



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Safety

- Radioactive sources
 - ^{244}Cm – alpha emitter (~6 MeV)
- High voltage
 - velocity filters run at up to +/-300kV
- Potential x-rays
 - high voltage sparks can generate x-rays
- Compressed gas
 - suffocation hazard, projectiles

**take-home message:
pay attention and do what we tell you!**

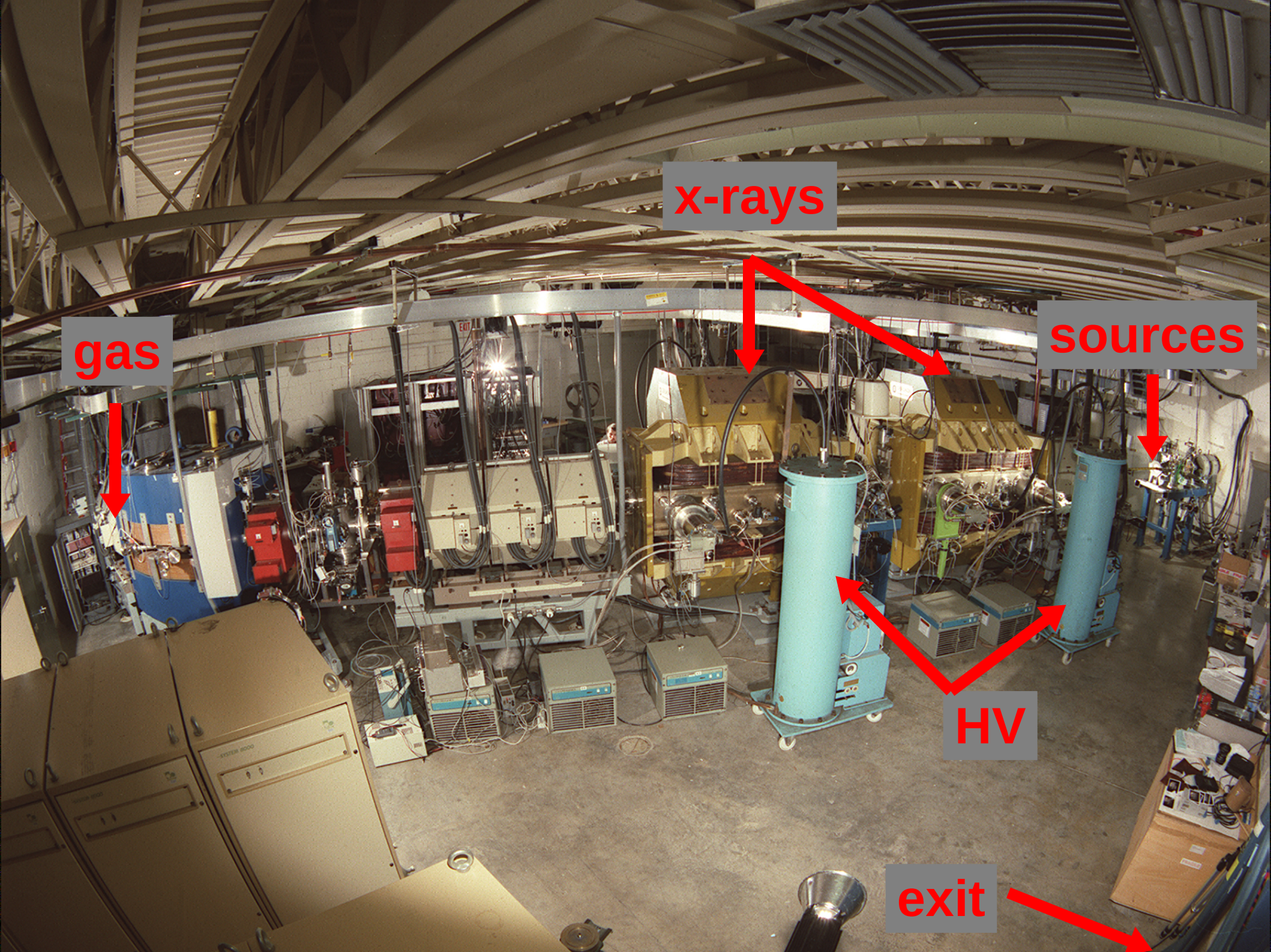
gas

x-rays

sources

HV

exit



Overview

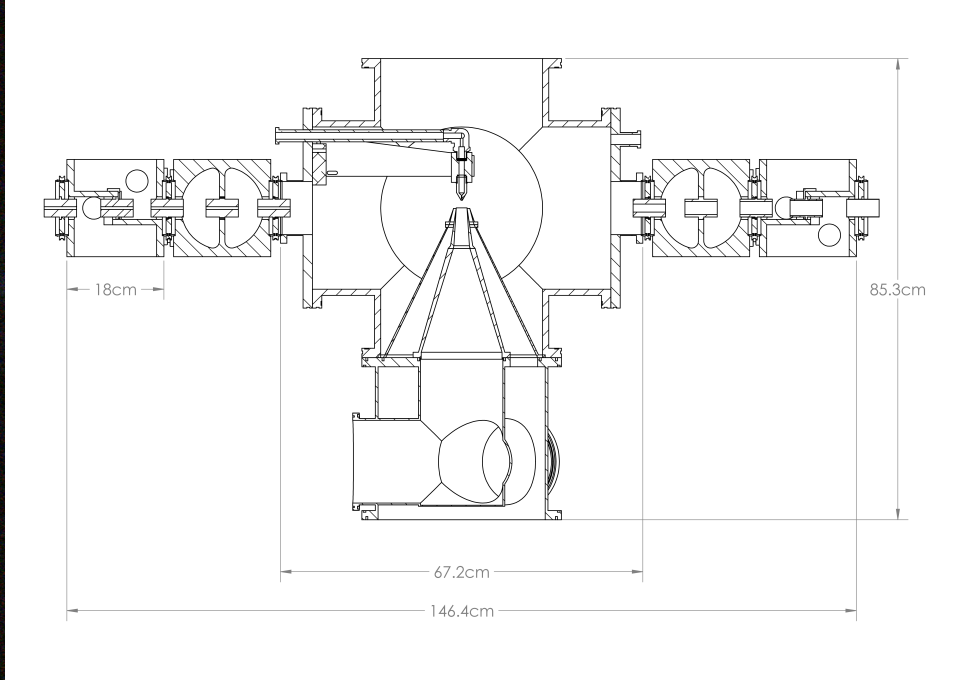
What is nuclear astrophysics?

- we study the reactions that power the stars and stellar explosions (novae, supernovae, x-ray bursts, etc)
- we do this in the lab, using radioactive beams and light (H or He) targets
- we can study these reactions either indirectly (study the properties of the nuclei involved) or directly (measure the exact reaction)
- all of this requires some specialized equipment

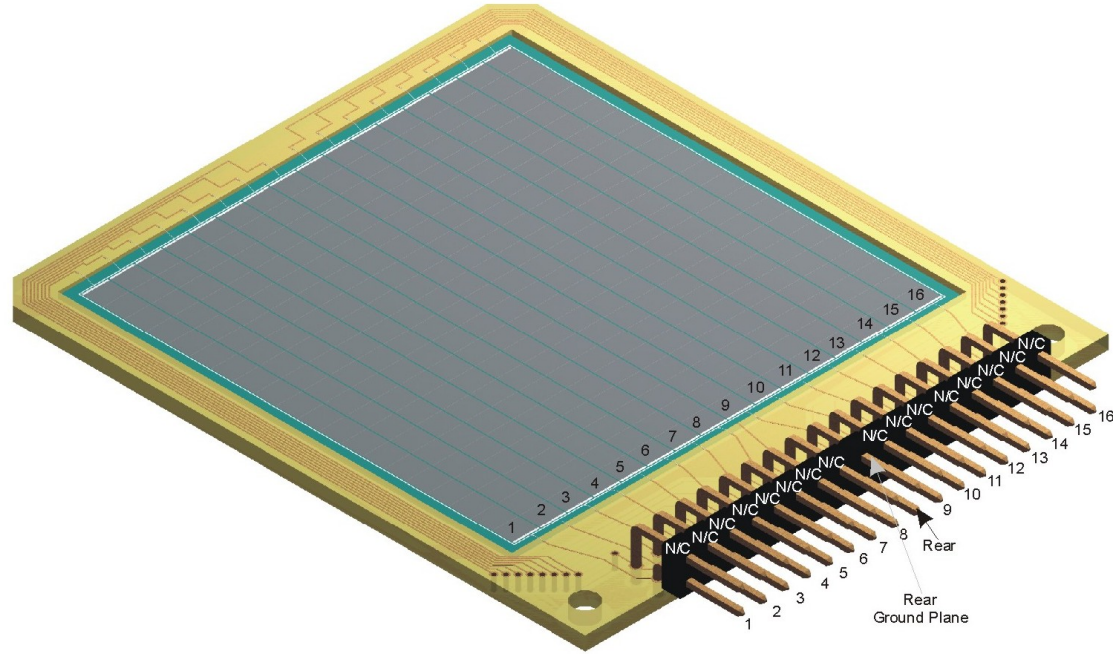
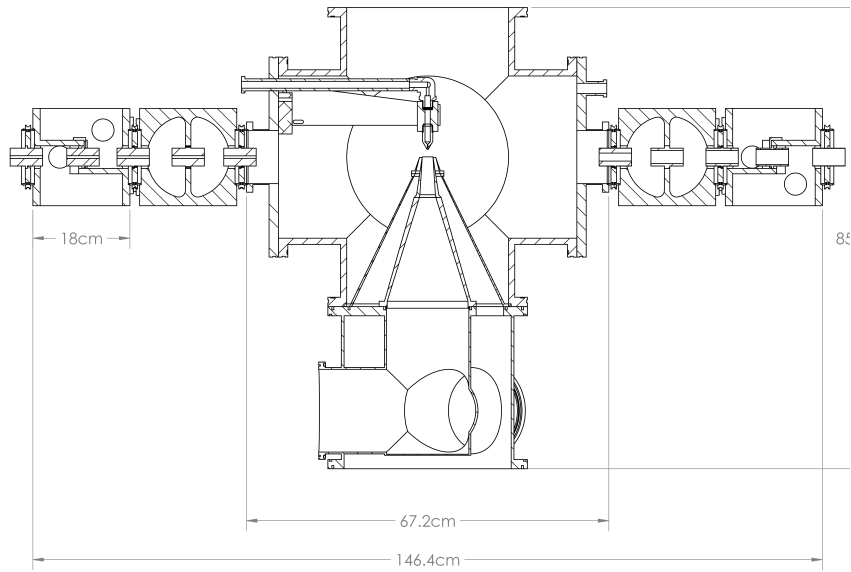
Equipment

- gas targets
- charged-particle detectors
- gamma-ray detectors
- recoil separators

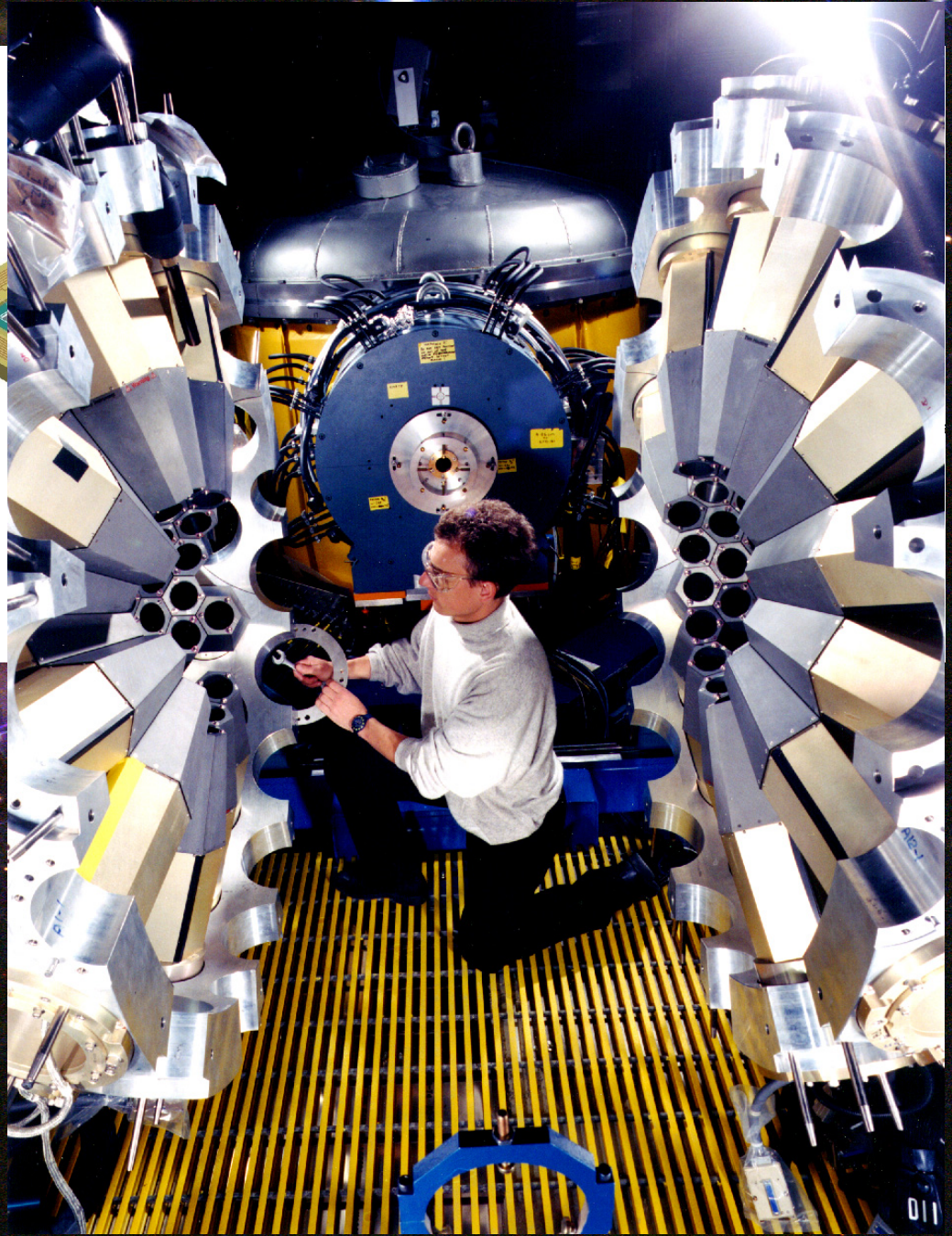
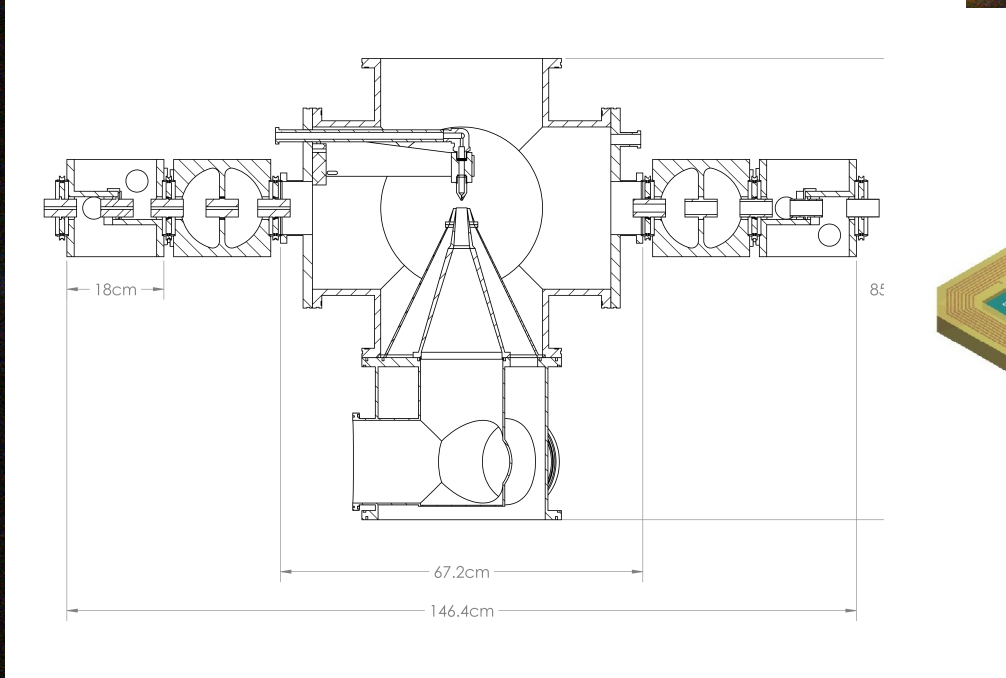
Equipment



Equipment



Equipment

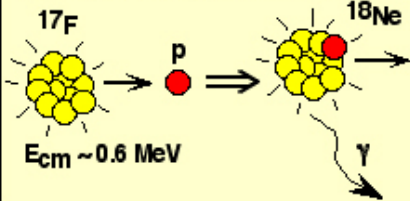


Equipment

HRIBF Daresbury Recoil Separator

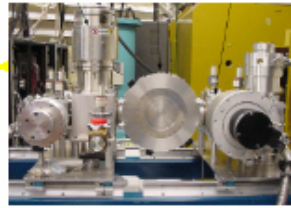
- Utilization: measurement of capture reactions such as ${}^7\text{Be}(p,\gamma){}^8\text{B}$ and ${}^{17}\text{F}(p,\gamma){}^{18}\text{Ne}$
- Status: commissioning with stable beams in progress

Resonant Proton Capture in Inverse Kinematics



- only 1 in 10^{12} fuse with protons; all other beam particles pass through target
- all fusion reaction products and unreacted beam particles enter separator located along beam axis
- recoil separator deflects beam particles away, steers recoils to detector

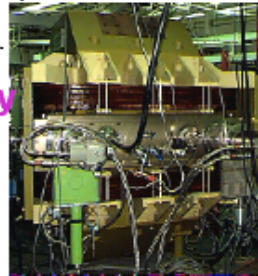
HRIBF
Radioactive
Beam



Gas Target System

Target
Quads

Velocity
Filter



Velocity
Filter

Quads

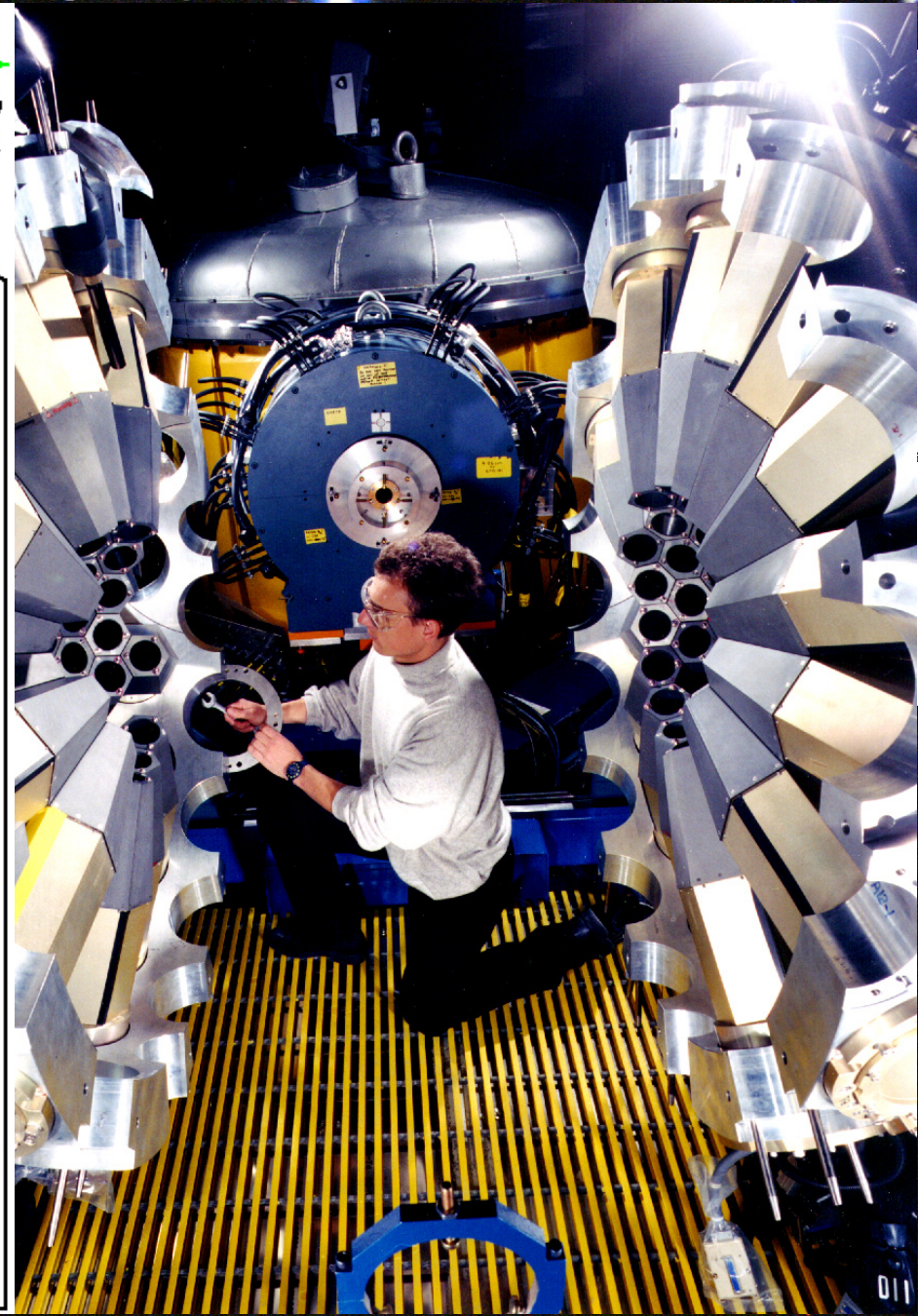
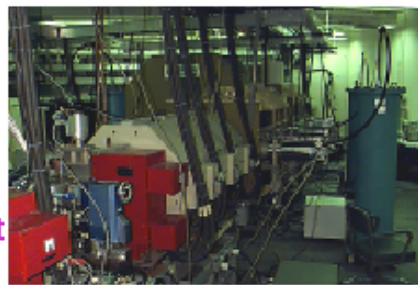
Slit Box



NEW
Focal Plane
Assembly

Dipole
Magnet

Quads



Activities

- In-person introduction to and discussion of our experimental systems (aka tour)
- Start up the Daresbury Recoil Separator (DRS)
- Tune alpha particles through the DRS
 - examine signals in position-sensitive silicon detector
 - examine different alphas from source
 - degrade alpha energy and see how tune changes