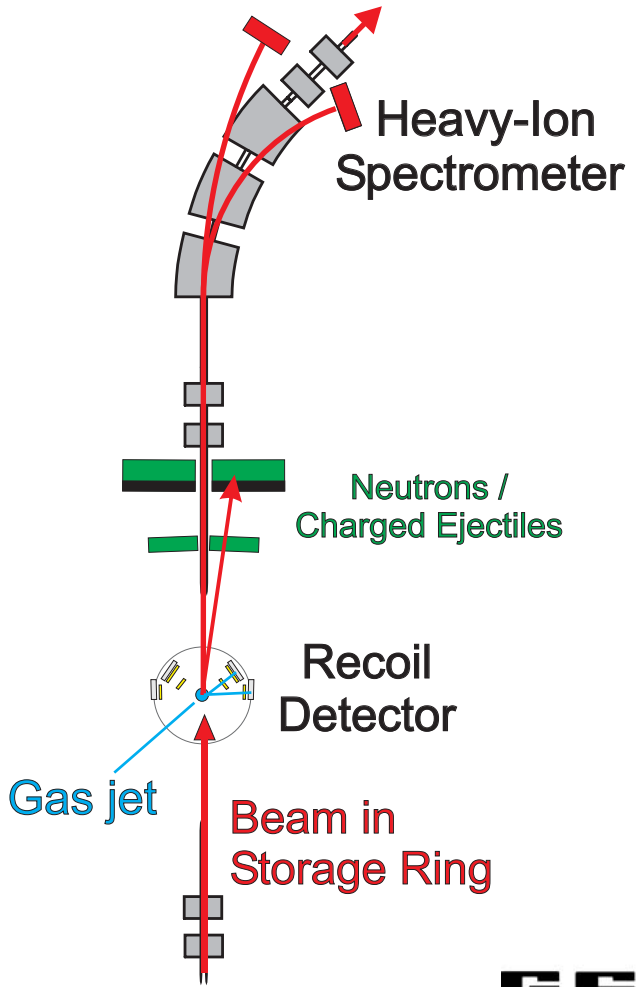
Excitation energy of the projectile residue

Invariant Mass for projectile fragment and ejectiles : resolution limit due to recoil

$$\Delta p/p \cong 10^{-3}$$

measured quantities for protons and neutrons:

- o identification
- o position
- o ToF



Protons from Projectile

Protons: emitted isotropically with E_P above Coulombbarrier

example: E_P= 5 MeV emitted transversal

E_{beam} = 740 MeV Θ_{max} = 70 mrad

E_{beam} = 500 MeV Θ_{max}= 90 mrad

⇨ proton acceptance of about 100 mrad

(detector size from 1 to 4 m^2)

resolution requirements from $\Delta p/p \cong 10^{-3}$

with distance s=10 m $\Delta x, \Delta y\ \Delta z \cong$ 1 cm

to the target $\Delta t \cong$ 40-50 ps

$\Delta\Theta \cong 1$ mrad

Proton Detectors

- drift chambers ⇨ x, y

  hexagonal drift cells (Proposal St. Petersburg Group)

  accuracy due to drift time measurement

  $\Delta x, \Delta y \cong 0.2\text{-}0.3$ mm (16 mm wire distance)

  efficiency ~ 100 % ; cost ~ 40.000 $ (for R3B)

- scintillator array ⇨ Z, t

  fast scintillation material & ultrafast phototubes

  $\Delta t < 100$ ps

  (serves also as veto for the neutron detector)

Neutrons from Projectile

Neutrons: emitted isotropically with low $E_n \cong$ 1-2 MeV
due to statistical decay

⇨ neutron acceptance of about 50 mrad or more

⇨ multi neutron detection

capabilities of LAND:

$\Delta t \cong$ 500-600 ps

$\Delta x,y,z \cong$ 7-10 cm

$e_{1n} >$ 90%

$\Delta p/p \cong 10^{-2}$ $\Delta E^* \cong 1$ MeV

improvements:

fast scintillator, ultrafast PM's

scintillator of higher density

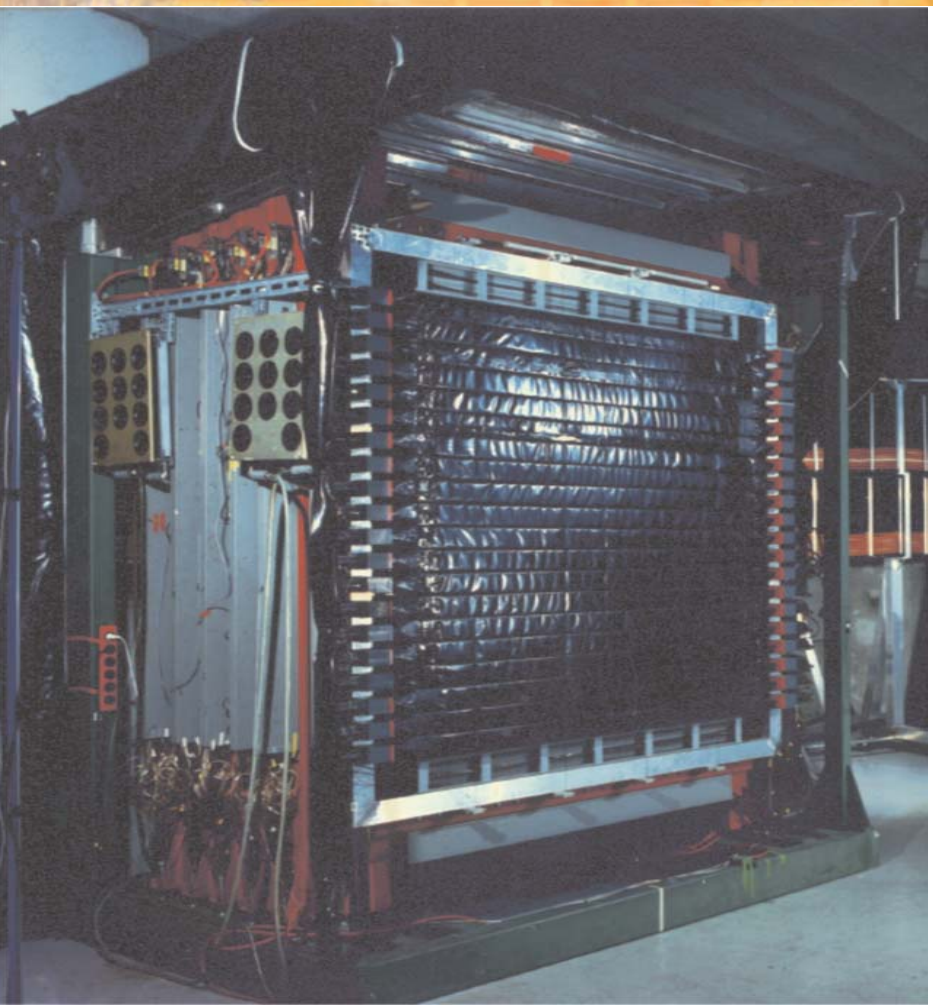
gain multi-n-recognition

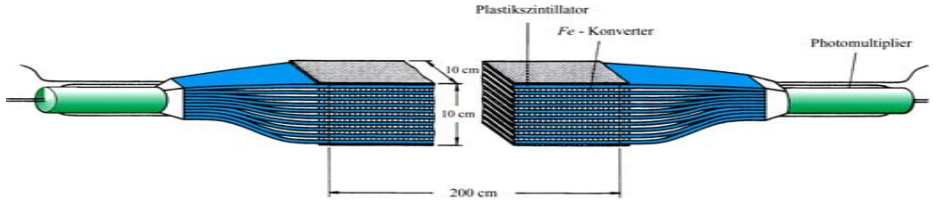
$\Delta p/p < 10^{-2}$ $\Delta E^* < 1$ MeV

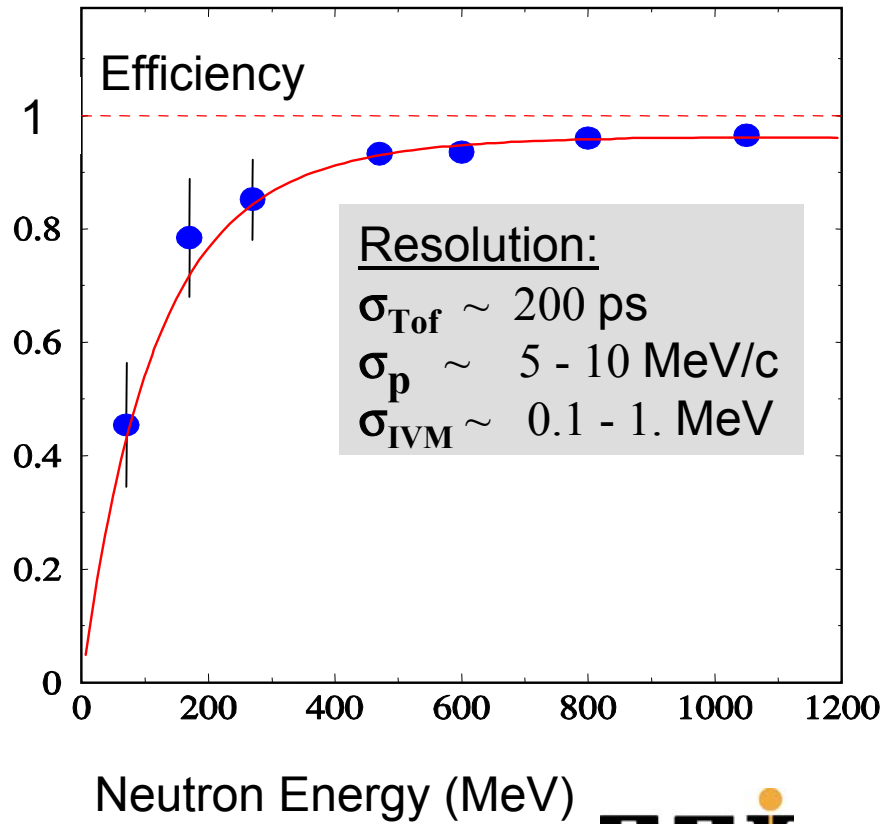
Neutron Detector Ideas

- Inorganic scintillator or organic scintillator plus converter
- Paddle Structure like LAND
- Tower Structure
- Frontplane with inorganic scintillator followed by LAND structure
- replace scintillator by multiwire chamber readout
- ...

LArge Neutron Detector LAND







Nucl. Instr. Meth. A314 (1992) 136