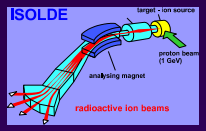
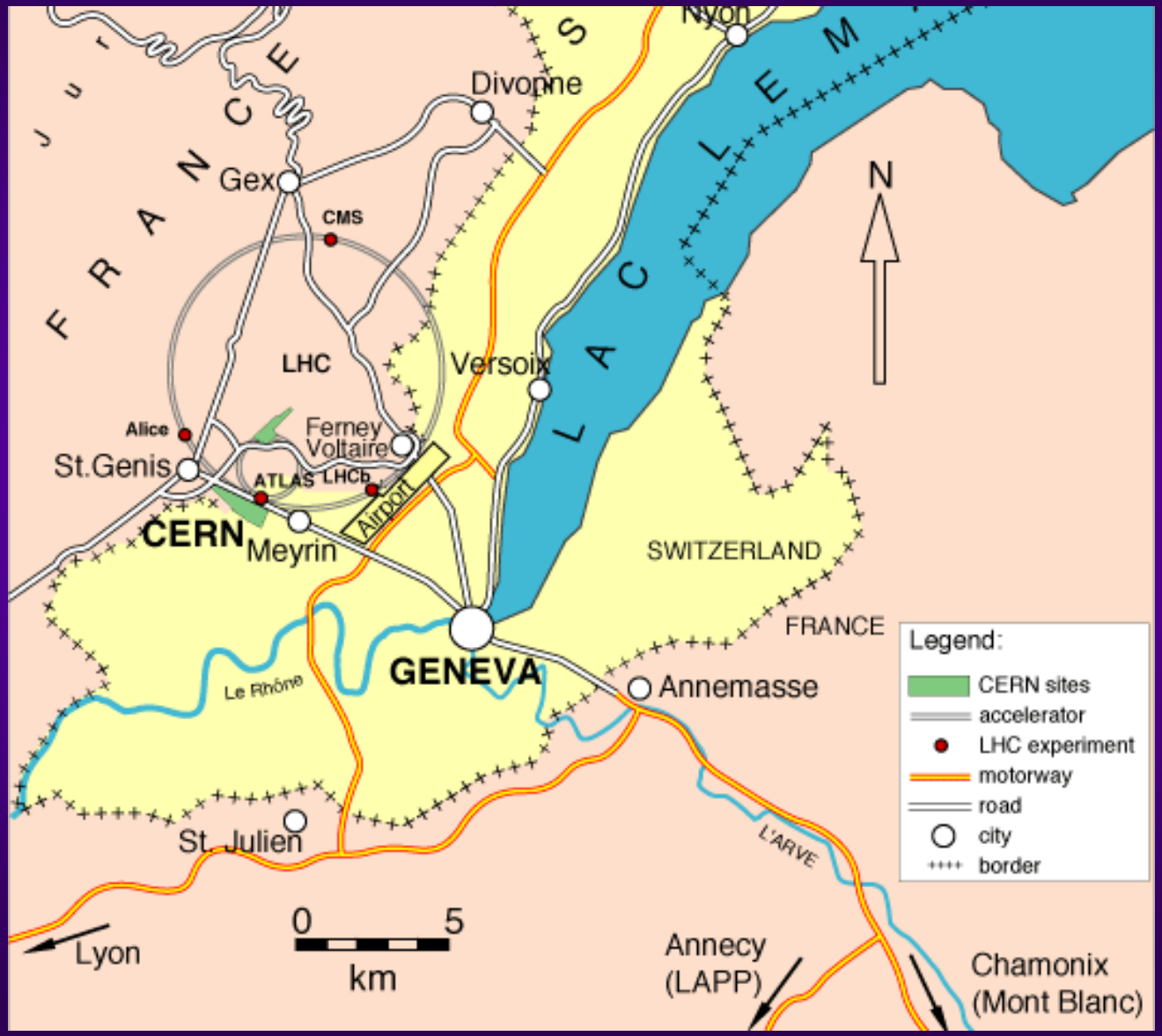
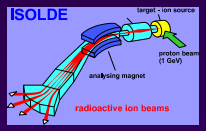


CERN Isolde and Rex Beam Instrumentation

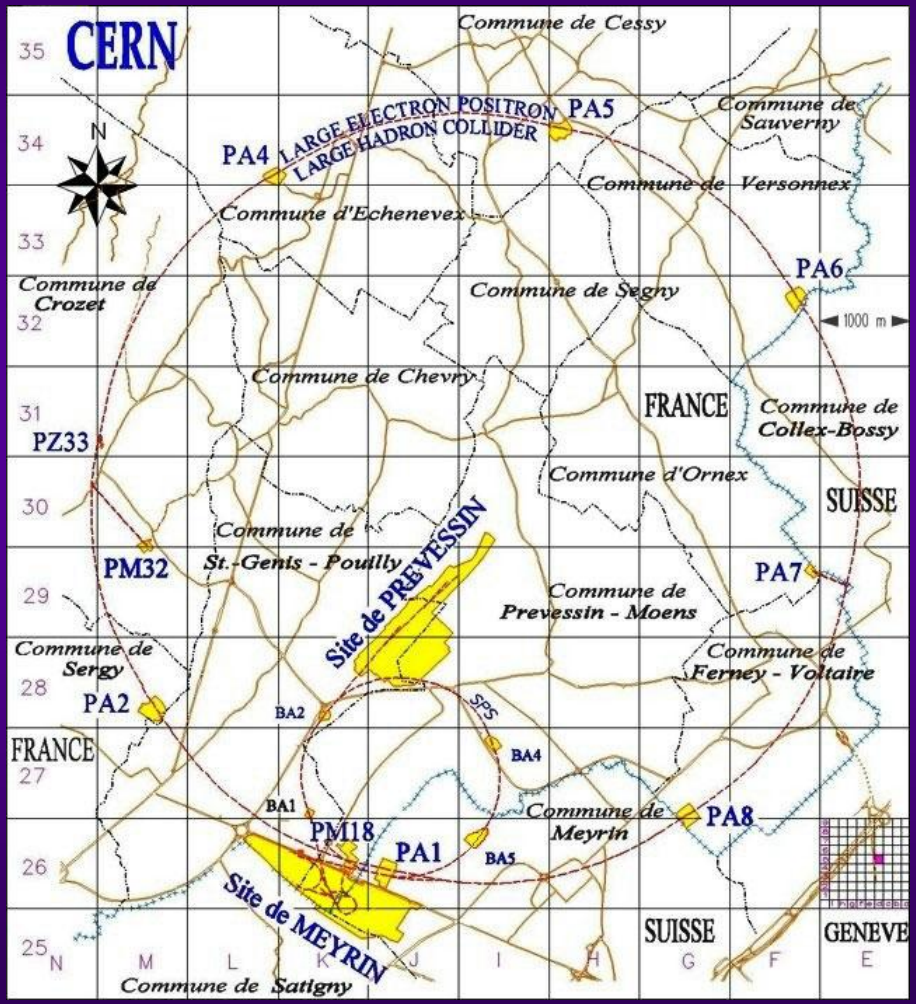
By Gerrit Jan Focker, CERN/BE/BI

Where is CERN



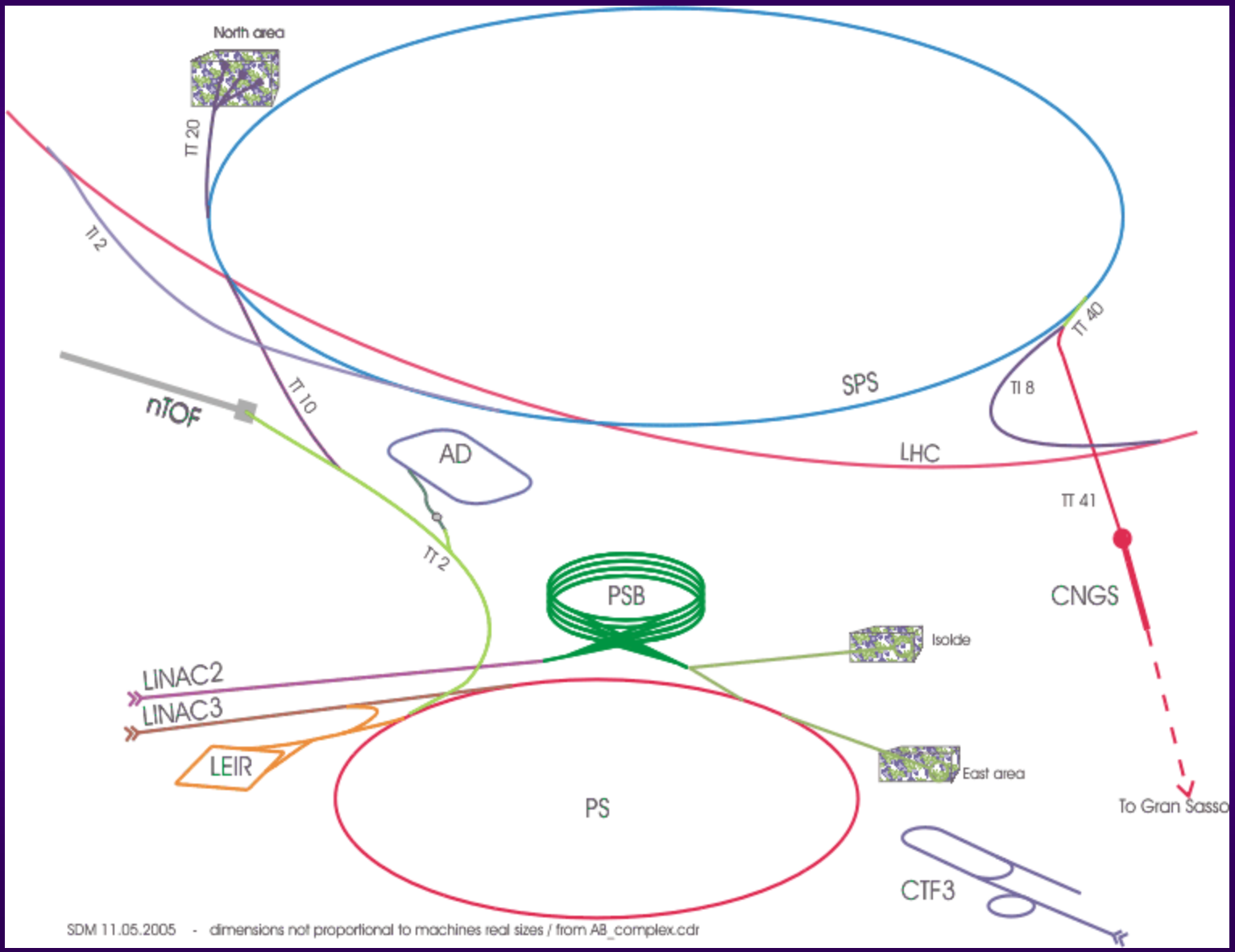


Where at CERN is Isolde

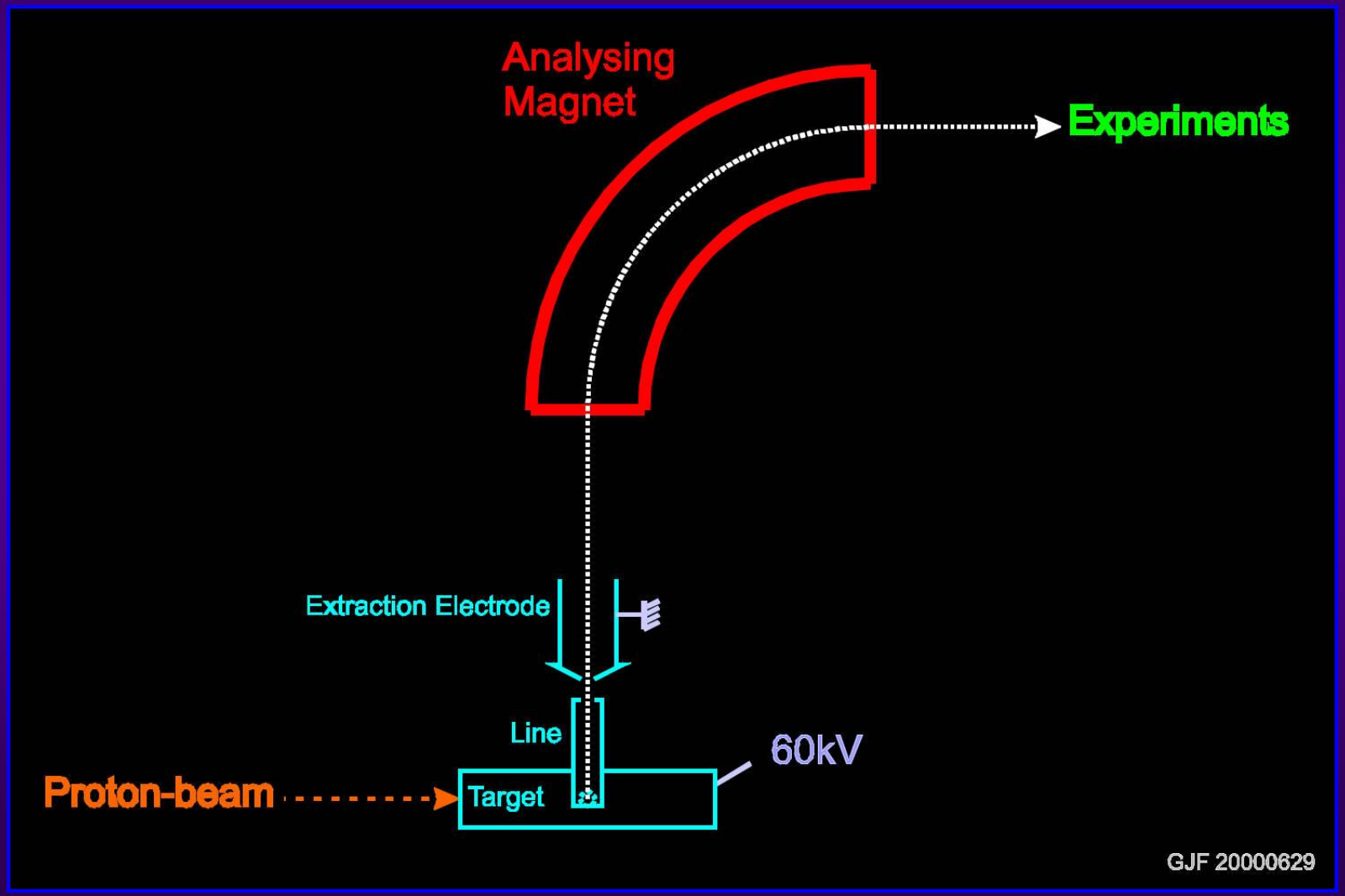


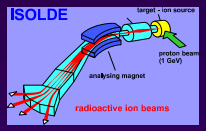
- Isolde gets its protons from the PS-"Booster" machine
- Proton Energy 1GeV or 1,4GeV
- Proton Current up to 2μA

Where at CERN is Isolde



Isolde Machine

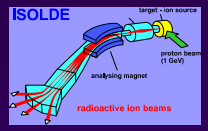


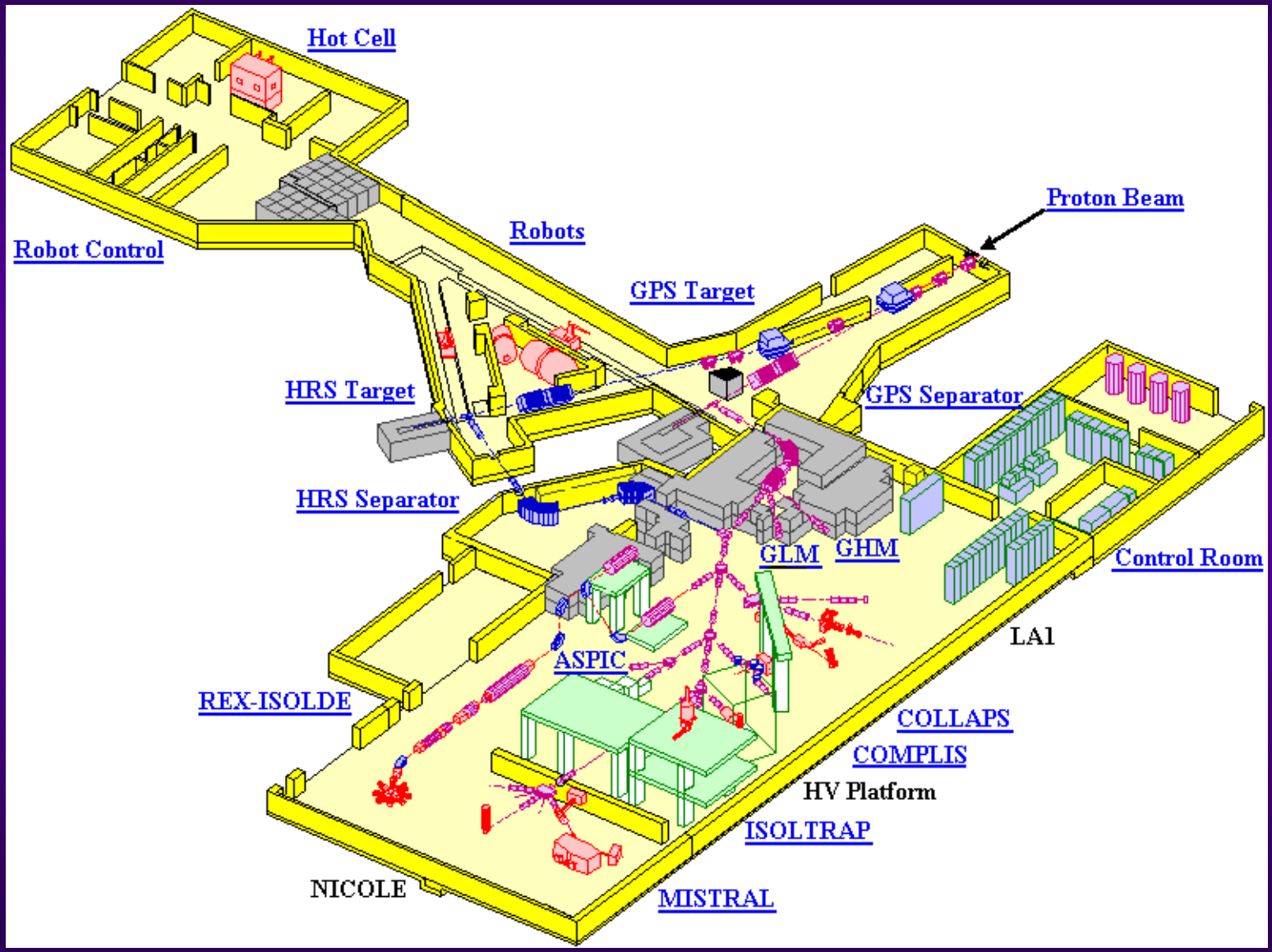


Isolde Machine

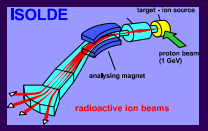
- Two Isolde machines:
  - GPS (General Purpose Separator)
    - One Analysing Magnet
  - HRS (High Resolution Separator)
    - Two Analysing Magnets
    - RFQ for beam cooling
- Target: many different versions
- Intensity: up to 10^{11} particles/second
- Ionisation: normally one electron taken off
- Acceleration Voltage: (up to) 60kV
- Focussing and deflection lenses are electrostatic (not mass-dependent)

Isolde Machine

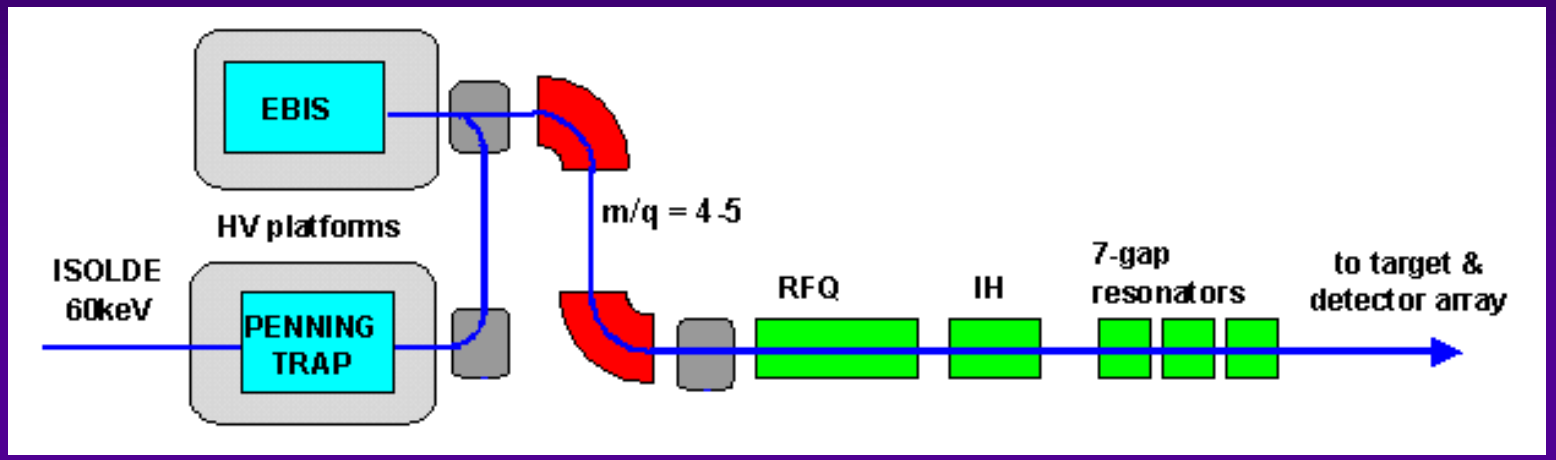




Picture taken from Isolde web-site

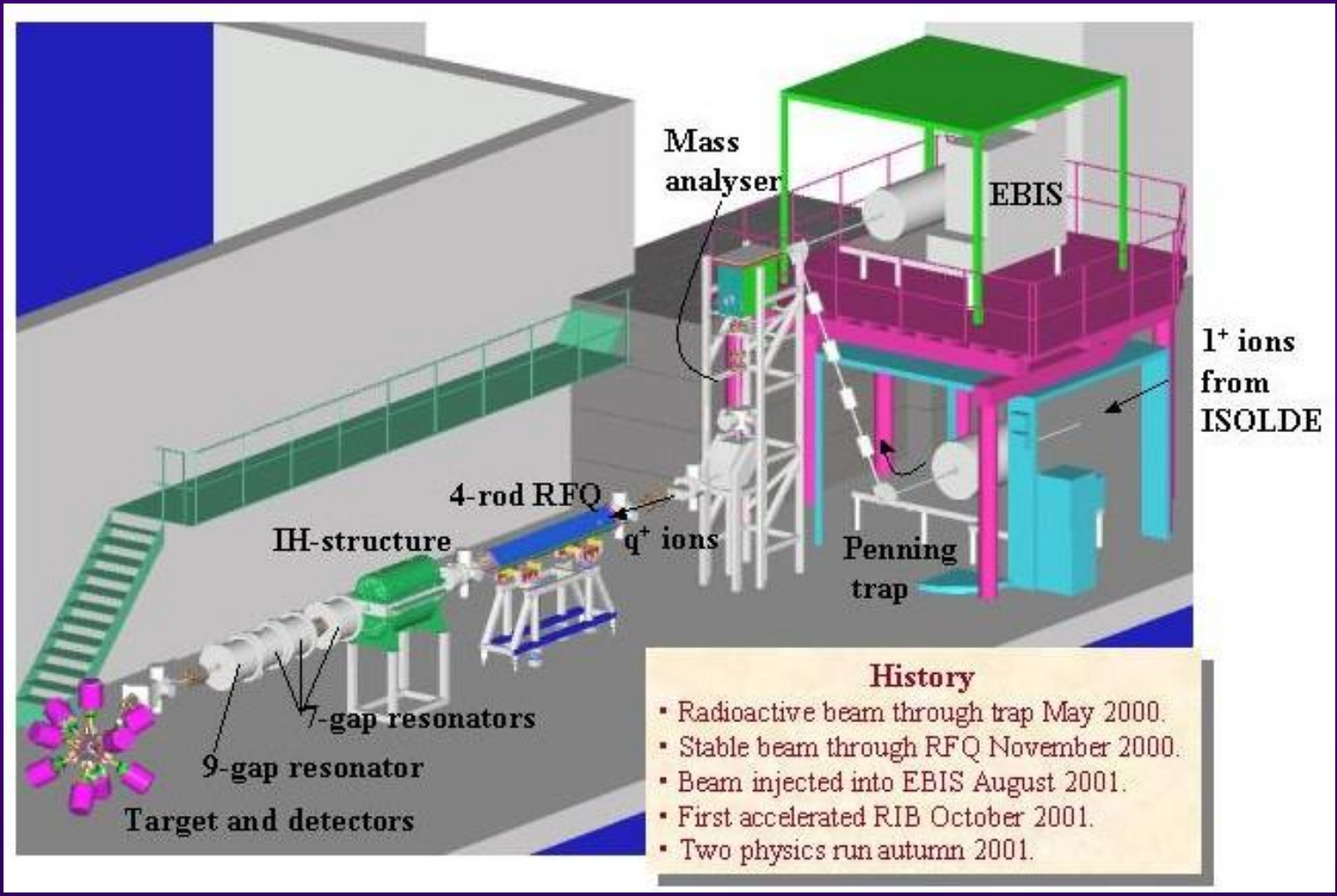


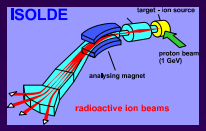
Rex Post-accelerator



- Isotopes are trapped,
- Transported to "EBIS" for charge-breeding
- Mass-separation
- Acceleration to 3MeV

Rex Post-accelerator



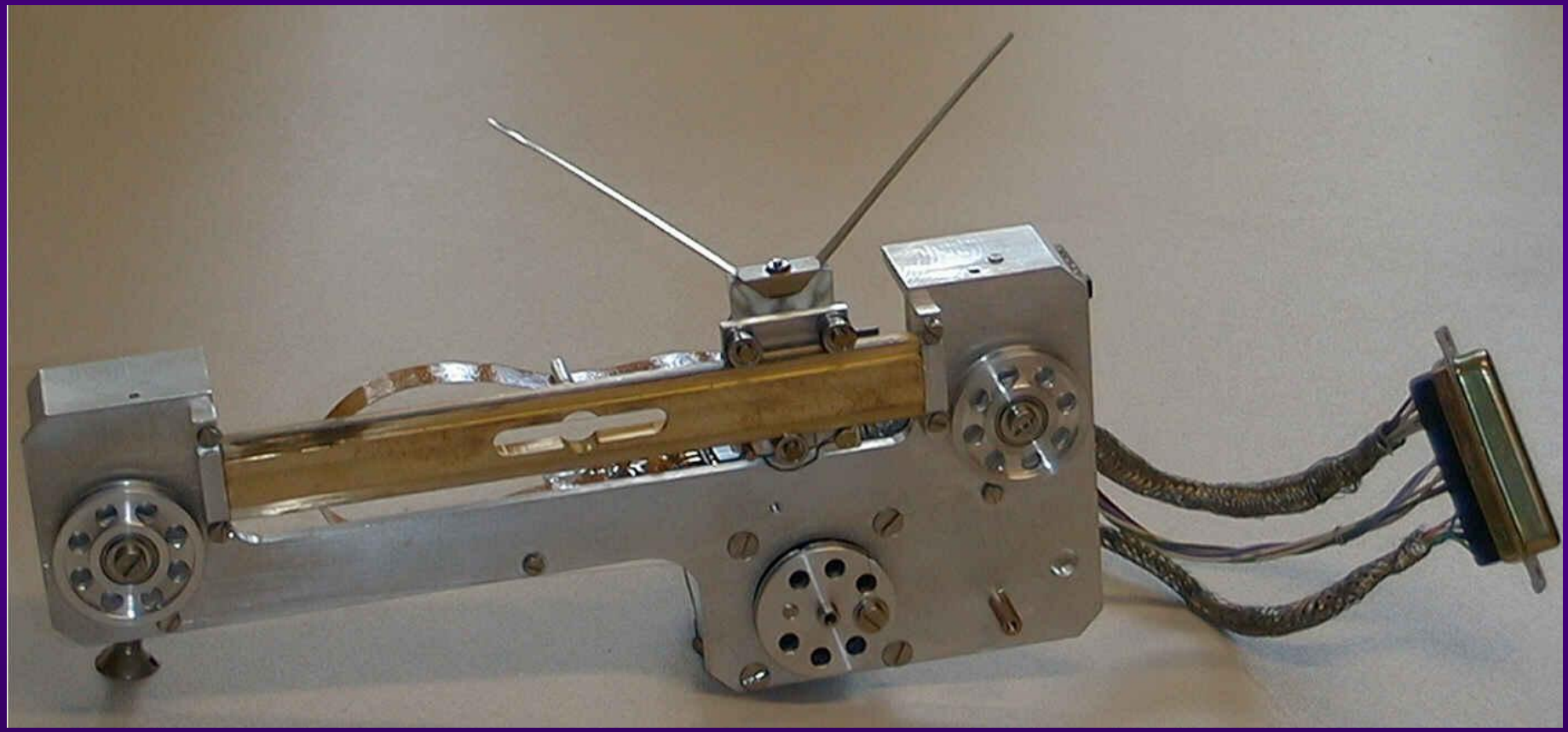


Isolde and Rex Beam Instrumentation

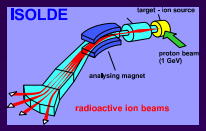
- Beam Scanners
- Wire-grids
- Fixed Needle Beam Scanner (FNBS)
- Faraday-cups
- Tape-stations
- Rex Instrumentation Boxes
- Not permanently installed:
  - Fast Faraday-cup
  - Emittance-meter

Isolde Beam Scanners

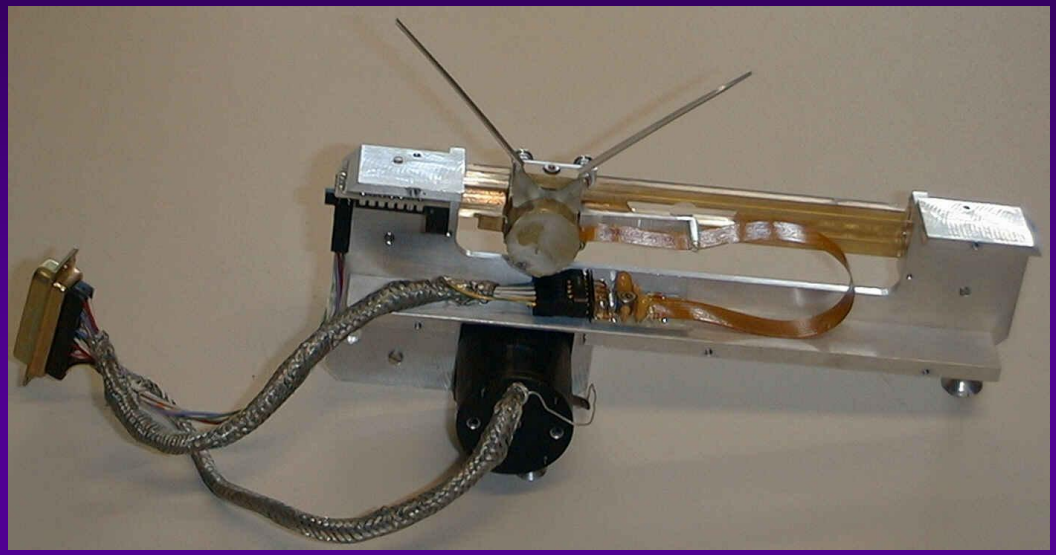
- **Original idea of G. Sidenius and A. Lindahl from the Niels Bohr Institute in Copenhagen**



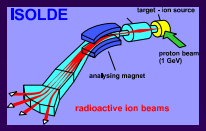
- **Protective plating taken off**
- **Driving wire barely visible**



Isolde Beam Scanners



- Small chariot driven by stepping motor
- The chariot contains the pre-amplifier and the needle is directly mounted at it
- Only one position reference (with a slotted opto-coupler)
- The scanner takes data in only one direction
- speeds up to 1m/s possible, typical scanning speed up to 400mm/s
  - The scanning-speed must be reduced at <=500pA due to pre-amplifier bandwidth
- Electrical input-sensitivity 25pA (full scale) to 20μA

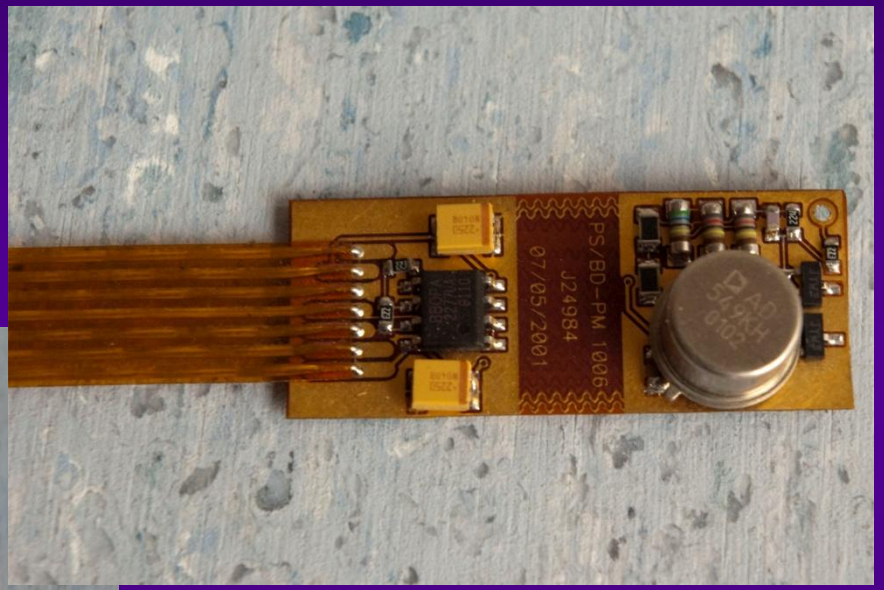


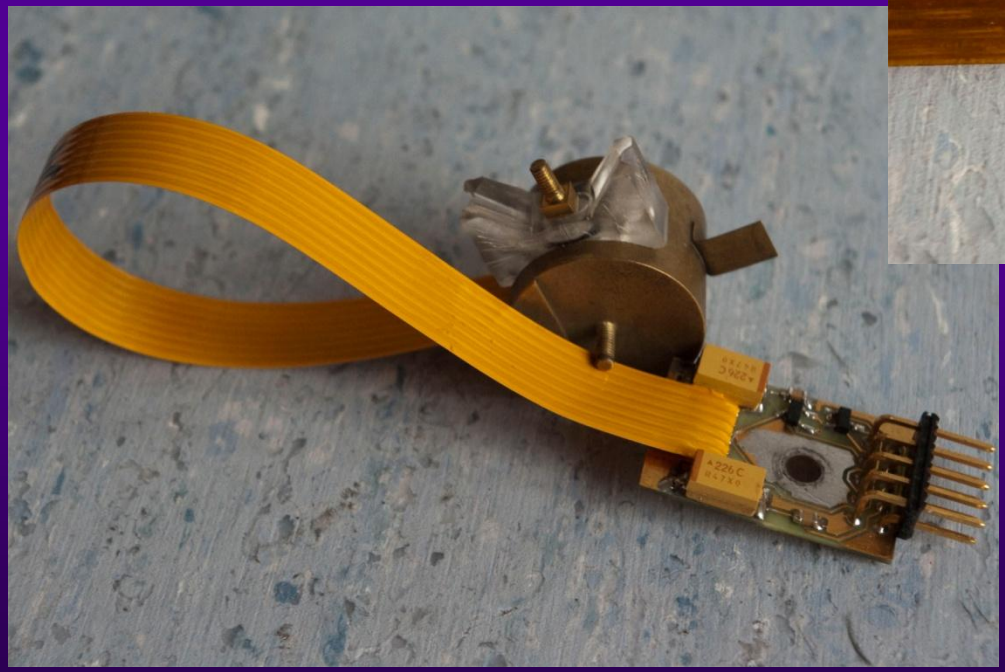
Isolde Beam Scanners

- 29 scanners, 5 horizontal and 24 X/Y

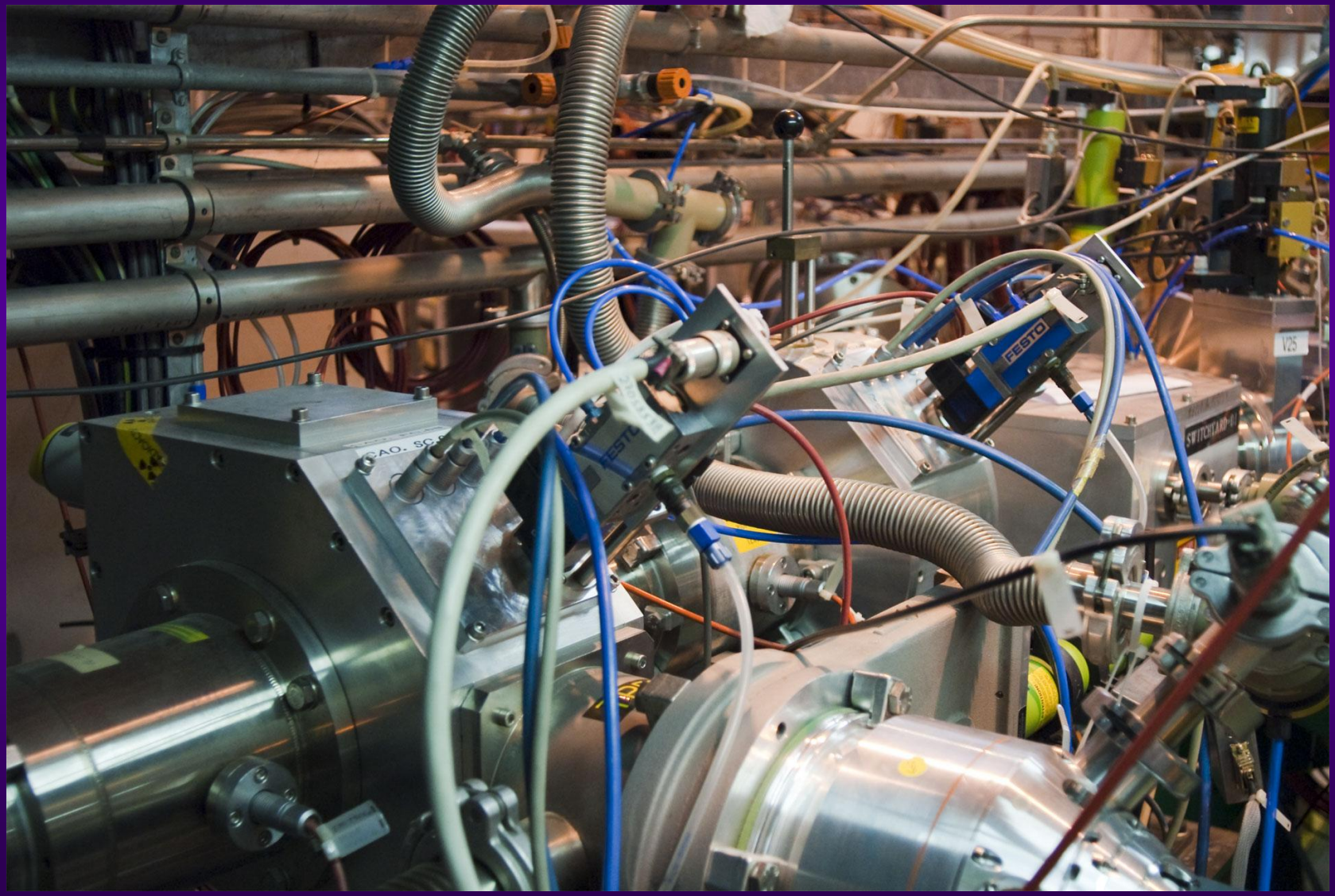
Isolde Beam Scanners

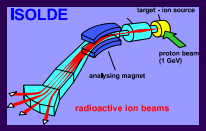
- **Pre-amplifier**



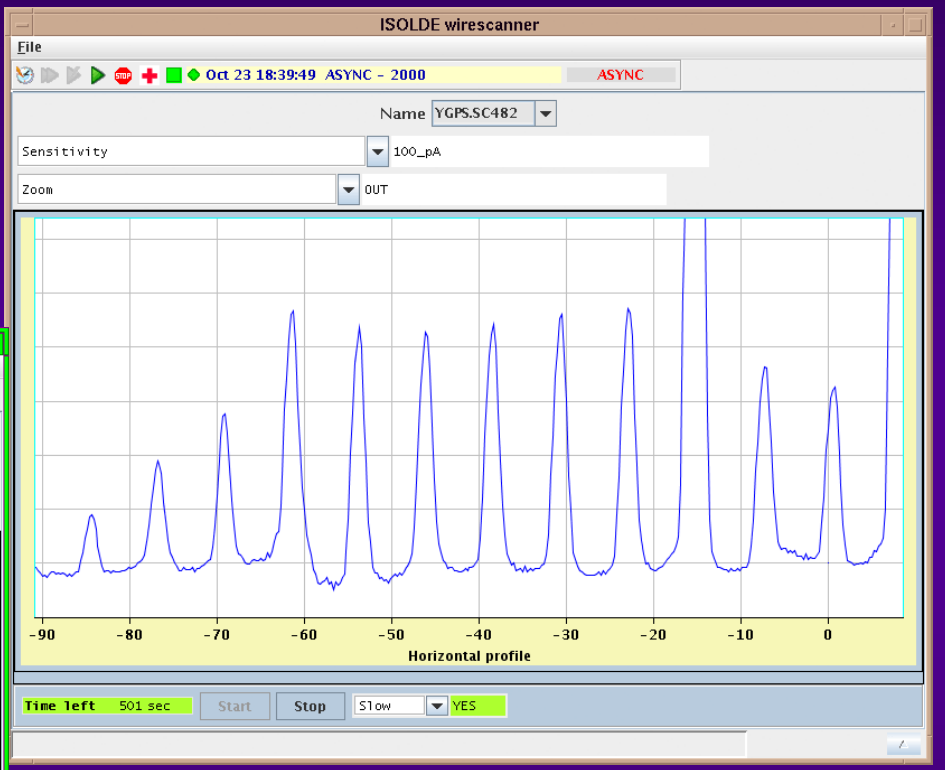


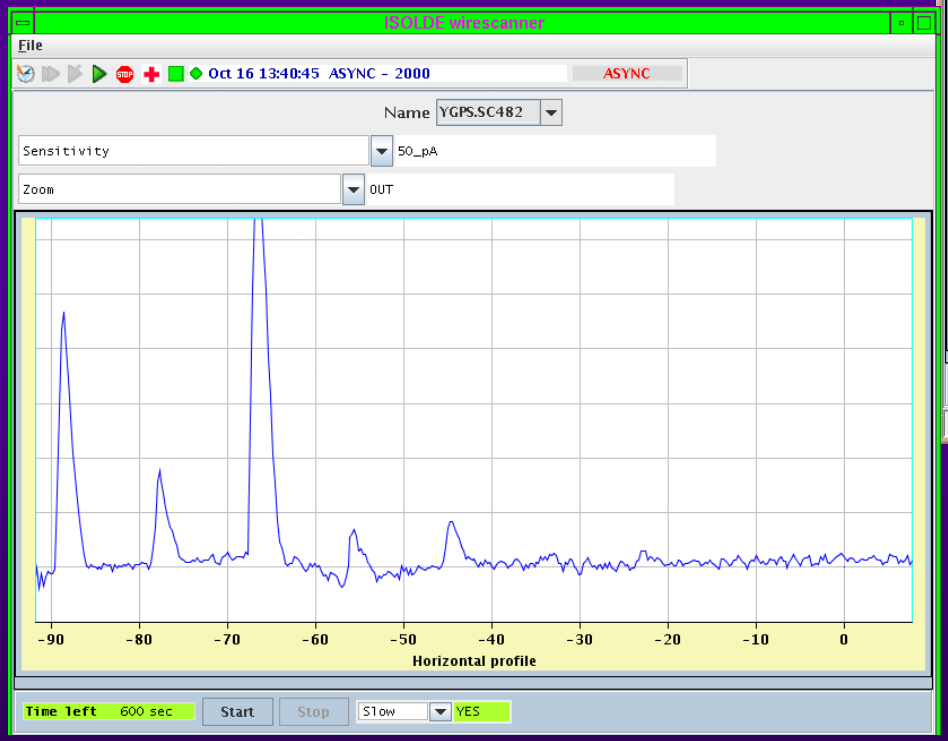
Isolde Beam Scanners



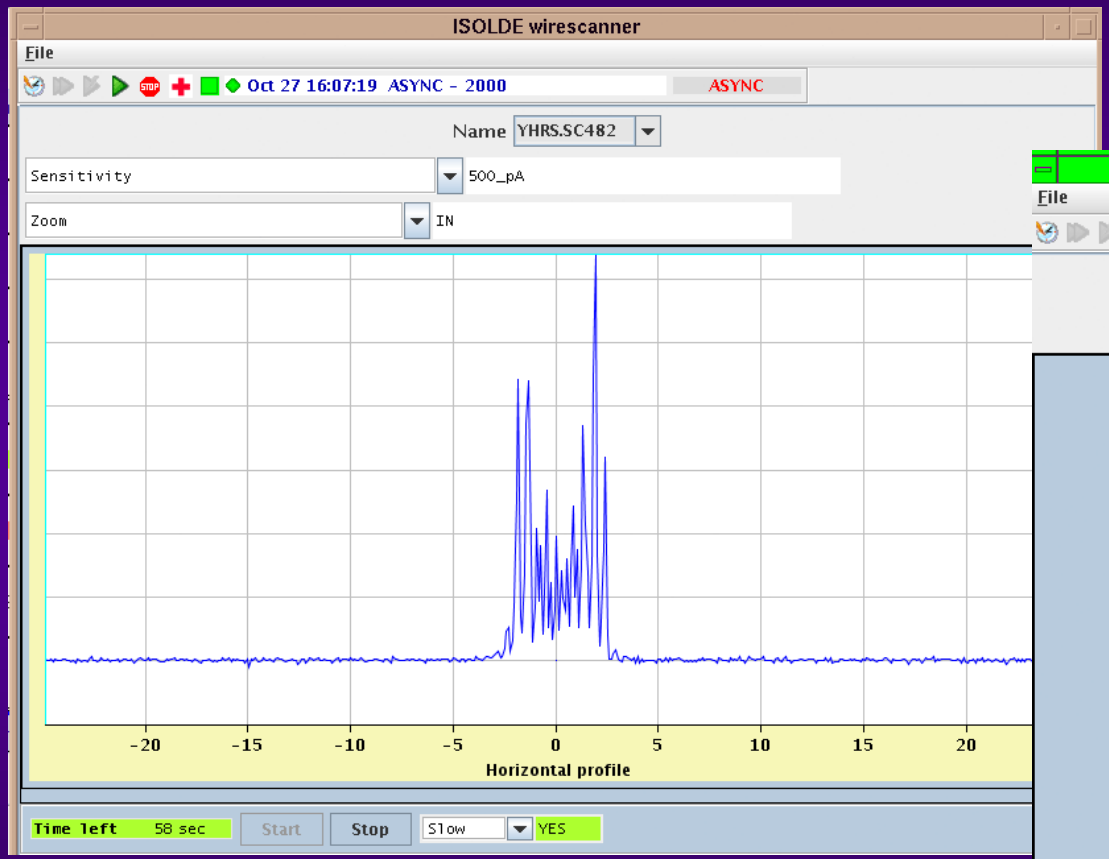


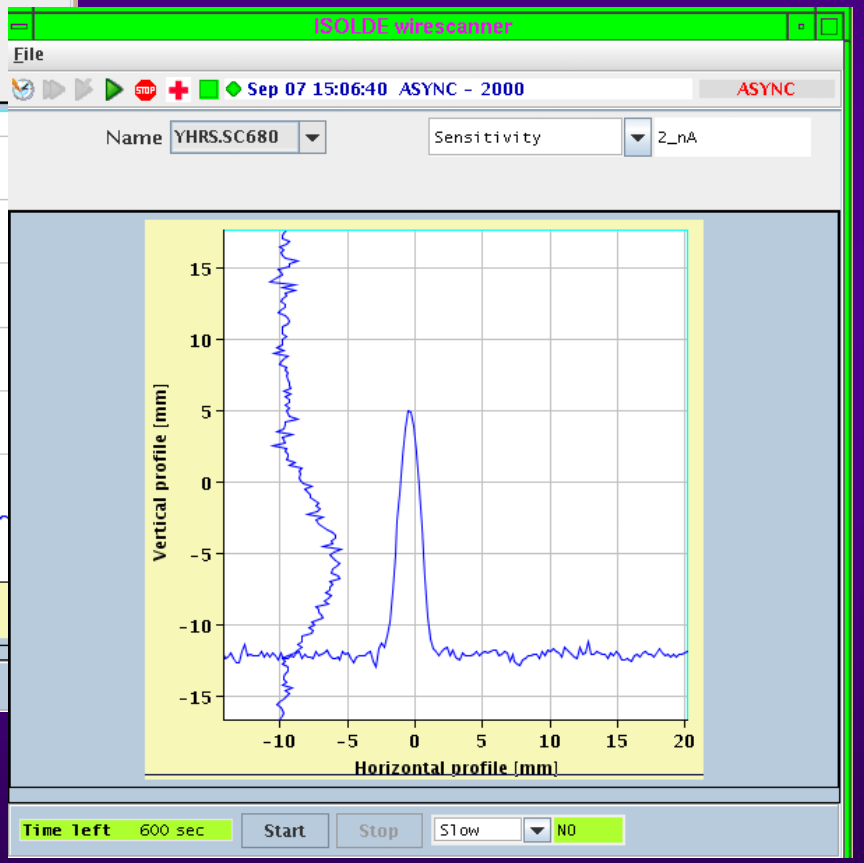
Isolde Beam Scanners



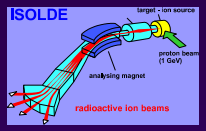


Isolde Beam Scanners



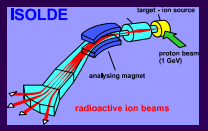


Electrical problem detected…



Isolde Beam Scanners

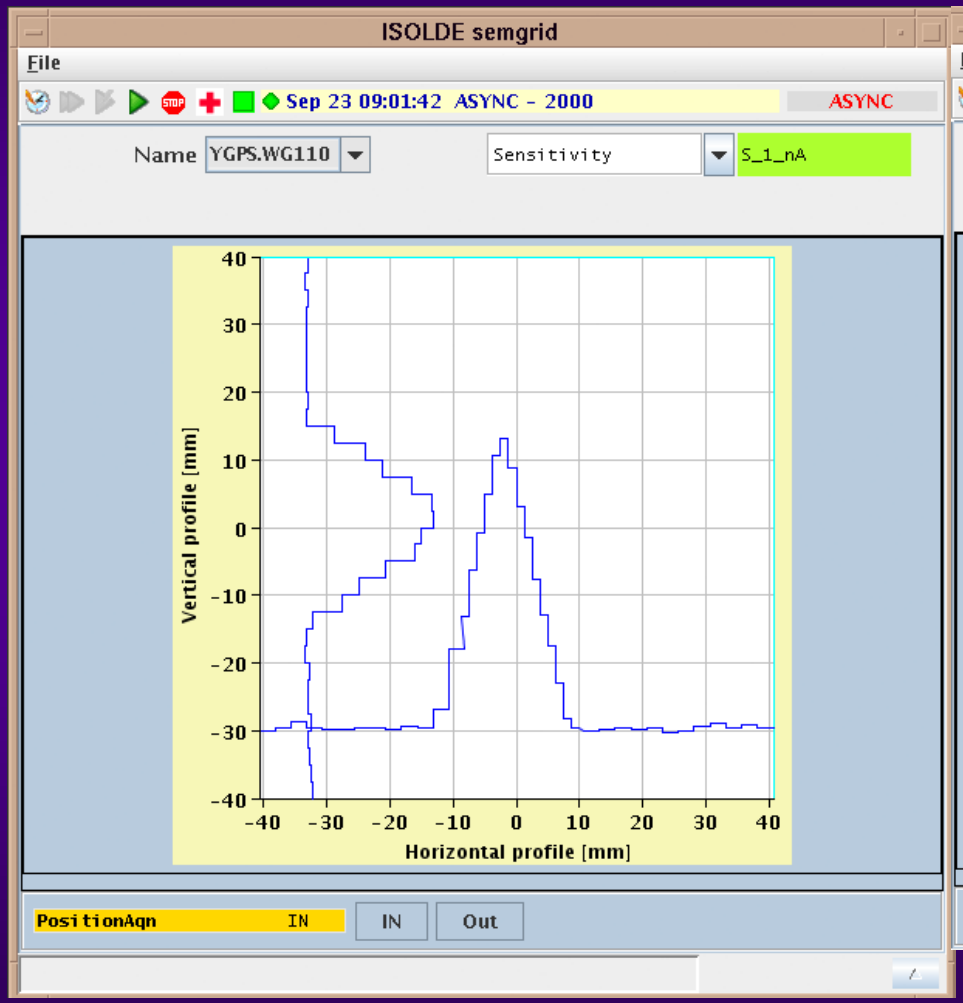
- Alternative measurements with scanners
  - By positioning the needle in the centre of the beam the intensity in the time-domain can be measured
  - By positioning the needle at the edge of the beam instability of the beam position can be measured



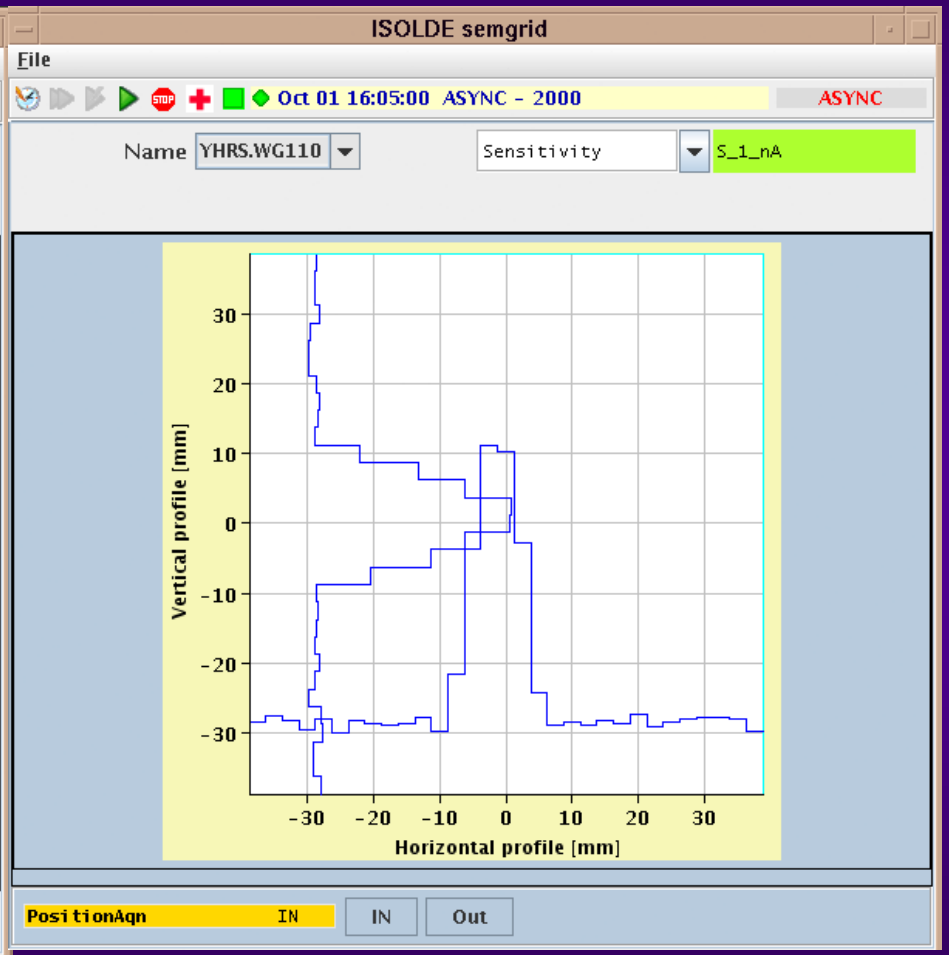
Isolde Wire-grids

- Wire-grids are used where the environment is expected to be too radio-active for scanners
- 3 grids of 31 * 31 wires (spacing 2.5mm)
- 2 grids of 40 * 32 wires, (the spacing of the vertical wires is halved in the middle)
- 2 grids of 20 horizontal wires (spacing 1mm), combined with a fixed slit and a hole
- 1 special grid for test-purposes in front of the second HRS-magnet, 29 * 8 wires, spacing 8mm
- Electrical sensitivity 20pA (full scale) to 2mA

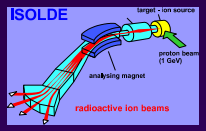
Isolde Wire-grids



40 + 32 wires



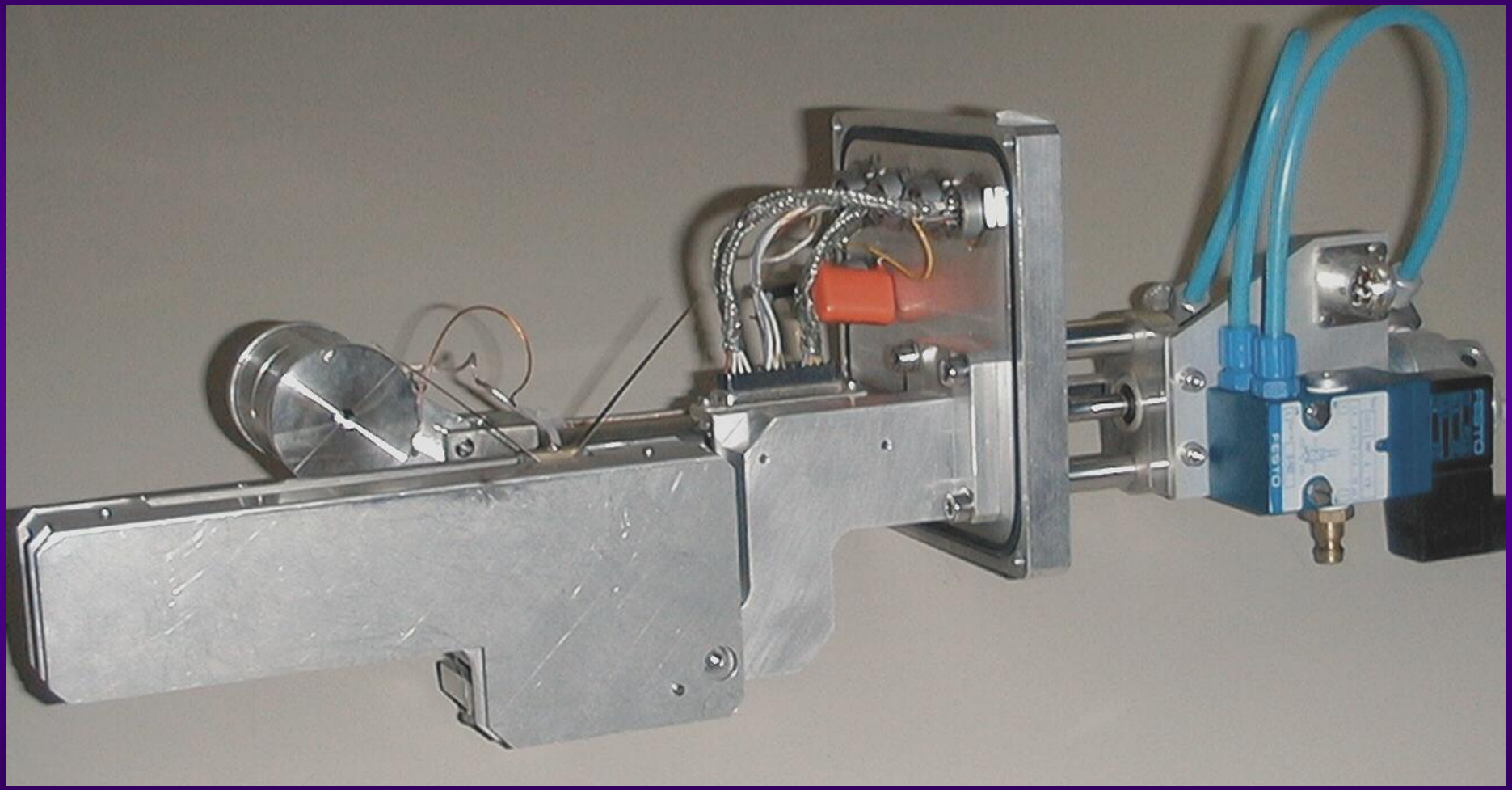
31 + 31 wires



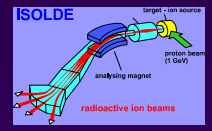
Isolde Faraday-cups

- Not counting REX there are 32 "standard" Faraday-cups (opening 25mm)
- And 2 large Faraday-cups at the Frontends
- Repeller-voltages 130V to 250V
- Readout:
  - Problems with read-out due to long cables
  - New electronics in test at Rex-Trap

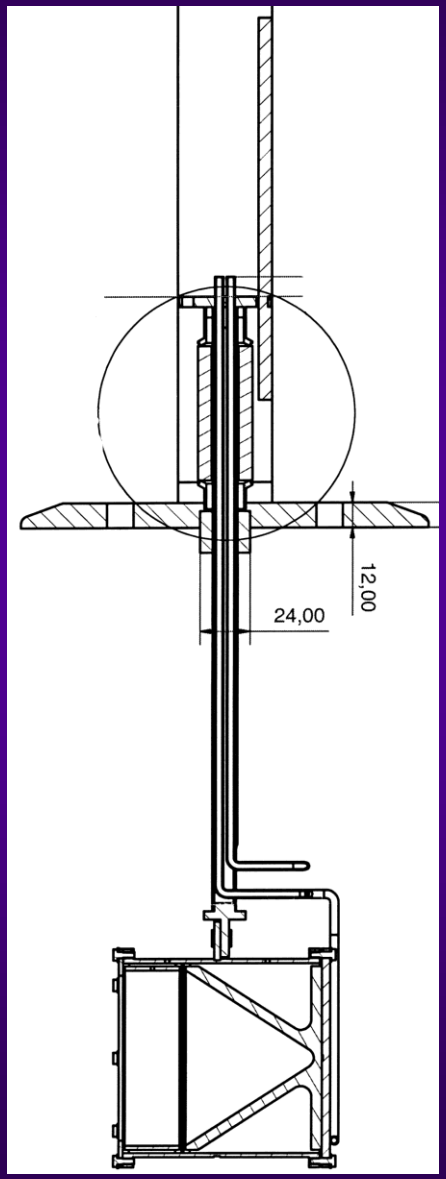
Isolde Faraday-cups

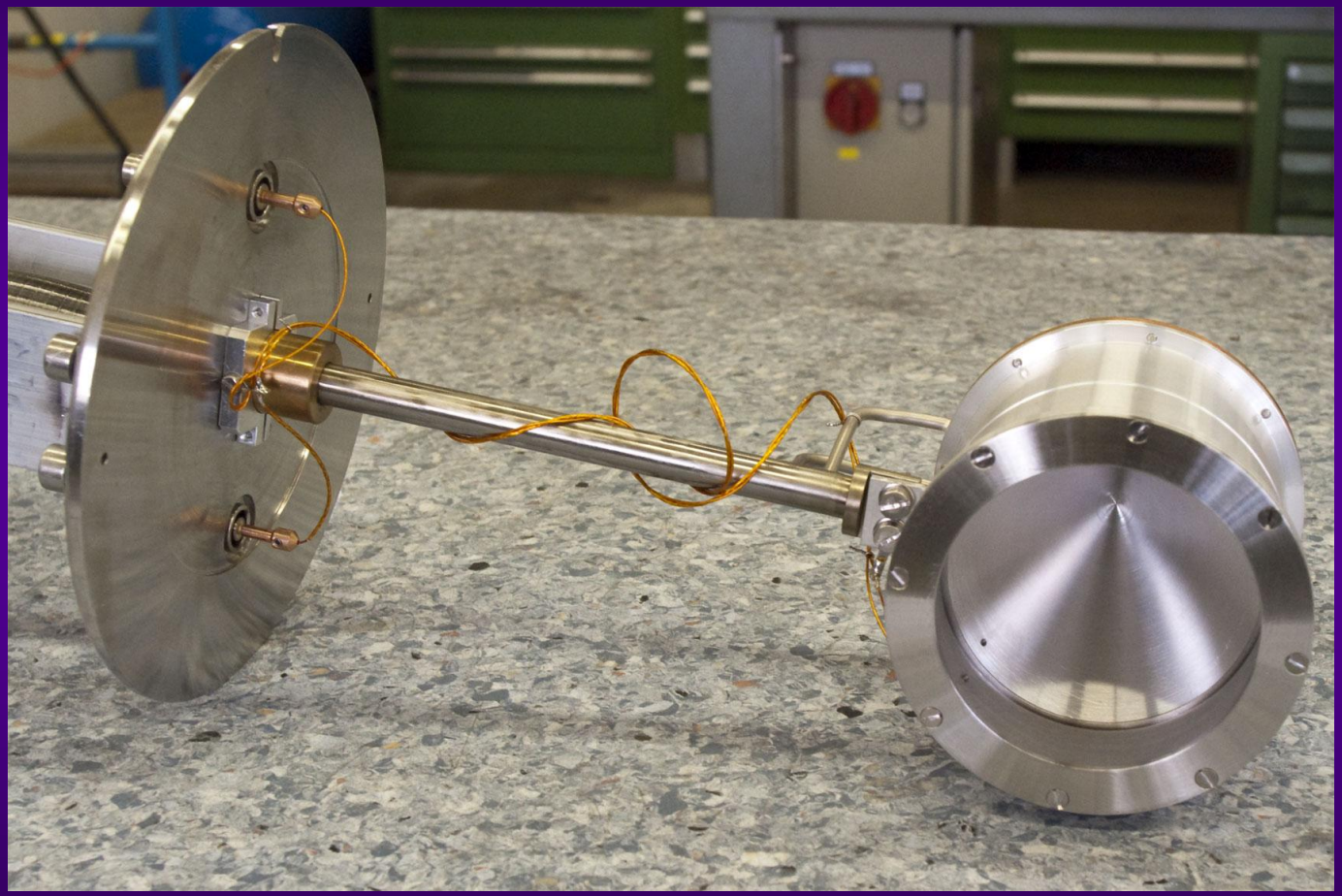


Standard Unit with X/Y scanner and Faraday-cup



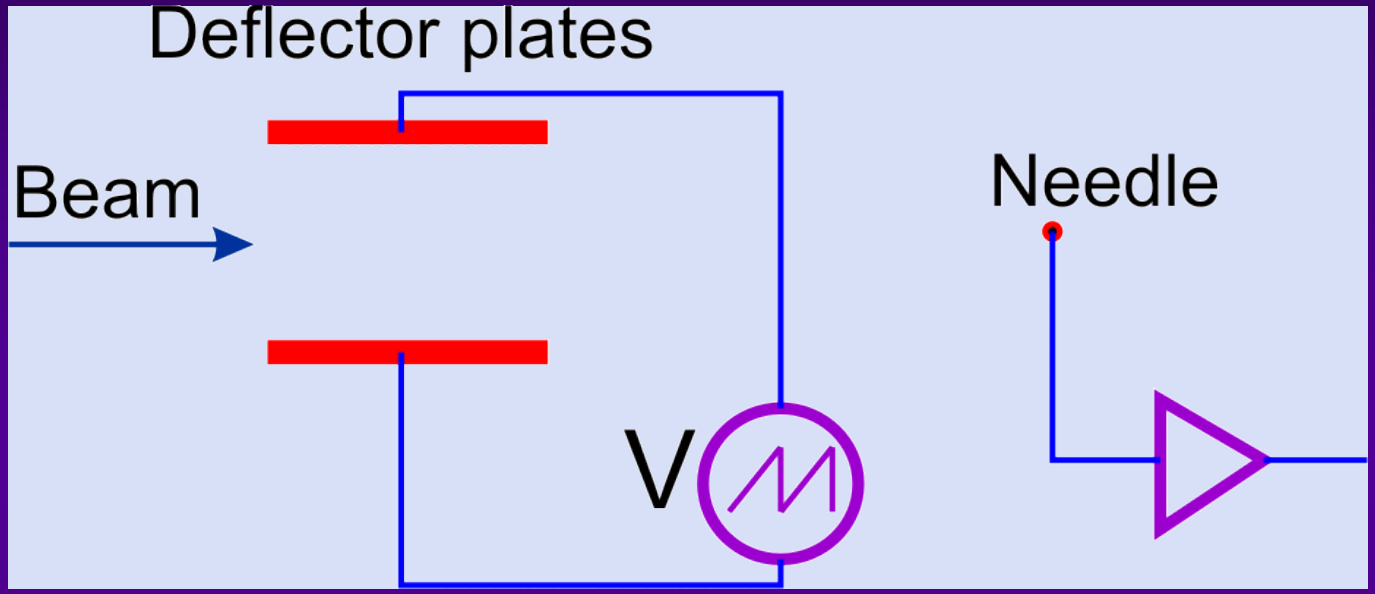
Isolde Faraday-cups



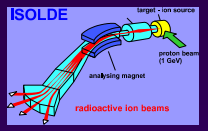


75mm Faraday-cup for Frontend

Fixed Needle Beam Scanner

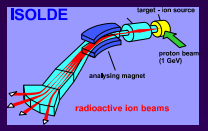


- Fixed wire of 0,05mm instead of moving needle
  - Can be moved in/out pneumatically
  - No mechanical movement while scanning
- Beam deflected electro-statically over a distance of maximum +/- 9,8mm
  - With saw-tooth signal of 1 to 10 seconds
- Electrical Input-sensitivity from 25pA (full scale) to 200μA



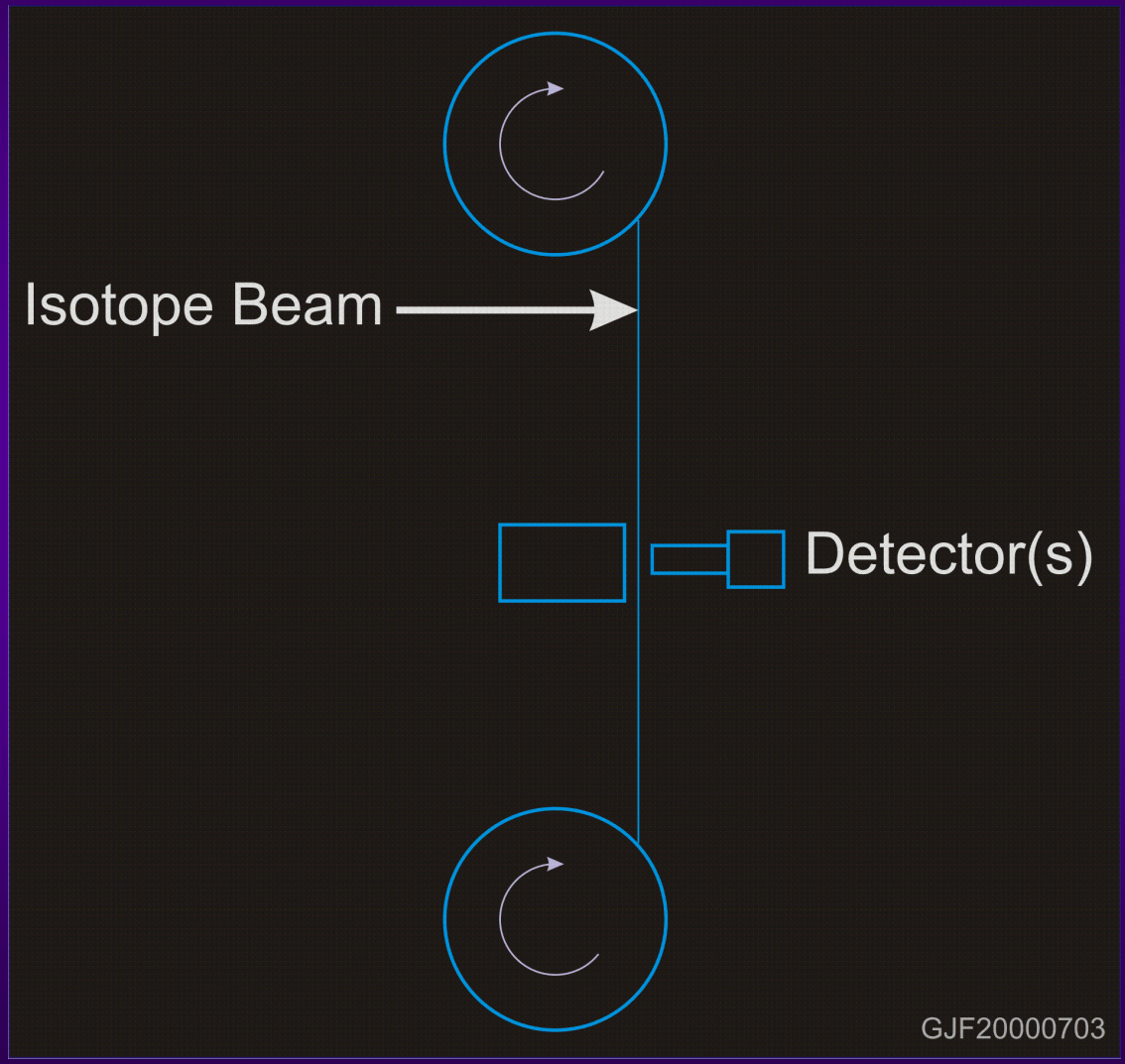
Isolde Tape-station

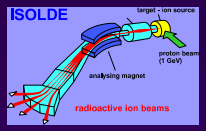
- The Tape-station allows to measure radioactive particles even if they cannot be seen by other beam instrumentation
- The Tape-station is used to:
  - Optimise and check the target and ion-source
  - Optimise the position of the proton-beam
  - Measure half-lives of isotopes by using a Multi-channel Analyser



Isolde Tape-station

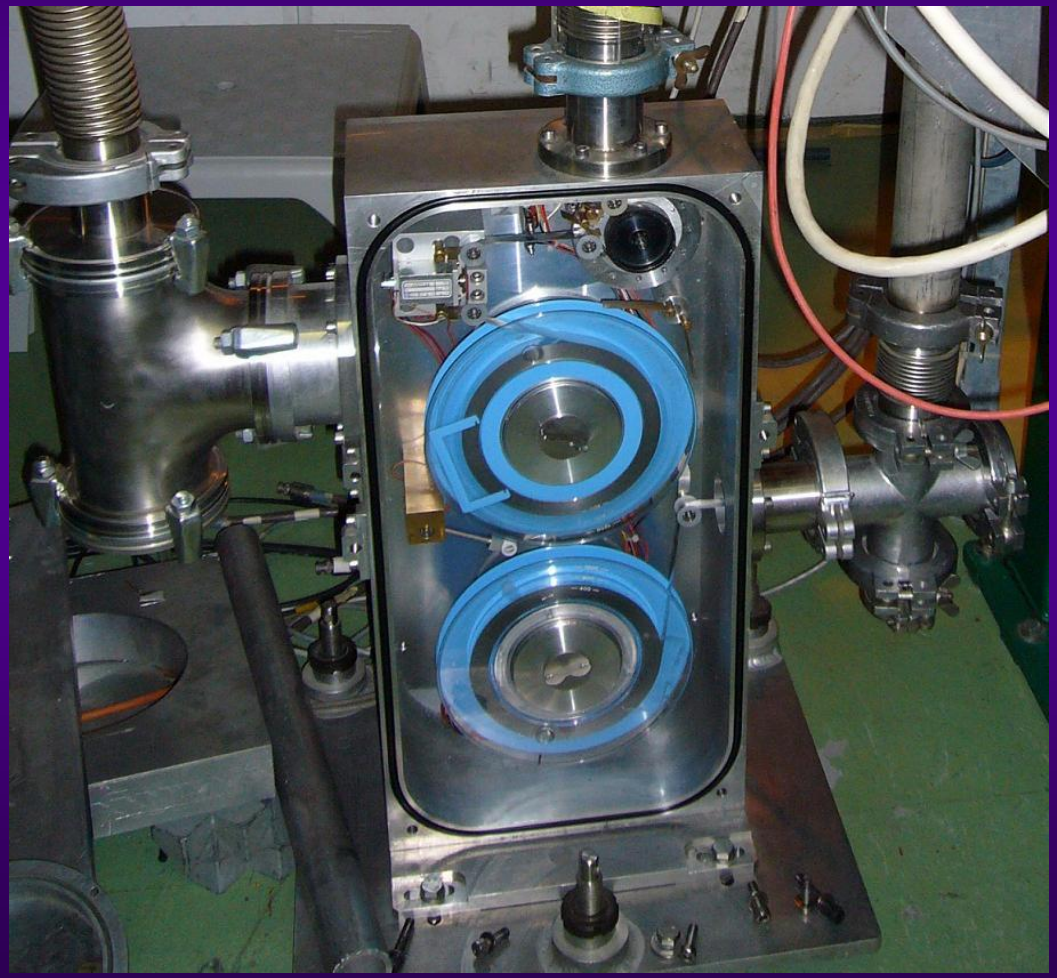
- An electrostatic Beam-gate is used to obtain an accurate timing for the collection of particles
- After Collection the tape is moved rapidly to transport the sample to the detector(s)
- Standard detector is a scintillator and photo-multiplier
- The tape is Mylar with an aluminium layer





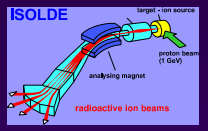
Isolde Tape-station

The old Tape-station

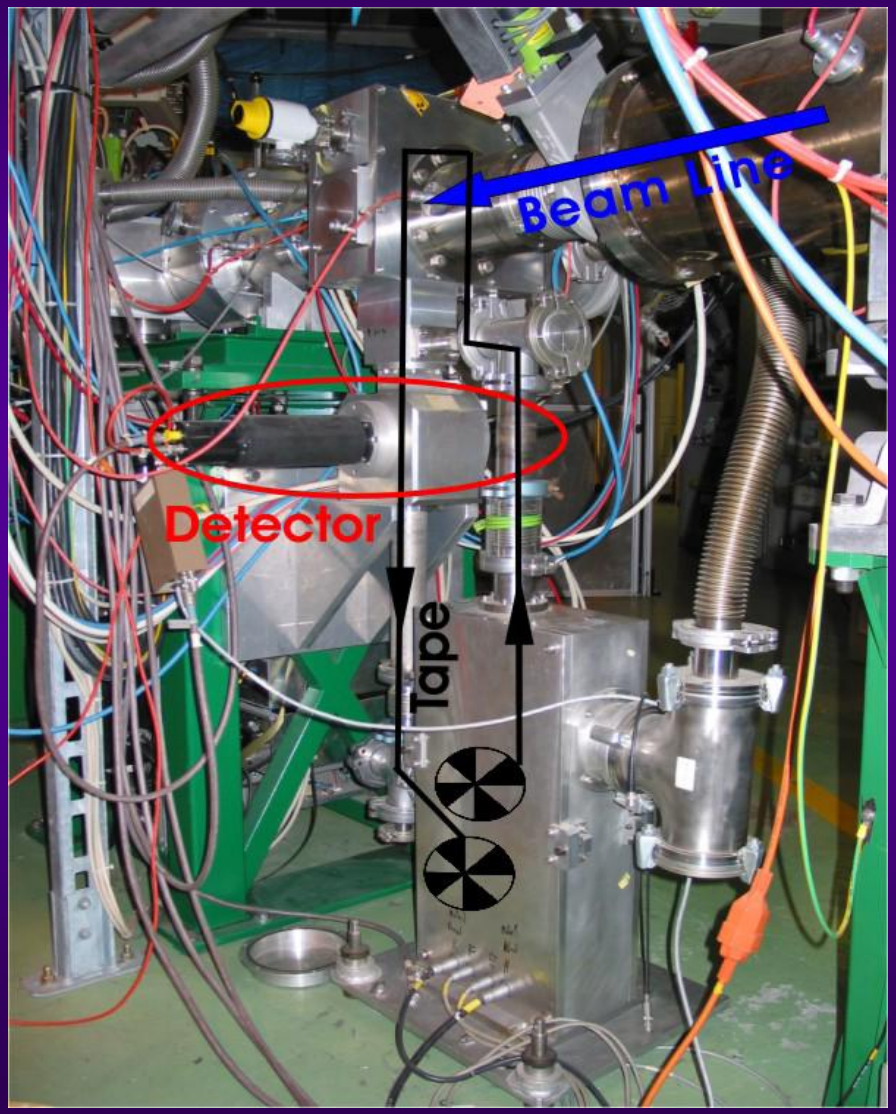


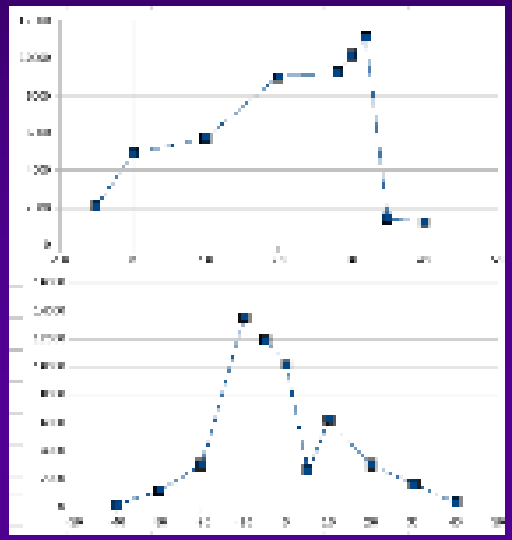
- First designs dated 1974, used electronics probably from 1978 or 1979

Picture from Erwin Siesling



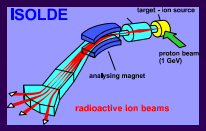
Isolde Tape-station



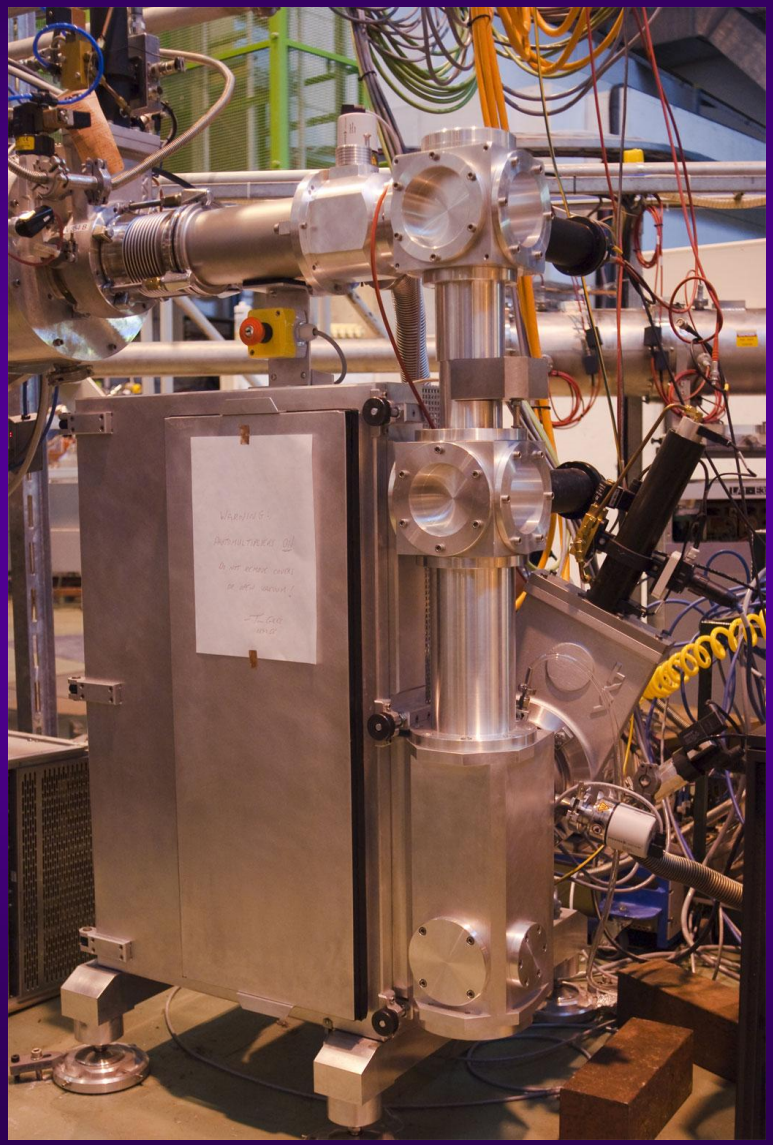


Release-curve

Picture from Martin Eller

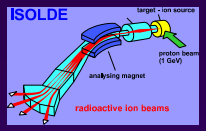


Isolde Tape-station



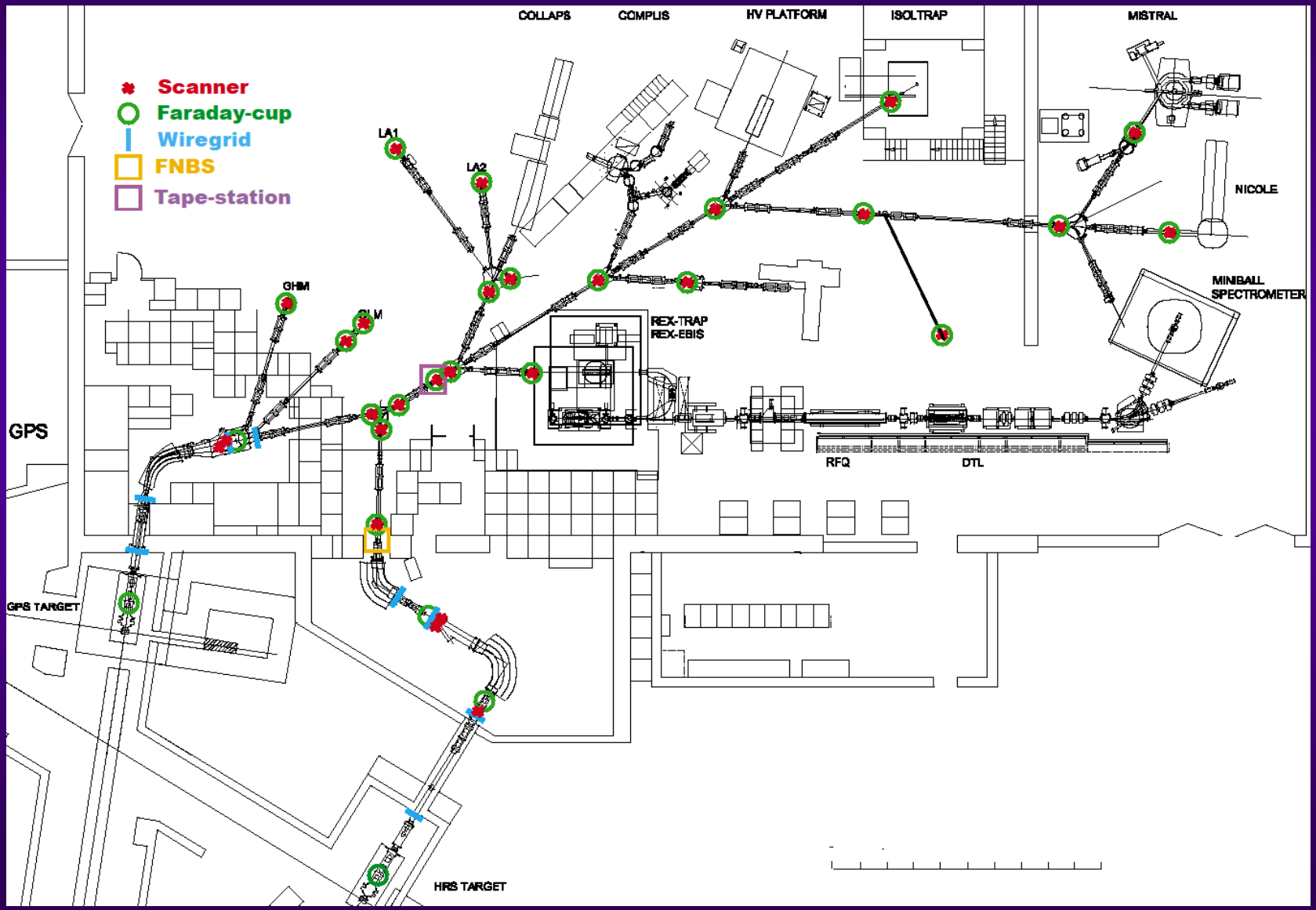
New Tape-station (being tested)

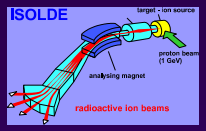
- Constructed in Strasbourg at the IPHC by Philippe Dessagne and his team.
- Transport time 210ms



Isolde Tape-station

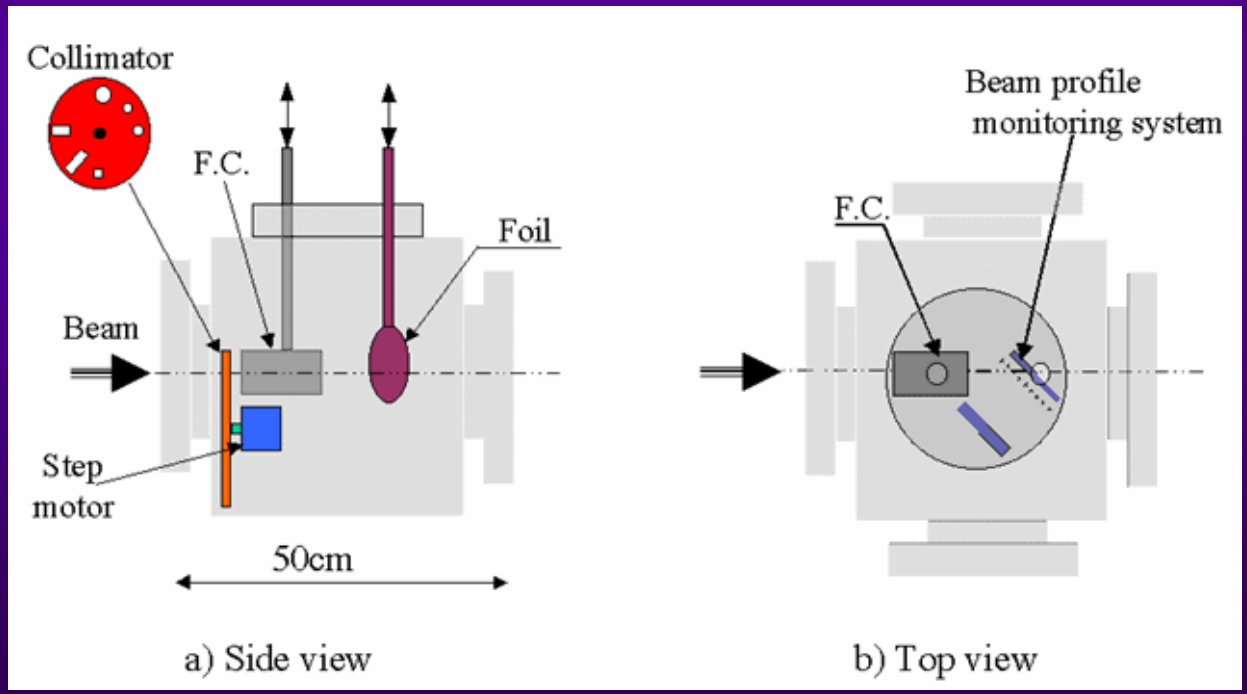
Isolde Instrumentation

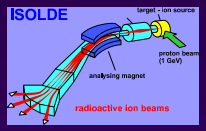




Rex Instrumentation Box

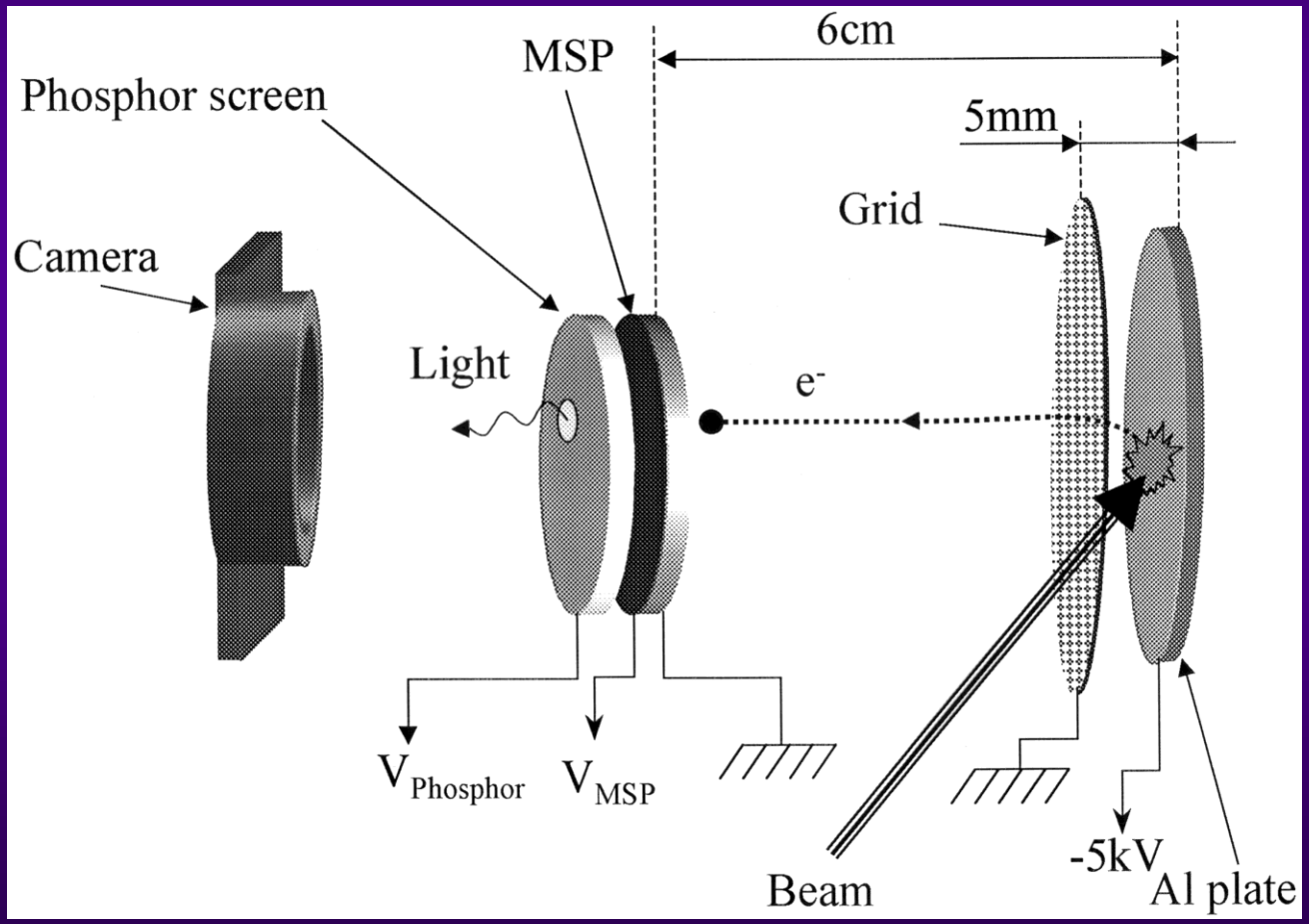
- Designed and built by Leuven University
- Collimator: rotating disc with different slits
  - Eventually used to mount filters
- Faraday-cup (25mm)
- Imaging system
- 9 boxes installed

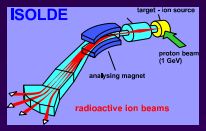




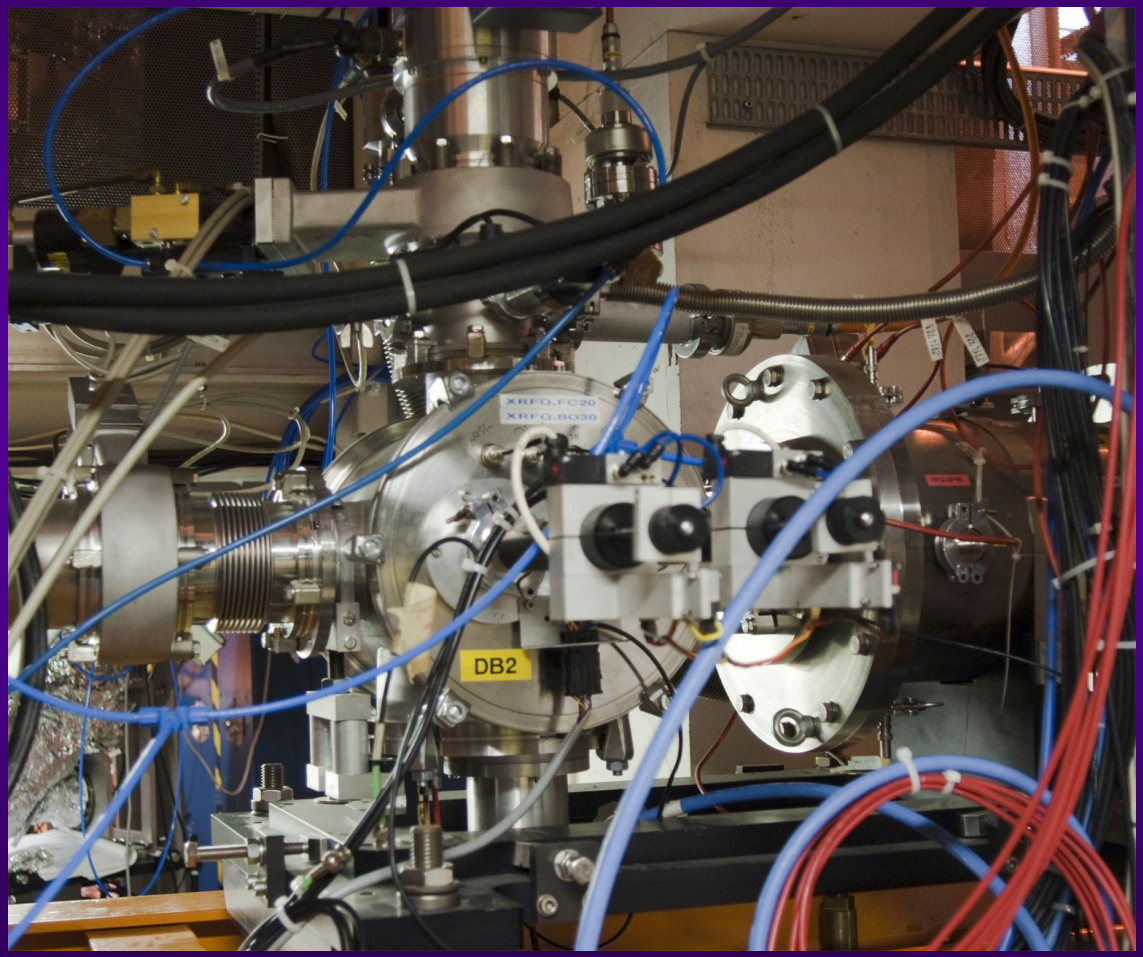
Rex Instrumentation Box

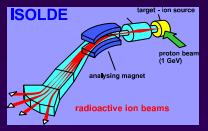
- **Imaging system**
  - **Foil**
  - **Grid**
  - **MultiChannelPlate**
  - **Phosphor screen**
  - **CCD Camera**



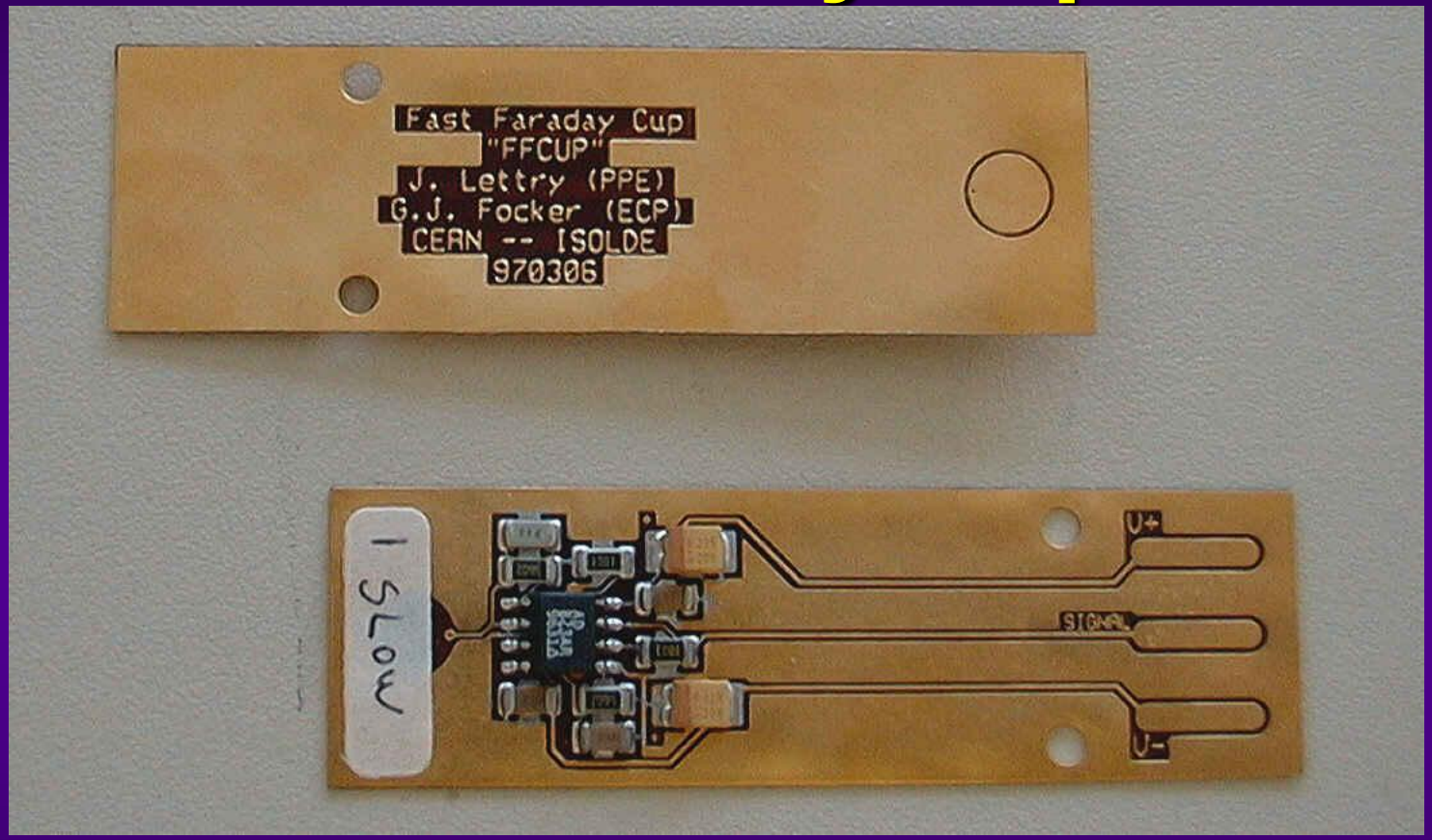


Rex Instrumentation Box



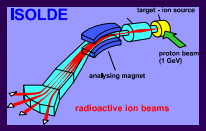


Fast Faraday-cup



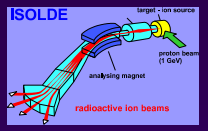
- (Not connected to control system)
- Allows to measure timing effects:

  (e.g. recovery of beam after proton pulse)



NTG Emittance Meter

- System with moveable slit and moveable grid
- Not connected to control system
- System is moved around to wherever it is needed



Conclusion

- Reliability: scanners improved
- More sensitive? => limits due to environment
- Missing equipment: Allison scanner (used at Triumf)

Thanks for listening!