CHARACTERIZATION OF PICASSO/PICO SUPERHEATED LIQUID DETECTORS

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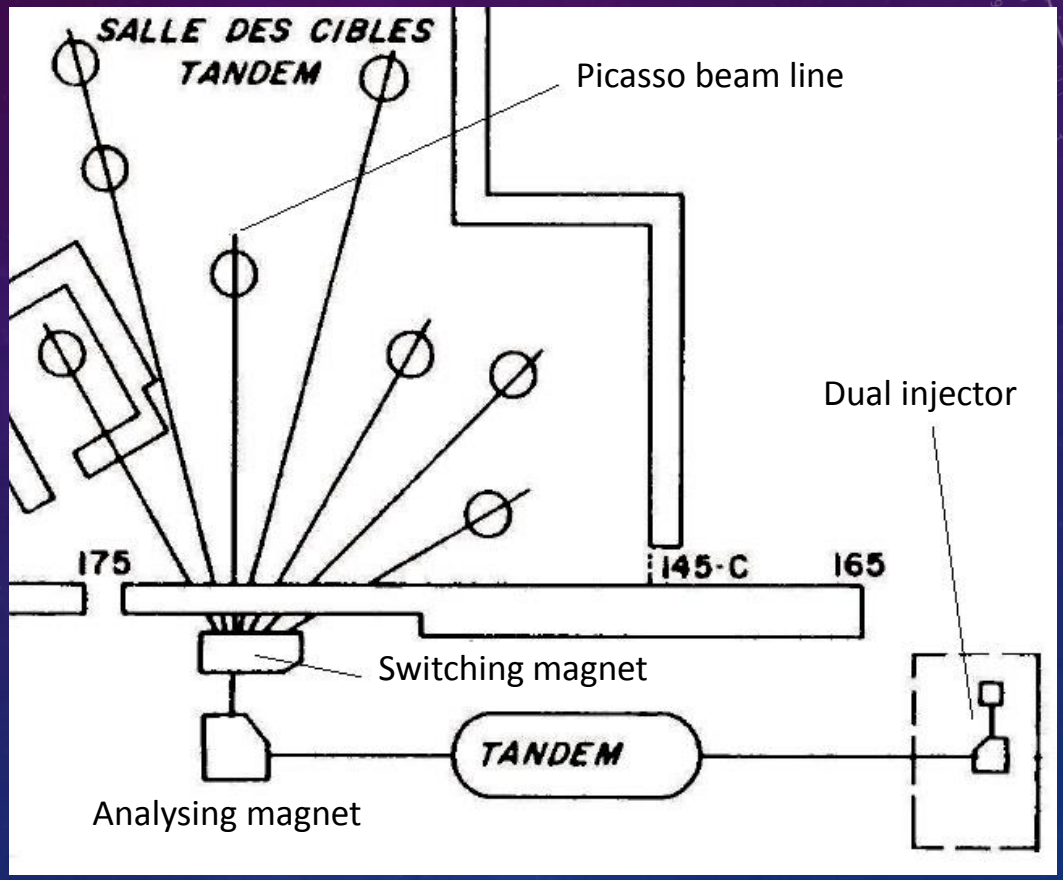
Picasso

PICO

TANDEM VAN DE GRAAFF ACCELERATOR

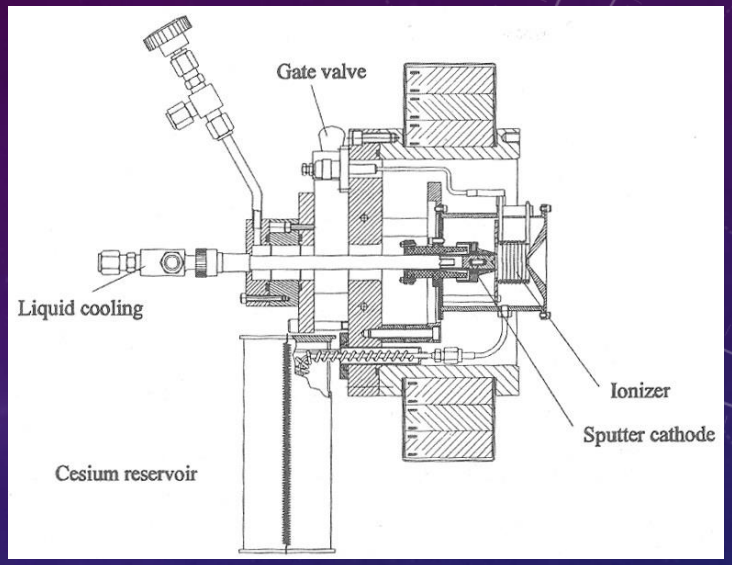
- Model EN-1 from HVEE
- Terminal voltage : 6 MV
- Maximum proton energy : 11 MeV
- Maximum current : 10 µA
- Beam spot size : ≈ 2 mm^2
- Beam stability : ± 1 keV

ACCELERATOR SETUP

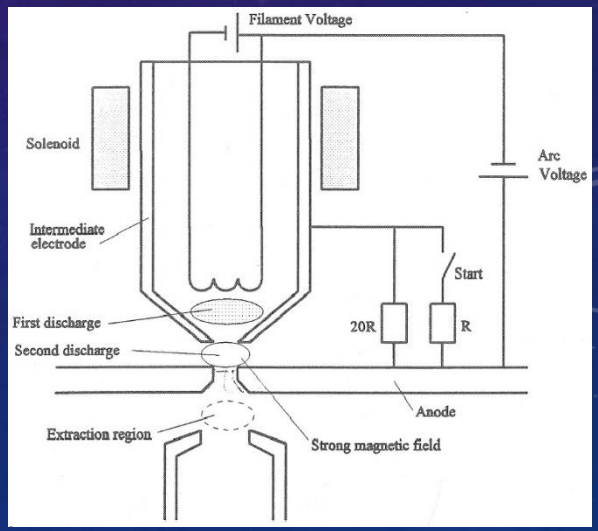


DUAL INJECTOR

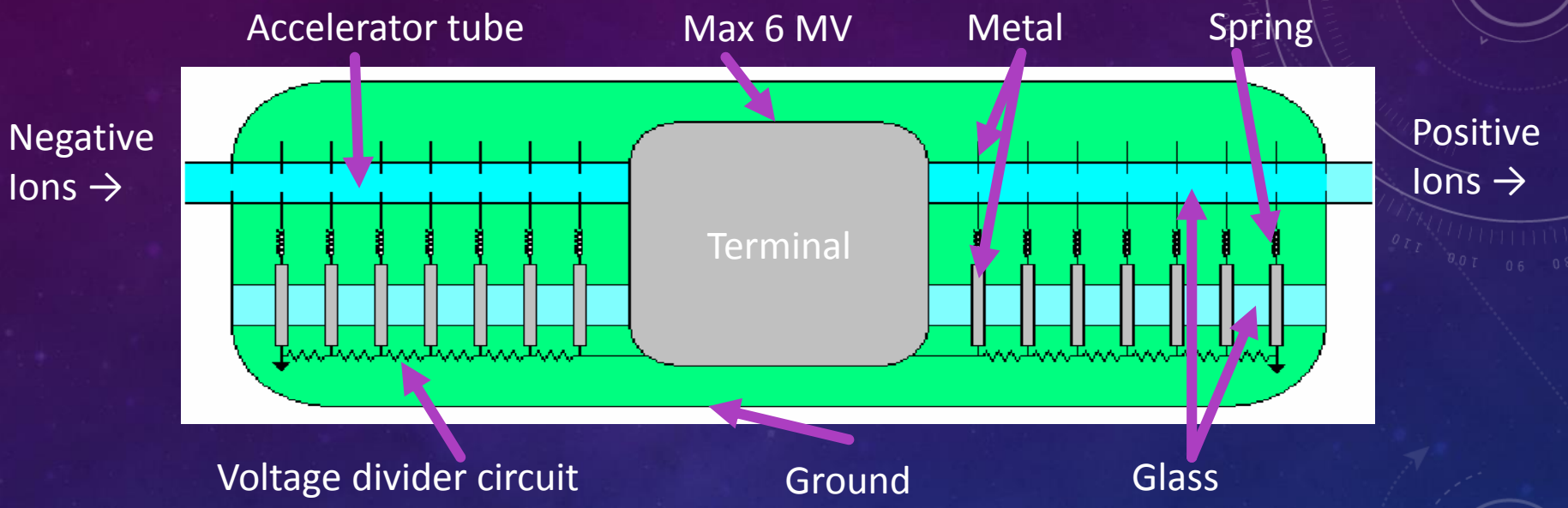
- Negative sputter ion source
  - Ions sputtered by cesium ions
  - Almost any element can be used
  - Cathode can be change really quickly
  - Negative ions
  - Cathode don't last for long



- Duoplasmatron ion source
  - Ions extracted from plasma
  - H_2, He_2 or other gases can be used
  - Positive and negative ions (need charge exchange canal for positive ions)
  - High current
  - Works as long as there is gas



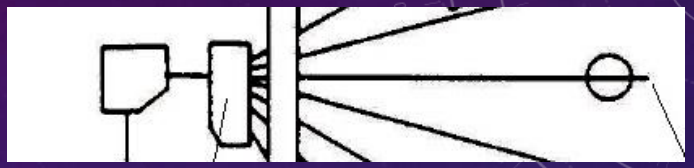
INSIDE TANDEM

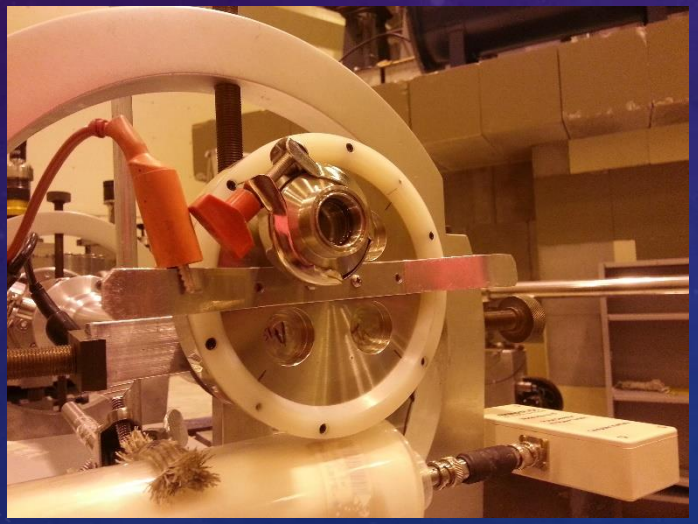


- Tandem → Dual acceleration!
- O_2 stripper removes electrons at the terminal, several charged states can be acheived
- Pressurized with insulating gas SF_6 at 180 PSI
- Whole column supported with 20 t of force applied via a huge spring

PICASSO 0° BEAM LINE

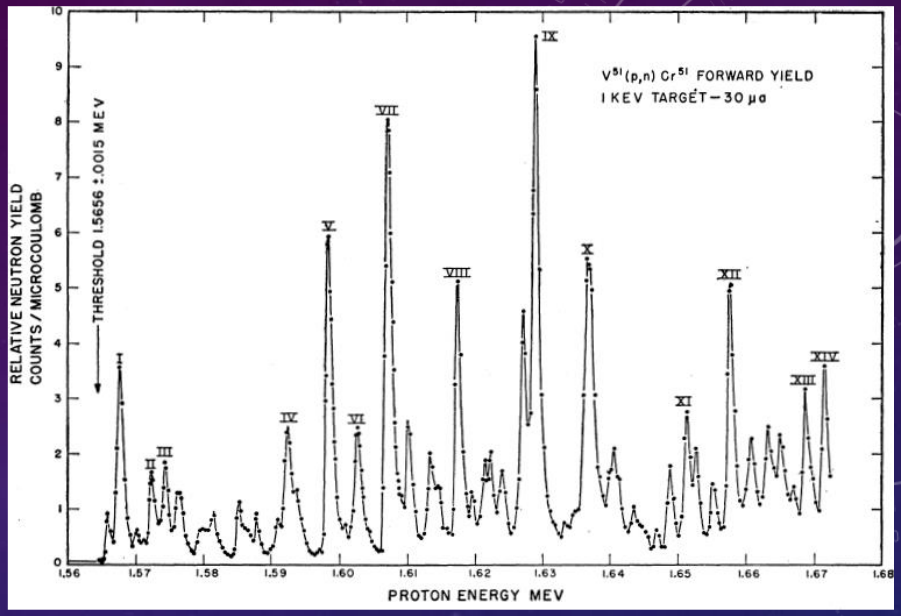
- Proton energy selected by analysing magnet field with NMR system
- Proton current : max 4 µA
- ^{7}Li and ^{51}V targets



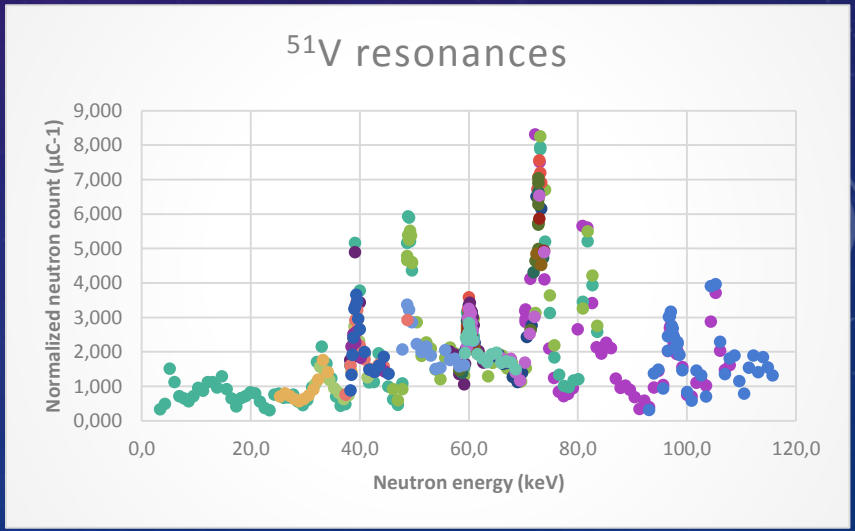


NEUTRON PRODUCTION

- $^{7}Li(p,n)^{7}Be$ and $^{51}V(p,n)^{51}Cr$ ressonnances produce monoenergetic neutron beam
- Every run, beam must be callibrated to find correspondance between analysing magnet field and neutron energy (½ hr)
- Analysing magnet resolution : ± 0,05 G
- Neutron energy resolution : ± 0,2 keV

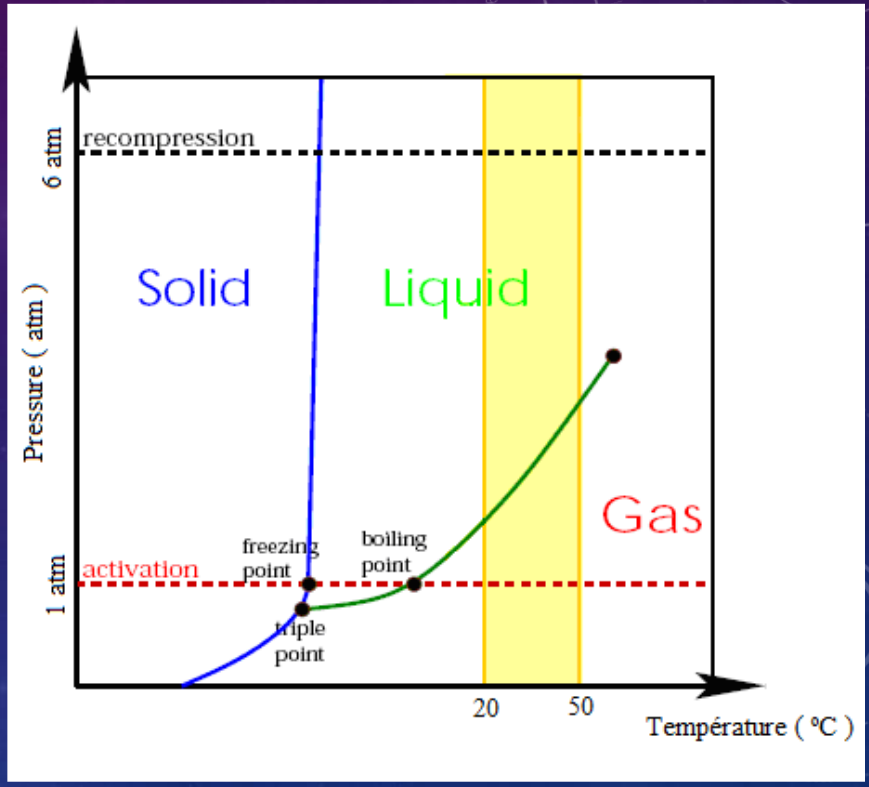


Résonance	E_p (MeV)	E_n (keV)
I	1.568	4.8
II	1.573	11.3
III	1.575	13.6
IV	1.592	34
V	1.598	40
VI	1.603	45
VII	1.607	50
VIII	1.617	61
IX	1.629	74
X	1.637	82
XI	1.651	97
XII	1.658	104
XIII	1.669	116
XIV	1.672	119



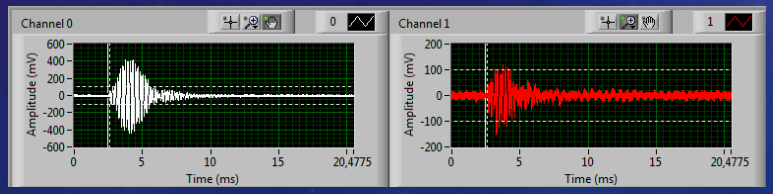
SUPERHEATED LIQUID DETECTORS

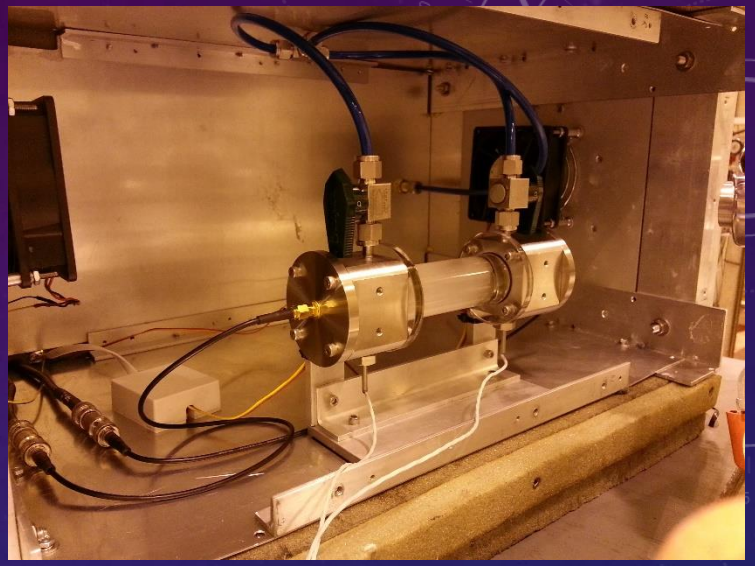
- Active liquid heated above boiling point
- Small energy deposition can trigger phase change (down to 1 keV)
- Recompression system must be used to condense evaporated gas
- Decompression reactivate the detector
- Whole system must be clean, surface smooth, radioactively pure, …

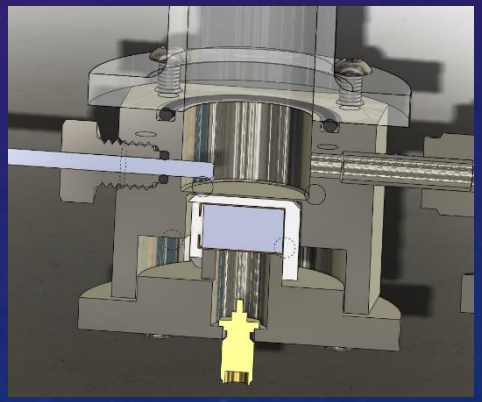


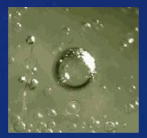
PICASSO BEAM DETECTOR

- C_4F_{10} dropplet detector
  - ≈ 5 g of active mass
  - Acrylamide polymer matrix
  - Mineral oil recompression fluid
- Acoustic trigger
  - 2 PZT piezos
  - 800 MS/s
- Temperature threshold scan
- 1 h recompression every 100 events



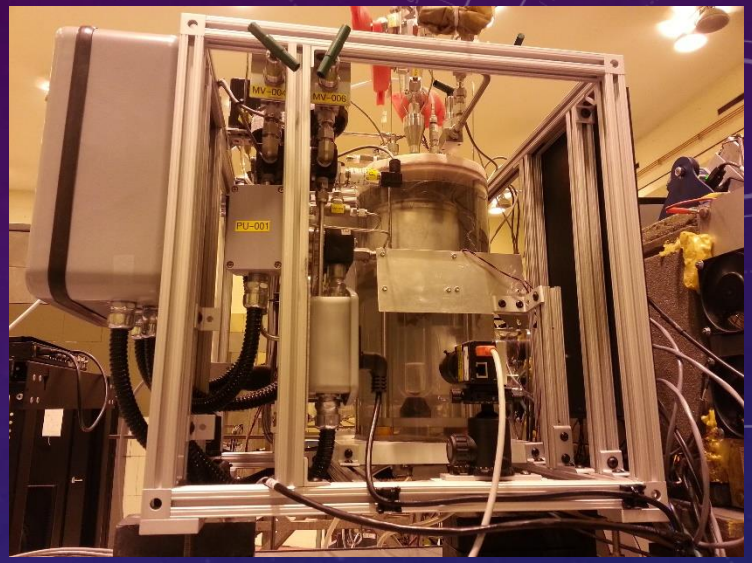






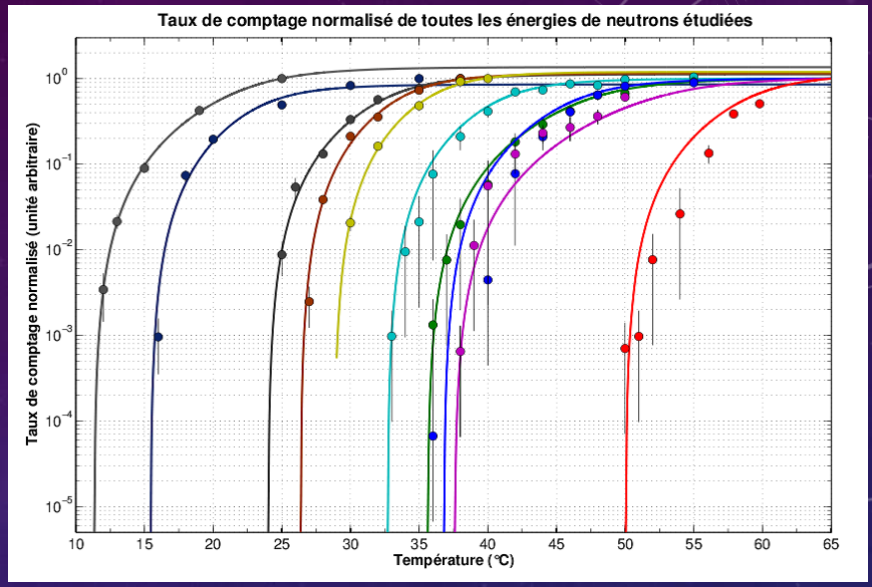
PICO 0.1 DETECTOR

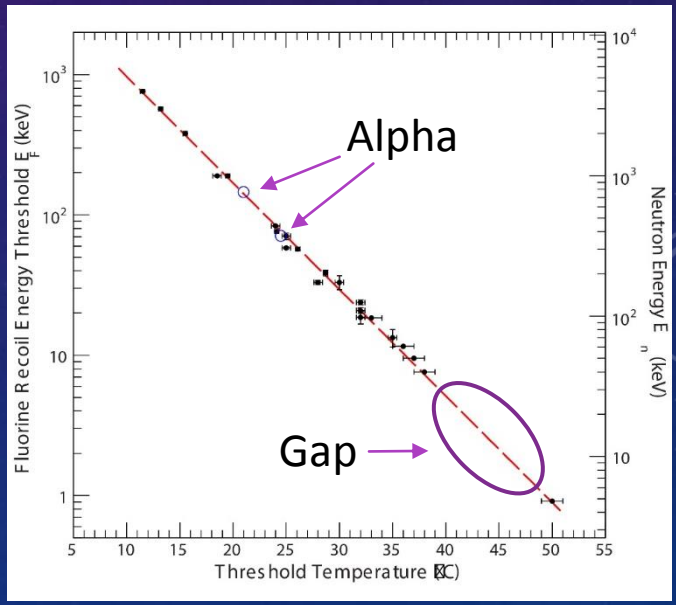
- C_3F_8 bubble chamber
  - 36 g of active mass
  - LAB buffer fluid
  - Mineral oil recompression fluid
- Video/pressure trigger
  - 150 fps – 2,5 MS/s
- Acoustics on the way
- Pressure threshold scan
- 1 min recompression every events



BEAM CALLIBRATION

- Calibration done with Picasso
  - High uncertainties on proton energies
  - Gap between 4,8 and 40 keV
- Current calibration runs
  - Better energy resolution with NMR
  - Better temperature control
  - Complete scan between 4,8 and 119 keV
  - Never done before
    - For a Pico bubble chamber
    - For C_3F_8

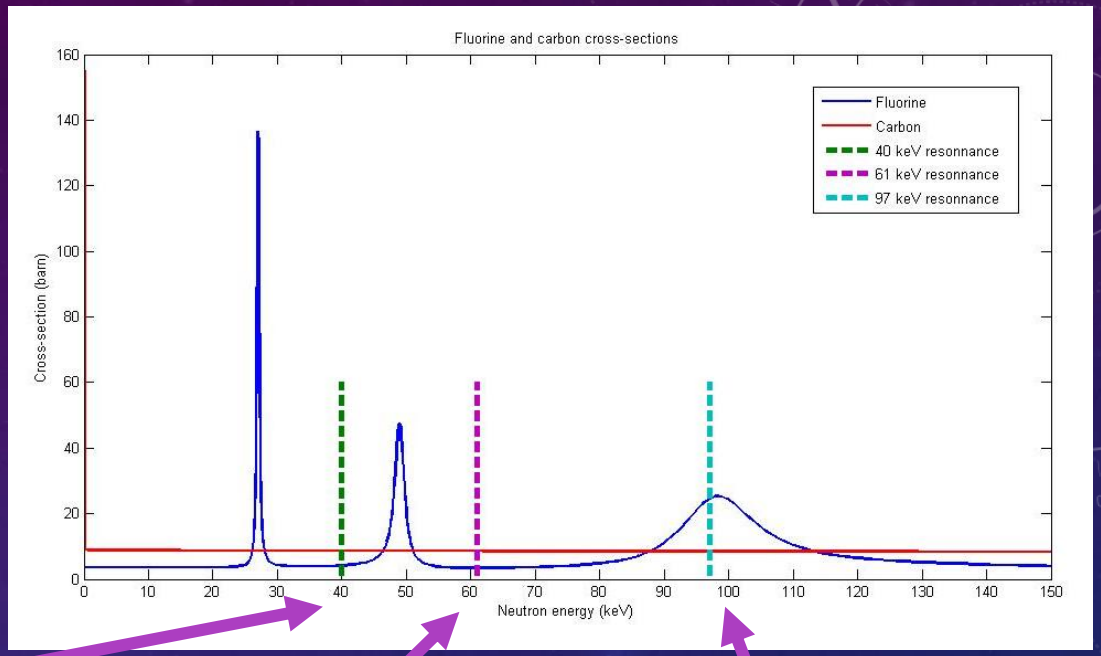


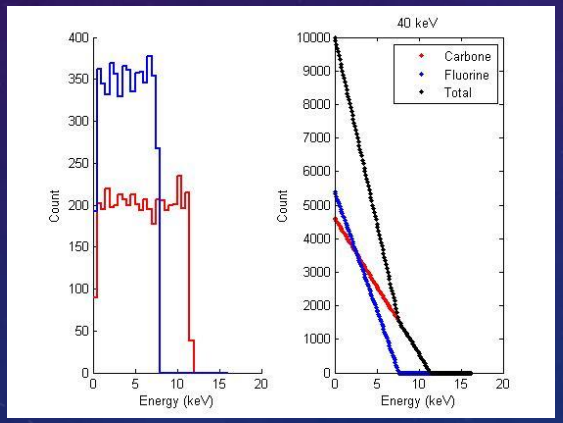


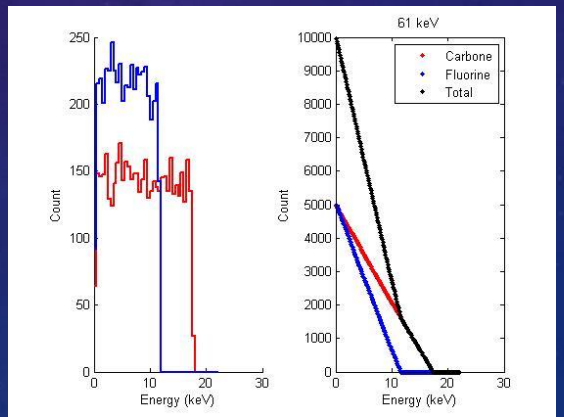
EXPECTED RESPONSE

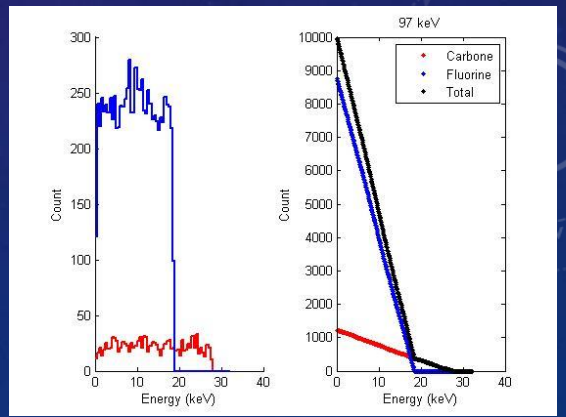
$$E_r = \frac{2A}{(1+A)^2}(1-\cos\theta)E_n$$

- Fluor $E_{r,\,max} = 0{,}19\ E_n$
- Carbone $E_{r,\,max} = 0{,}28\ E_n$



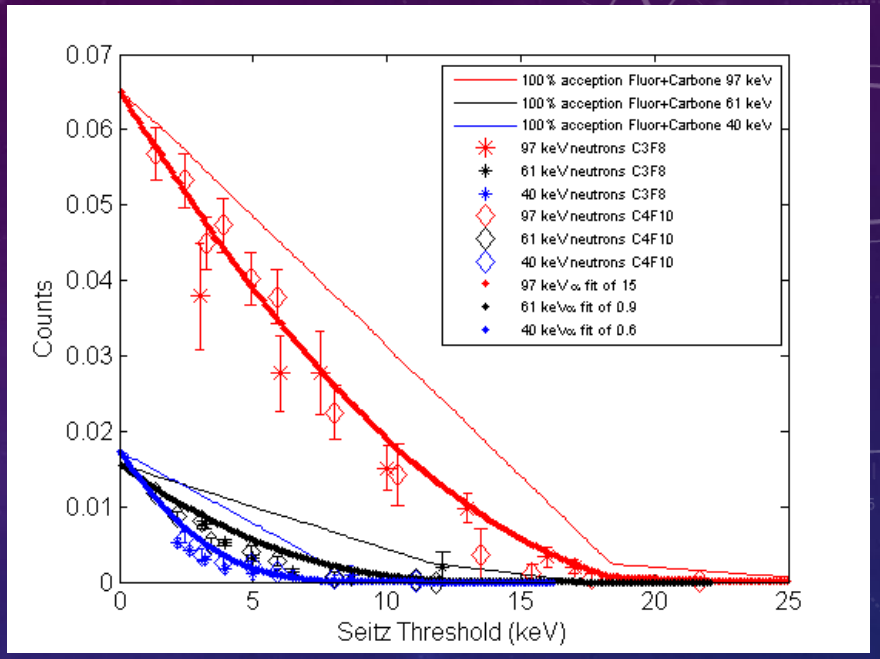


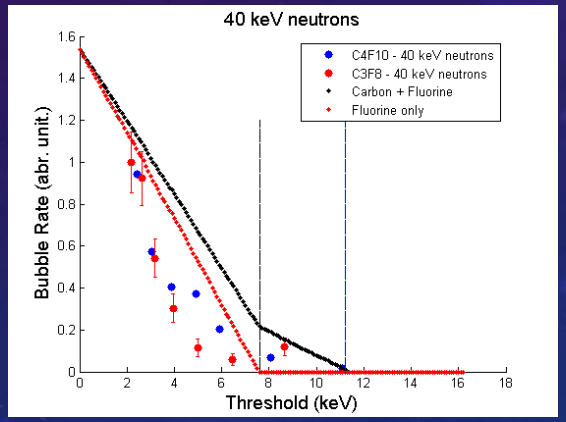


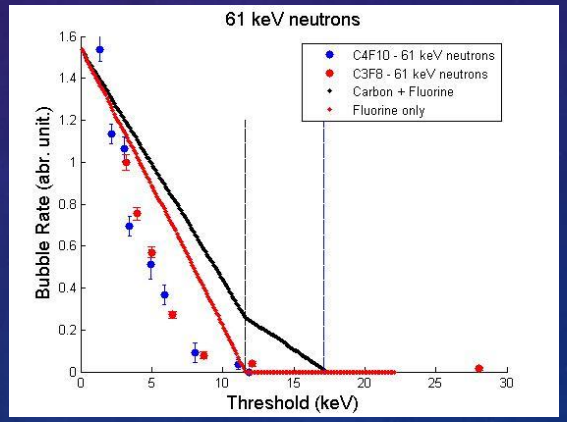


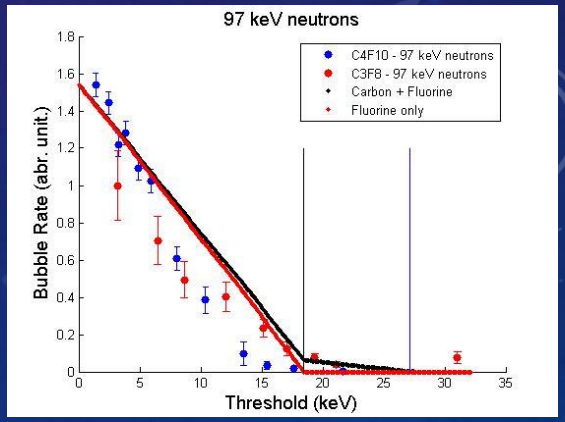
DATA COMPARISON

- C_3F_8 and C_4F_{10} in good agreement
- Count rate proportionnal to cross section as expected
- Soft threshold need to be caracterized
- Does C or F trigger?
- See A.Plante poster









CONCLUSION

- Data taking on the way
- Improoved energy resolution
- **Good agreement between freons/detectors**
- Gradual threshold as to be studied
- Gap region will be probed soon

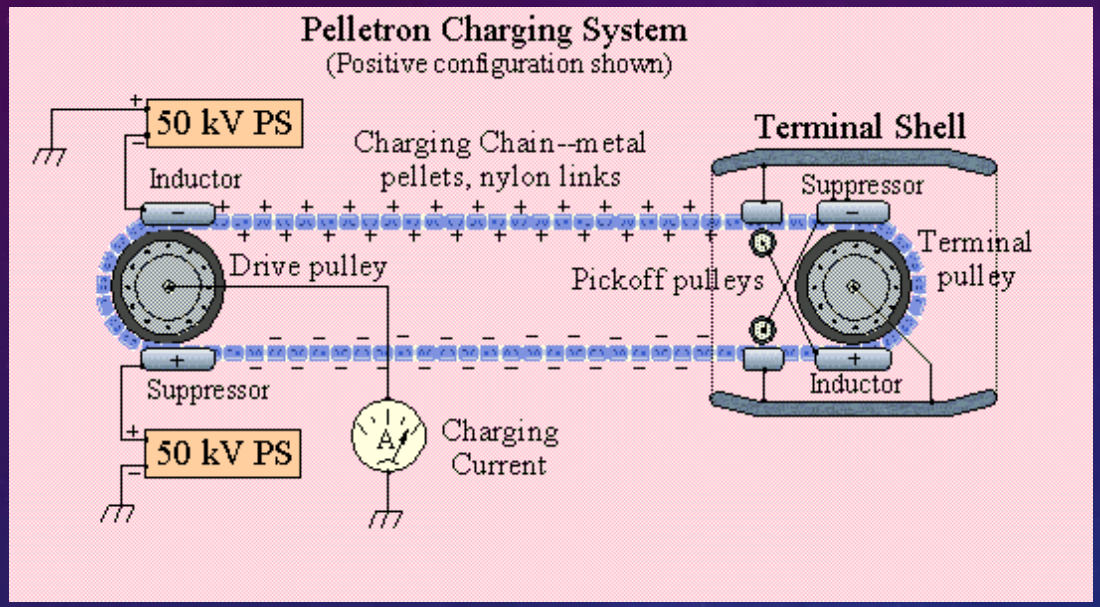
BACKUP

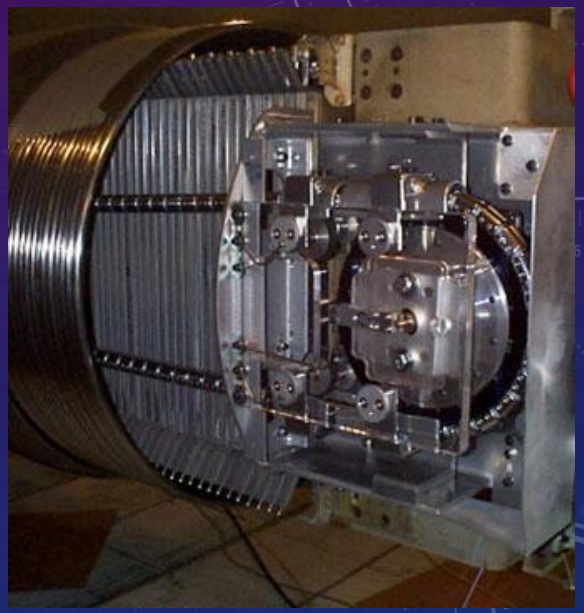
WHY TANDEM?

- Negative ions enter acceleration tube
- Ions are attracted towards central terminal
- Then they enter the stripper section filled with O_2 gas, where they loose their electrons
- Because of the polarity change, the ions are now repulsed from the central terminal towards the end of the tube
- Dual acceleration!

INSIDE TANDEM

PELLETRON CHARGING SYSTEM





- Not a Van de Graff anymore
- Belt replaced with 2 Pelletron system

ENERGY SELECTION/CORRECTION SYSTEM

- Analysing magnet sets the ion energy
- Slits are used to measure deviation and to control the corona probe
- The corona probe draws more or less current on the terminal to adjust its voltage, correcting the energy

PICO 0,1