Light nuclei, new set-ups, persistent challenges

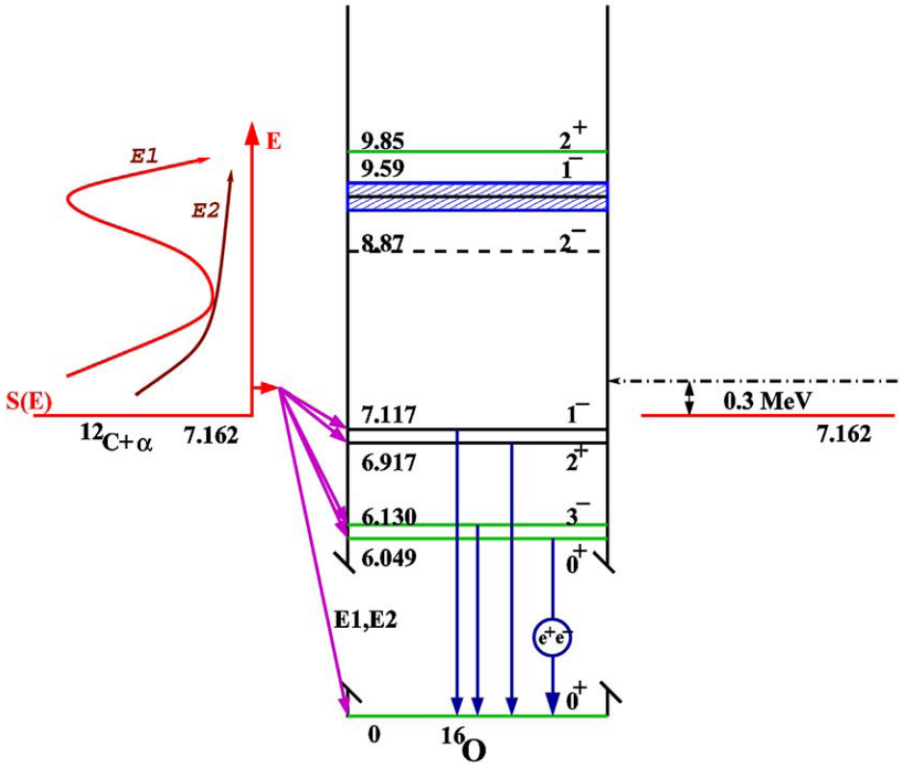
K. Riisager on behalf of
O.S. Kirsebom, O. Tengblad,
IS605 and IS561 collaborations

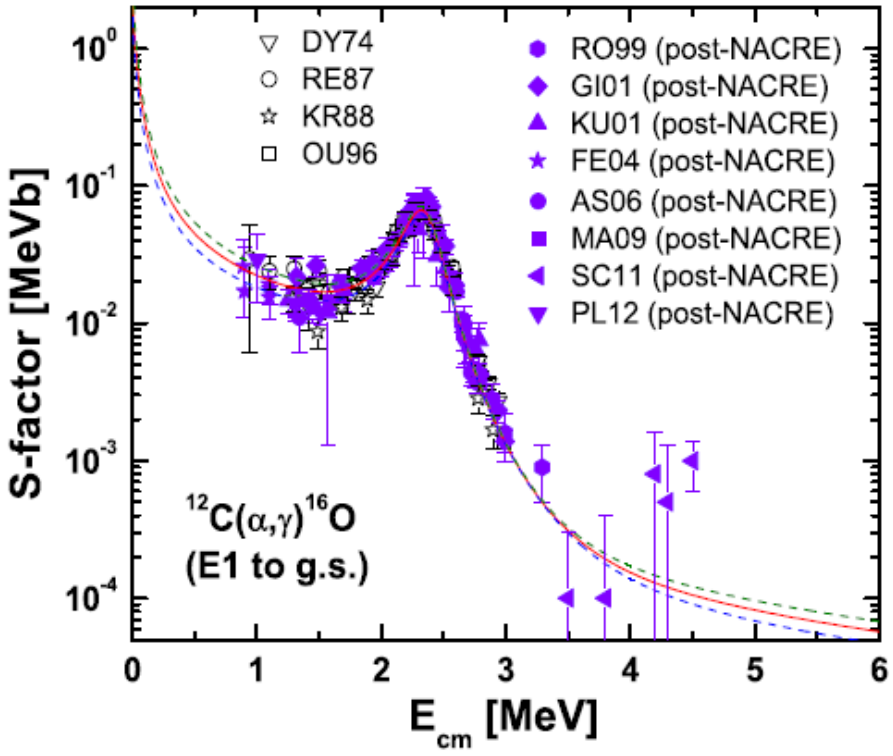
“Persistent challenges”

P. Gregers Hansen: some problems take decades…

- ISOL beams / reaching exotic nuclei
- the nature of neutrinos
- He-burning in stars
- nucleon-nucleon force
- structure of drip-line nuclei

^{12}C to ^{16}O…



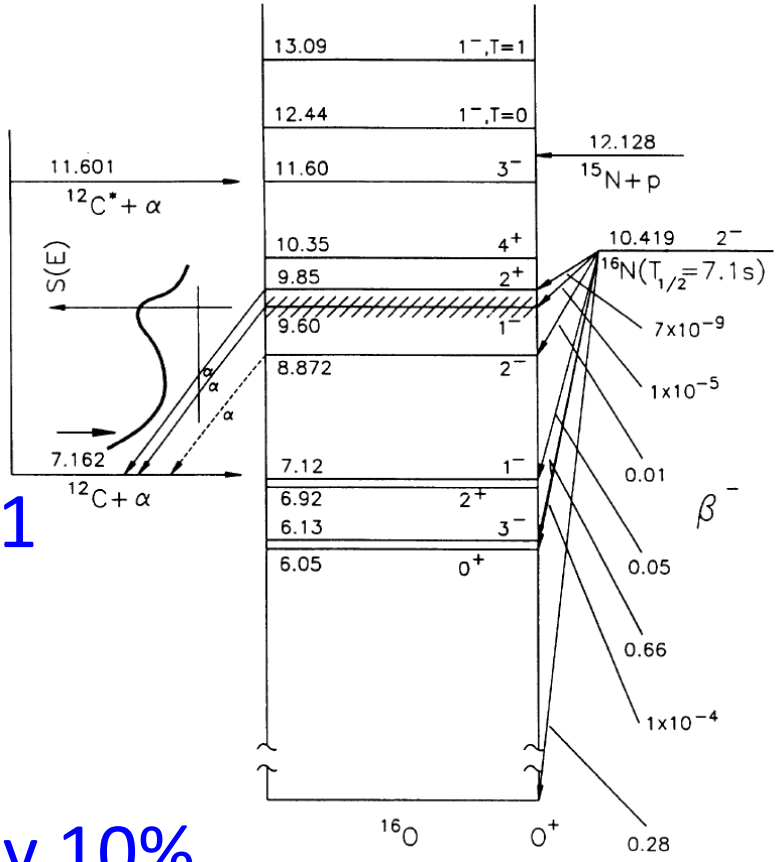


S-factor needed to 10%, look here at E1 part
(recent improvements on E2 and cascade parts)

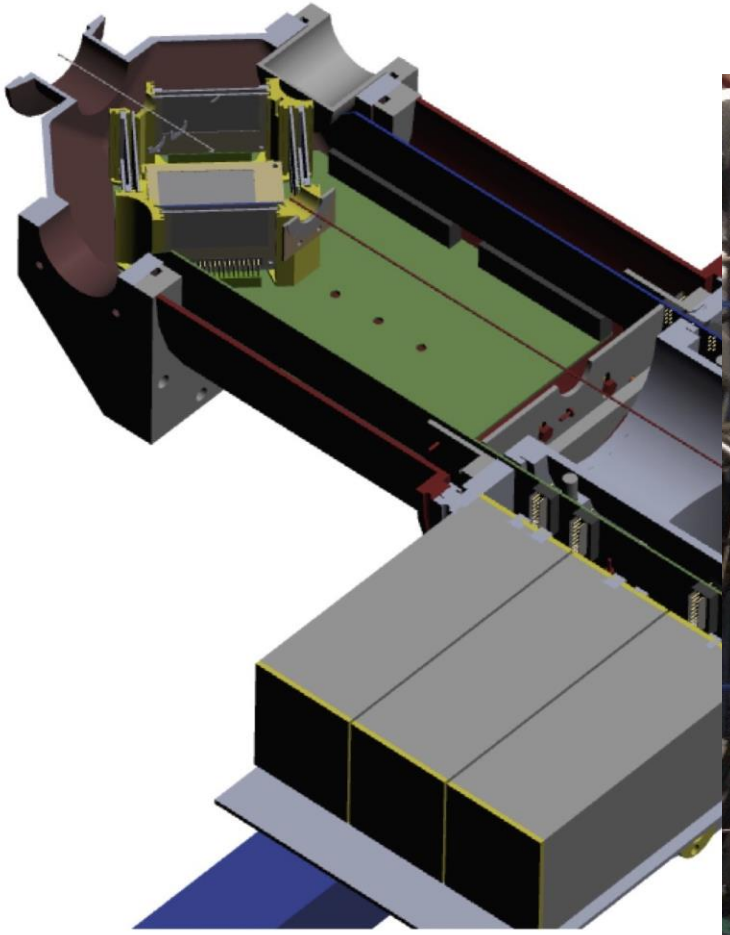
Information from decay of ^{16}N

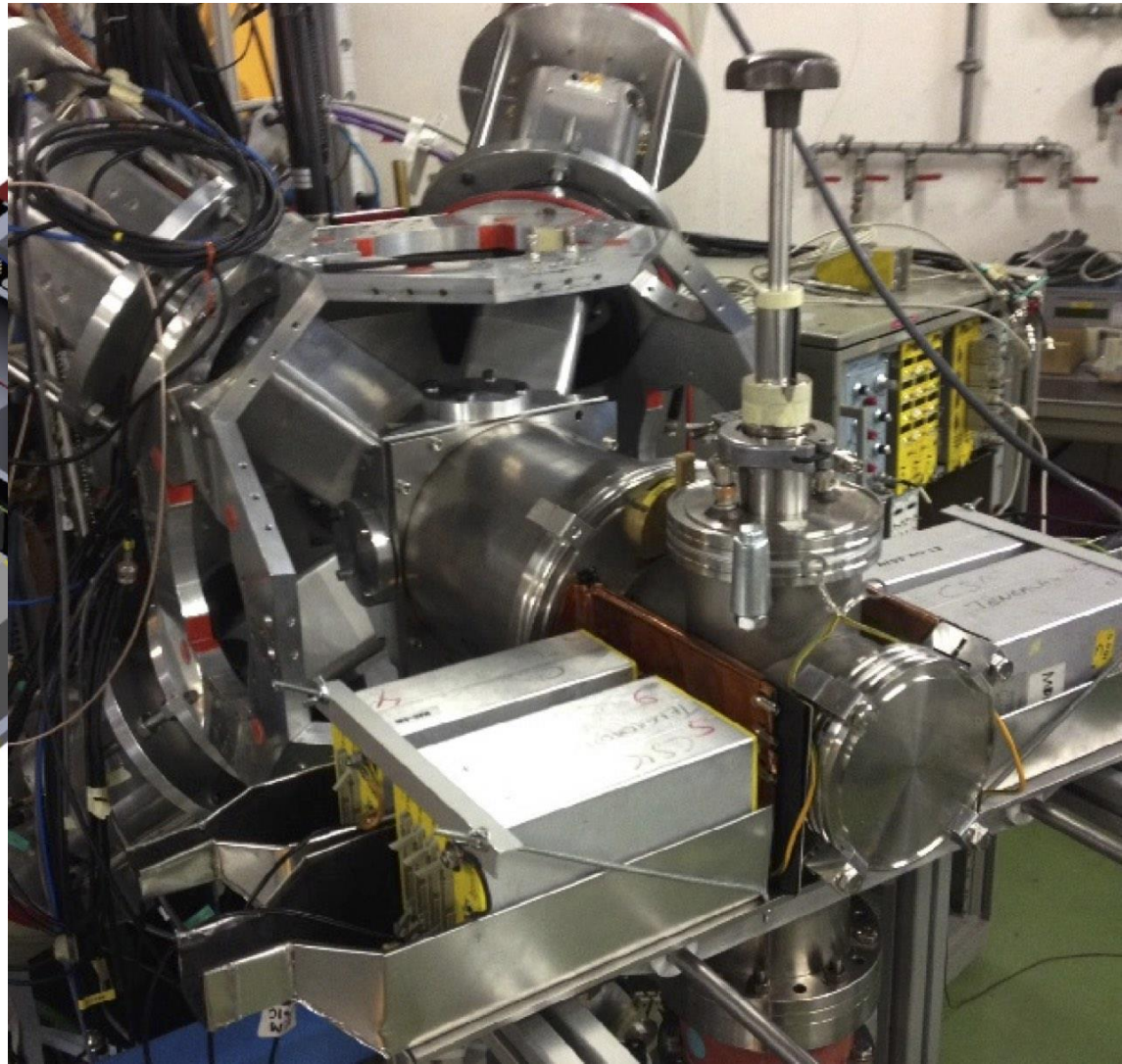
- Shape well known
- Azuma et al, PRC50, 1194

- Branching ratio ?
- Tabulated value from 1961
- New KVI exp: 24% higher
- Refsgaard et al, PLB752, 296
- Would increase S-factor by 10%



IDS new set-up



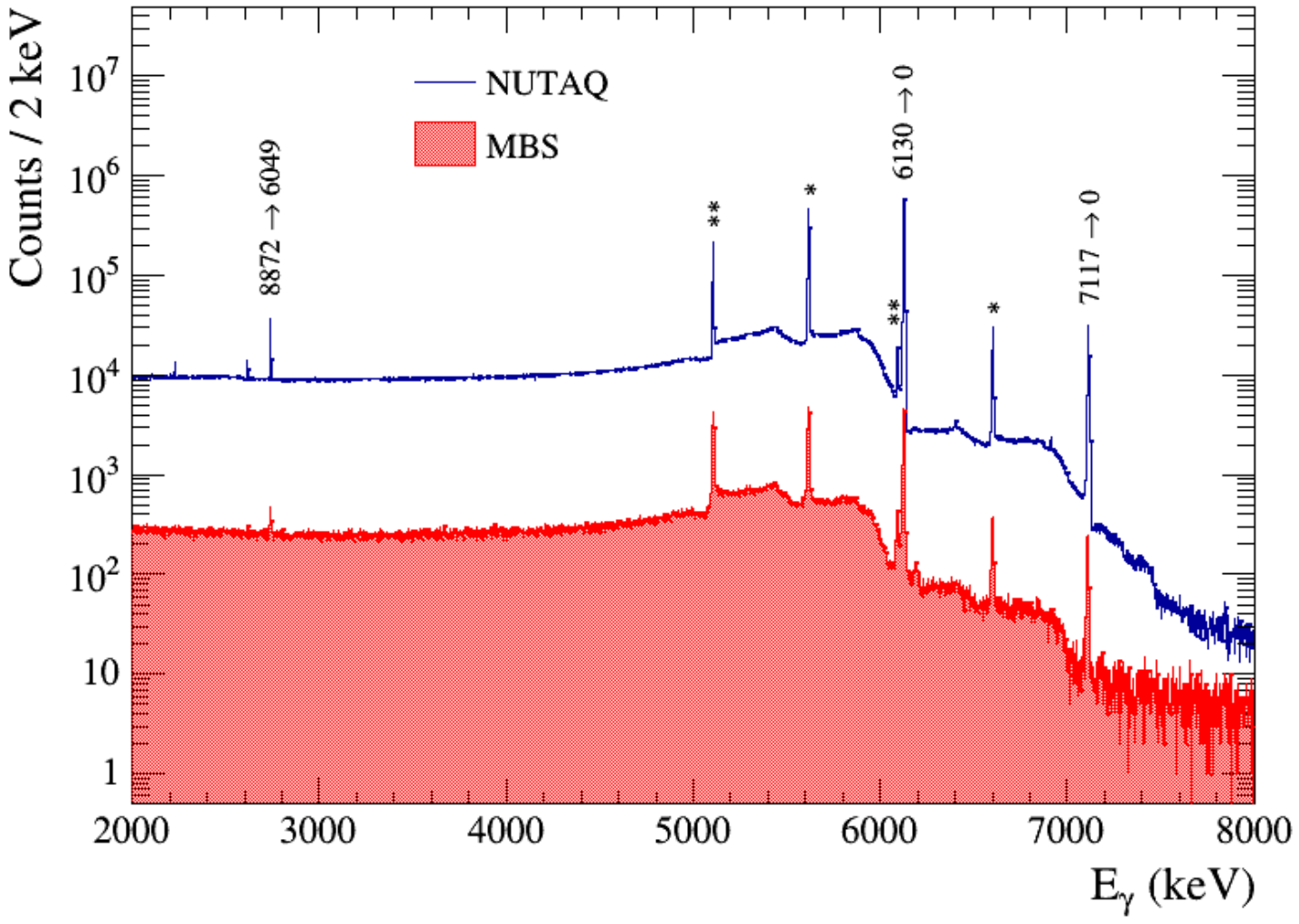


IS605 = ^{16}N beta-alpha branching

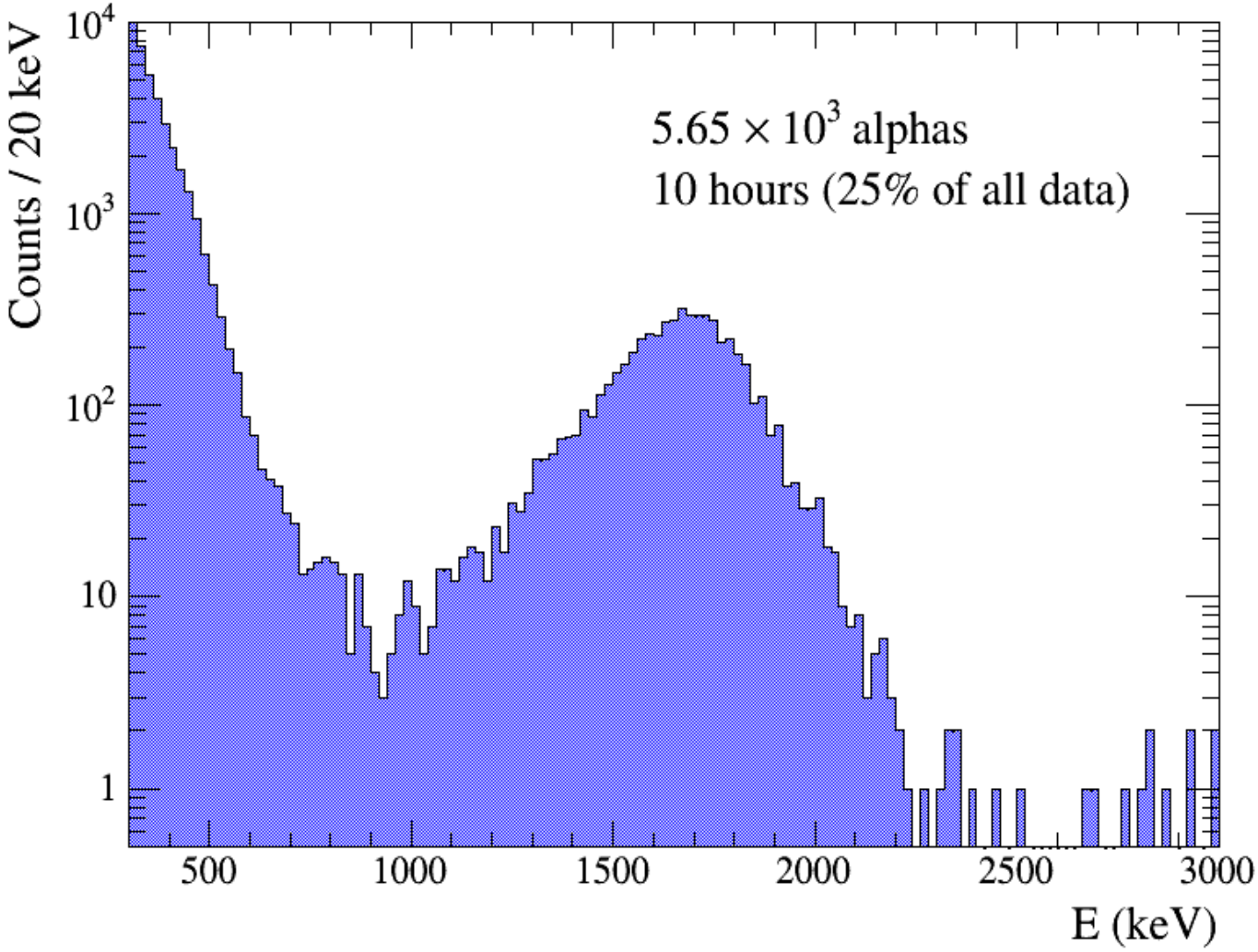
- Normalize with gamma-transition
  - 2.74 MeV gamma-ray known to 7% accuracy
  - sources + ^{34}Ar gammas, could get 10%...
  - 6.13 MeV gamma-ray known to 0.9% accuracy
  - ^{16}N or ^{17}Ne via coincidence/singles, reach 2% ?

- Measure alpha intensity…
- Branching ratio better than 5% within reach !

^{16}N gamma-spectrum, addback



^{16}N β-delayed α spectrum

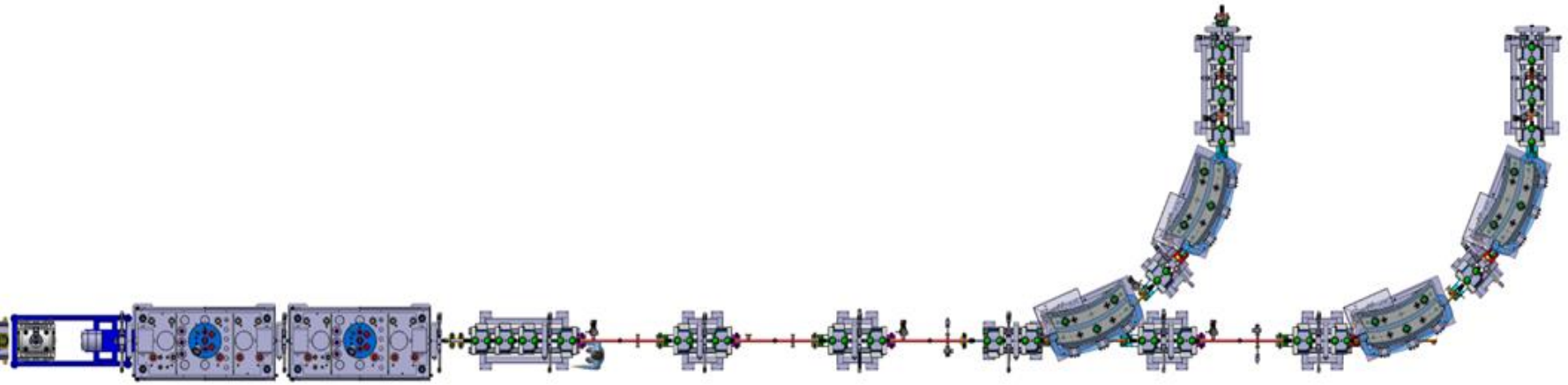


Future use at IDS

- Beta-delayed charged particle emission
- Nuclei with beta-proton/alpha and beta-gamma competition
- Very proton-rich nuclei with beta-proton-gamma cascades, e.g. elements Na-Cl

XT02 beamline

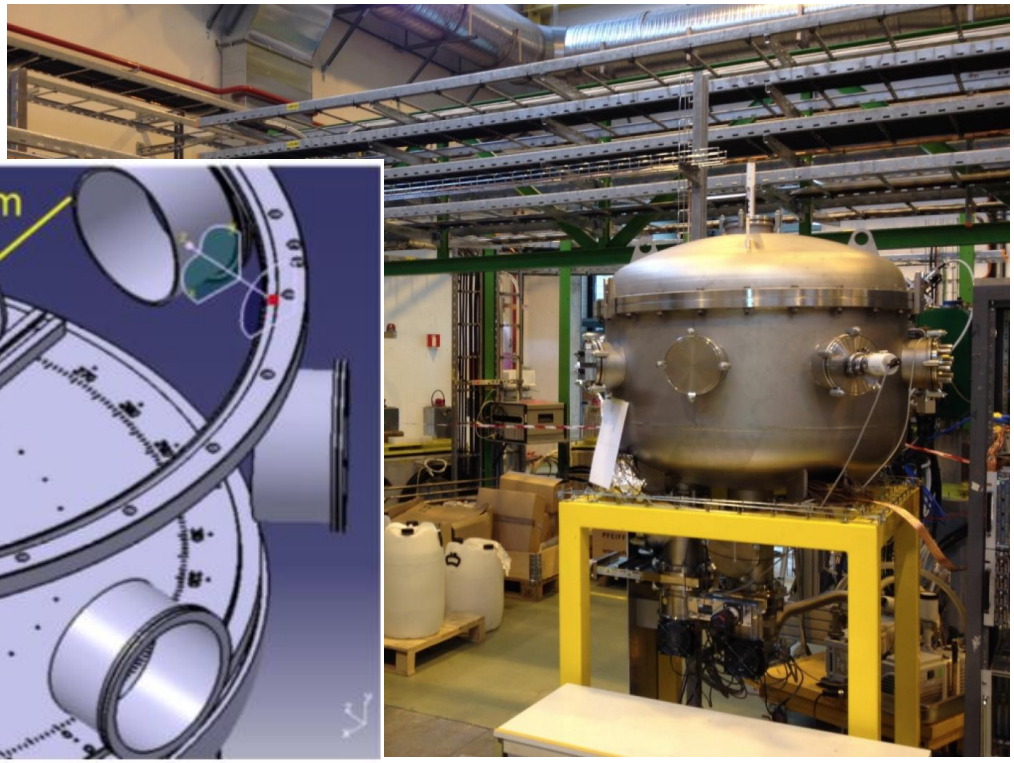
- HIE-ISOLDE M.J.G. Borge + KR, Eur.Phys.J. A (2016) 52: 334
- Now: General purpose scattering chamber
- Miniball at XT01
- With 3rd beamline: ISS

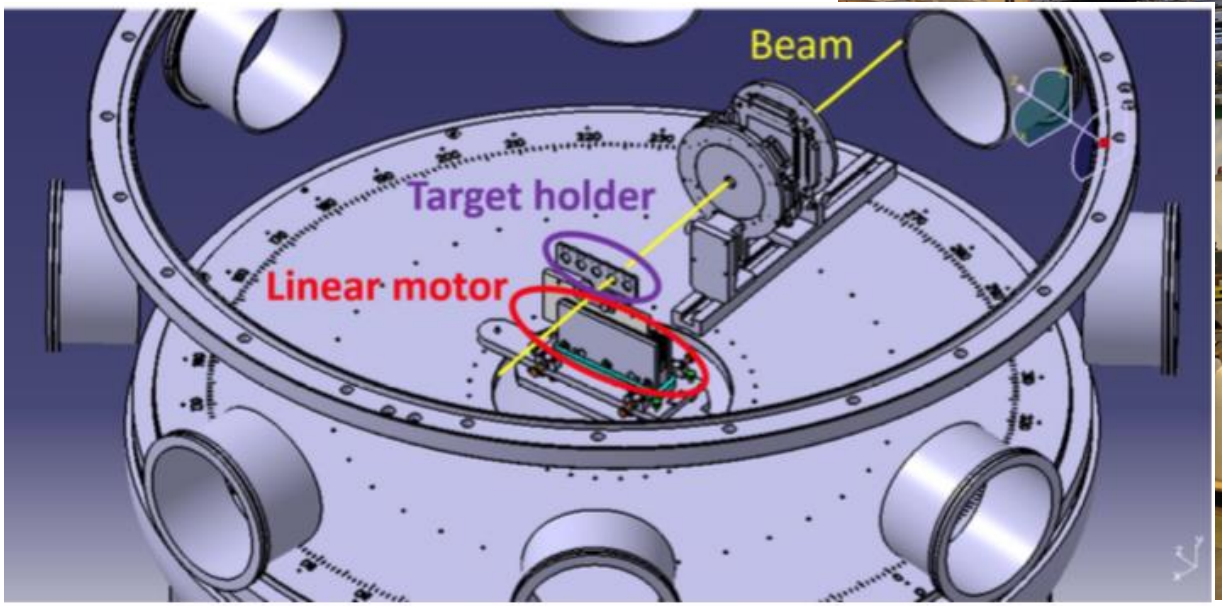


General purpose scattering chamber

- Several different experiments:

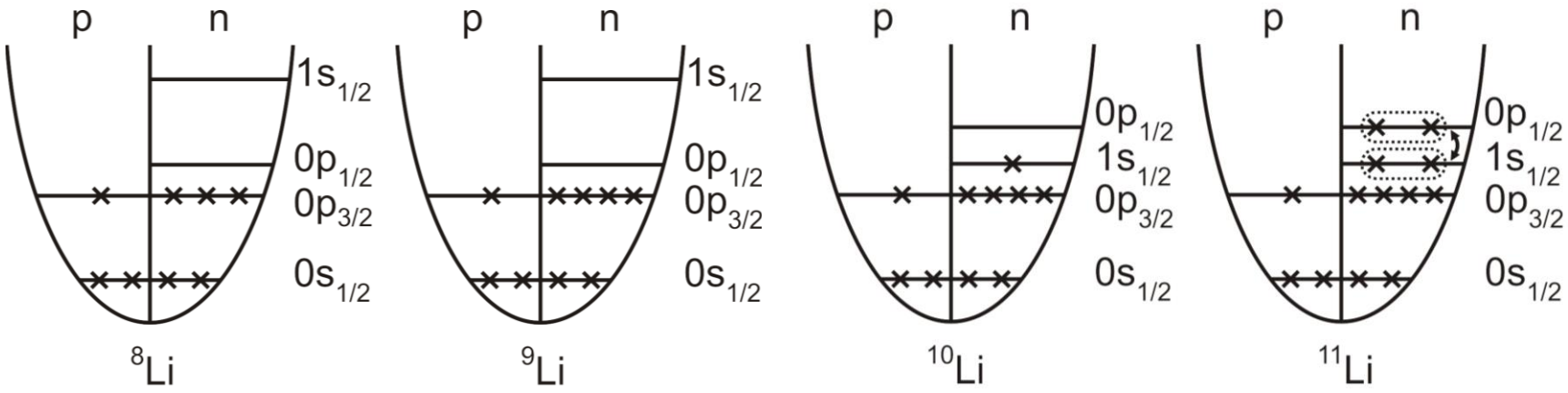
  IS550 (Z_1+Z_2=120), IS561 (^{9}Li), IS616 (^{8}B), …





Inside the vacuum chamber, the transmitter and the motorized system.

IS561 = ^{9}Li+d/t scattering

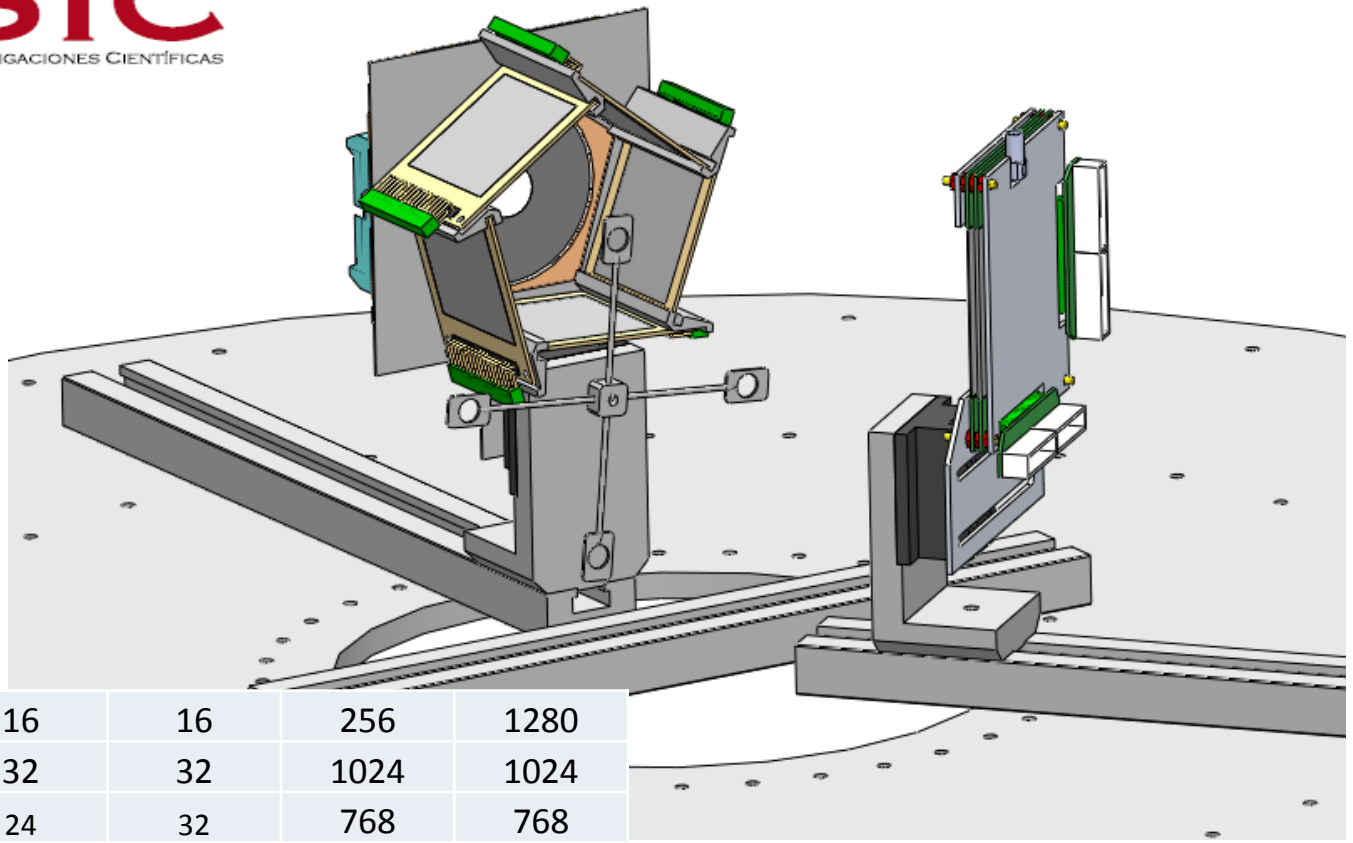


Purpose: Study the structure of neutron-rich lithium isotopes using transfer reactions.

Goal: Reaction cross-sections compared with theoretical models, spectroscopic factors.

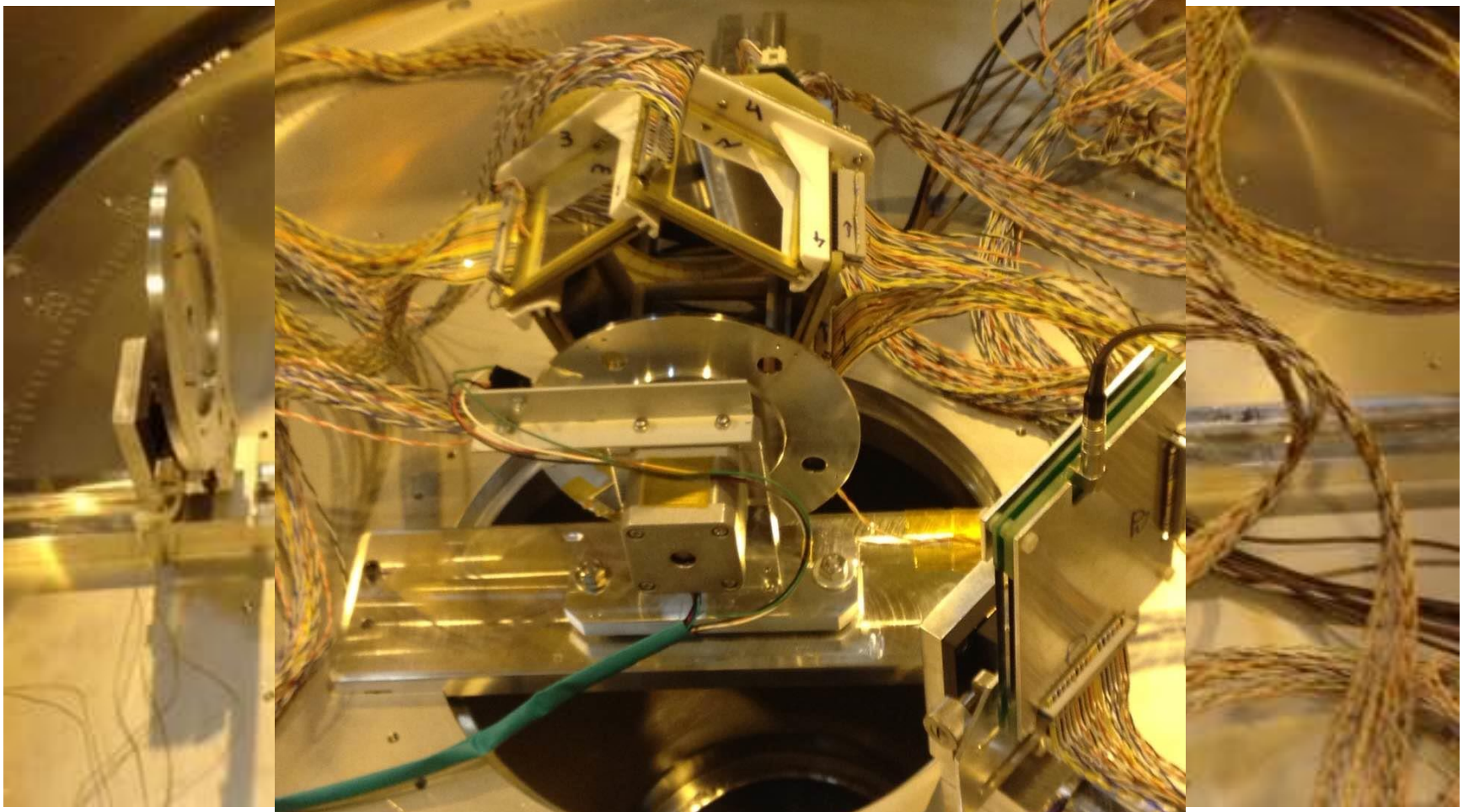
Experimental set-up for ^{9}Li

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS



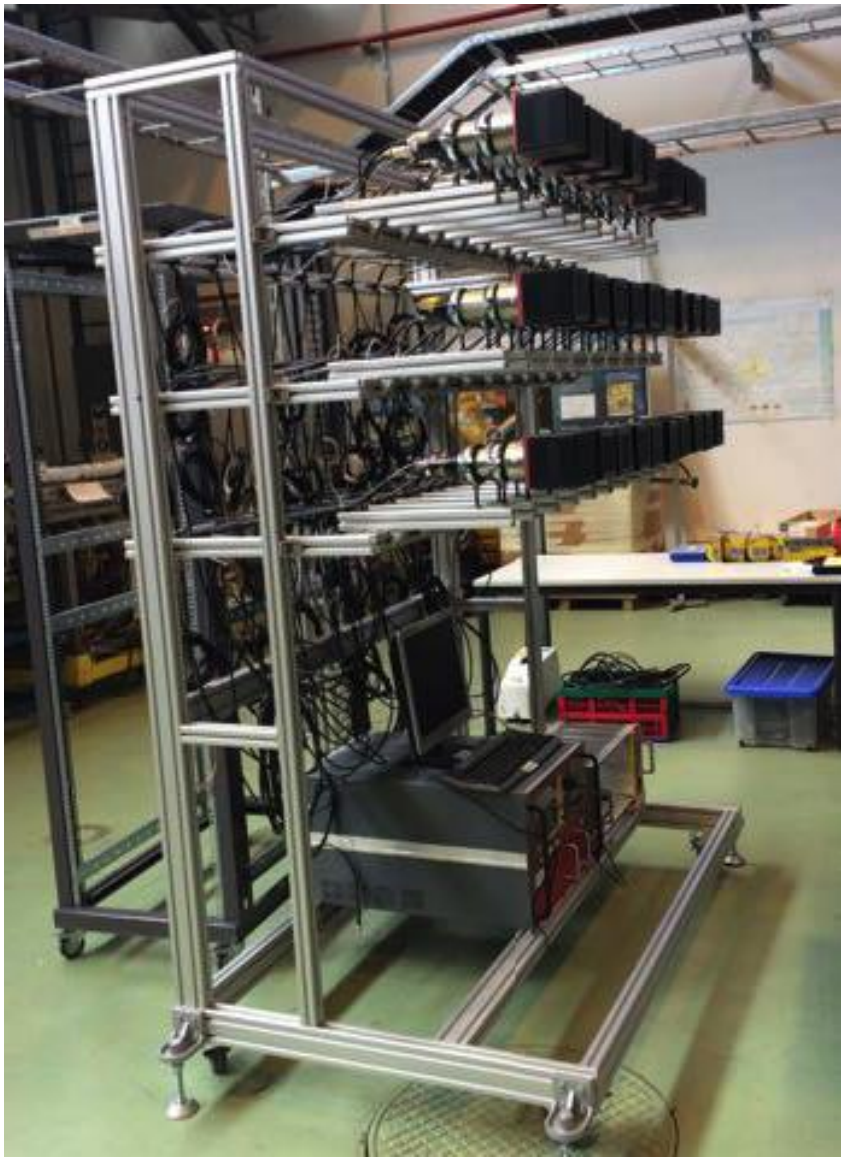
5	16	16	256	1280
1	32	32	1024	1024
1	24	32	768	768
		Total number of pixels: 4 - 9 mm^2		3072

Photo mber



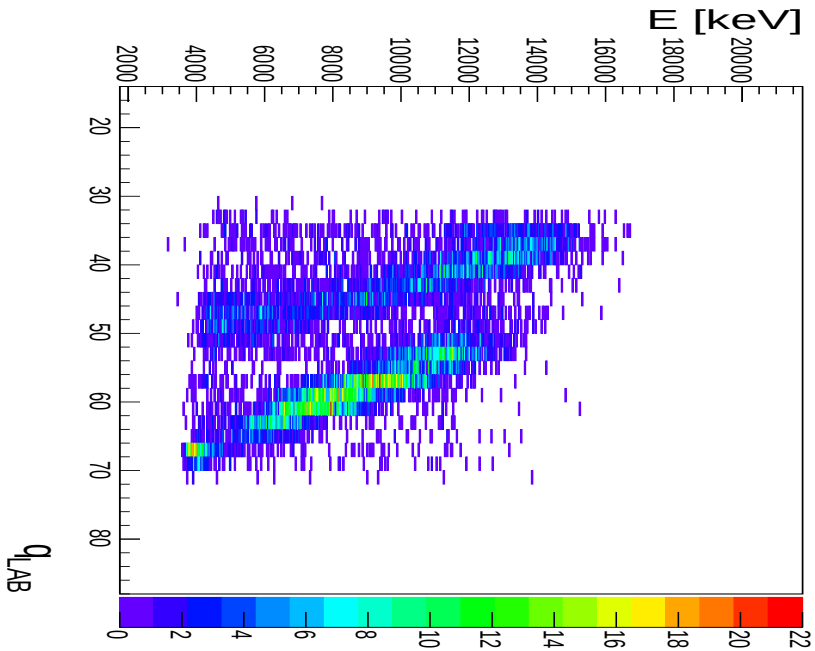
Neutron detector array SAND

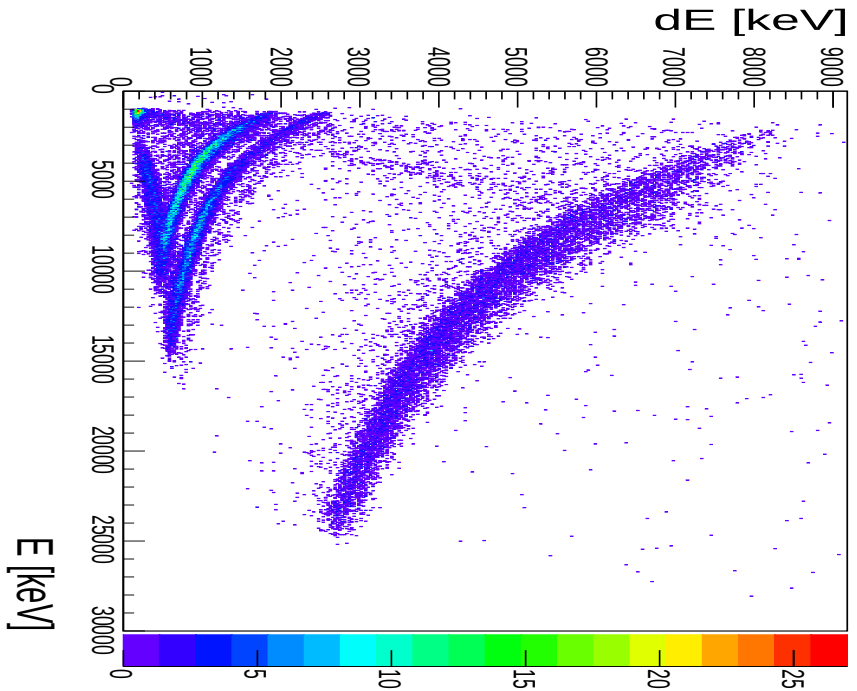
30 individual modules
Plastic scincillator 10x10x10cm/TPS-100
Fast PM tubes/XP4312 PHOTONIS
SY1527 CAEN Power Supply (neg. V)



Preliminary results

- Run with A/Q = 3, 6.8 MeV/u
- Low ^{9}Li intensity, contaminants not a problem
- Alignment difficulties
- Good data taken:

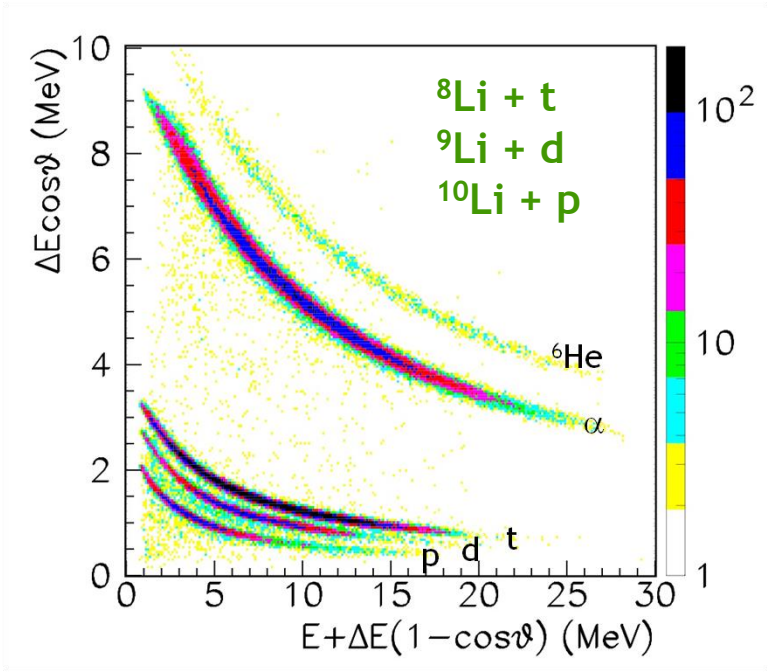


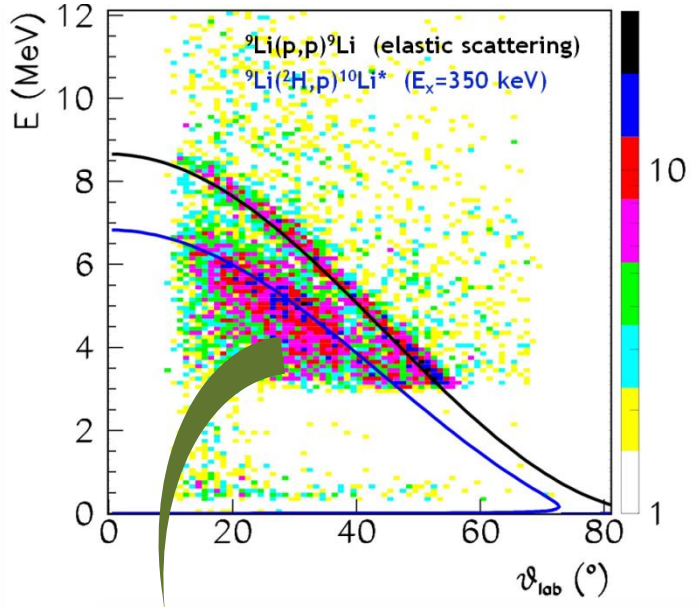


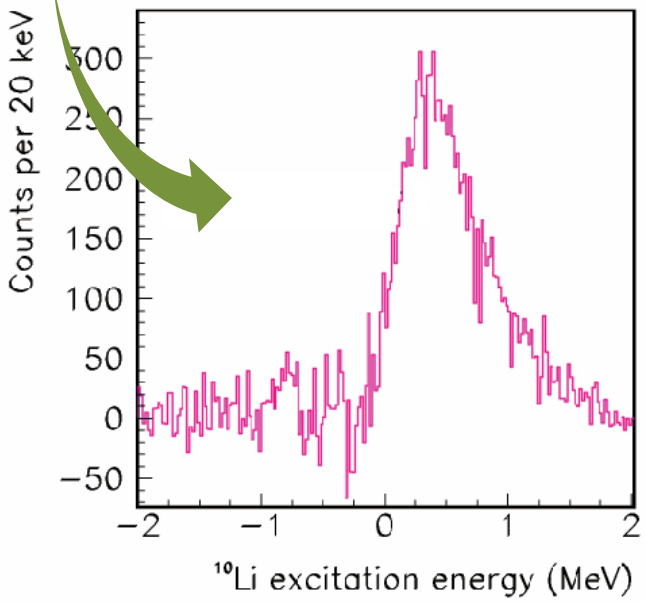
Courtesy Jesper H Jensen

Comparison to 2.77 MeV/u

- 2 10^5 9Li/s
- ^{10}Li from protons







Outlook

- XT02 + scattering chamber in operation
- IS561 to continue in 2017
- More physics possibilities at HIE-ISOLDE…

New/improved set-ups enables ISOLDE to contribute on persistent challenges