Confirmation of the molecular structure of excited bands in ^{21}Ne

AGATA with TRACE

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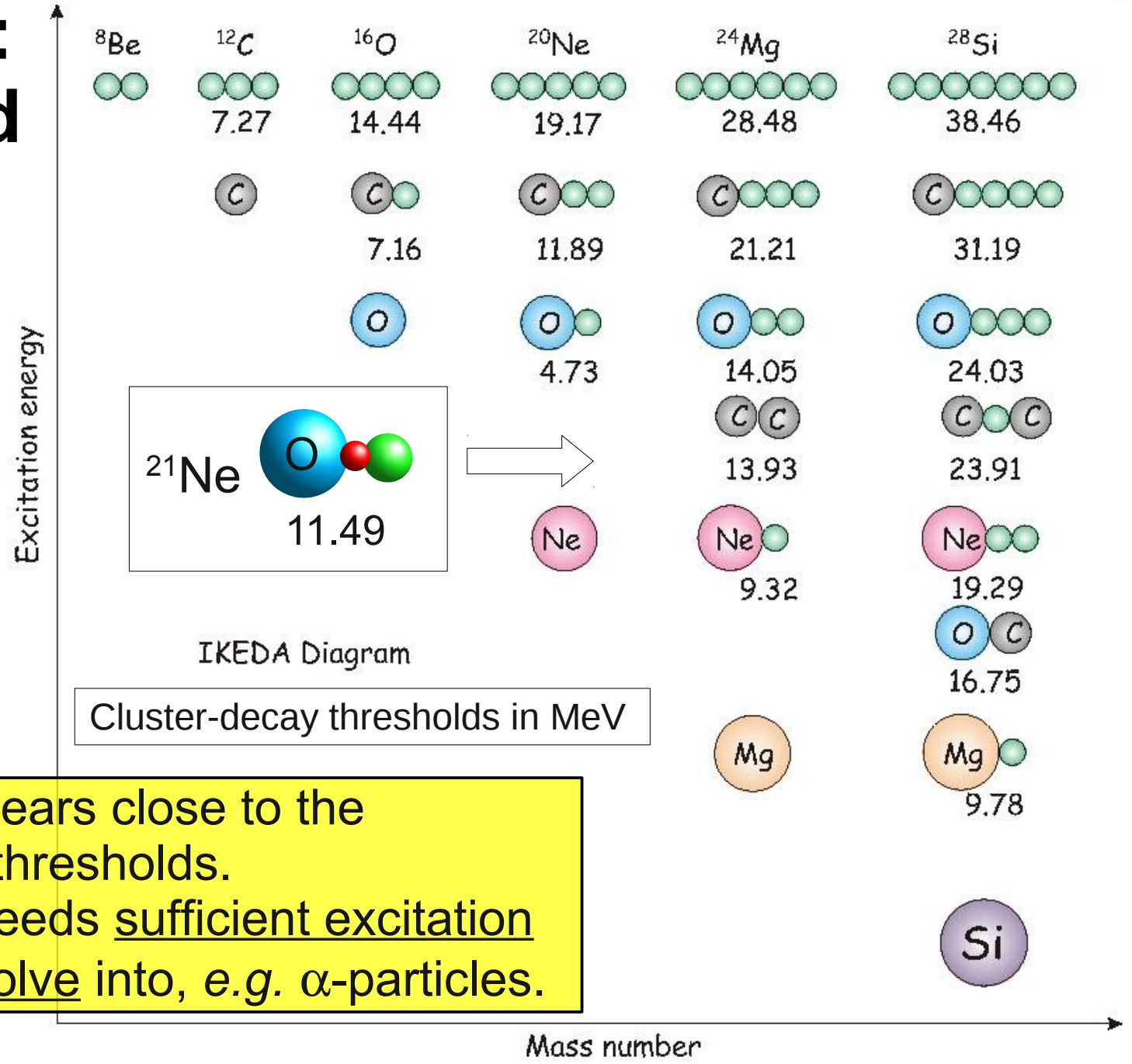
Clustering: a threshold effect

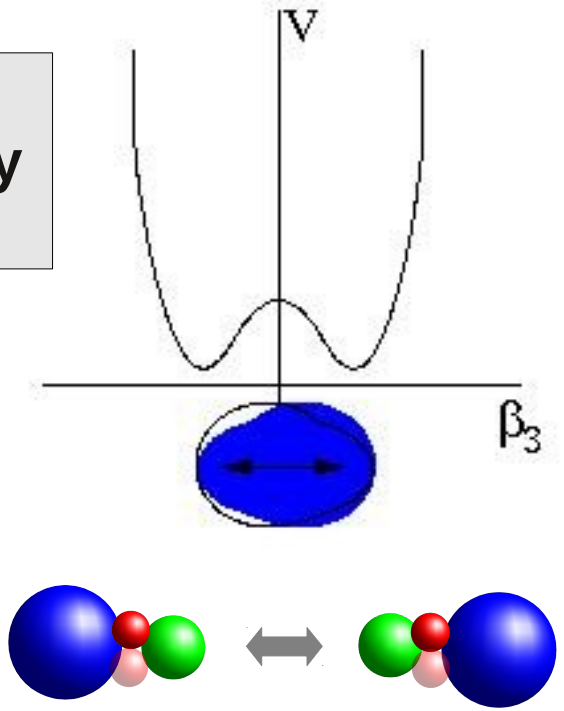


Clustering appears close to the cluster-decay thresholds.
The nucleus needs <u>sufficient excitation energy to dissolve</u> into, *e.g.* α-particles.

Tunnelling & octupole deformation in ^{21}Ne

^{21}Ne: K=3/2 doublet

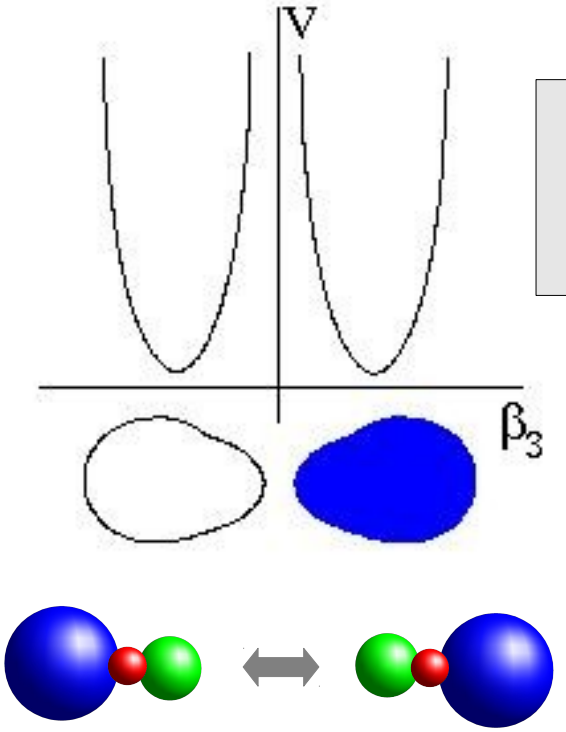
Tunnelling: **large energy splitting**



π-bond: *n*-distribution **away** from axis

^{21}Ne: K=1/2 doublet

No tunnelling: **degenerate levels**



σ-bond: *n*-distribution **on** the axis

Results from GASP+ISIS

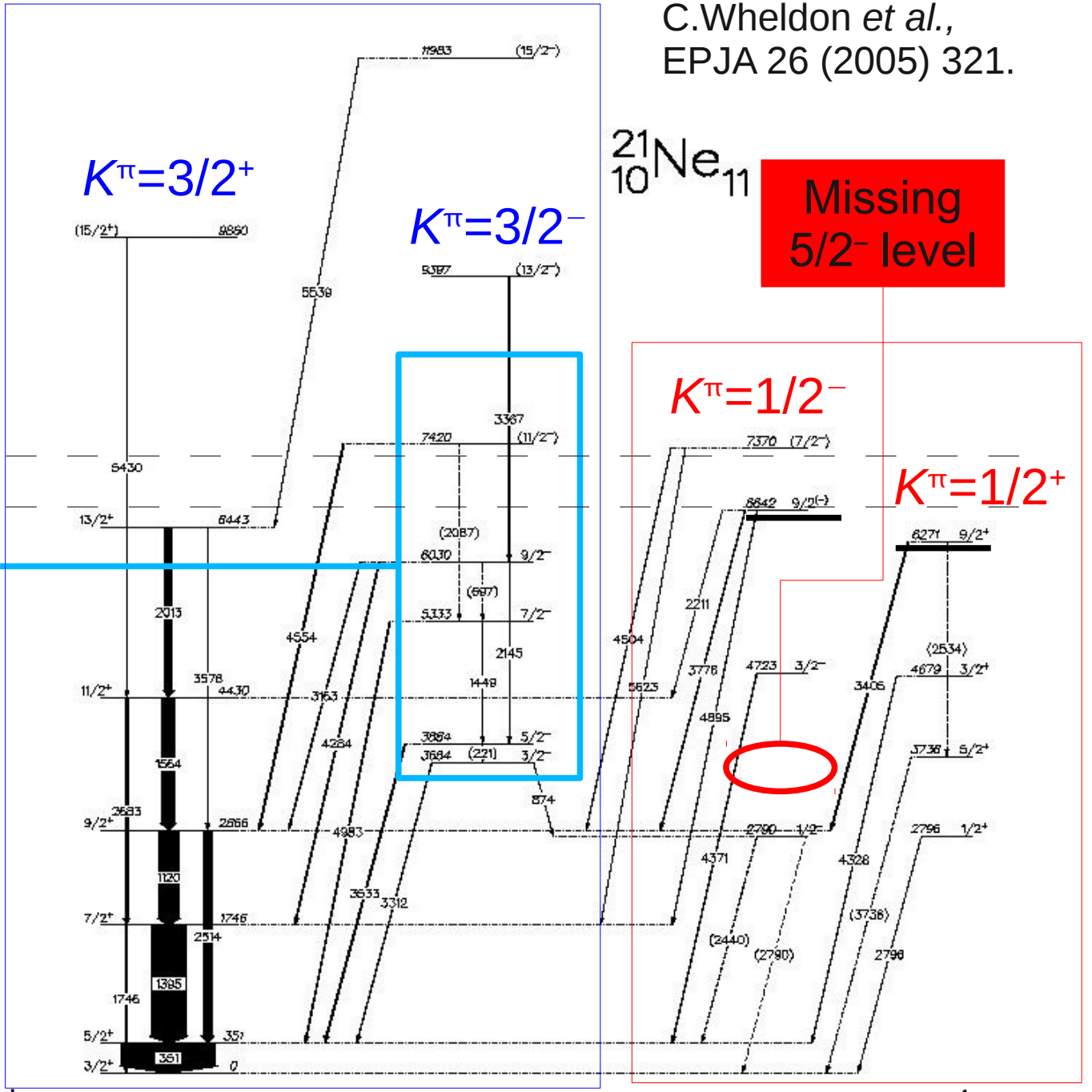
Neon-21 was the contaminant channel

C.Wheldon *et al.*, EPJA 26 (2005) 321.

In-band transitions

Both parity-doublet pairs are observed → the reaction populates the states of interest.

$^{16}O(^{7}Li, n\,p)^{21}Ne$



What makes a rotational band?

Gamma-ray spectroscopist	Particle spectroscopist
•Enhanced in-band transitions	•Common cluster decay widths
•Rotational energy dependence	•Rotational energy dependence
•In-band branching ratios	•Decays to similar daughter states

Usually, without the in-band transitions, some degree of uncertainty over band structures remains. This is true for many cluster bands in light nuclei.

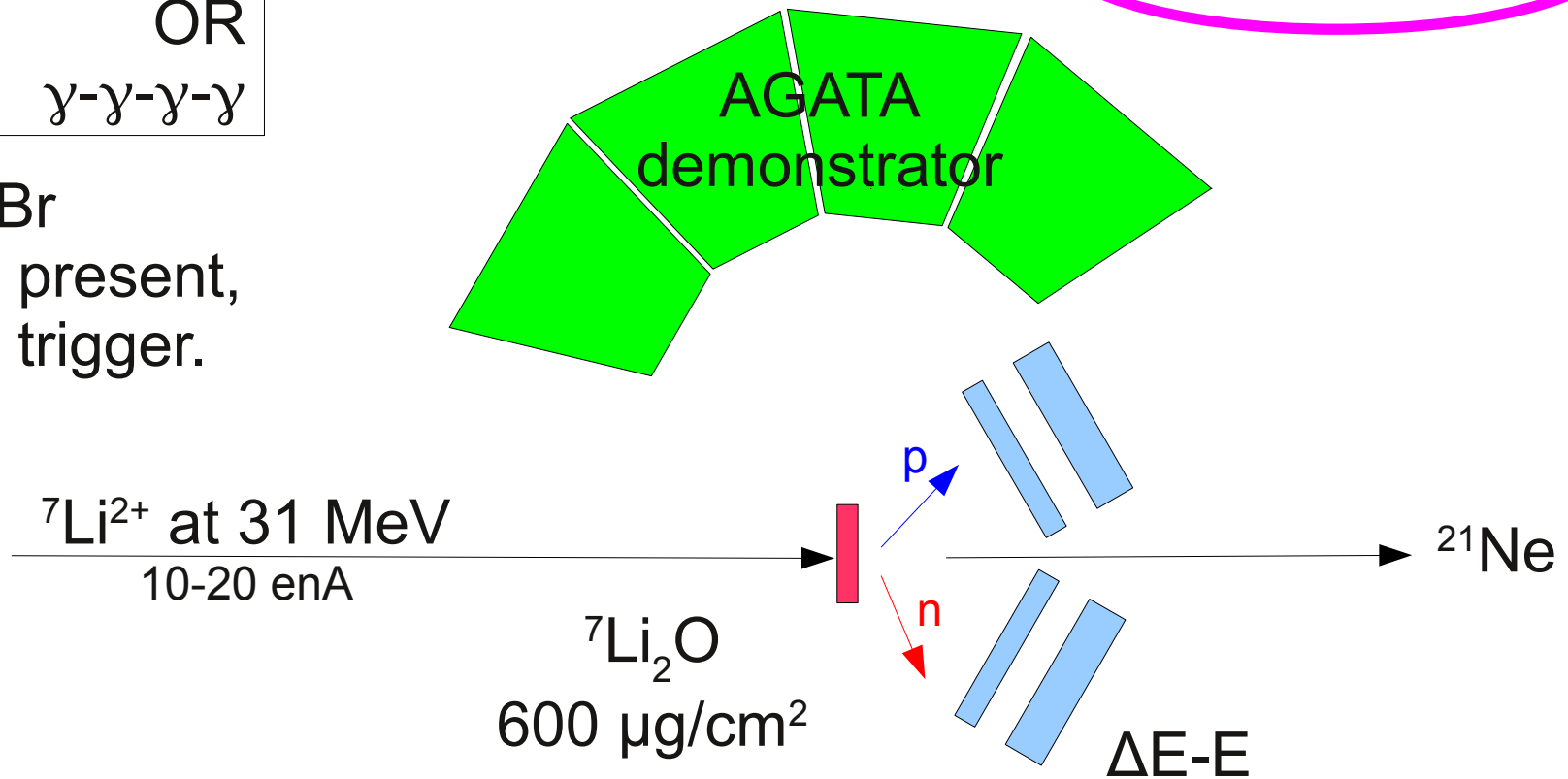
Neon-21 is UNIQUE. The structures can be assigned and studied unambiguously.
Level lifetimes are known. Need branching ratios.

Experimental set-up

Trigger: γ-γ-Trace
OR
γ-γ-γ-γ

Some LaBr detectors present, but not in trigger.

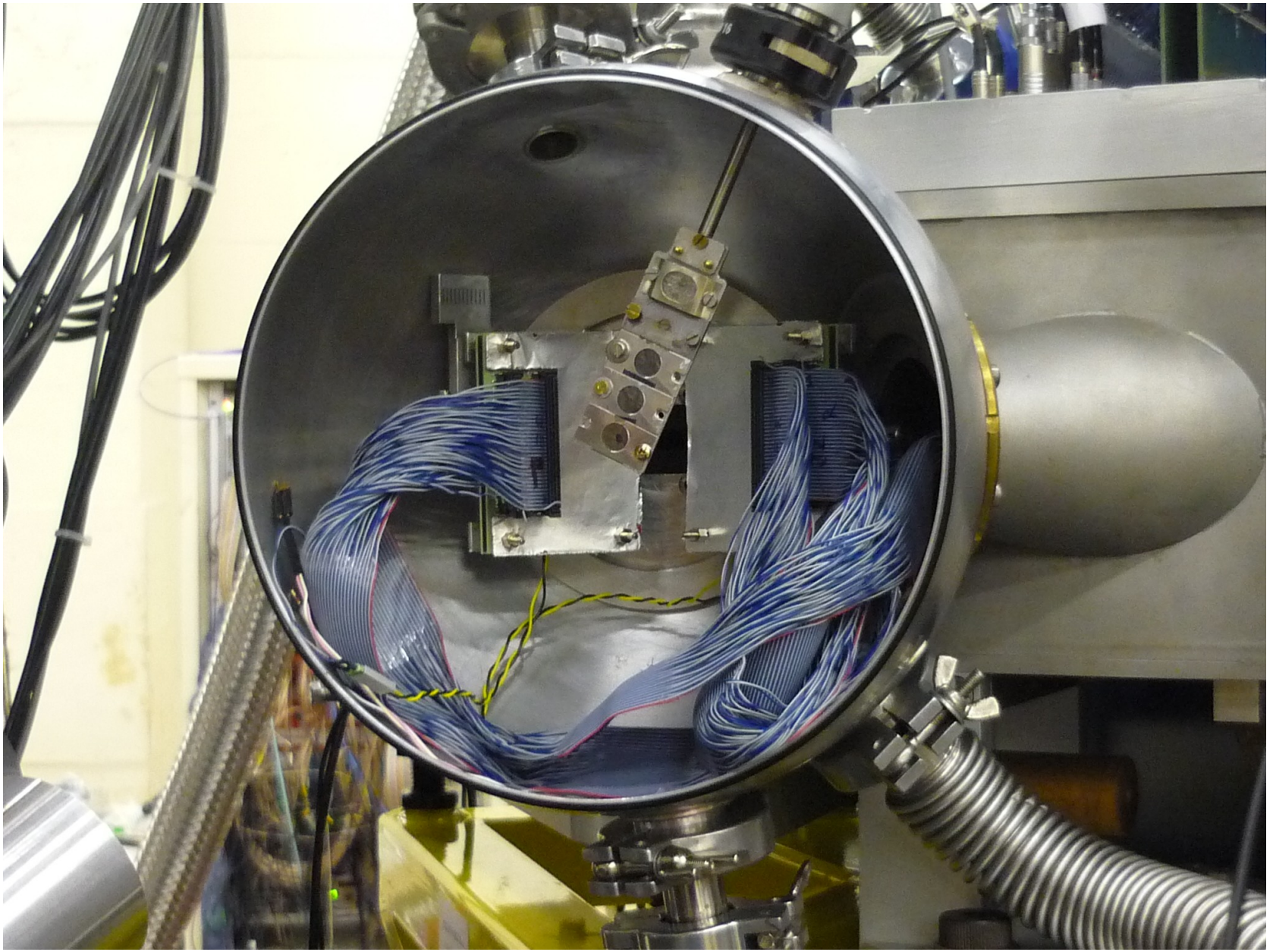
$^{16}O(^{7}Li, n\ p)^{21}Ne$



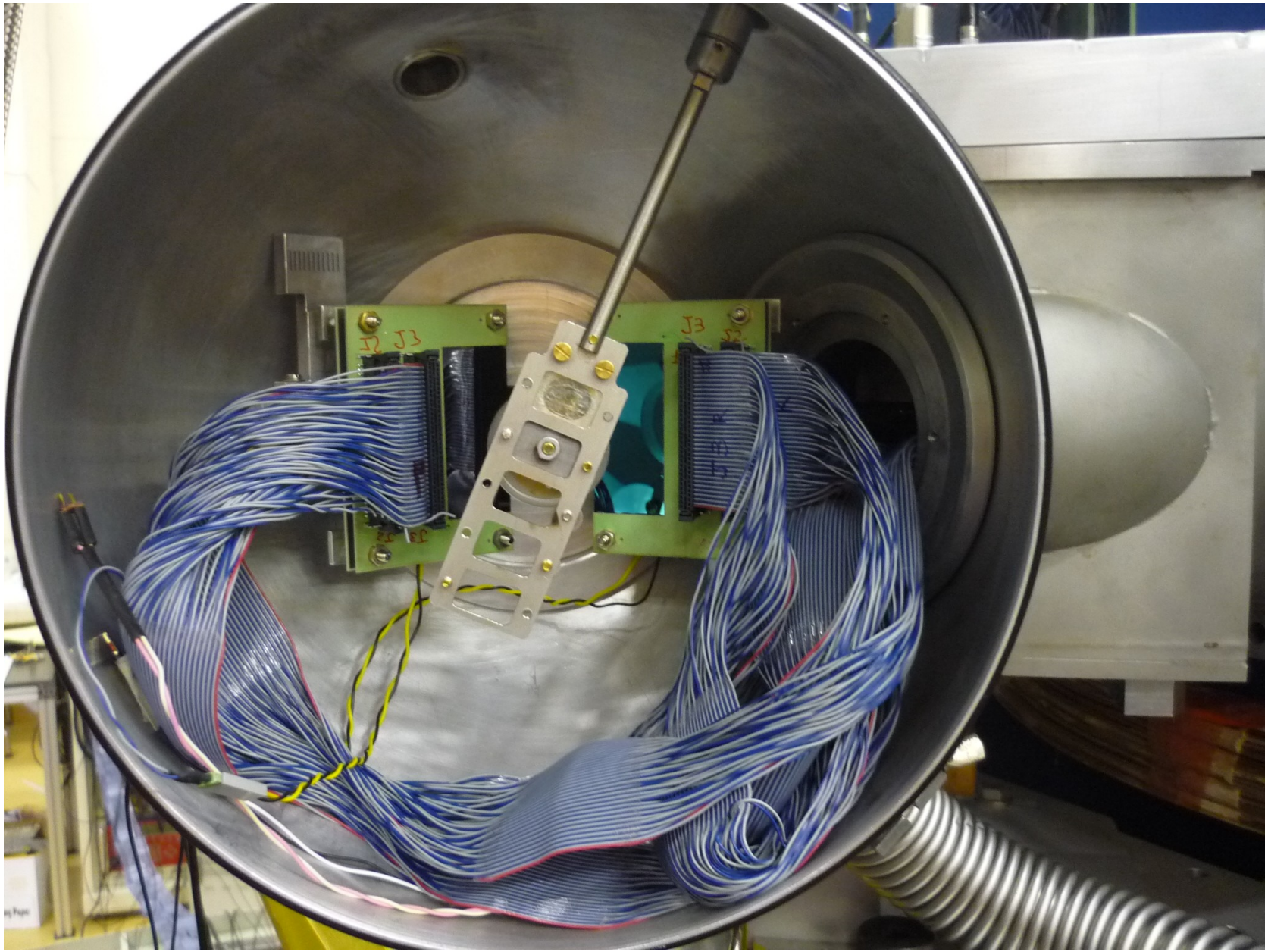
AGATA-target distance: 155 mm
AGATA rate: <10 kHz (validated)
Trace rate: <6 kHz (30% validated)

Al absorbers → protons > 4 MeV

Experimental set-up



Experimental set-up

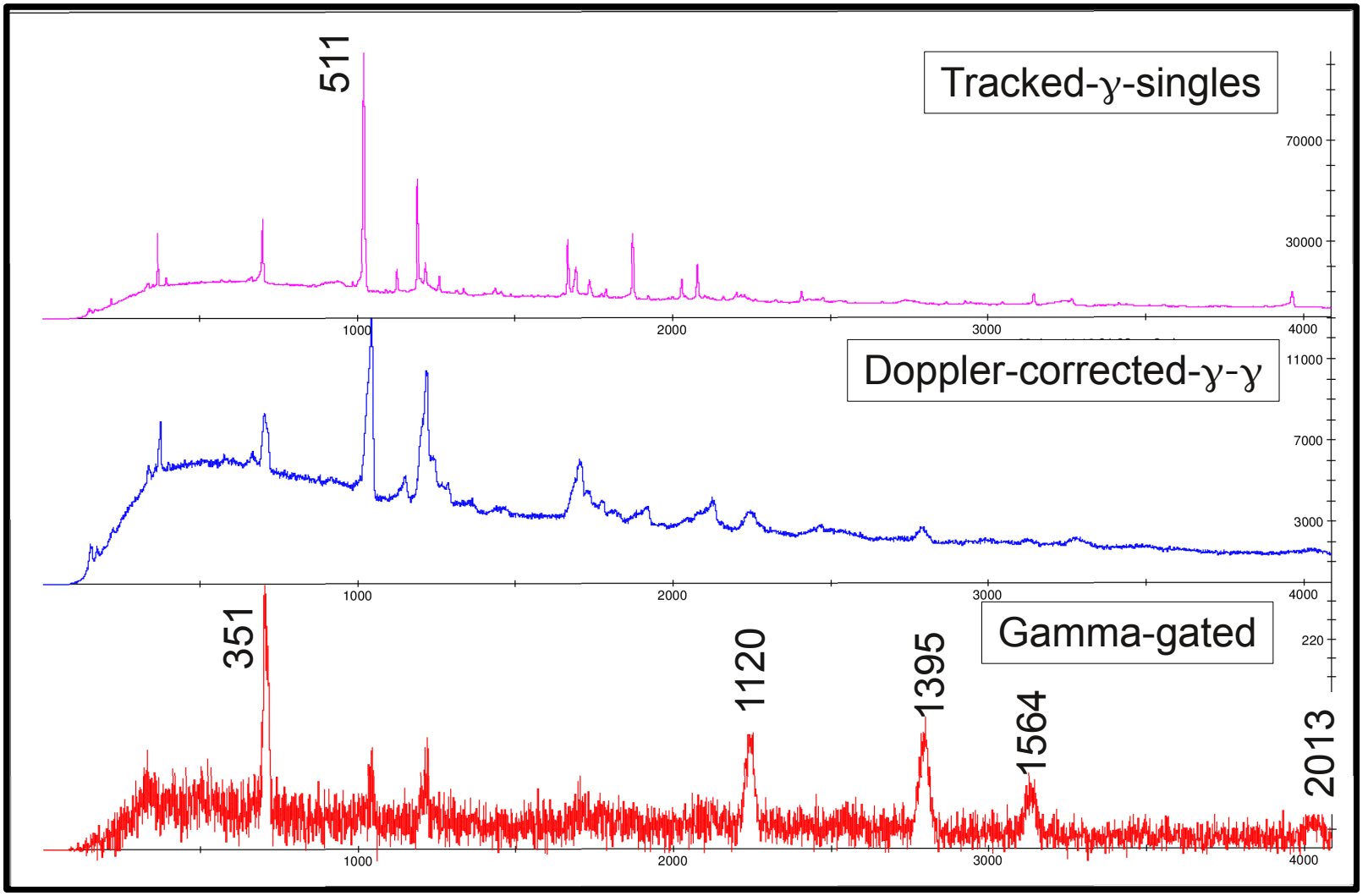


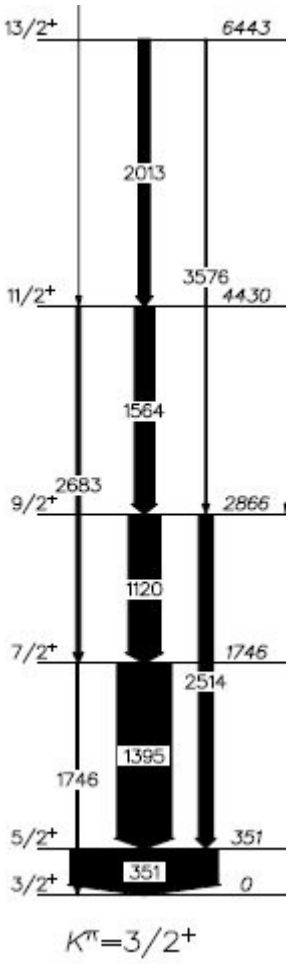
Experiment

- Five days of beam time.
- No significant issues; stable beam conditions.
- Energy and initial efficiency calibration made with ^{152}Eu.
- Due to accelerator problems for making the ^{56}Co source, still awaiting high-energy efficiency calibration. Source production, 29th July, followed in August by calibration.

Spectra

Disclaimer: different collection times/runs (near-line analysis)!





Summary

Successful beam time.

Gamma- and particle-coincidences are working

(from near-line analysis).

Aim to measure transition rates via branching ratios.

Final efficiency calibrations to collect.

Collaborators

Birmingham: N. Ashwood, M. Barr, N. Curtis, Tz. Kokalova, J. Malcolm

Krakow: N. Cieplicka

Legnaro: G. De Angelis, D. Bortolato, A. Gottardo, V. Modamio, A. Pipidis, E. Sahin, J.J. Valiente-Dobon

Manchester: D. Cullen

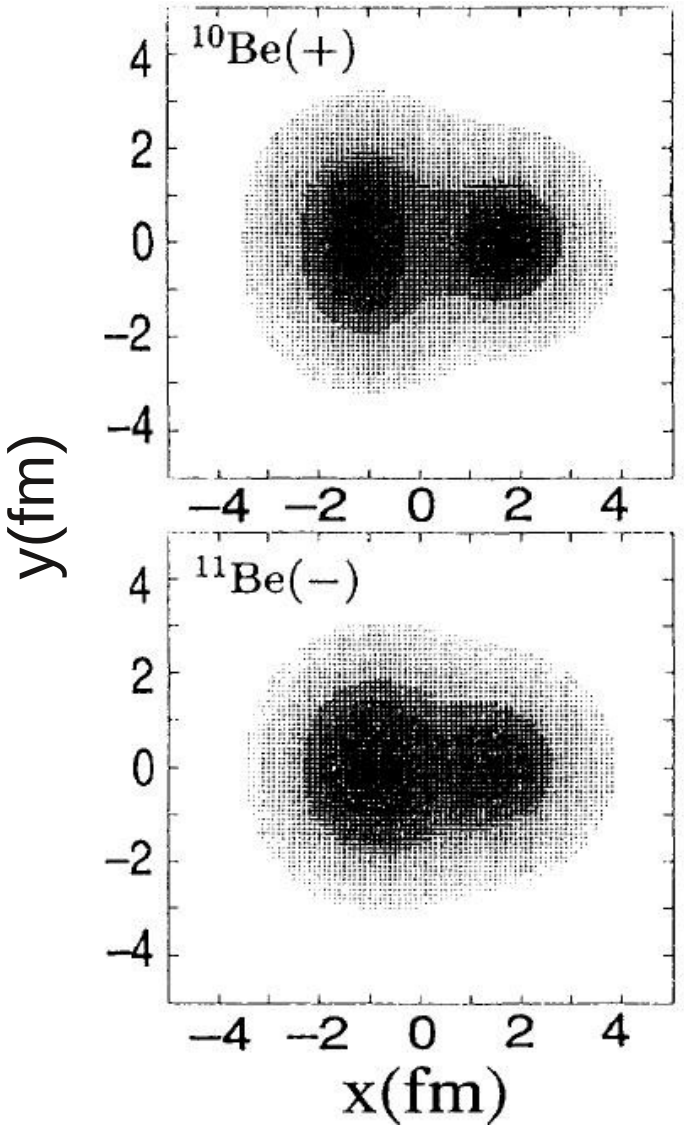
Milano: S. Brambilla, C. Boiano, A. Bracco, S. Leoni, R. Nicolini, S. Riboldi

Padova: D. Bazzacco, E. Farnea, C. Michelagnoli, F. Recchia, C. Ur

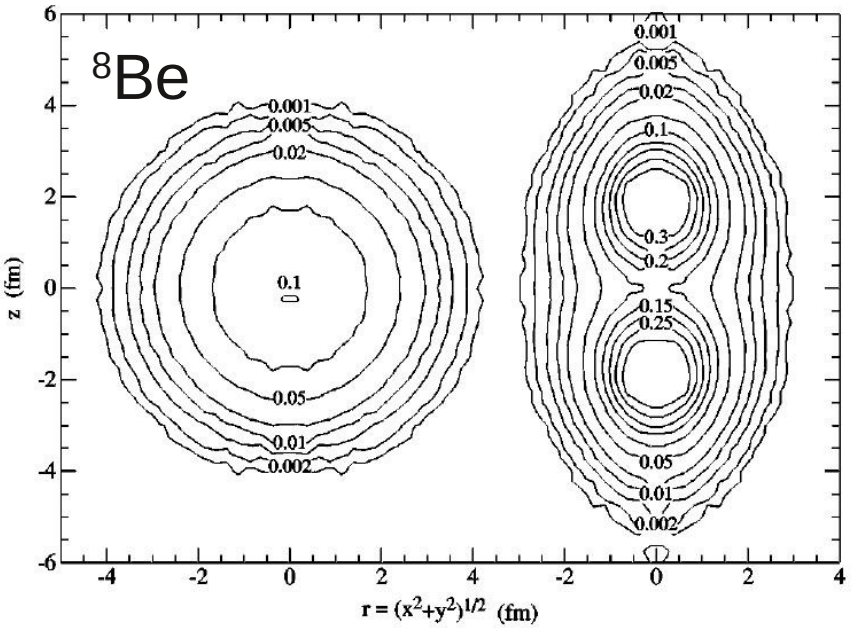
UWS: L. Capponi, D. Mengoni

and the **AGATA Collaboration**.

AMD[1]



GFMC[2]



Results from *ab initio* calculations:
anti-symmetrised molecular dynamics (AMD)
and Green's function Monte Carlo (GFMC).

[1]Y. Kanada-En'yo *et al.*, Phys. Rev. C52 (1995) 628.
[2]R.B. Wiringa et al., Phys. Rev. C62 (2000) 014001.