



INSTITUTO GALEGO
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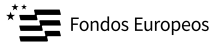
25 → * 1999
2024

$\nu^0 p_{1/2} - \nu^0 p_{3/2}$ **spin-orbit splitting in ^{20}O**

M. Lozano-González, B. Fernández-Domínguez, J. Lois-Fuentes
T. Roger, F. Delaunay

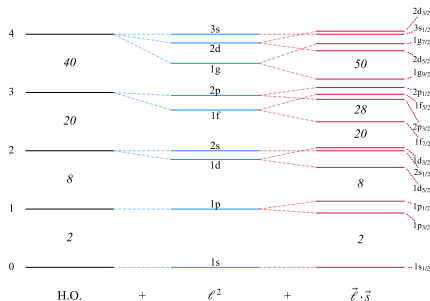
USC-IGFAE, GANIL and LPC-Caen

EuNPC 2025 - Caen



A recap on the SO splitting

Introduced by M. Goeppert-Mayer, the SO potential successfully reproduces magic numbers in stable nuclei.



It is mainly a surface effect:

$$V_{\text{SO}} = -\frac{1}{\hbar^2} V_{\text{so}}(\vec{l} \cdot \vec{s}) \left(\frac{1}{r} \frac{dV}{dr} \right)$$

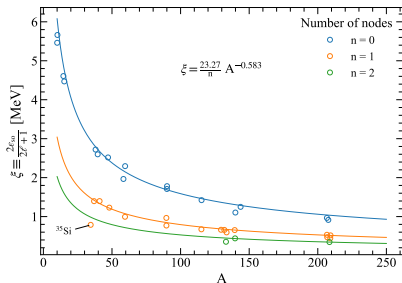
yielding a ℓ -dependent gap:

$$\Delta_{\text{so}} = \frac{\hbar^2}{2} (2\ell + 1) \xi$$

⇒ Expected to evolve towards more exotic nuclei, as surface blurs and hence $\xi \sim dV/dr$ changes.

A recap on the SO splitting

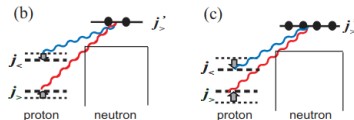
G. Mairle *et al.* (PLB 304 (1993)) found systematic trends easily parametrizable.



Proton-neutron
interactions drive **shell
evolution**

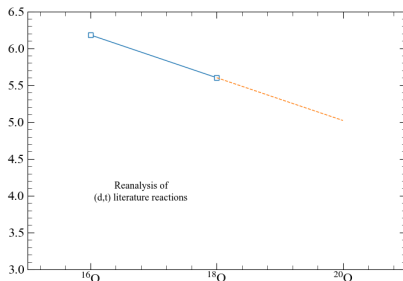
Deviations from the trend are found though:

- 1 Loosely bound orbitals
- 2 Nuclear matter depletion (^{35}Si ?)
- 3 Role of **tensor force**



SO gap for $Z = 8$ isotopes

Evolution of the SO gap is plotted below for neutron-rich O isotopes.

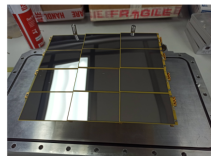


Will ^{20}O follow the trend?

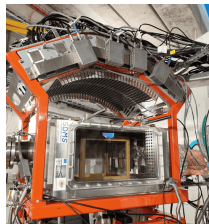
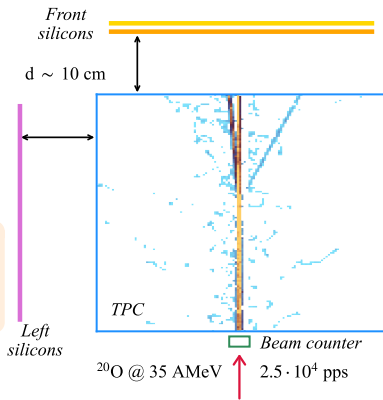
Could be determine tensor $\pi\nu$ contribution?

Experimental setup

E796 @ LISE in 2022. First transfer experiment with ACTAR TPC!



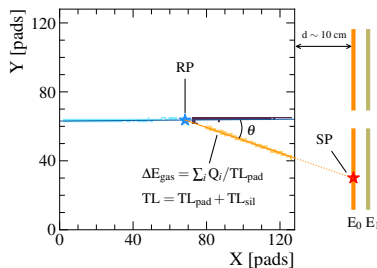
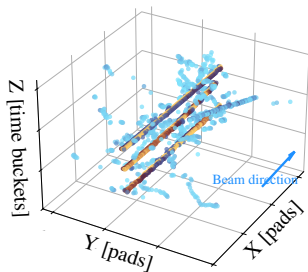
Silicon sizes:
 $80 \times 50 \times 0.5 \text{ mm}^3$



Gas setup:
90 % D_2 + 10 %
 iC_4H_{10}
@ 950 mbar

A window to the analysis

Intricate analysis to extract reactions of interest out of noisy data.



Conversely, the TPC offers unique advantages:

1 Precise **vertex** determination

2 Improved ΔE corrections

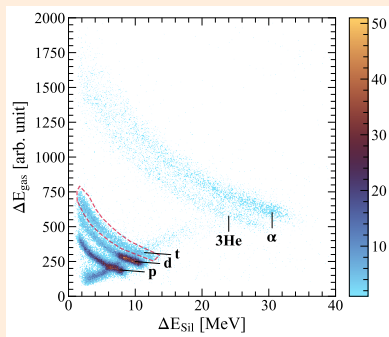
3 Factor 10 in target number

4 Implicit PID with ΔE_{gas}

A window to the analysis

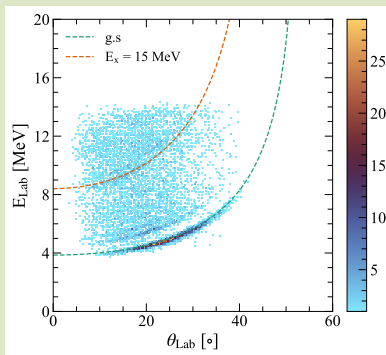
Two steps needed after data has been processed.

1 Triton identification in PID



Vetoing punch-through to 2nd front layer

2 Reconstruct E_x by missing-mass technique



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