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INFN-2024

L. Zago, F. Galtarossa, A. Gottardo, J. J. Valiente Dobón
and the AGATA collaboration

Mixing between single-particle and intruder states towards the N=20 island of inversion:

lifetimes in ^{37}S

AGATA
ADVANCED GAMMA TRACKING ARRAY

UNIVERSITAS STUDII PADUANI MCCXXII

INFN LNL

N=21 nuclei

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Reduced spin-orbit splitting in ^{35}Si: Weak binding or density-depletion effect?

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Effect of Weak Binding on the Apparent Spin-Orbit Splitting in Nuclei

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The apparent splitting between orbitals that are spin-orbit partners can be substantially influenced by the effects of weak binding. In particular, such effects can account for the observed decrease in separation of the neutron $1p_{3/2}$ and $1p_{1/2}$ orbitals between the ^{41}Ca and ^{35}Si isotopes. This behavior has been the subject of recent experimental and theoretical works and cited as evidence for a proton "bubble" in ^{34}Si causing an explicit weakening of the spin-orbit interaction. The results reported here suggest that the change in the separation between the $1p_{3/2}$ and $1p_{1/2}$ partners occurs dominantly because of the behavior of the energies of these $1p$ neutron states near zero binding.

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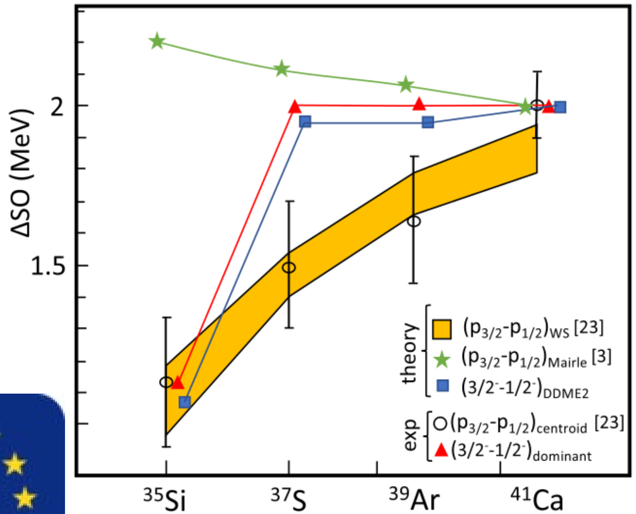

ARTICLES
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nature physics

A proton density bubble in the doubly magic ^{34}Si nucleus

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Many properties of the atomic nucleus, such as vibrations, rotations and incompressibility, can be interpreted as due to a two-component quantum liquid of protons and neutrons. Electron scattering measurements on stable nuclei demonstrate that their central densities are saturated, as for liquid drops. In exotic nuclei near the limits of mass and charge, with large imbalances in their proton and neutron numbers, the possibility of a depleted central density, or a 'bubble' structure, has been discussed in a recurrent manner since the 1970s. Here we report first experimental evidence that points to a depletion of the central density of protons in the short-lived nucleus ^{34}Si. The proton-to-neutron density asymmetry in ^{34}Si offers the possibility to place constraints on the density and isospin dependence of the spin-orbit force—on which nuclear models have disagreed for decades—and on its stabilizing effect towards limits of nuclear existence.

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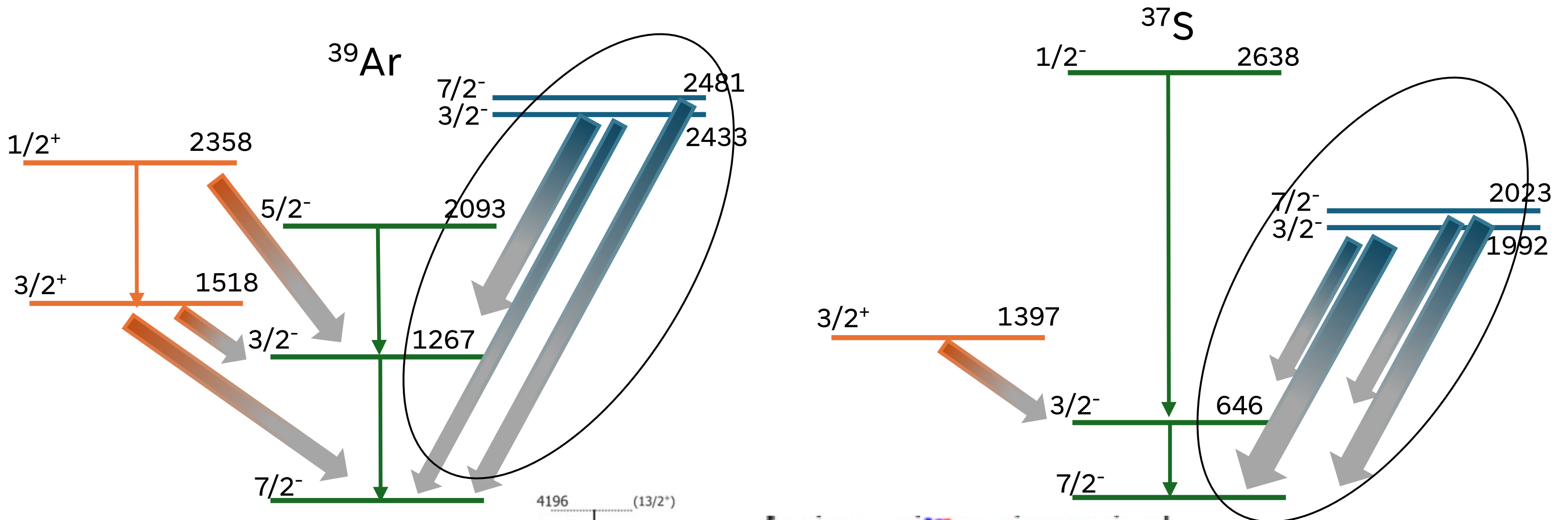
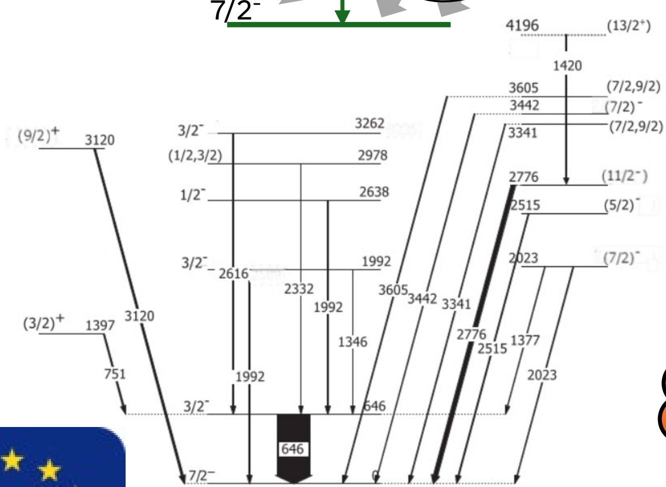
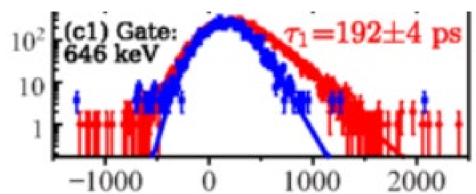
^{37}S and the N=20 IoI

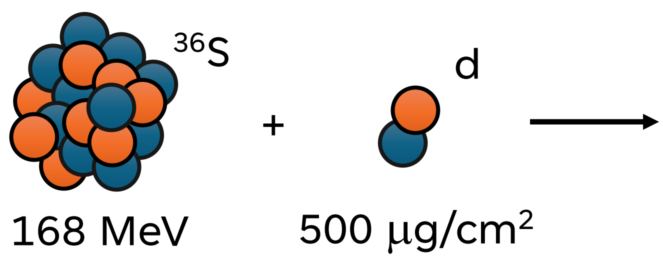


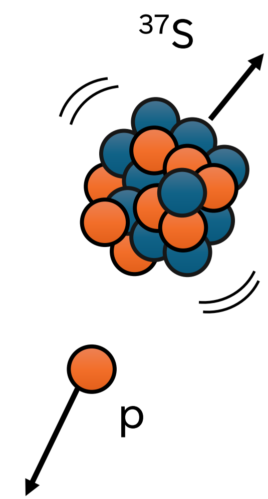


Chapman *et al.*, Phys. Rev. C, **93** 044318 (2016)



Wang *et al.*, Phys. Rev. C, **94** 044316 (2016)





The experiment

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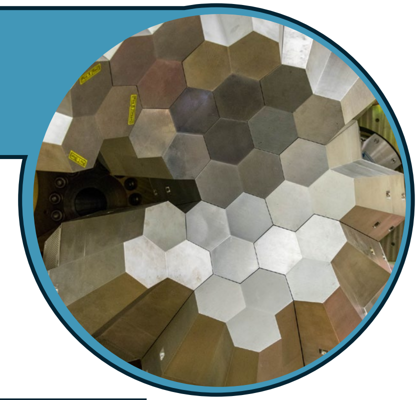
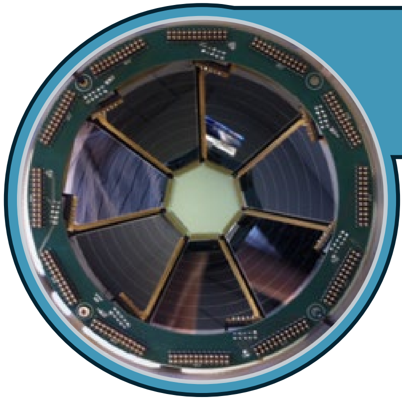


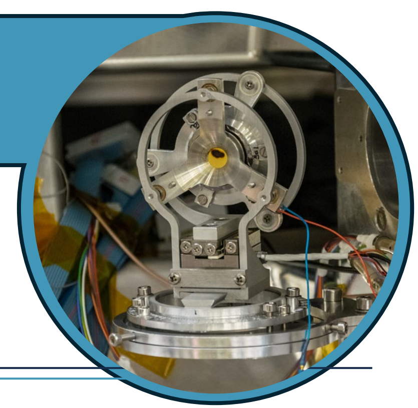
State-of-the-art γ-ray array. 33 HPGe crystals, with PSA and tracking algorithm to increase efficiency.
FWHM = 2.5 keV @ 1332.5 kev
ε = 3% @ 2 MeV (with tracking)

SPIDER



LNL resident 7x8 segmented Si charged particle array, covering backwards angles from 124° to 161°.
FWHM = 30 keV for α @ 5 MeV (Am-Cm-Pu), 300 keV for p @ 2 MeV
$\Delta\Omega$ = 17%

PLUNGER



Device built from a collaboration between LNL and Cologne to measure nuclear lifetimes in the range of 10-500 ps via the Differential Decay Curve method.

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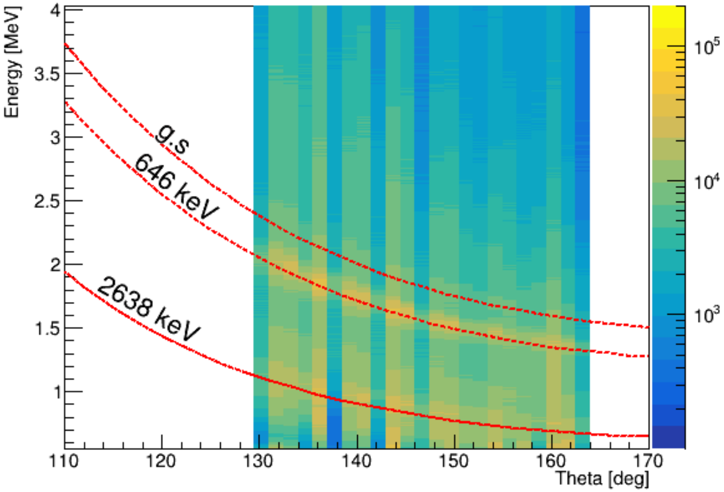
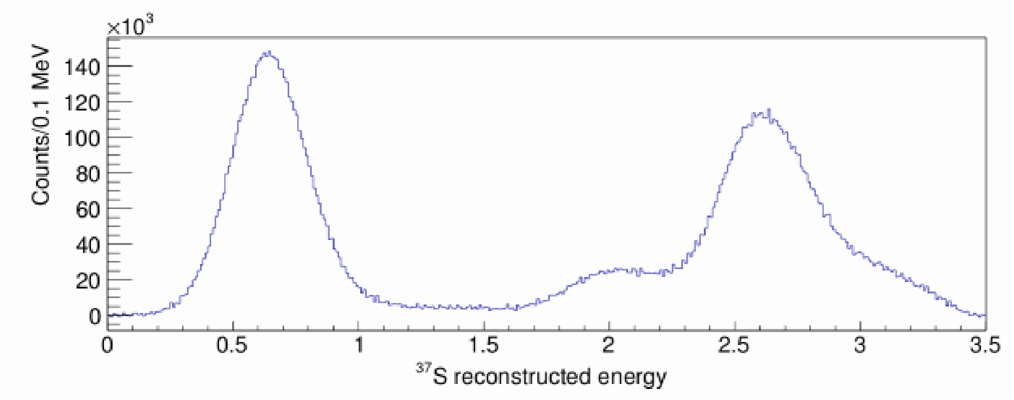
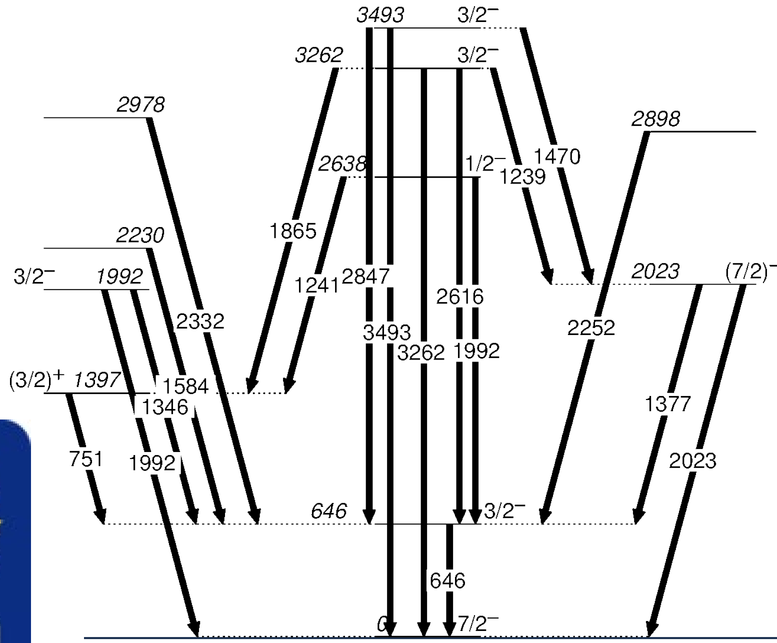
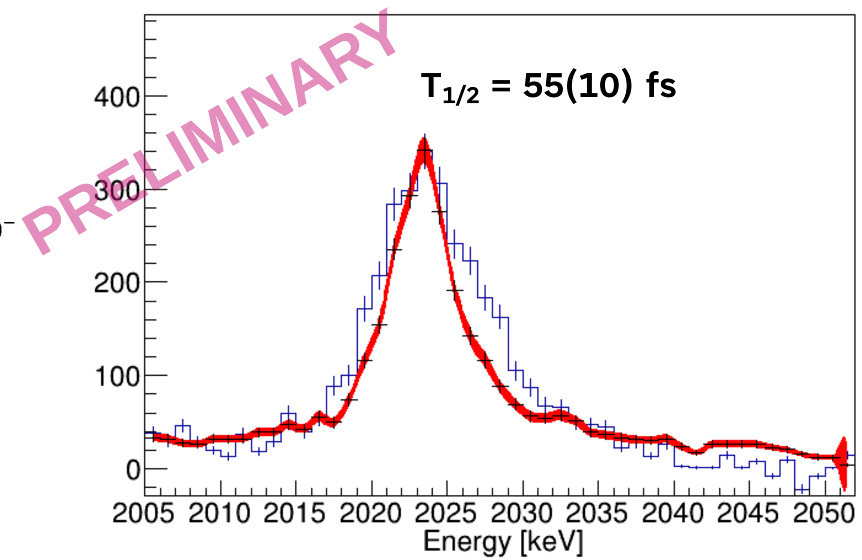
Results snippet









Thank you for your attention

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