



# Stable and radioactive beam studies @ ALTO

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### The ALTO facility

![](_page_1_Picture_1.jpeg)

#### **Experimental areas**

![](_page_2_Figure_1.jpeg)

# <sup>26</sup>Al nucleosynthesis in massive stars

#### N. de Séréville & A. M. Laird N-SI-36

![](_page_3_Figure_2.jpeg)

### **LICORNE II** – fast-neutron source

![](_page_4_Picture_1.jpeg)

![](_page_4_Picture_2.jpeg)

Hydrogen gas cells

H<sub>2</sub> pressure and flow control system

**Development of a kinematically focused neutron source with the p(<sup>7</sup>Li,n)<sup>7</sup>Be inverse reaction** *M.Lebois, J.N. Wilson et al., Nucl. Instrum. Meth. A 735 145 (2014)* 

# TDRIV on H-like ions: <sup>24</sup>Mg

![](_page_5_Picture_1.jpeg)

### High-accuracy g-factor measurements are essential for constraining the theories! COMEX5 18 Sept. 2015, Kraków, Poland

#### MINORCA in Orsay (June 2014 – March 2015)

![](_page_6_Picture_1.jpeg)

![](_page_6_Picture_2.jpeg)

![](_page_6_Picture_3.jpeg)

12 ORGAM CS HPGe x 0.1% 8 Miniball TC at ~14 cm from target 7.3% efficiency @ 1.33 MeV ancillary detectors:

- Orsay plunger (OUPS)
- particle detector
- DSSD

# **MINORCA – experiments performed**

#### 1. Time dependent recoil in vacuum for Na-like <sup>56</sup>Fe ions

- spokespersons: A. Stuchbery, D. Balabanski

2. Shape coexistence in <sup>74</sup>Se studied through complete low-spin spectroscopy after Coulomb excitation

- spokespersons: M. Zielinska, K. Wrzosek-Lipska

- 3. Measurement of octupole collectivity in Nd, Sm and Gd nuclei using Coulomb excitation spokespersons: P.A. Butler, M. Zielinska
- 4. Spectroscopy of the neutron-rich fission fragments produced in the <sup>238</sup>U(n,f) reaction spokespersons: J. Wilson, M. Lebois
- 5. Evaluation of the Angular Momentum Dependence of the <sup>96</sup>Mo γ Strength Function - spokesperson: B. Goldblum
- 6. Lifetime Measurement of <sup>100</sup>Ru: A possible candidate for the E(5) critical point symmetry spokesperson: Th. Konstantinopoulos
- 7. Lifetime measurements in <sup>113</sup>Te: Determining Optimal effective charges approaching the N=Z=50 doubly-magic shell closure.

- spokesperson: D.M. Cullen

![](_page_7_Picture_11.jpeg)

# Most-recent results

- First in-beam experiments of Demonstrator
  - 2,048 Micromegas pads
  - 4 DSSDs + 12 Pad Si integrated
  - Newly-made GET electronics to take data

DSSD

- 2 successful runs (June to July '15)
  - <sup>12</sup>C @80 MeV + He gas
  - <sup>6</sup>Li @11 to 23 MeV + He gas
- 35 visitors (16 domestic, 19 international)

![](_page_8_Picture_9.jpeg)

Pad Si

Micromegas

![](_page_8_Figure_10.jpeg)

![](_page_8_Picture_11.jpeg)

### **ACTAR TPC: Demonstrator**

- Two experiments performed at ALTO:
- ba  $\alpha$ -clustering in light nuclei actar 300 Ν (sample) Beam 204 (pad) 150 60  $\overset{_{40}}{X}$  (pad) 2Ó 30 30 300 visu\_zy visu\_yx visu\_zx 300

![](_page_9_Figure_3.jpeg)

### ALTO - RIB

### First operational RIB facility based on photo-fission

![](_page_10_Figure_2.jpeg)

Illiante Sept. 2015, Kraków, Poland

Fission cross section

#### **Rialto: Resonant laser ionisation at Alto**

S. Franchoo et al.

Mezzanine of the mass separator/RIB zone

Nd:Yag pump laser (532 nm, 90 W)

2 dye lasers (540-850 nm, 8W @ 30W pump, 10 ns pulse width, 3 GHz line width)

BBO doubling units (270-425 nm, >100 mW)

### Nuclear structure in β-decay

#### BEDO setup

![](_page_12_Picture_2.jpeg)

neutron detection TETRA fast timing LaBr3

![](_page_12_Picture_5.jpeg)

![](_page_12_Picture_6.jpeg)

up to 5 Ge detectors ( $\epsilon$  = 5-6%) 4 $\pi$   $\beta$  trigger

80 <sup>3</sup>He tubes  $\epsilon$ (<sup>252</sup>Cf) = 53% borated polyethylene shielding

Fast-timing studies using LaBr<sub>3</sub> detectors

![](_page_12_Picture_10.jpeg)

### Results from BEDO in $\beta$ -delayed $\gamma$ -spectroscopy mode

 $^{82}\text{Ge} \rightarrow ^{82}_{33}\text{As}_{49}$ 

(1) problem of the spectral distribution of 1<sup>+</sup> states in the N=50 region

( $\rightarrow$  responsible for the half-life of the mother nucleus, possible consequences on the r-process) interpreted by the theoretical work of Severyukhin... <u>Giai</u> et al. (influence of couplings to 2p-2h and tensor interaction)

![](_page_13_Figure_4.jpeg)

(2) ubiquitous presence of intruder states of the type 1p-2h  $\rightarrow$  signature of shape coexistence

![](_page_13_Figure_6.jpeg)

Though this phenomenon seems to concern all shell-closure regions: not a single study at N=50 for more than 3 decades! (Z=50 a textbook case)

conclusion: an «island of inversion» is « missed » at N=50 by 0.5 MeV only !

![](_page_13_Picture_9.jpeg)

A. Etilé et al., Phys. Rev. C 91, 064317 (2015)

### **Present setups and near-future projects**

![](_page_14_Picture_1.jpeg)

Laser-Induced nuclear orientation ( $\mu$ ,Q, J<sup> $\pi$ </sup>)

- Stable and Radioactive beam facility
- R&D on ISOL & RIB
- Iow-energy physics program based on photo-fission
- R&D and physics at ALTO a step towards a next-generation ISOL RIB facility:

initiate physics program, train ISOL physicists, develop instruments and methodologies

![](_page_15_Picture_5.jpeg)