Proposal for a Nuclear Physics Experiment at RI Beam Factory

(RIBF NP-PAC-05, 2009)

Spectroscopy of ^{40}Mg

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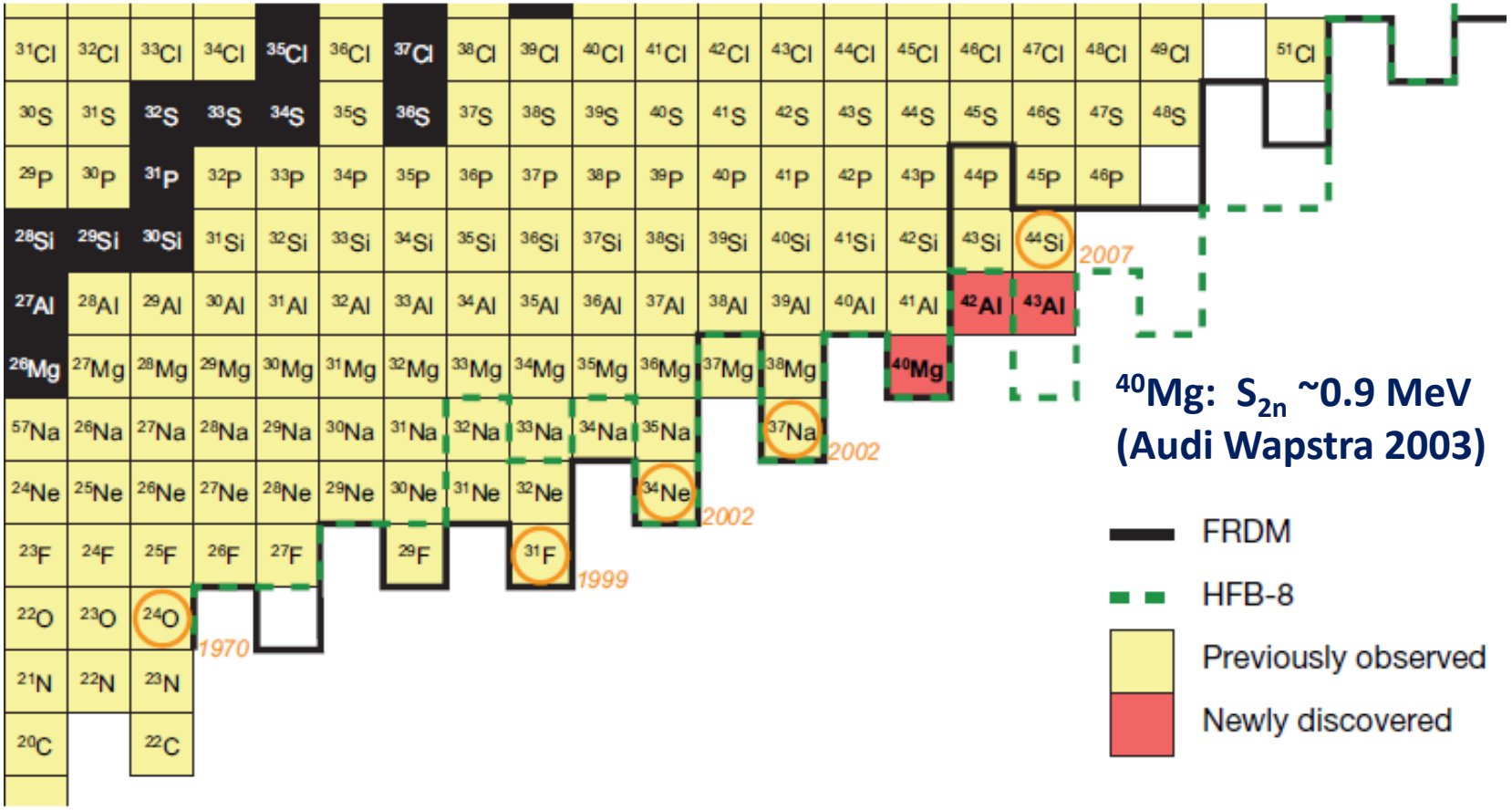
^{40}Mg - first observation 2007

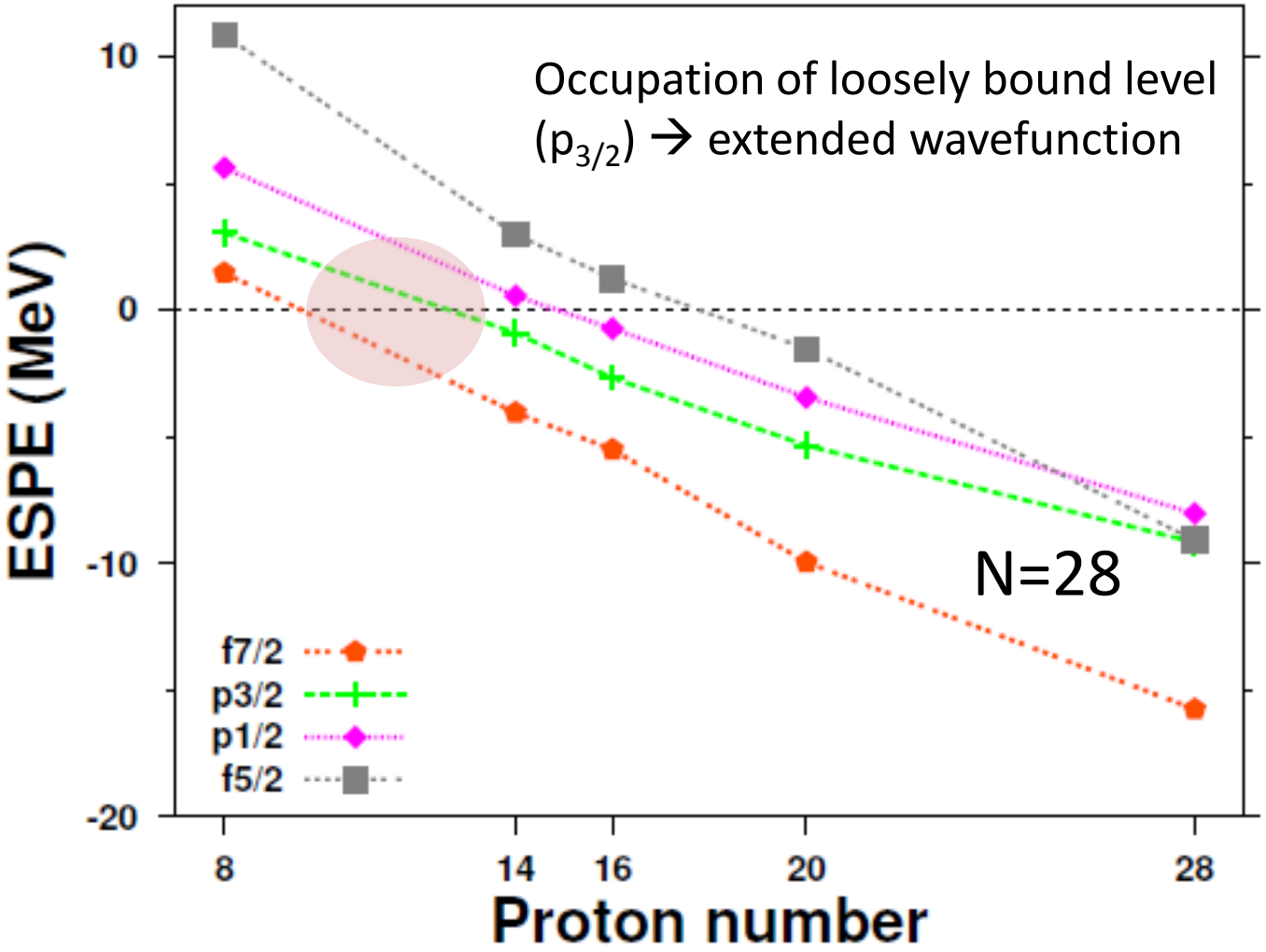
T.Baumann et al., Nature Letters Vol. 449 (2007)



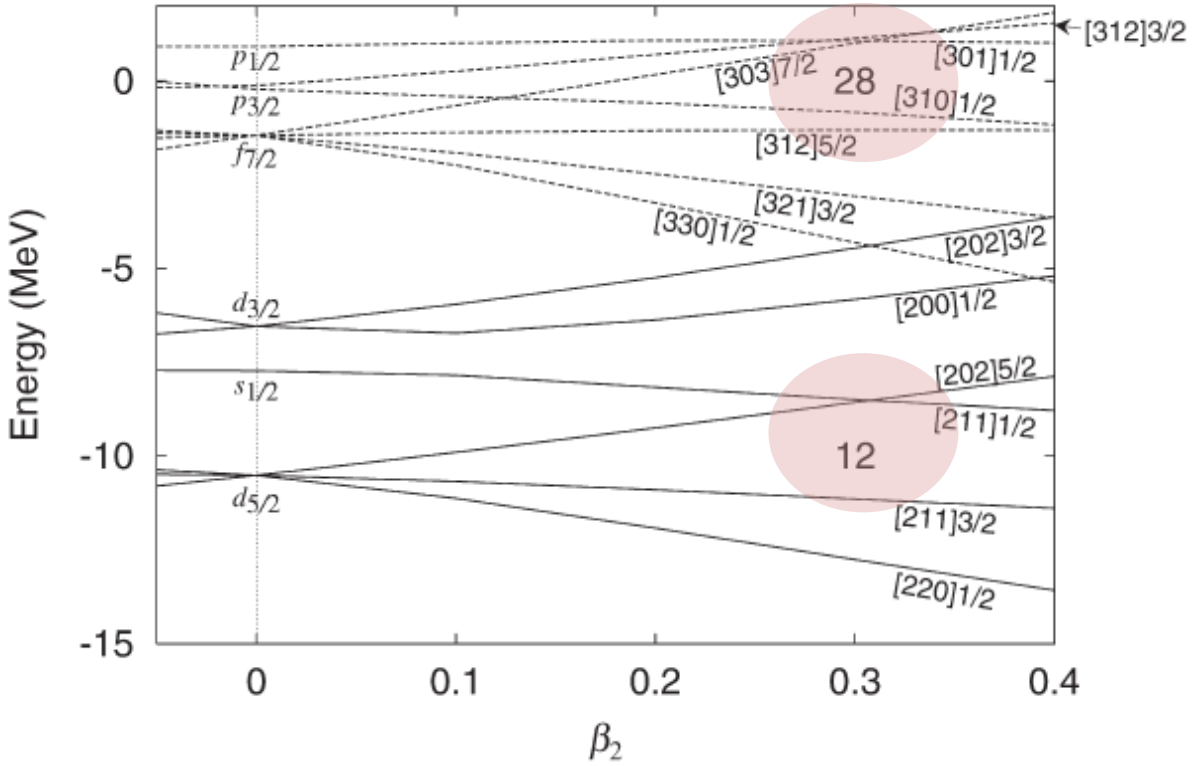
The high-intensity high-energy ^{48}Ca primary beams now available at RIBF provide a major gain in experimental reach

Effective neutron single-particle energies at N=28

F.Nowacki and A. Poves, Phys. Rev. C 79, 014310 (2009)



^{40}Mg expected to be prolate



^{40}Mg - a *prolate core* surrounded by a *neutron halo*

Goals of ^{40}Mg experiment

- Identify and measure gamma-ray decay of the 2^+ state
- Measure inclusive and exclusive 2p removal σ
  →information on wavefunction

	A=34	A=36	A=38	A=40
$E^*(2_1^+)$ th.	0.84	0.50	0.58	0.57
$E^*(2_1^+)$ exp.	0.67	0.66		
Q_s	-14	-19	-19	-20
BE2↓ th.	66	89	101	99
BE2↓ exp.	110(20)			

F.Nowacki and A. Poves, Phys. Rev. C 79, 014310 (2009)

S_{2n} ~0.9 MeV (Audi Wapstra)

^{38}Mg - approved experiment

^{40}Mg – this proposal

Neutron (near)dripline nuclei

- Experiments have limited reach (Mg, S, Ca?)
- Rely on theory
  - Major challenges: deformation, pairing, weak-binding, …. all need to be treated
- Benchmarking/constraining theory where experiment can reach is important
  - Requires data on excited state and ground state properties (to address multiple dimensions of the problem)

^{40}Mg experimental setup

- This measurement will use a 200 pnA, 345 MeV/u ^{48}Ca primary beam on a ~3000 mg/cm^2 Be target to produce a ^{42}Si secondary beam.
- The ^{42}Si beam will be transported through BIGRIPS and undergo reactions on a ^{12}C secondary target located at F8.
- The ^{40}Mg products from the ^{42}Si→ ^{40}Mg 2-proton removal reaction will be identified by the Zero Degree Spectrometer.
- Prompt gamma-rays will be detected using the high efficiency DALI2 (NaI) detector array surrounding the ^{12}C secondary target.