Is there a problem with protons in N=28 ^{46}Ar ?

AGATA-MUGAST-VAMOS Experiment

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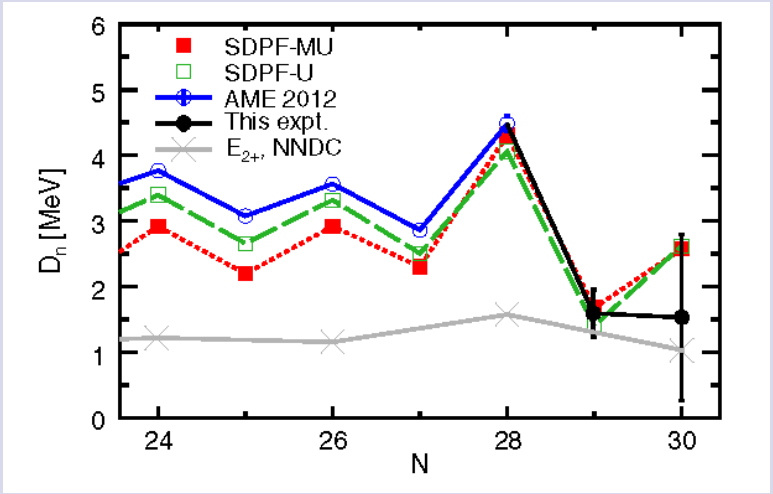
Do we understand physics at N=28, Z=18 ?

Neutron observables understood



Excellent theory for neutron-space related quantities:

- confirming N=28 shell closure in ^{46}Ar
- SDPF interaction describes valance-core neutrons interaction very well

Z. Meisel et al. PRL 114, 022501 (2015)

Large discrepancy in B(E2)

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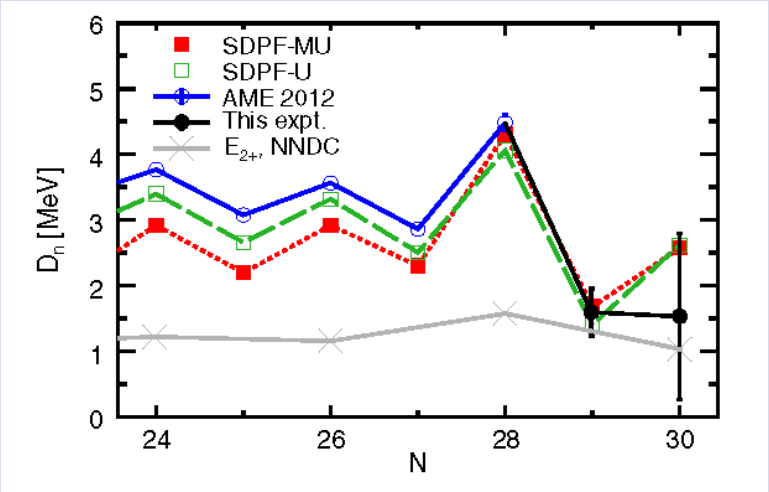

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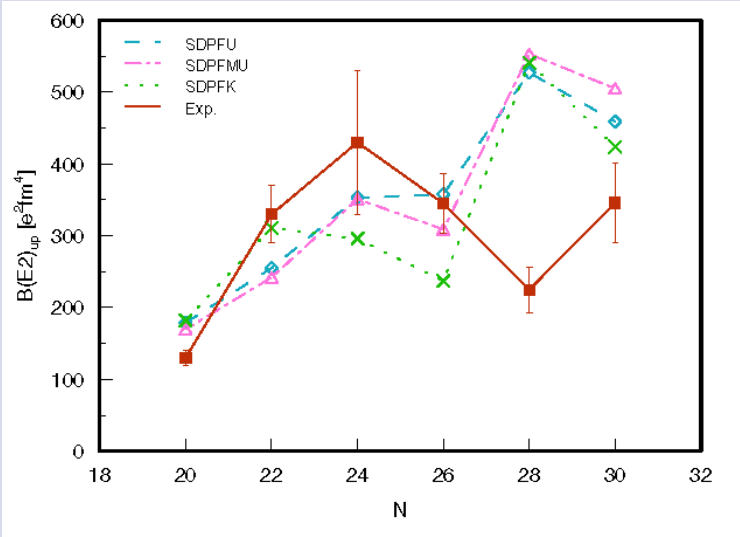

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Problem with the predicted proton wave function (?)

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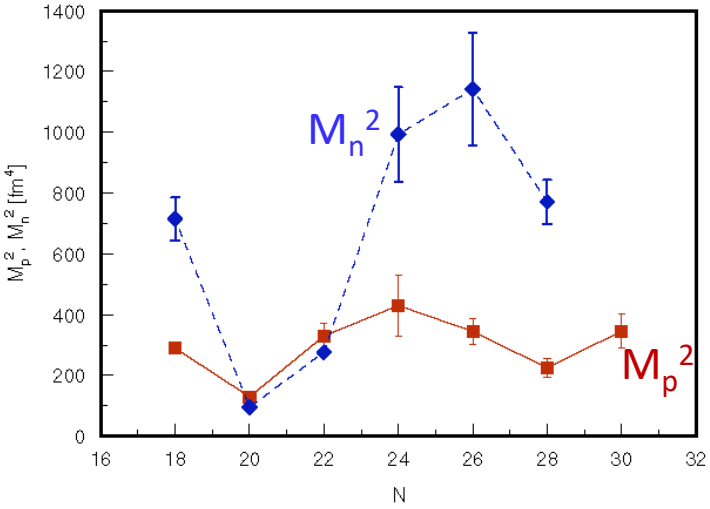
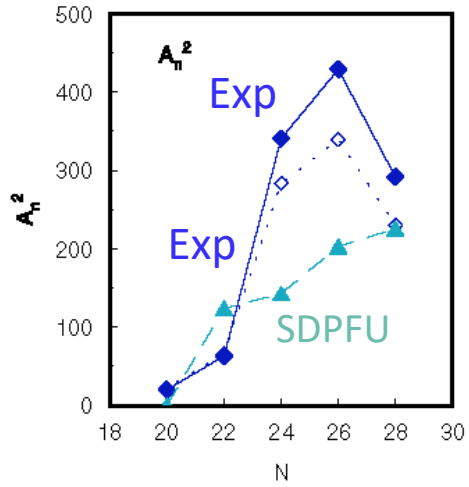
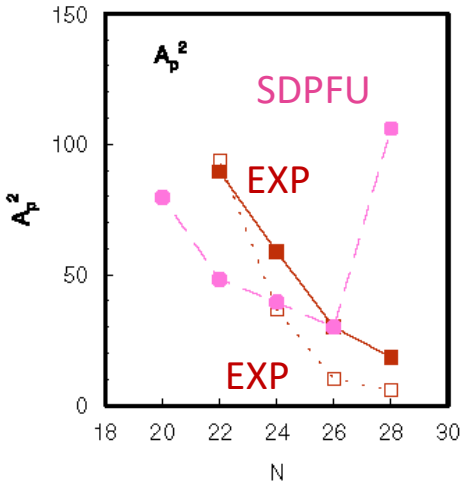
S. Calinescu et al., PRC 93, 044333 (2016)

L. A. Riley et al., PRC 72, 024311 (2005)





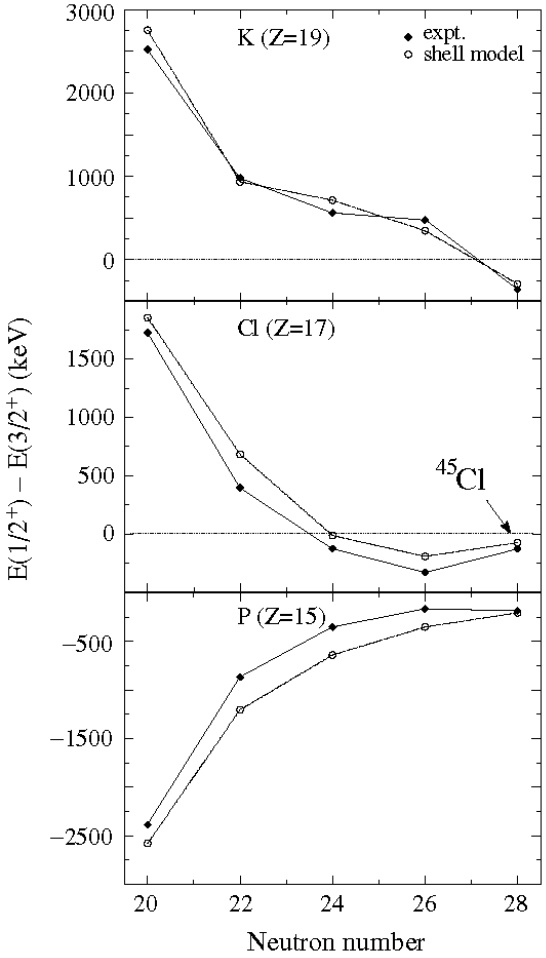


Need to probe the proton wave function predicted by SDPF:

Example: $\pi s_{1/2}$ almost full or empty in ^{46}Ar to decrease B(E2) to exp. value

Smaller effect from N=28 quenching:with $\nu p_{3/2}$ almost full, $B(E2)_{up}$ in ^{46}Ar still ~ 350 e^{2}fm^4

$\pi d_{3/2} - \pi s_{1/2}$: a reciprocal chase



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in ^{45}Cl $3/2^+$ is maybe the fundamental state (forbidden M1 strength)

A measurement of $\pi s_{1/2}$ depletion in ^{46}Ar will help to assess a possible change in the $\pi s_{1/2}$- $\pi d_{3/2}$ positions

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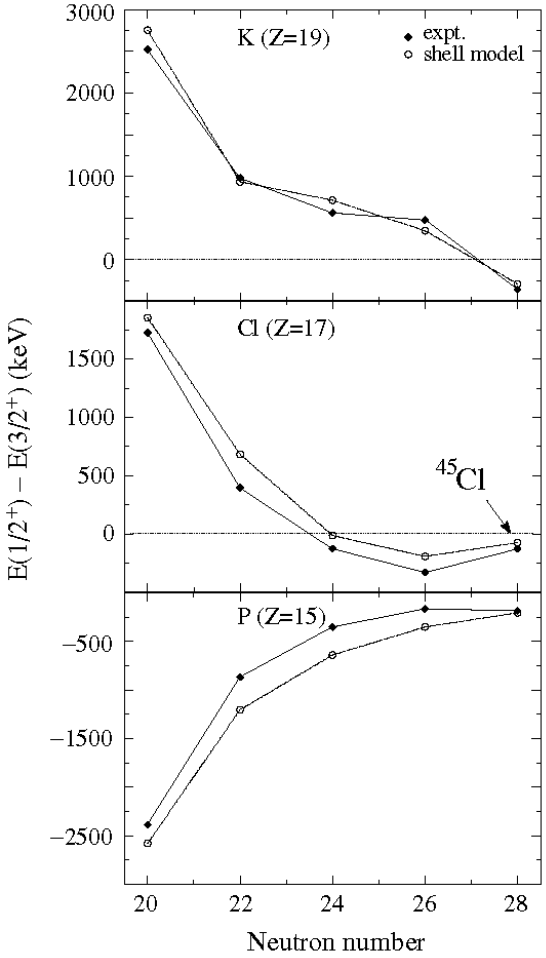

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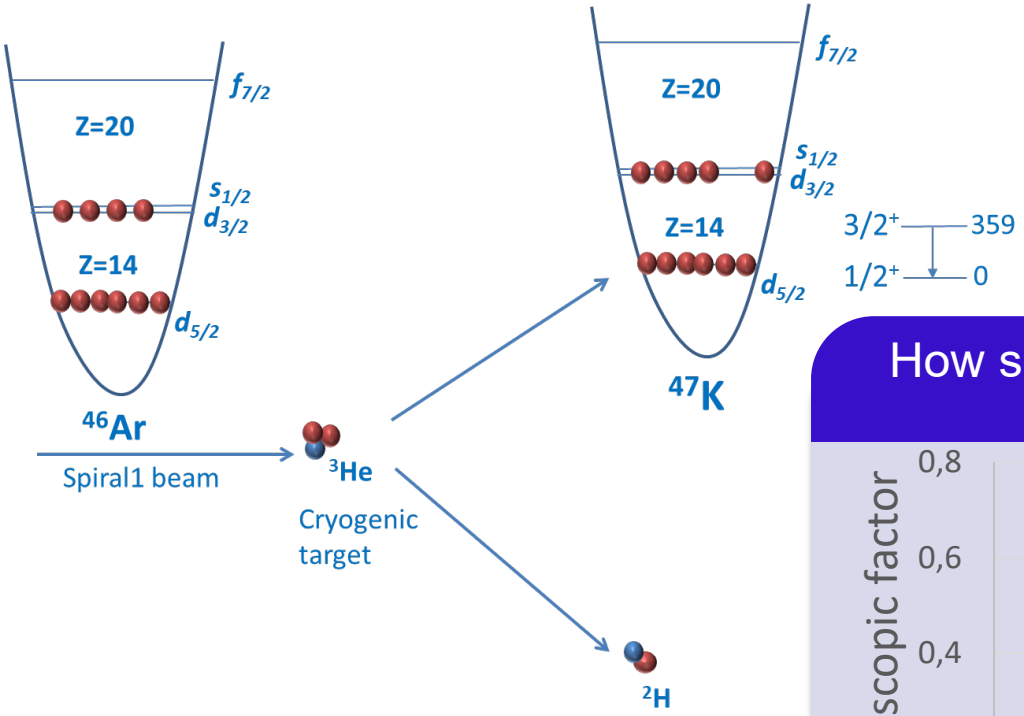
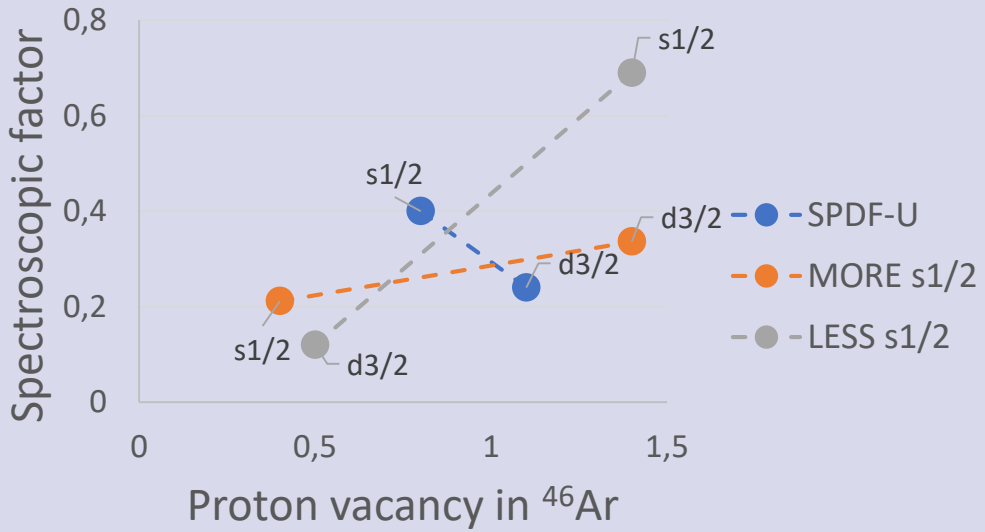
^{46}Ar(^{3}He,d)^{47}K proton pick-up reaction



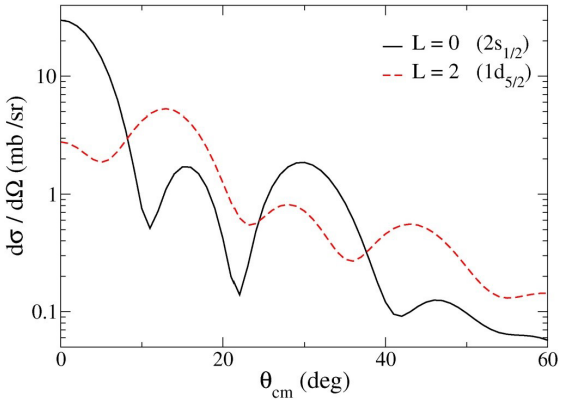
Significant dependence of spectroscopic factors from occupation numbers !

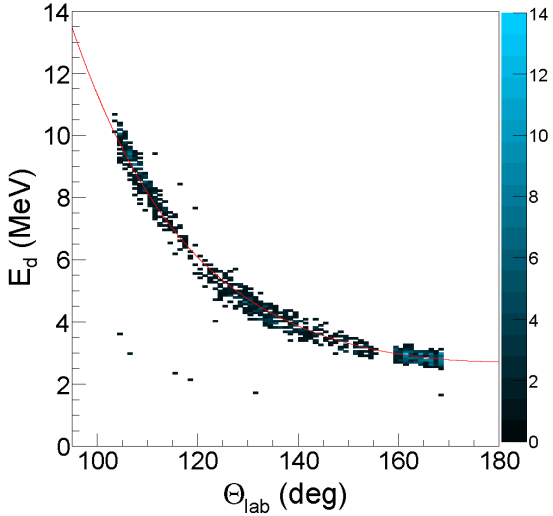
How sensitive are calculated SF to proton wave function in ^{46}Ar ?



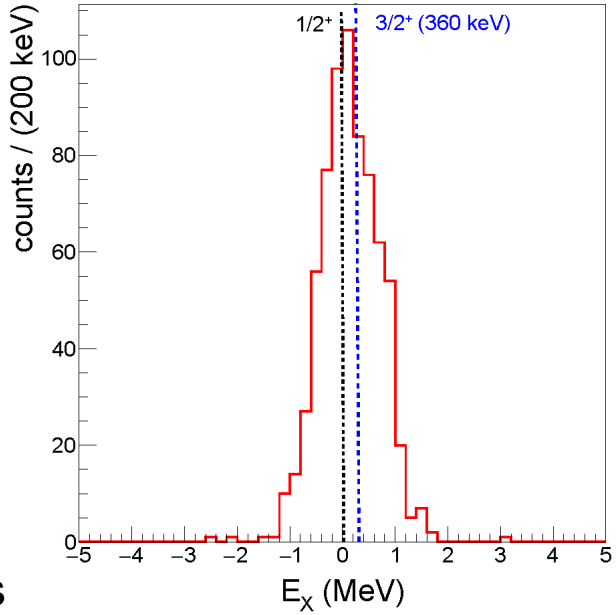
^{46}Ar(^{3}He,d)^{47}K: Geant4 simulations

Realistic simulations





Good energy for deuterons detection



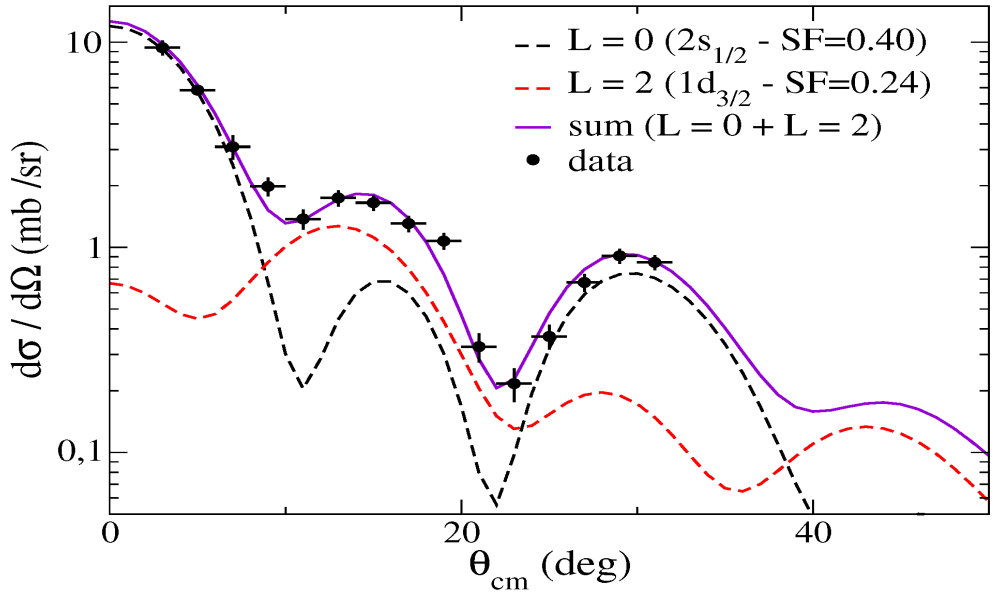
Insufficient energy resolution from particles: γ rays needed

- ^{46}Ar beam: 2·10^{4} pps @10 MeV/u (SPIRAL 1)
- ^{3}He target: 3 mm-thick, T=8 K, P=1 atm (equivalent 1.5 mg/cm^{2})

^{46}Ar(^{3}He,d)^{47}K: statistics expected

Calculations of cross section with DWBA theory

State in ^{46}Ar	Cross sections (mb)	Normalized SF	Deuterons/ week	Deuterons-γ/ week
$1/2^+$	2.5	0.4	1100	-
$3/2^+$	2.7	0.2	640	70

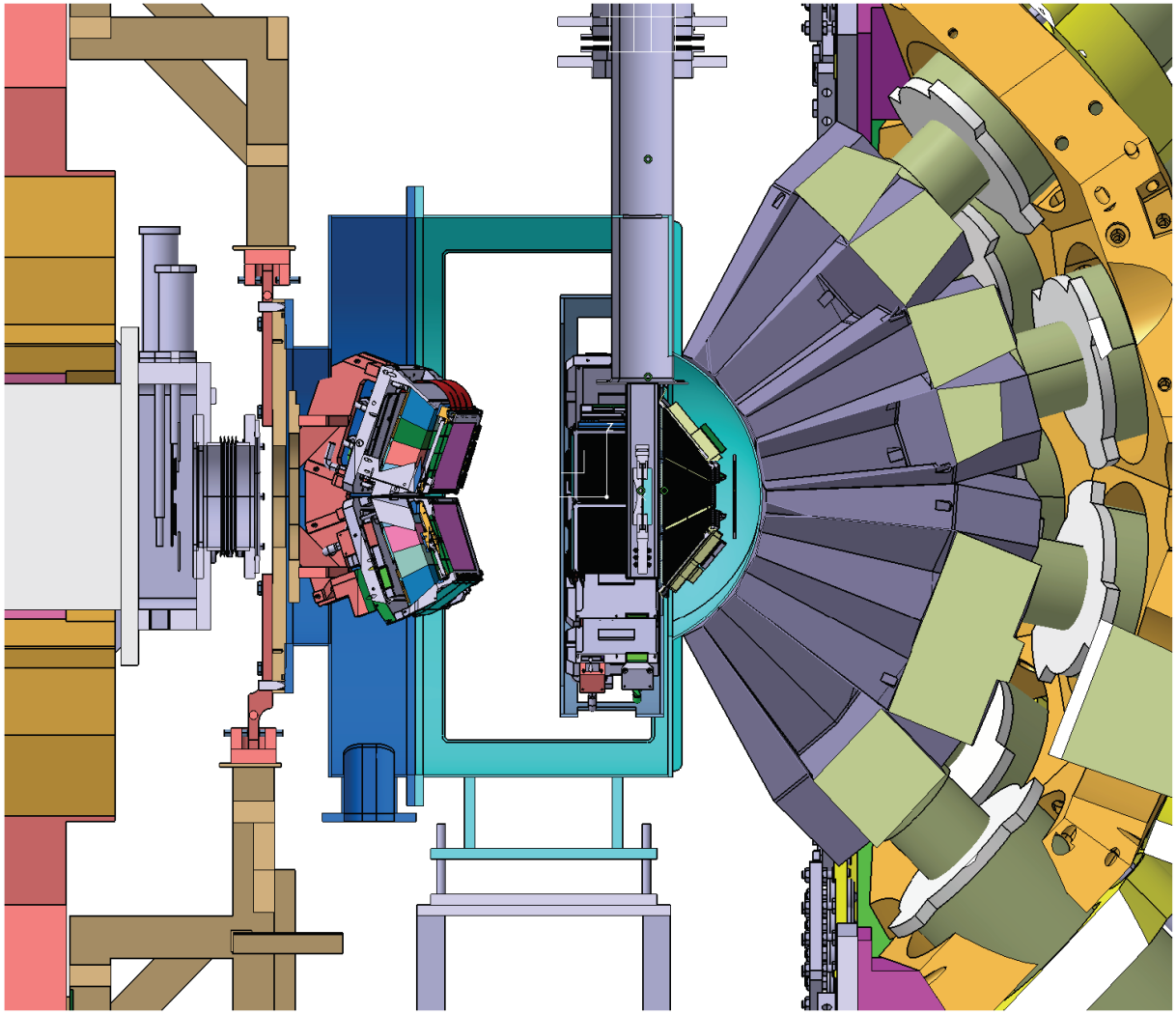


Fit on simulated curves: statistical errors < 10% on measured cross sections

Experimental setup

Setup

- ^{46}Ar beam: $2 \cdot 10^4$ pps @10 MeV/u (SPIRAL 1)
- Cryogenic ^{3}He target: 3 mm-thick, T=8 K, P=1 atm (equivalent 1.5 mg/cm^2)
- MUGAST for deuterons detection
- AGATA for γ-ray spectroscopy
- VAMOS for helping in identification and spectra cleaning



Beam time

Seven days (21 UTs) of beam time requested

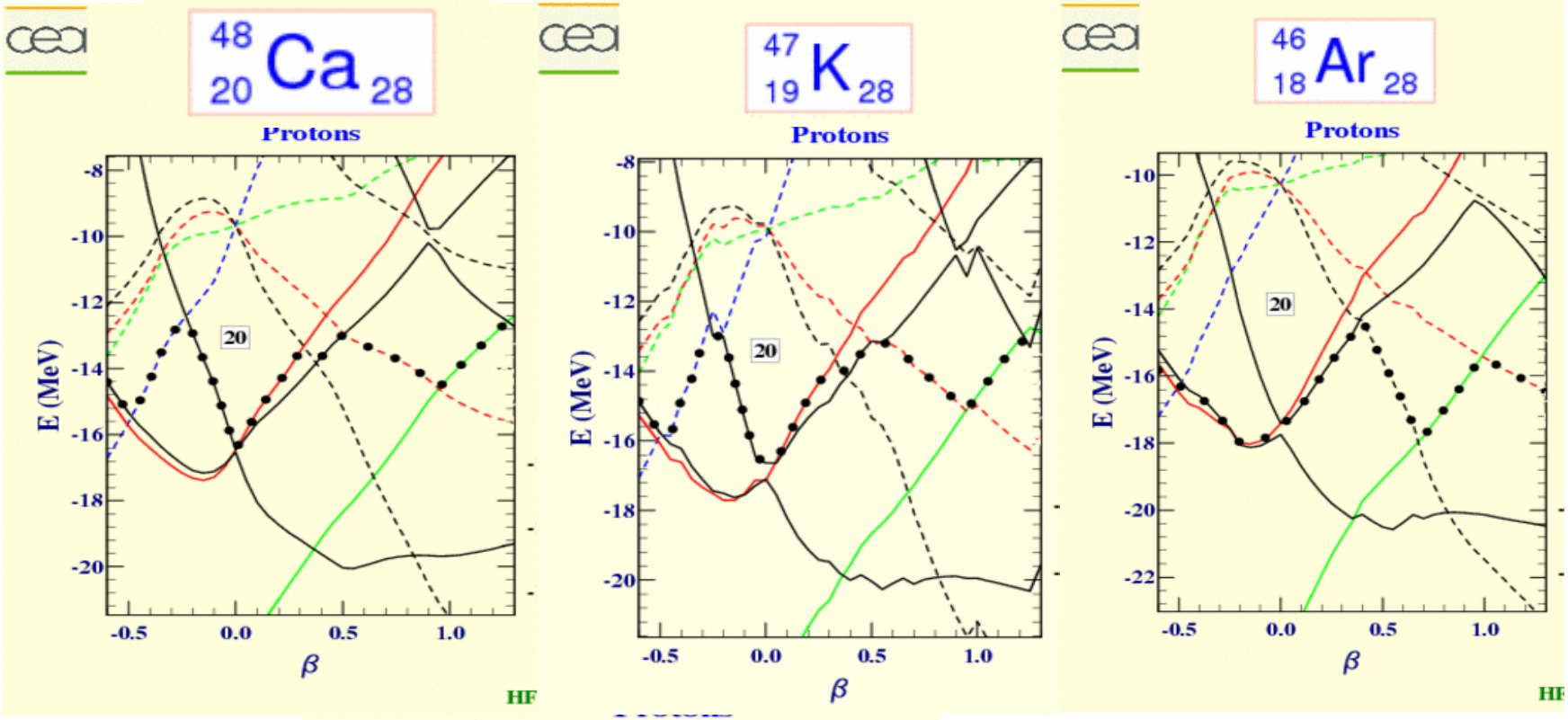
- Statistical errors small enough (around 10%) for meaningful comparison with theory

TAC comments:

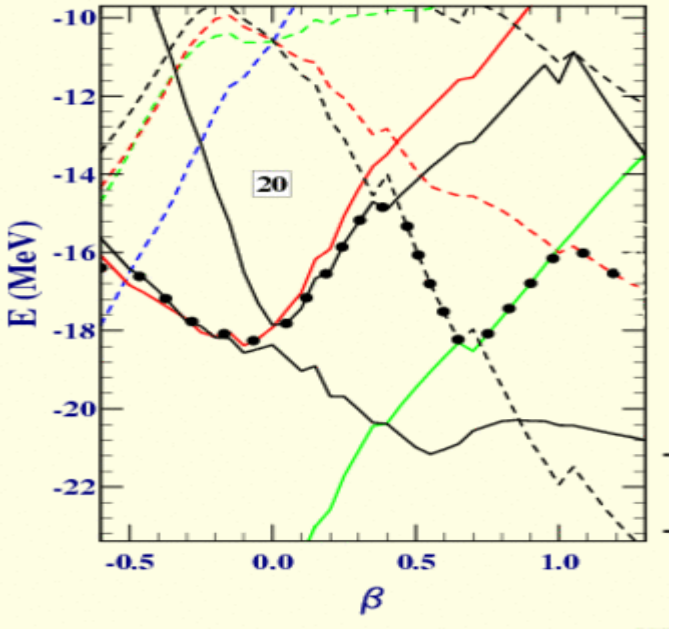
1- The installation of the ^{3}He target has been agreed with GANIL, test at GANIL in February

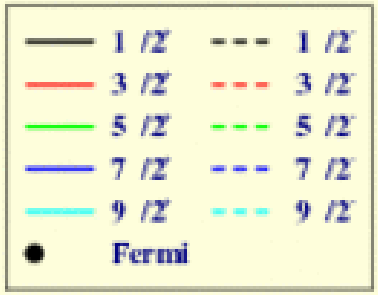
2- Decision to take the ^{46}Ar option and drop the ^{47}K beam with ^{3}H target.

BACKUP


48 20 Ca 28
Protons
E (MeV)
β
20
HF
47 19 K 28
Protons
E (MeV)
β
20
46 18 Ar 28
Protons
E (MeV)
β
20
HF


45 17 Cl 28


E (MeV)
β
20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