Proton resonance elastic scattering on ^{30}Mg: IS526

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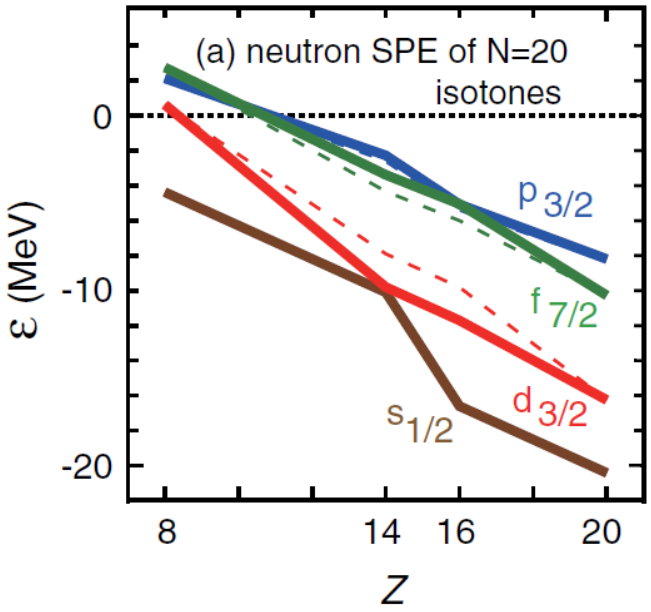
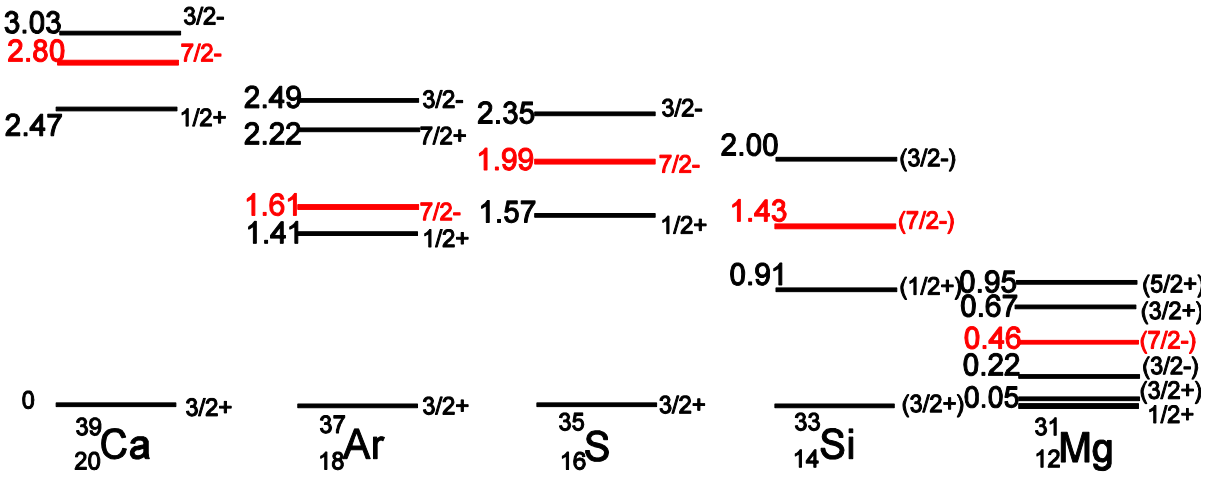
Single particle energies at 'Island of inversion'

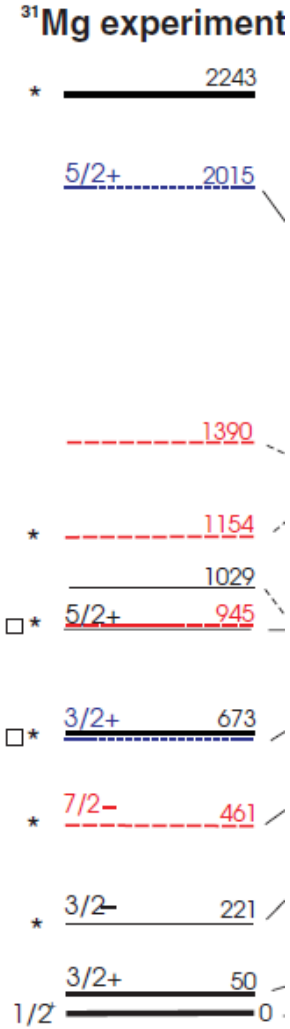


T. Otsuka et al, PRL104,012501

- Energy gap between *pf-sd* orbits.
- Single particle states will be a direct evidence of the shell evolution.



Experiments of ^{31}Mg: so far



- g factor: ^{31}Mg gs. Jp = 1/2$^+$

  G. Neyens *et al.*, Phys. Rev. Lett. **94**, 022501 (2005).

- ^{31}Na(3/2$^+$) βdecay

  → **1st excited state: π =+**

- ^{32}Na(π=-) β-delayed n

  → **2nd and 3rd excited state: π = -**

  G. Klotz *et al.*, Phys. Rev. C **47**, 2502 (1993).

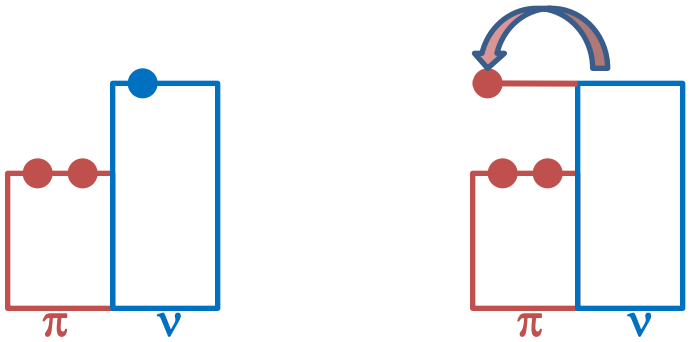
- Lifetimes of 1st, 2nd and 3rd excited states

  → **λ were assigned.**

  H. Mach *et al.*, Eur. Phys. J. A **25**, 105 (2005).

G. Neyens, Phys. Rev. C84, 064310

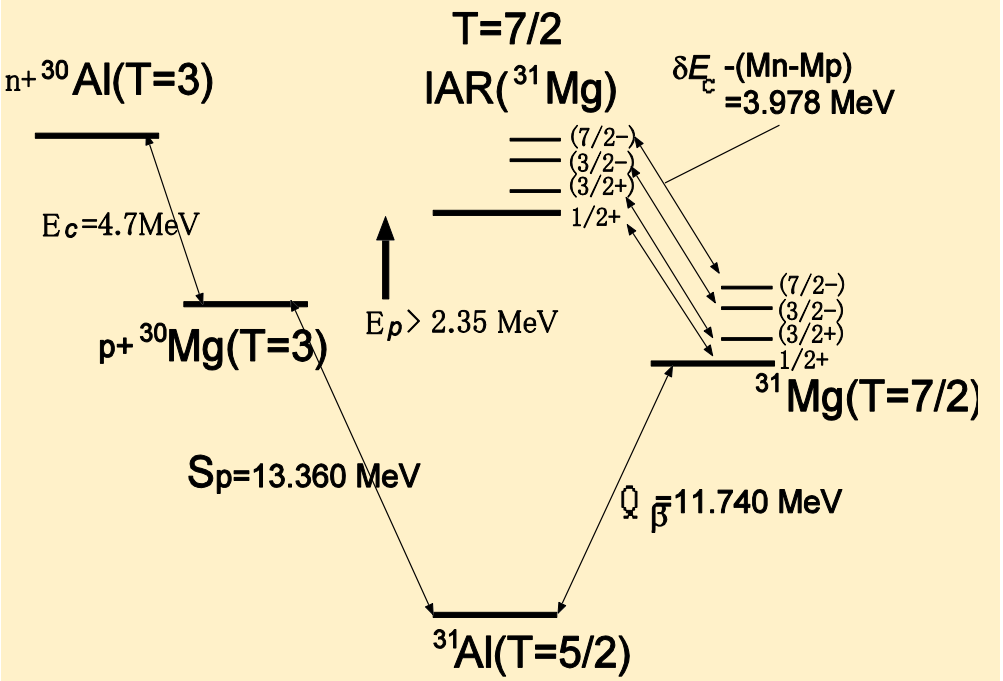
Isobaric Analog Resonances of bound states of ^{31}Mg



Parent state IAS

$\phi_{core}\phi_\nu \quad \phi_\nu = \phi_\pi \quad \phi_{core}\phi_\pi$

Resonance shape
= angular momentum (*l*)
Resonance width
= total width (Γ_{tot})
Resonance height
= proton width (Γ_p) ~ S^{pp}



Thick target inverse kinematics(T^2IK) proton resonance elastic scattering with RIBs

Excitation function of $d\sigma/d\Omega(\theta_{lab.}\sim 0)$

cf.) V.Z. Goldberg, ENAM98

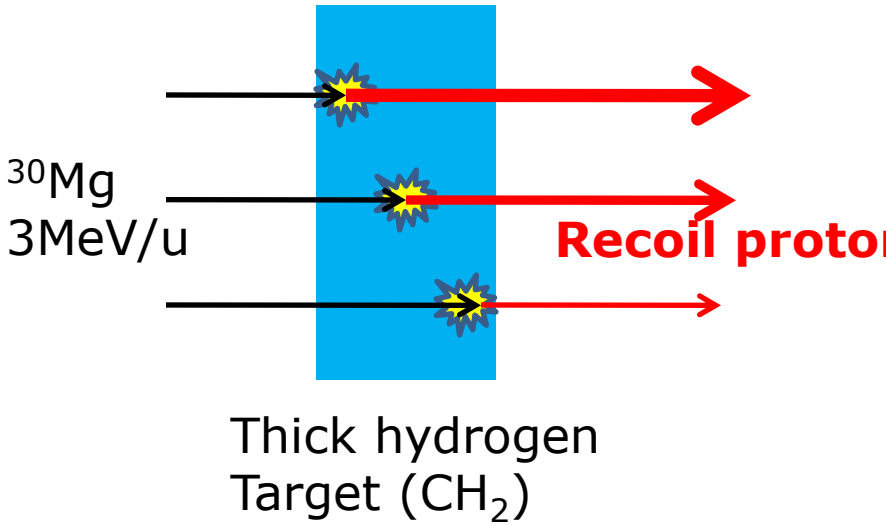
1. High-energy recoil proton

   ~ 4x E_{reso}

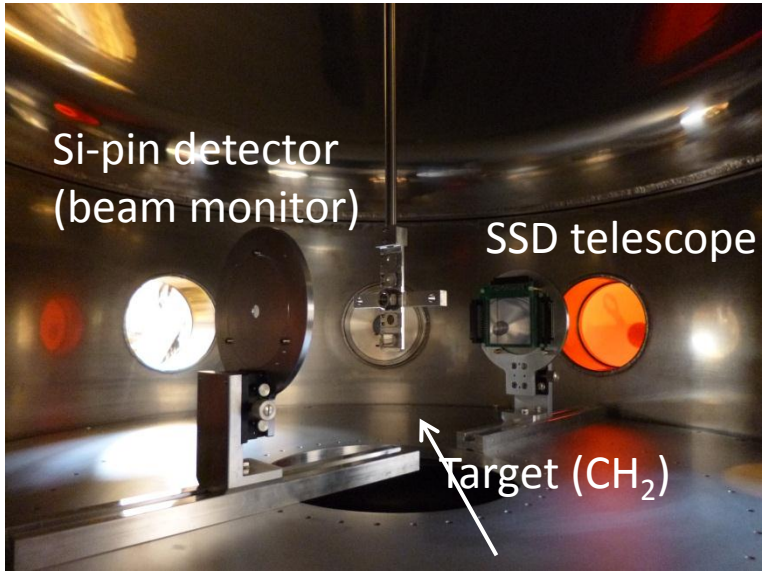
2. One fixed energy

3. Large cross section

   ~ several 10 mb/sr

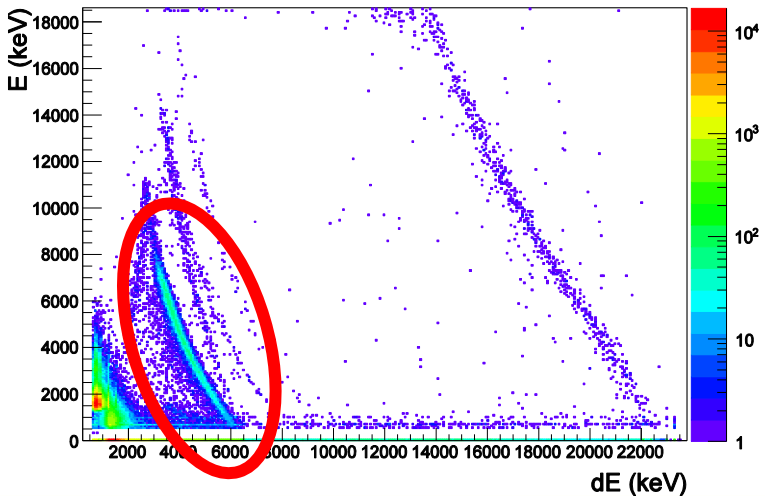


Experimental Setup

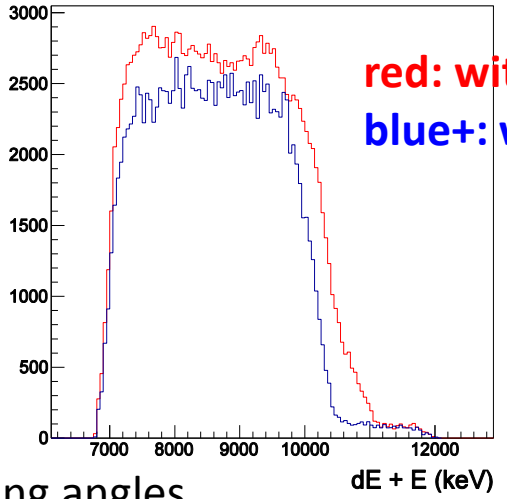


- **At the second beam line in REX**
- **Beam: $^{30}Mg^{7+}$: 2.92 MeV/u ~ 10^5 pps**
  ^{26}Mg :2.88 MeV/u : for calibration
- **Target**: 5. 6mg/cm^2 thick CH_2
  10.7 mg/cm^2 thick C
- **Detector**: dE-E detector (0.31+ 1.0 mm)
  dE: 32x 32ch doubly sided striped
- **Absolute σ:** off-resonance cross sections

Analysis



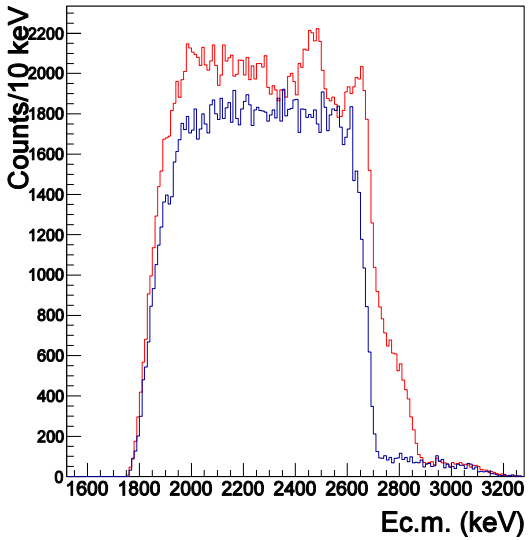
Only *p*



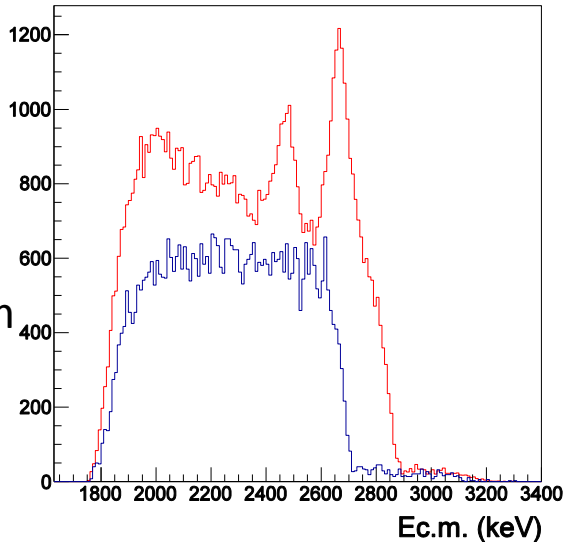
red: with lasers

blue+: w/o lasers

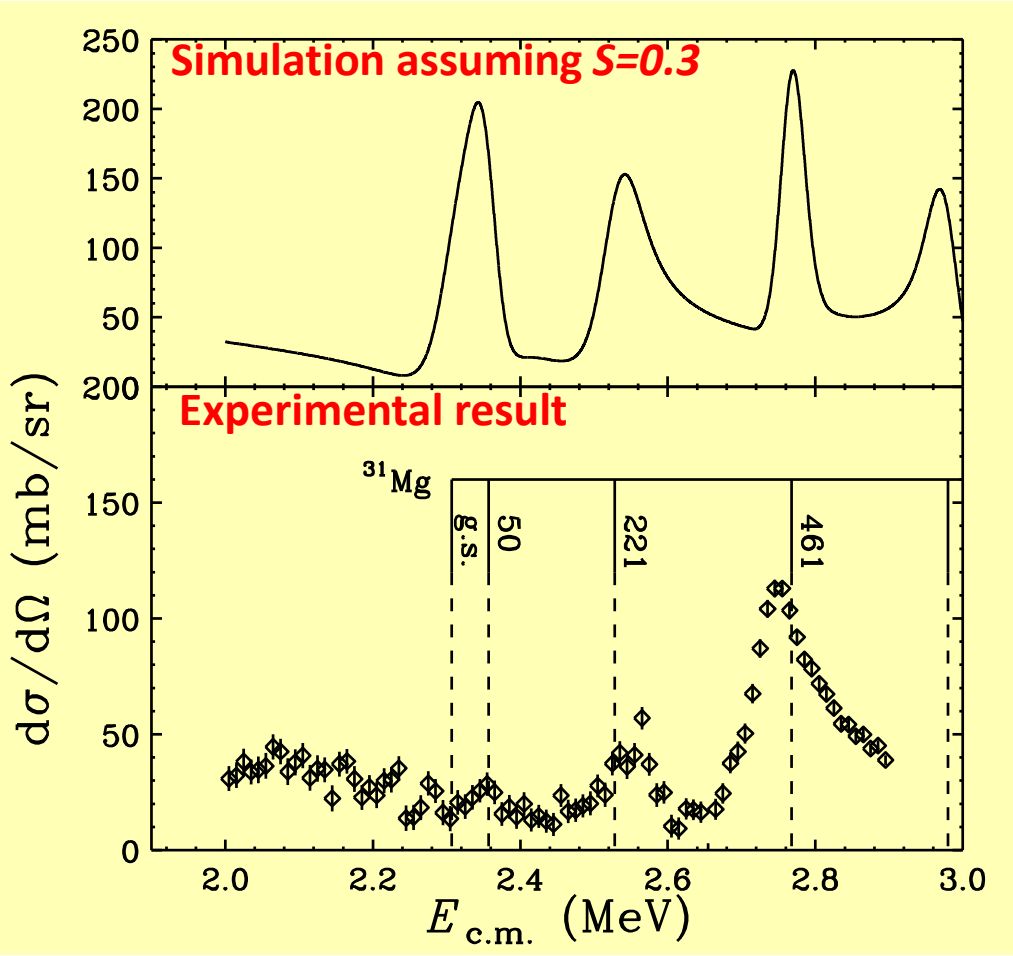
Scattering angles



Up to 100 ms from Proton impact



Experimental result



Resonance parameters for *S=0.3*

#	Ex (keV)	J^{π}	E_{cm} (MeV)	Γ_p (keV)
1	0.	1/2+	2.307	57.
2	50.	(3/2+)	2.357	11.
3	221.	(3/2-)	2.528	50.
4	461.	(7/2-)	2.768	6.
5	673.	(3/2+)	2.980	27.
6	945.	(5/2+)	3.252	27.

Tentative conclusion

- IARs of g.s. and 1st excited states of ^{31}Mg were strongly suppressed.

  S for(^{30}Mg(g.s.)+ 1n) < 0.1

- IARs around 2.5 and 2.8 MeV supports the assignments 3/2$^-$ for 221 and 7/2$^-$ for 461 keV.

R-matrix fitting is on-going…

Summary

- Proton resonance elastic scattering on ^{30}Mg was successfully measured with 2.92 MeV/u ^{30}Mg beams.
- IARs of ground and 1st excited states in ^{31}Mg were found to be strongly suppressed.
- The shapes of IARs at 2.5 and 2.8 MeV show L=1 and 3, respectively.

Collaborators

- KEK : N.I., M. Mukai, Y.X. Watanabe
- Lund: J. Cederkall, P. Golubev
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- Chalmers: J. Haakan
- Kyusyu-U: T. Teranishi
- CNS, Univ. o Tokyo: D. Kahl