



Status report of experiments

IS476 (H. Fynbo, B. Blank),

IS507 (H. Fynbo),

IS541 (K. Riisager)

Maria J G Borge
for the MAGISOL collaboration



Maria J. G. Borge , CERN, PH-Dept

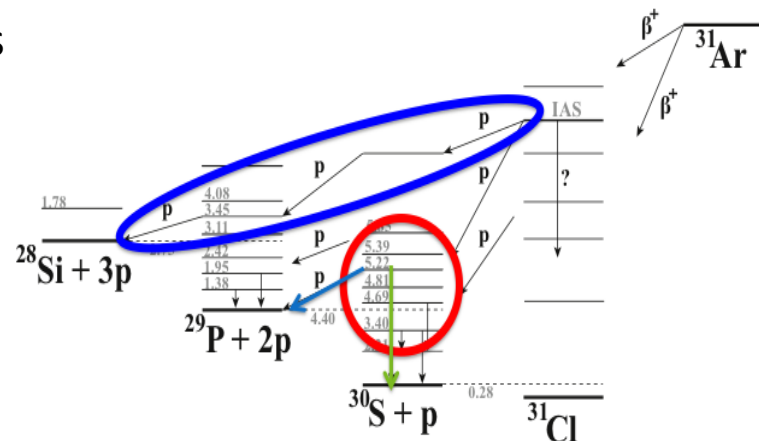


IS476: Studies of β -delayed 2p emission in ^{31}Ar

● Beam time allocated 27 shifts , remaining 5 shifts

● Motivation

- Elucidation of 2p emission mechanism in the β -decay of ^{31}Ar
- Spin and decay properties $\Gamma_{\gamma} / \Gamma_p$ of near proton threshold resonances in ^{30}S of astrophysical relevance.



● Beam Time : 2009-2012,

- ✓ Valuable data from the 2009 run although the yield was only 1 $^{31}\text{Ar}/\text{s}$.
- ✓ Two tries in 2012 focusing in the properties of the excited states in ^{30}S → technical problems at the Facility.

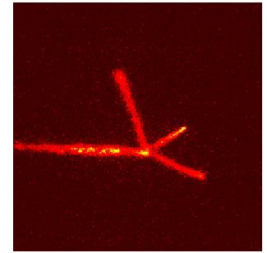
● Results: G. Koldste et al., Phys. Rev. C87 (2023) 055808

- ✓ G. Koldste et al, in $\beta 3p$ detection, intended for Phys. Lett. B

● Academic Training: Jeppe Kusk, Master 2011

- ✓ Gunvor Koldste, master 2012 and Ph.D. at the end of 2014

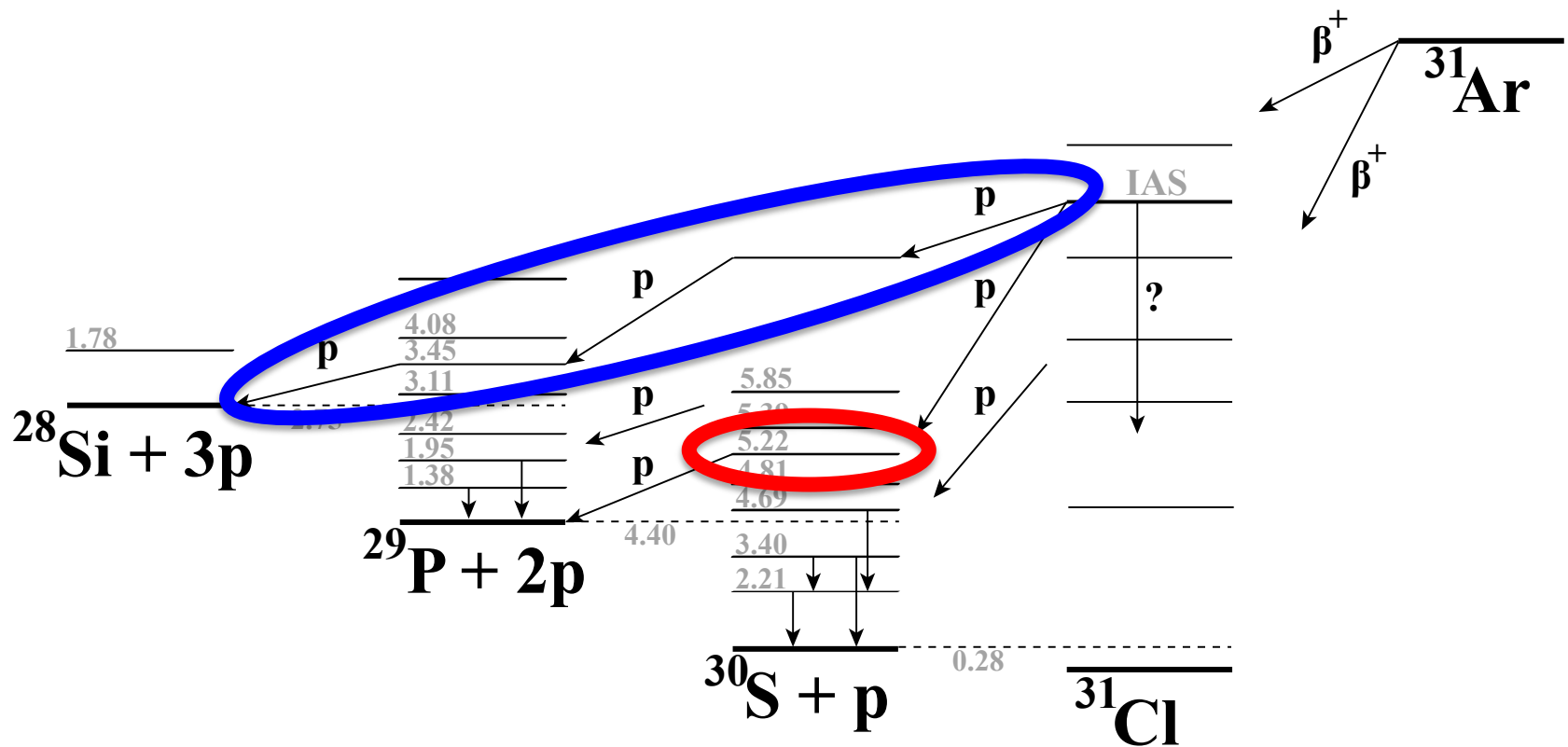
IS476: Motivation and results

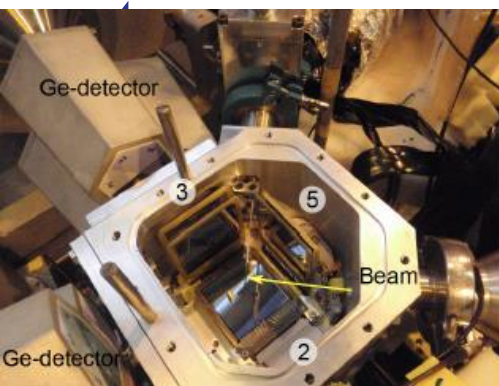


M. Pfützner *et al.* (2012)

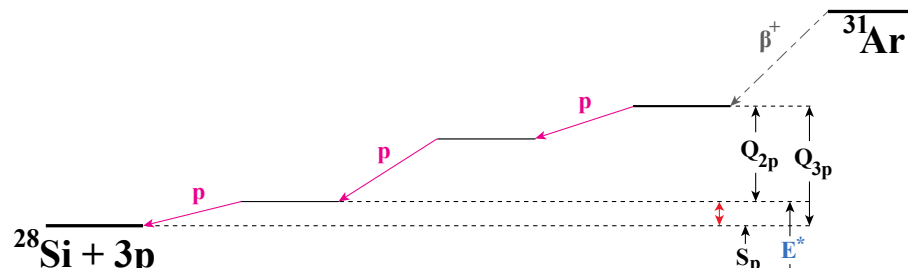
Results

- Identification of 3p emission in the β -decay of ^{31}Ar
- Spin and decay properties of the 5.22 MeV state in ^{30}S





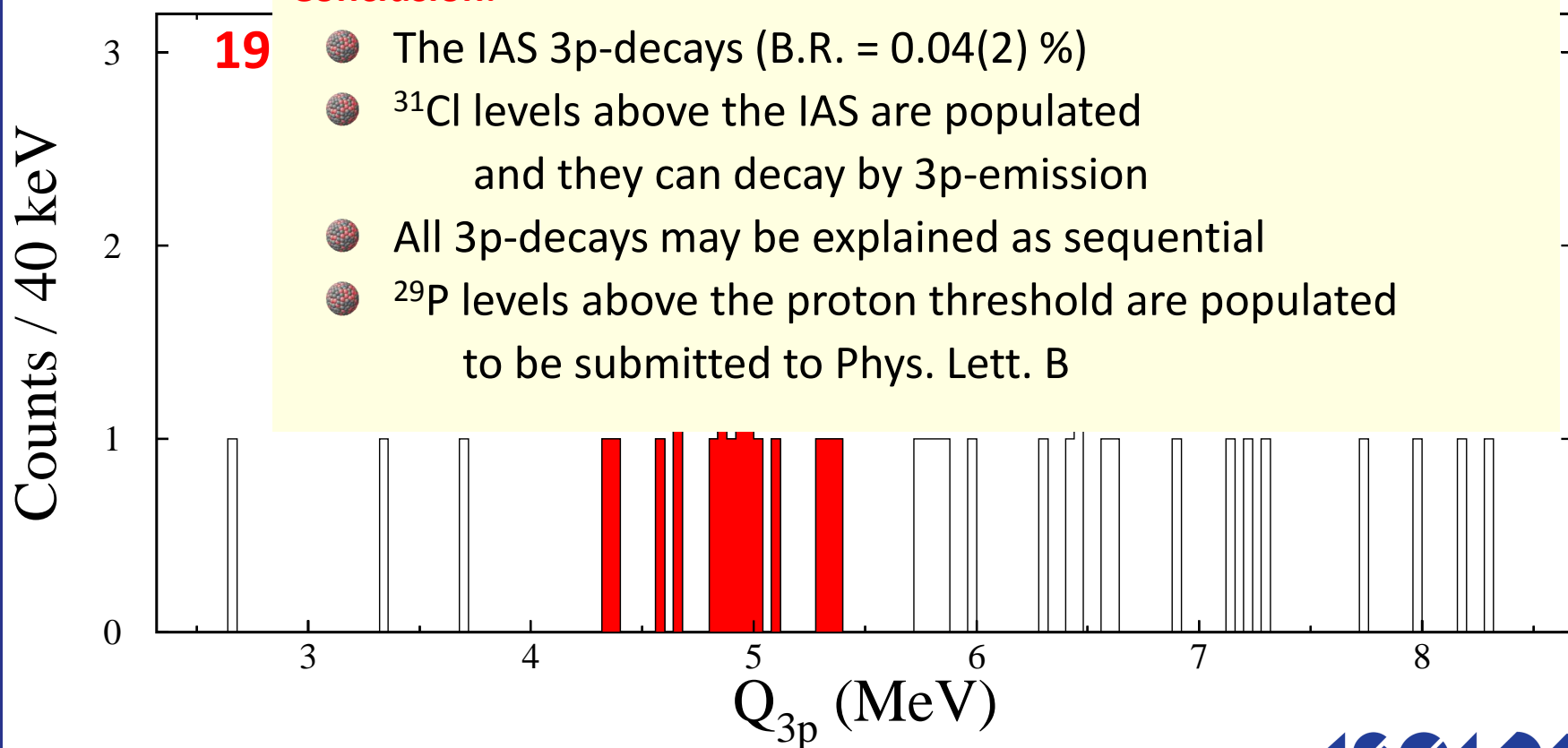
Identification of $\beta 3p$ events



Conclusion:

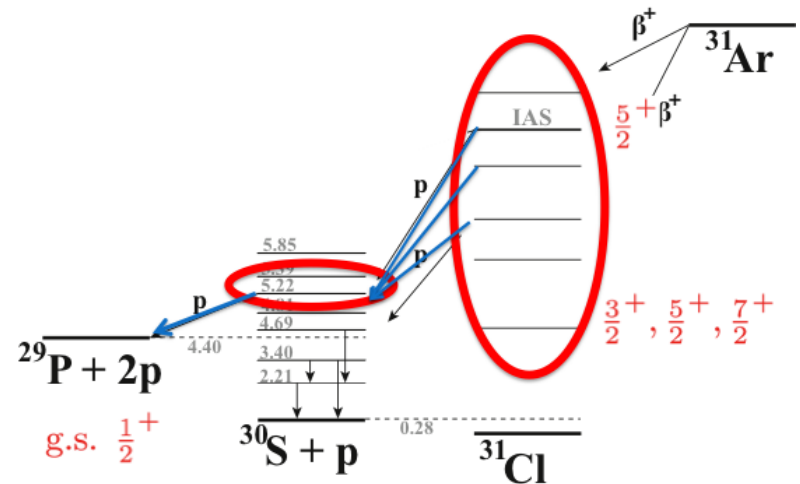
19

- The IAS 3p-decays (B.R. = 0.04(2) %)
- ^{31}Cl levels above the IAS are populated and they can decay by 3p-emission
- All 3p-decays may be explained as sequential
- ^{29}P levels above the proton threshold are populated to be submitted to Phys. Lett. B



Spin determination of the 5.22 MeV level in ^{30}S

- Study of angular correlation between the two emitted protons



- Angular distributions are compared with uniform or asymmetric distribution using kolmogorov test and fitting to Legendre polynomials

Conclusion: the 5.22 MeV level in ^{30}S
 It is either a 3^+ or 4^+ level
 Our data indicates 3^+

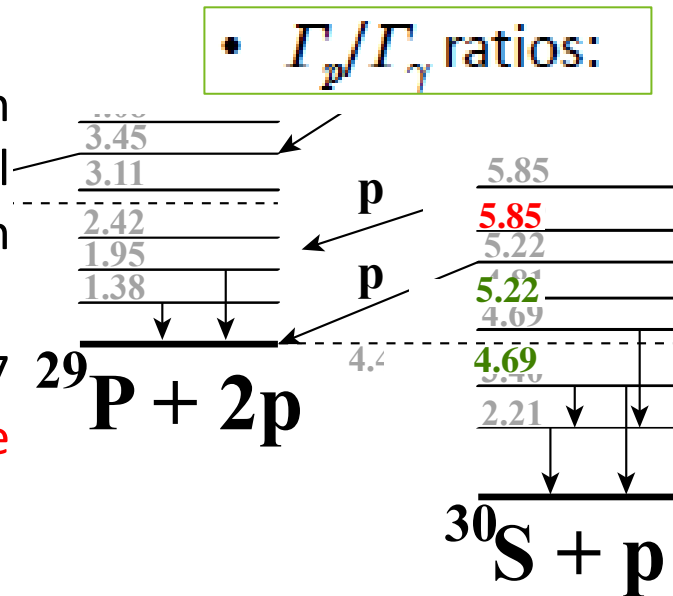
Literature: 5.22 MeV level is either $0^+/3^+$ or perhaps two levels; one 0^+ and one 3^+

Request for the pending shifts for IS476

IS476

- Spin and decay properties of near proton threshold resonances in ^{30}S of astrophysical relevance. Special emphasis in the detection of low energy protons.

Motivation overlaps with new accepted IS577 **BUT 12 shifts are insufficient for doing these measurements.**



isotope	yield (/uC)	target – ion source	Shifts (8h)
^{31}Ar	10	CaO, Vadis source	4.9
^{33}Ar	1000	Idem	0.1
		Total shifts:	5

- SETUP: New ISOLDE decay station + highly performing charged particle detection system + upgraded electronics & DAQ

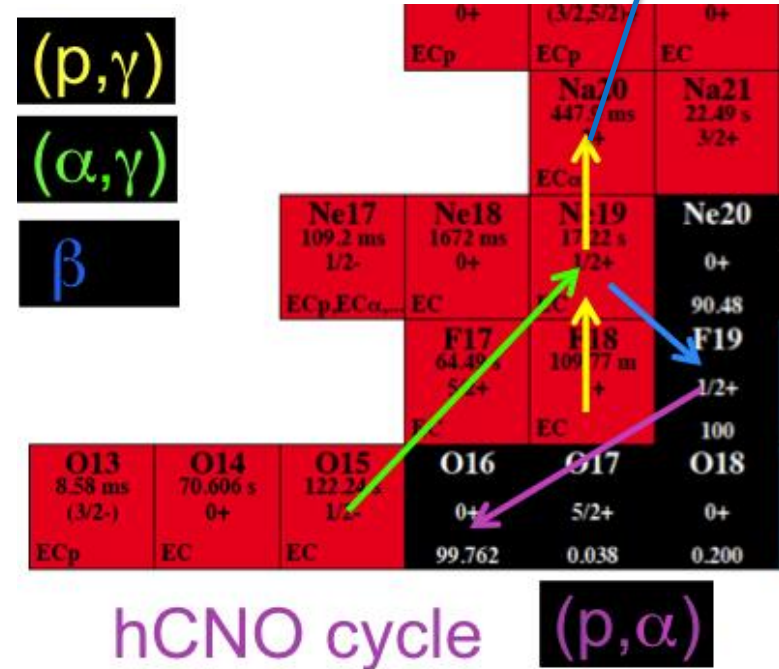
IS507: Study of β -decay of ^{20}Mg

rp-process

● Beam time allocated: 18 shifts, remaining 10,5

● Motivation

- Determination of position and decay properties of resonances in ^{20}Na , in particular $E^* \approx 2650$ keV
- Study of mirror asymmetry between the decay of ^{20}O and ^{20}Mg
- Detailed decay to compare with SM calculation at $N=8$



● Experimental setup:

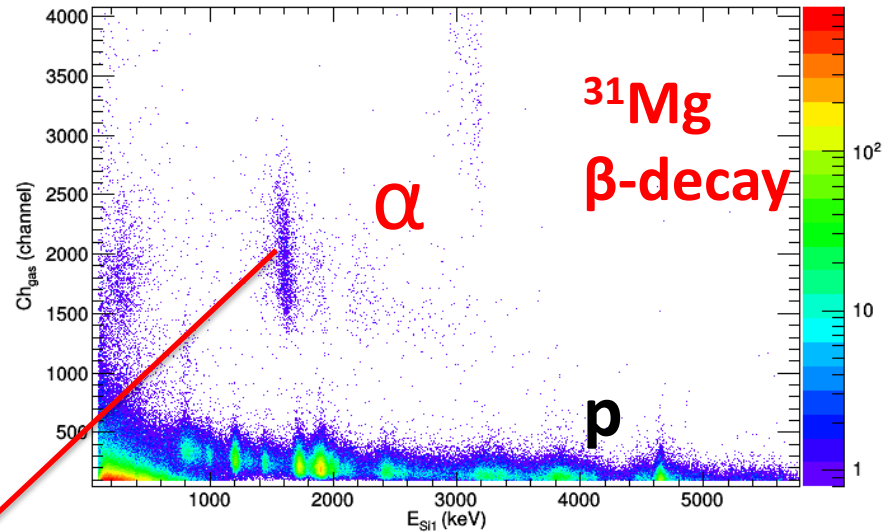
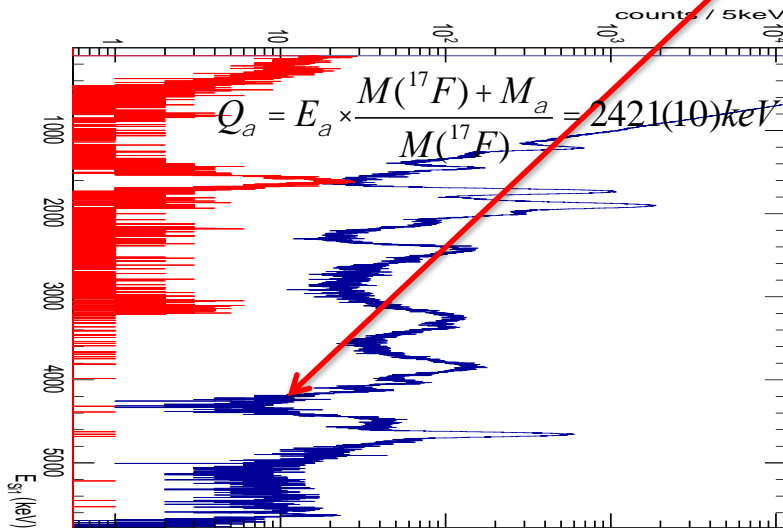
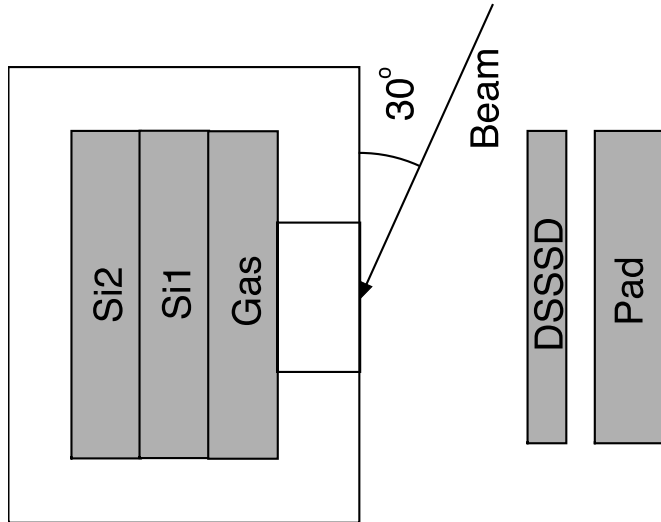
- Measure β -delayed proton and γ spectrum with high statistics and under much improved conditions: **Gas-Si telescope: DONE in 2011**
- Measure βp , $\beta \gamma$ and γp coincidences to correctly assign p-peaks: **Large efficiency setup PENDING**

● **Academic Training:** Malin Klintefjord, Master 2012

✓ Morten Lund, master 2014 and Ph.D. at the end of 2015

IS507: preliminary results

Highly performing setup



- Identification of $\beta\alpha$ in the decay of ^{31}Mg for first time.
- High quality of low energy βp spectrum.
- Limits for feeding of 2650 keV level equivalent to recently measured at Texas AM[Wallace et al., PLB712 (2012)59]
- Encouraging results to be able to accomplish motivation 2 & 3

Request for the pending shifts for IS507

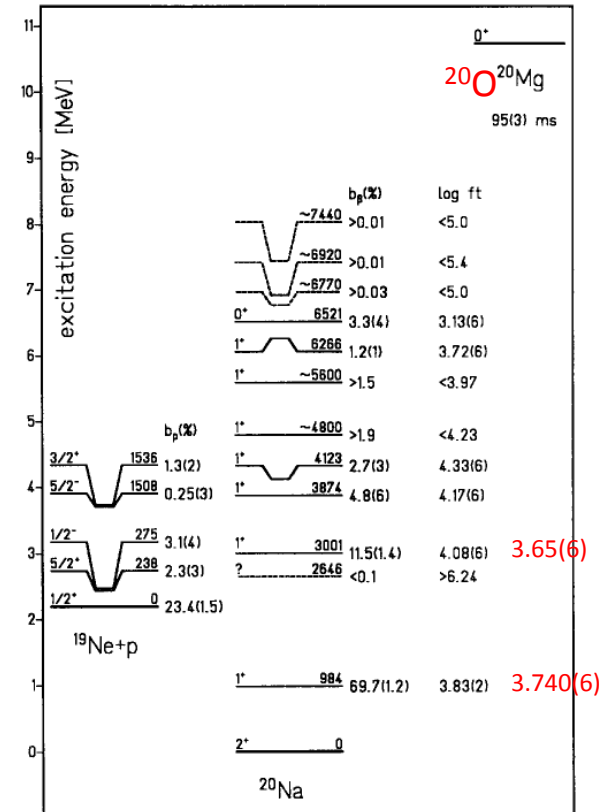
IS507

- Study of mirror asymmetry between the decays of ^{20}O and ^{20}Mg .
- GT Distribution to compare with SM calculation at N=8. Previously bad agreement.

isotope	yield (/uC)	target – ion source	Shifts (8h)
^{20}Mg	50	SiC, RILIS (possibly LIST).	10
^{21}Mg	1000	Idem	0.5
		Total shifts:	10,5

Improved yield of ^{20}Mg with the use of LIST will allow to put more stringent limits in the feeding to the 2650 keV level in ^{30}S .

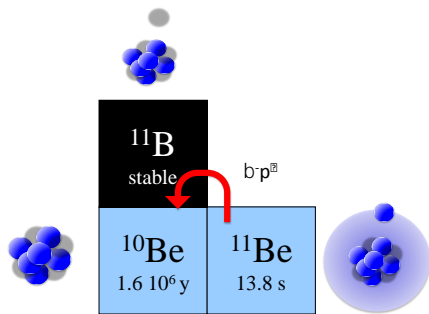
- SETUP: New IS decay station + highly performing charged particle detection system + upgraded electronics & DAQ



IS541: Search for βp in halo ^{11}Be nuclei

● Beam time allocated:

● Motivation



- ✓ βd observed in ^6He & ^{11}Li halo nuclei decay directly to the continuum \rightarrow simpler mode in 1n-halo nuclei
- ✓ ^{11}Be best case to search for βp , $Q_{\beta p} = 280.7$ keV
- ✓ Expected B.R. 10^{-8} assuming direct decay
D. Baye & Tursonov, Phys. Lett. 696 (2011) 464
- ✓ Previous attempt gave inconclusive result with BR = $2.5(25) \times 10^{-6}$; Borge et al., J. Phys G 40 (2013) 035109

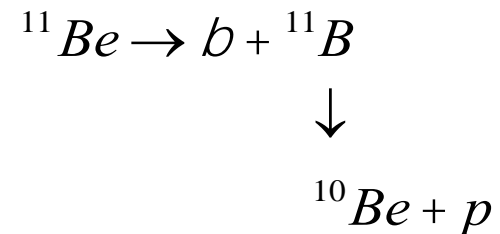
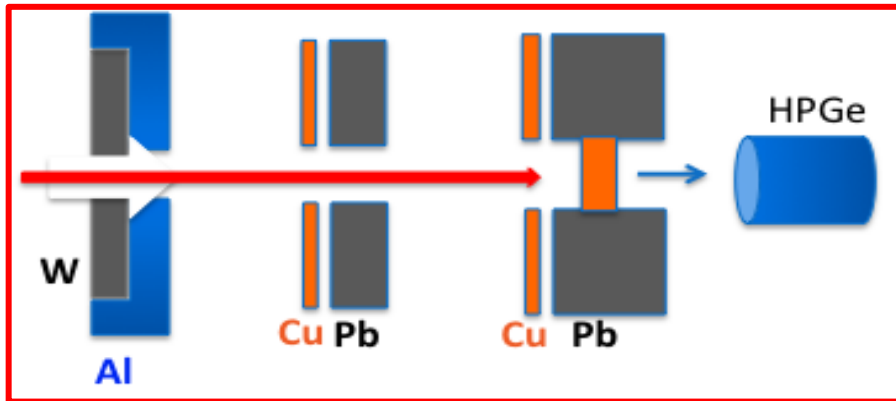
● Beam time: July 2012, technical problems \rightarrow Dec 2012, reduced beam time, extra samples for studying systematic effects were not possible.

● Results: K. Riisager et al., submitted to Phys. Lett. B

● Academic Training: Morten Lund, master 2014 and Ph.D. at the end of 2015

IS541: Results

A 200 keV 10^{-8} proton branch is challenging to detect →
Detect ^{10}Be daughter by AMS



- Contaminations measured to be negligible.
 - Several cross checks missing to be done.
- B.R. = $8.4(6) \times 10^{-6}$ **Consistent with previous results**

❖ The measured BR is two orders of magnitude higher than expected. Although recent calculations may be able to explain this BR it is imperative to validate this result by finishing the study of systematic effects that were not possible to be done in Dec 2012 due to lack of beam time.

Request for the pending shifts for IS547

IS547

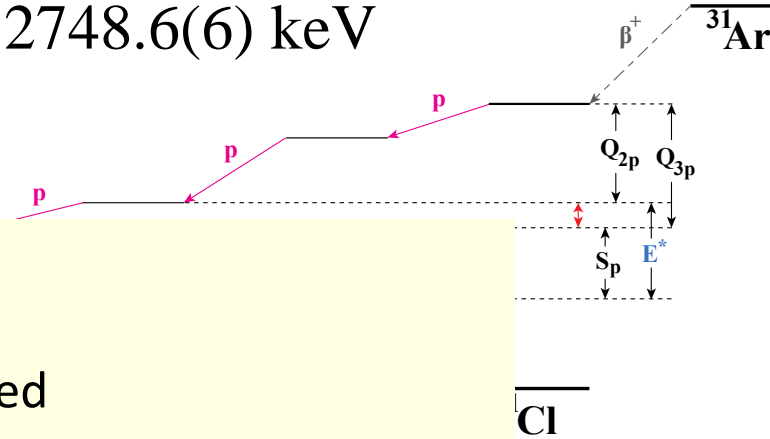
- Remaining shifts for systematics cross check of the results
 - ✓ Confirmation of decay branch by a measurement on ^{11}Be position
 - ✓ Test of the BeH molecule contamination with lasers blocked
 - ✓ Mass profile study using off-mass samples.
 - ✓ Calibration with ^{10}Be samples produced at ^{11}Li mass position.

isotope	yield (/uC)	target – ion source	Shifts (8h)
^{11}Be	10^7	Ta + RILIS	4
^{11}Li	10^3	Ta	1
		Total shifts:	5

- SETUP: The same that used previously in Dec 2012

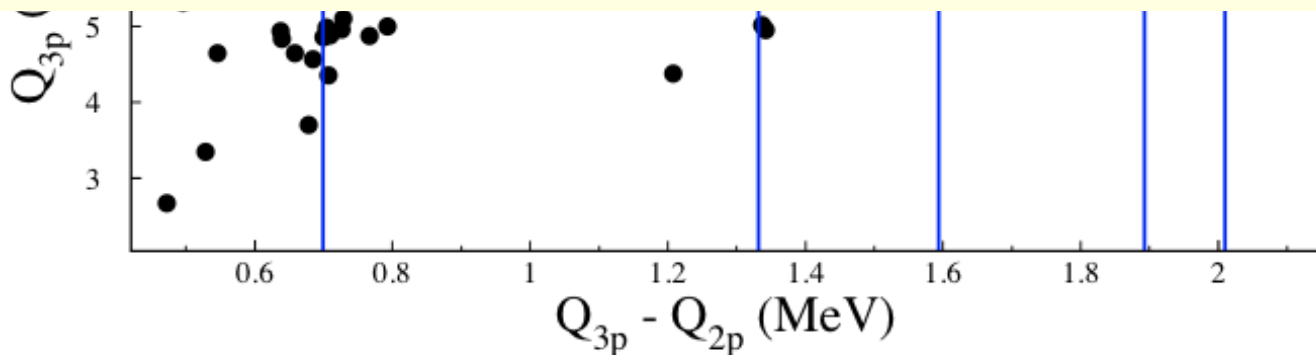
Identification of $\beta 3p$ events(II)

$$Q_{3p} - Q_{2p} = E(^{29}\text{P}) - S_p(^{29}\text{P}) = E(^{29}\text{P}) - 2748.6(6) \text{ keV}$$

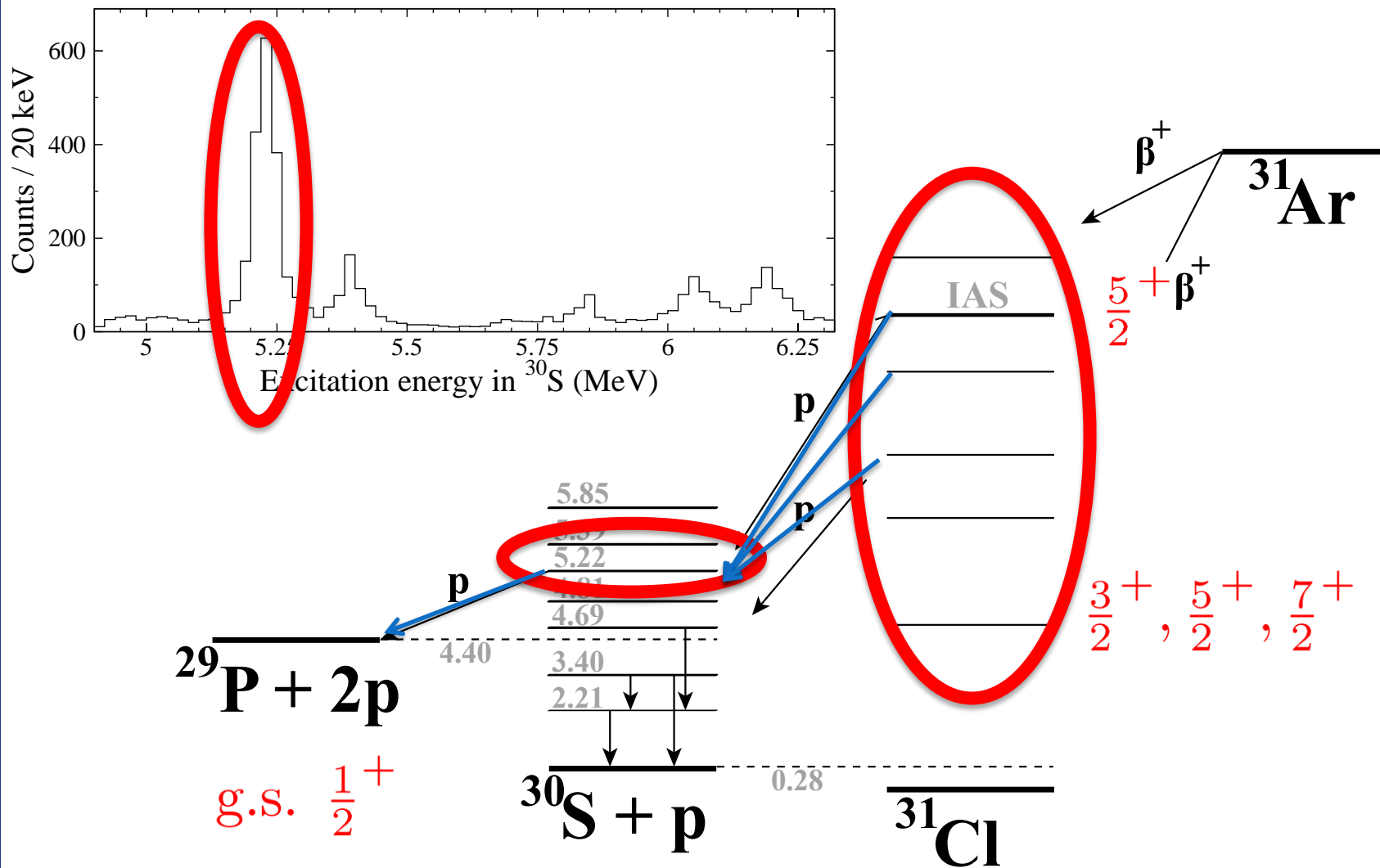


Conclusion:

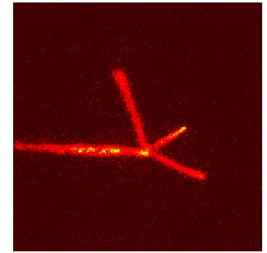
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Spin determination of levels in ^{30}S



IS476: Motivation and results



M. Pfützner *et al.* (2012)

Results

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