

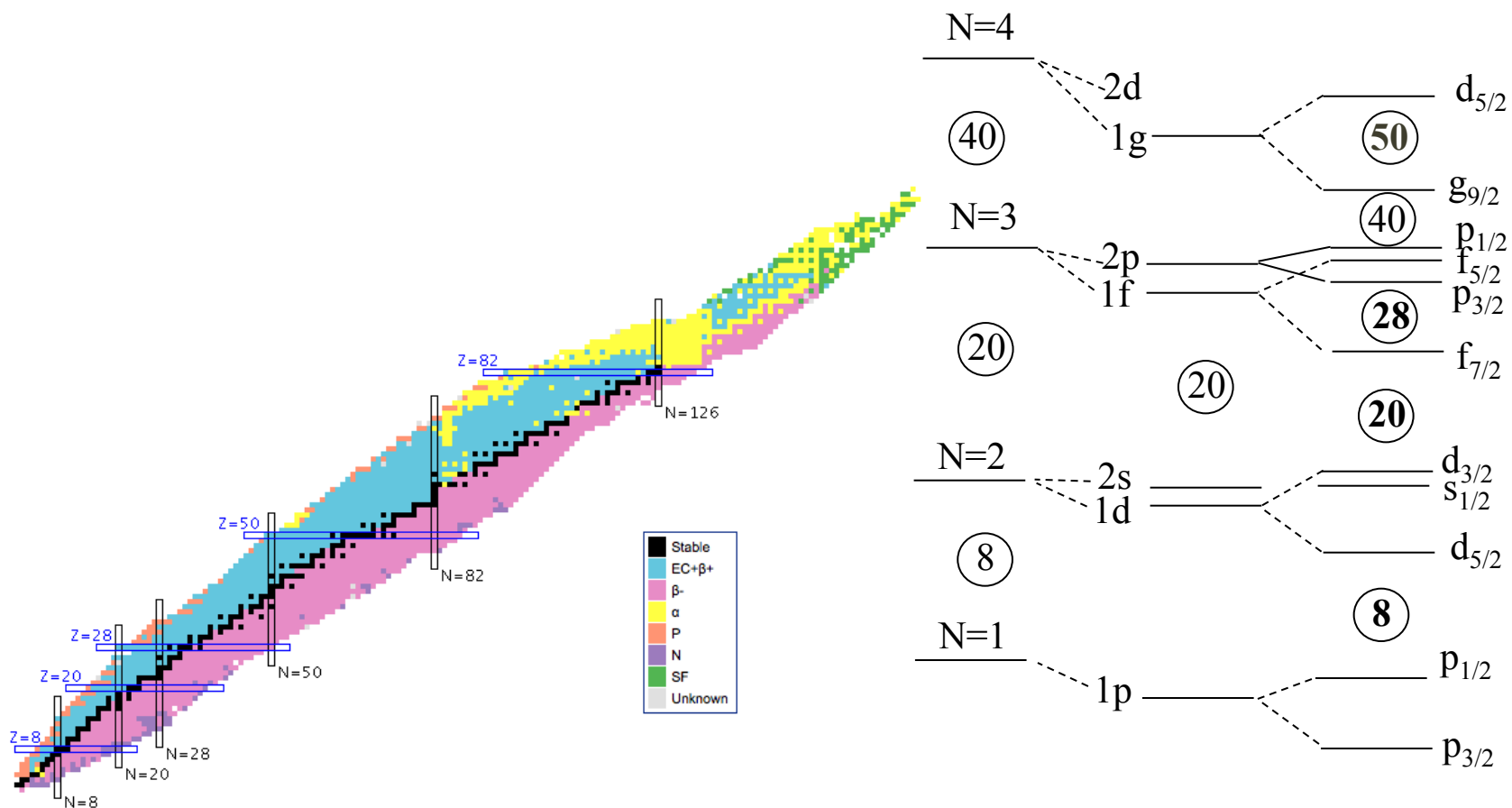
Neutron rich Ni
isotopes studied
by intermediate
energy knock-out
reactions

Francesco Recchia

NATIONAL
SUPERCONDUCTING
CYCLOTRON
LABORATORY

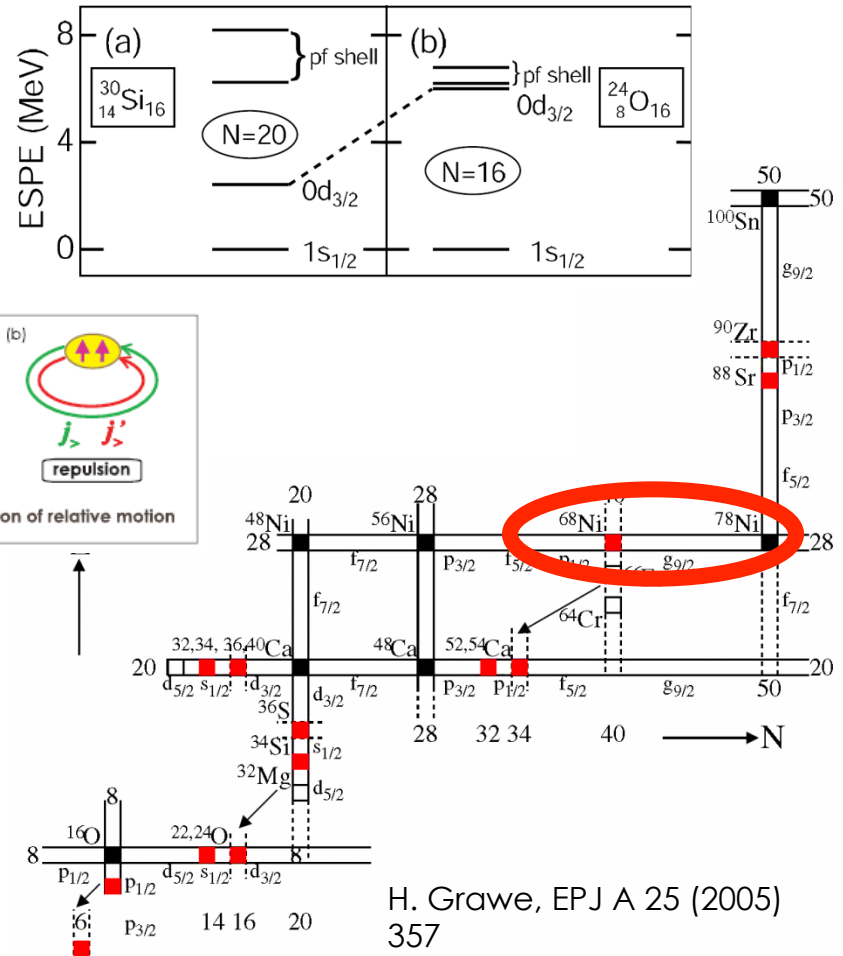
DIPARTIMENTO DI
FISICA E ASTRONOMIA
UNIVERSITA' DEGLI
STUDI DI PADOVA

The “spin-orbit” magic numbers



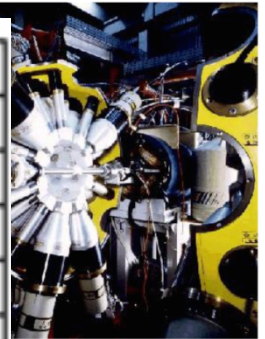
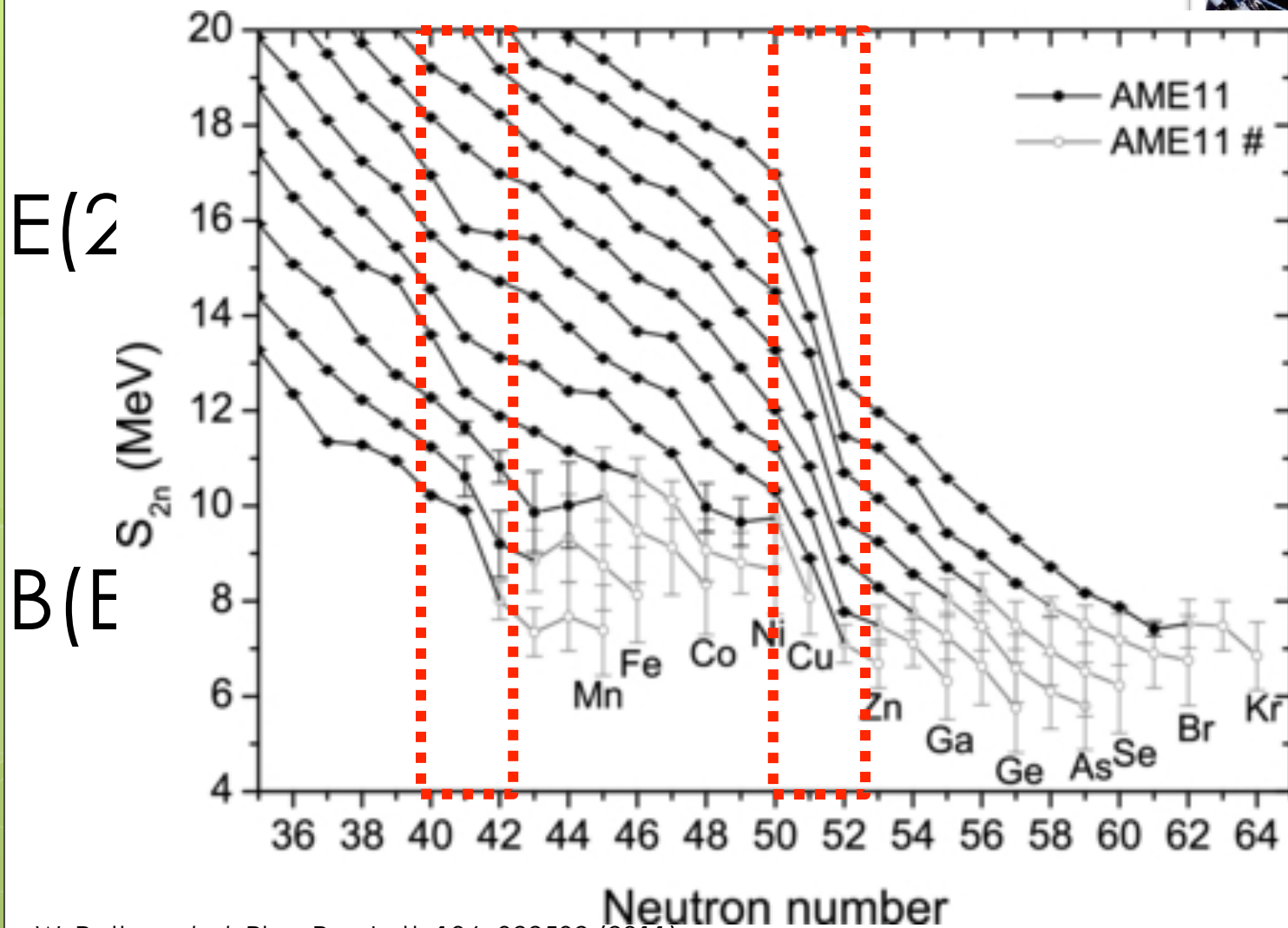
Shell evolution

- Disappearance / appearance of magic numbers
- P-N attraction between **spin-flip partner orbits**
- Monopole part of the **tensor term**
- Monopole part of the **three-body force**

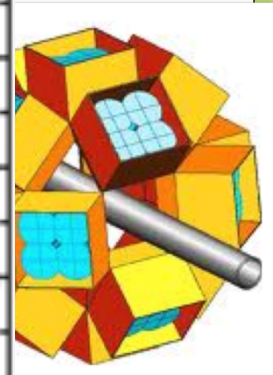


T. Otsuka et al. EPJ A 20 (2003) 69-73, PRL 95, 232502 (2005),
 J.D.Holt et al 2012 J. Phys. G: Nucl. Part. Phys. 39 085111

Observables at N=40



da et al.,
4, 868 (95)



rlin et al. PRL
2501 (2002)

W. Rother et al. Phys. Rev. Lett. 104, 092502 (2010)

A. Kankainen, et al., J.Phys.G 39, 093101 (2012)

FRANCESCO RECCHIA - INFN TS

Single Particle Strength in the odd, neutron-rich Ni isotopes

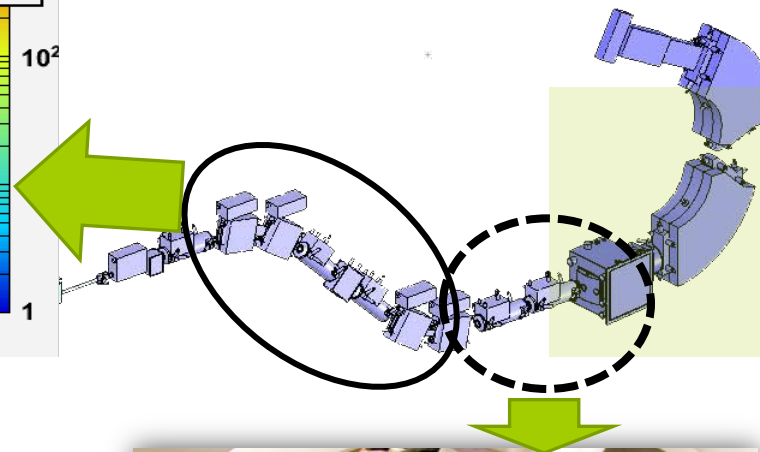
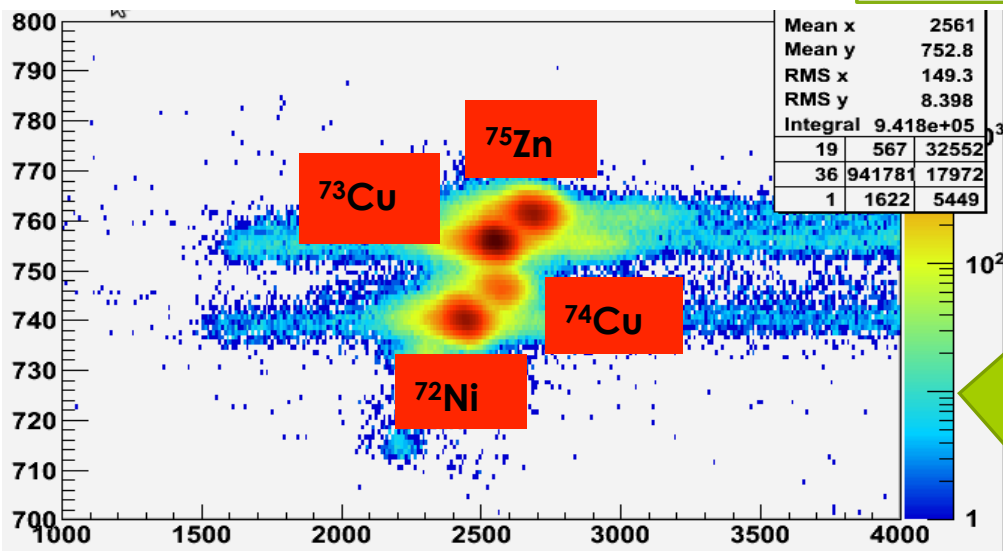
- **Persistence** of customary magic numbers
- Spin-isospin part of the **nn interaction**
- **Single particle strength** in $A^{-1}\text{Ni}$

- components in the g.s. in $A\text{Ni}$
- comparison to shell model calculations

- Provide the first gating transitions for GS data



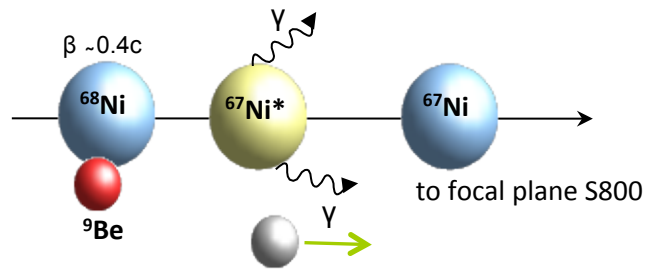
Dec 8 – 12 2012



A1900 fragment separator

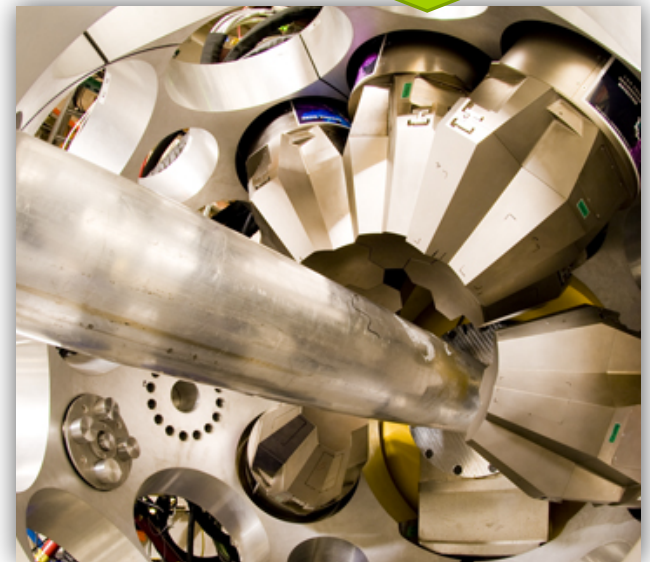
$^{82}\text{Se}^{34+}$,
140 MeV/u



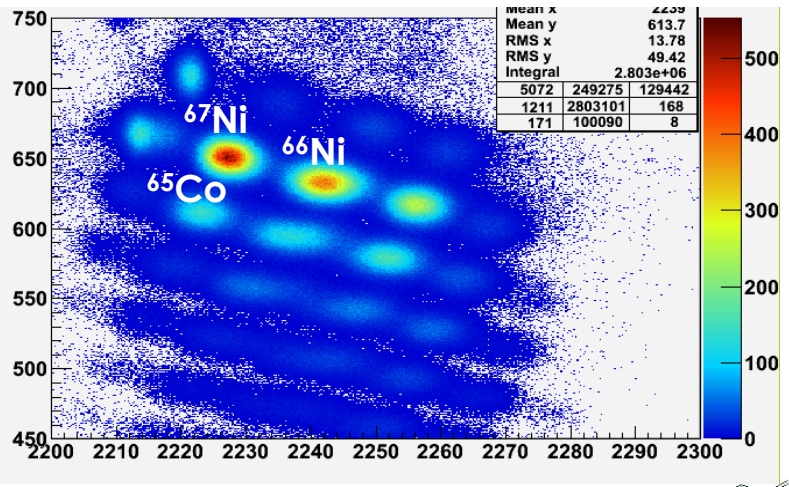


Reaction target
100-281 mg/cm²

A1900 fragment separator



Gated on ^{68}Ni

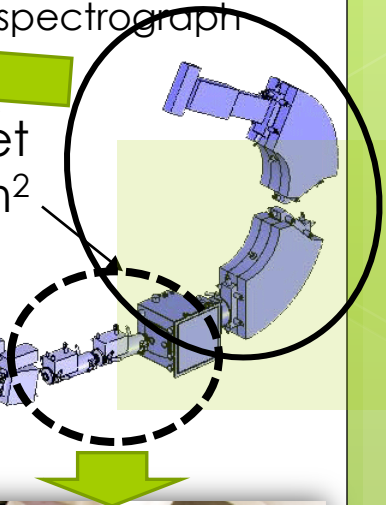


Velocity vector

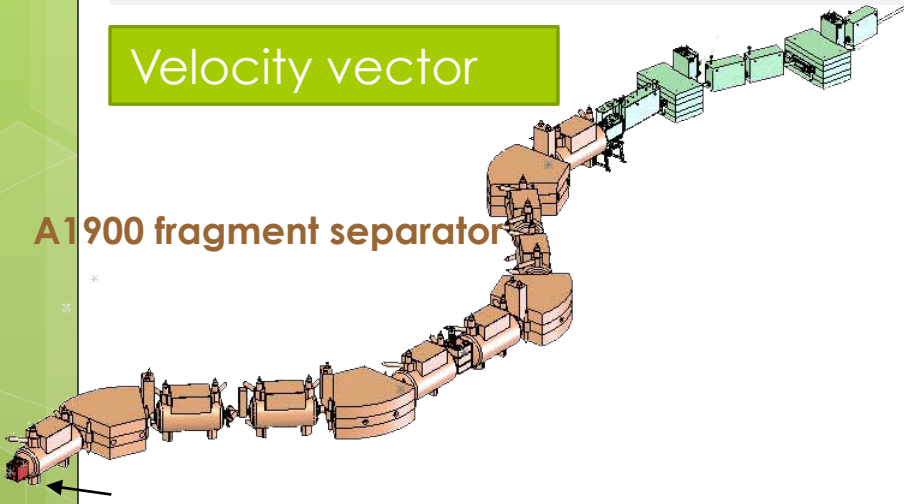
Reaction product identification
S800 spectrograph



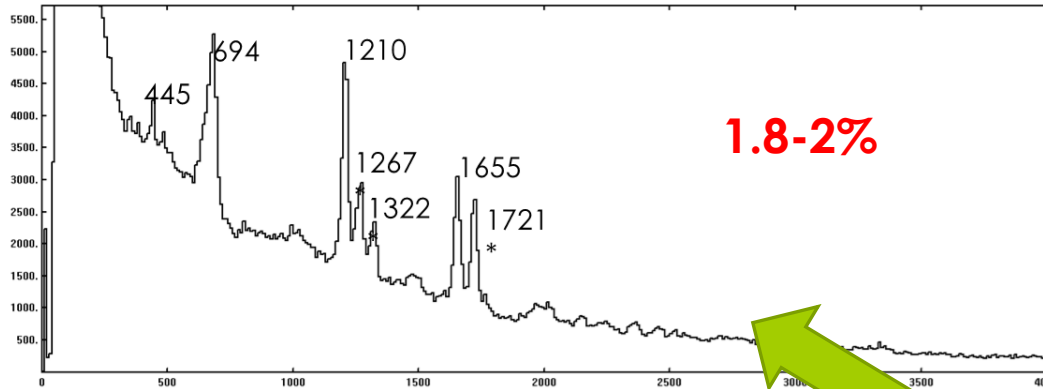
Reaction target
100-281 mg/cm²



A1900 fragment separator



Gated on ^{68}Ni and ^{67}Ni

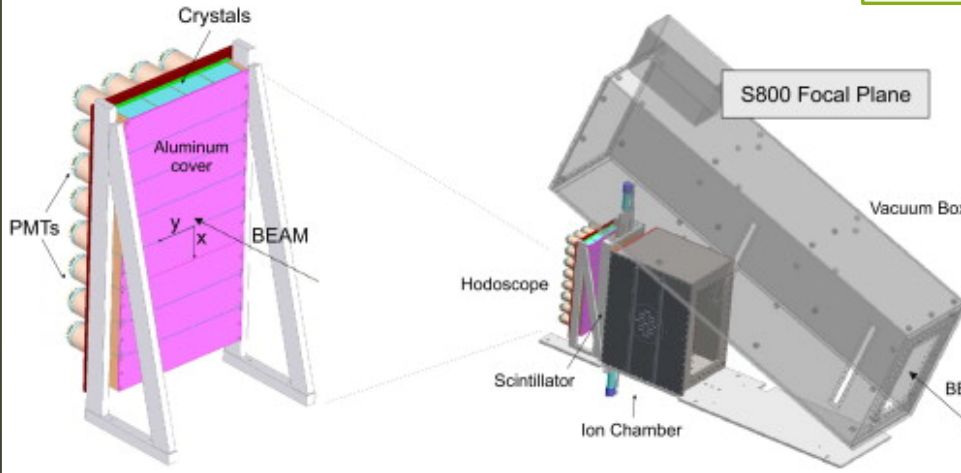


Reaction product
identification
S800
spectrograph

Reaction target
00-281 mg/cm²

A1900 fragment separator

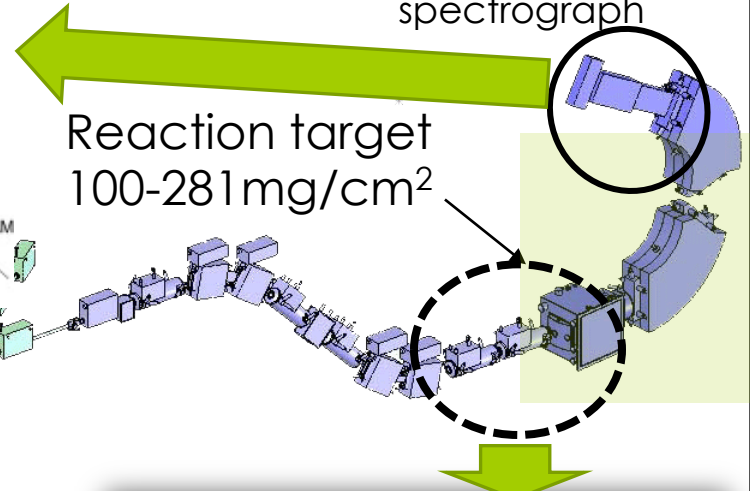




K. Meierbachtol et al. NIM A 652 (2011) 668-670

Reaction product identification
S800 spectrograph

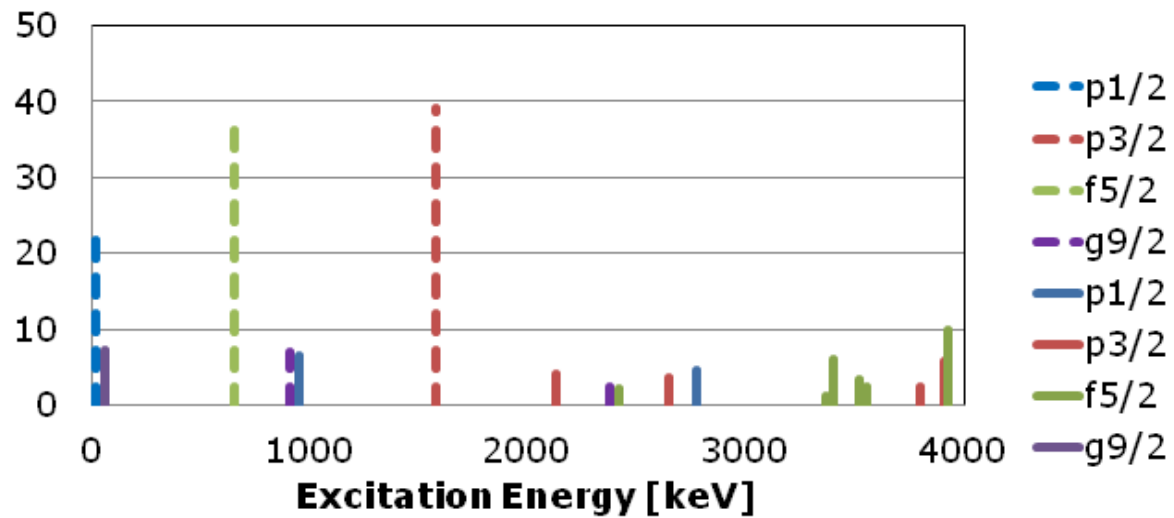
Reaction target
100-281 mg/cm²



A1900 fragment separator



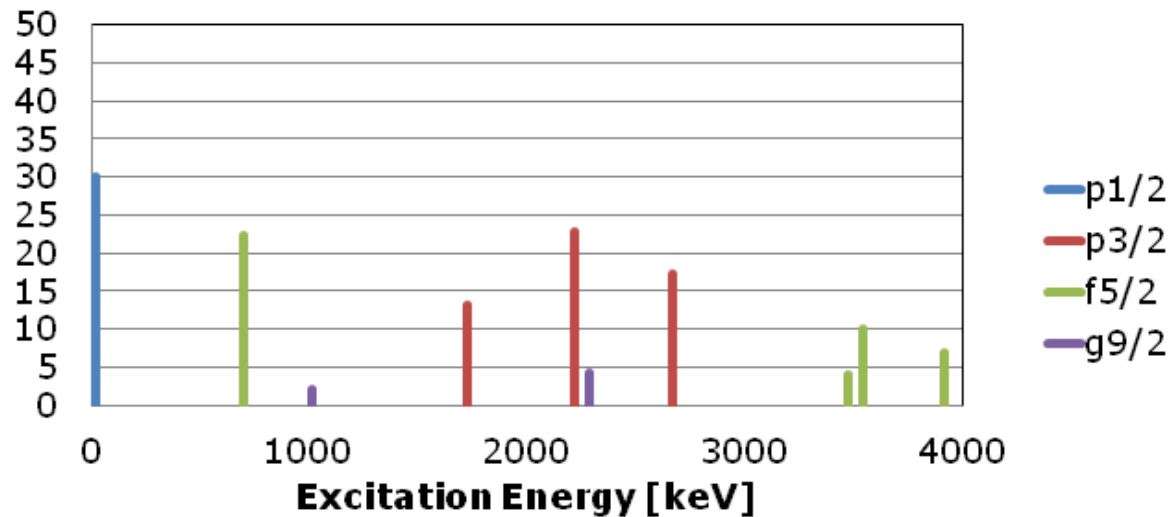
Partial Cross sections



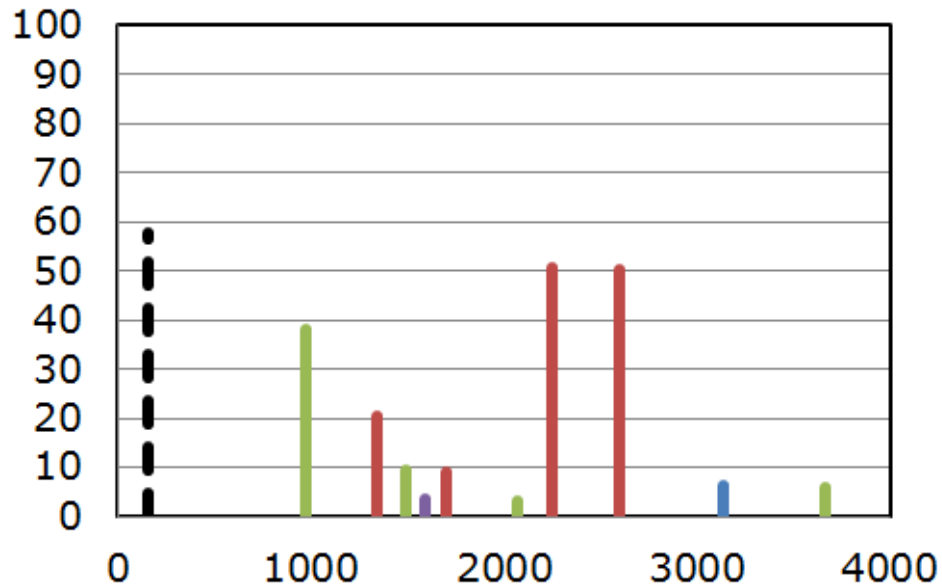
5⁻ isomeric
content: 39(5)%

jj44

Partial Cross Sections

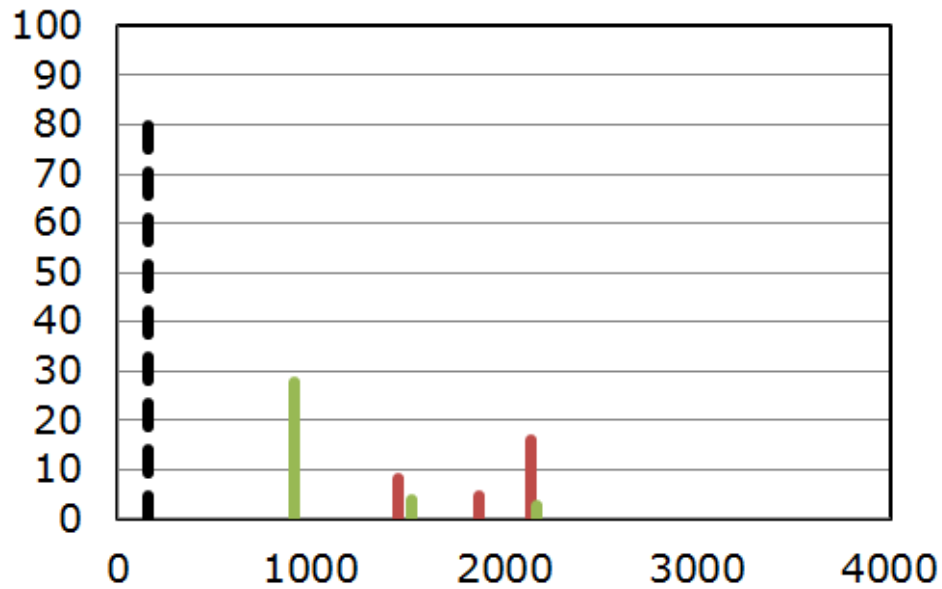


EXP



8+ isomeric
content: 8(1)%

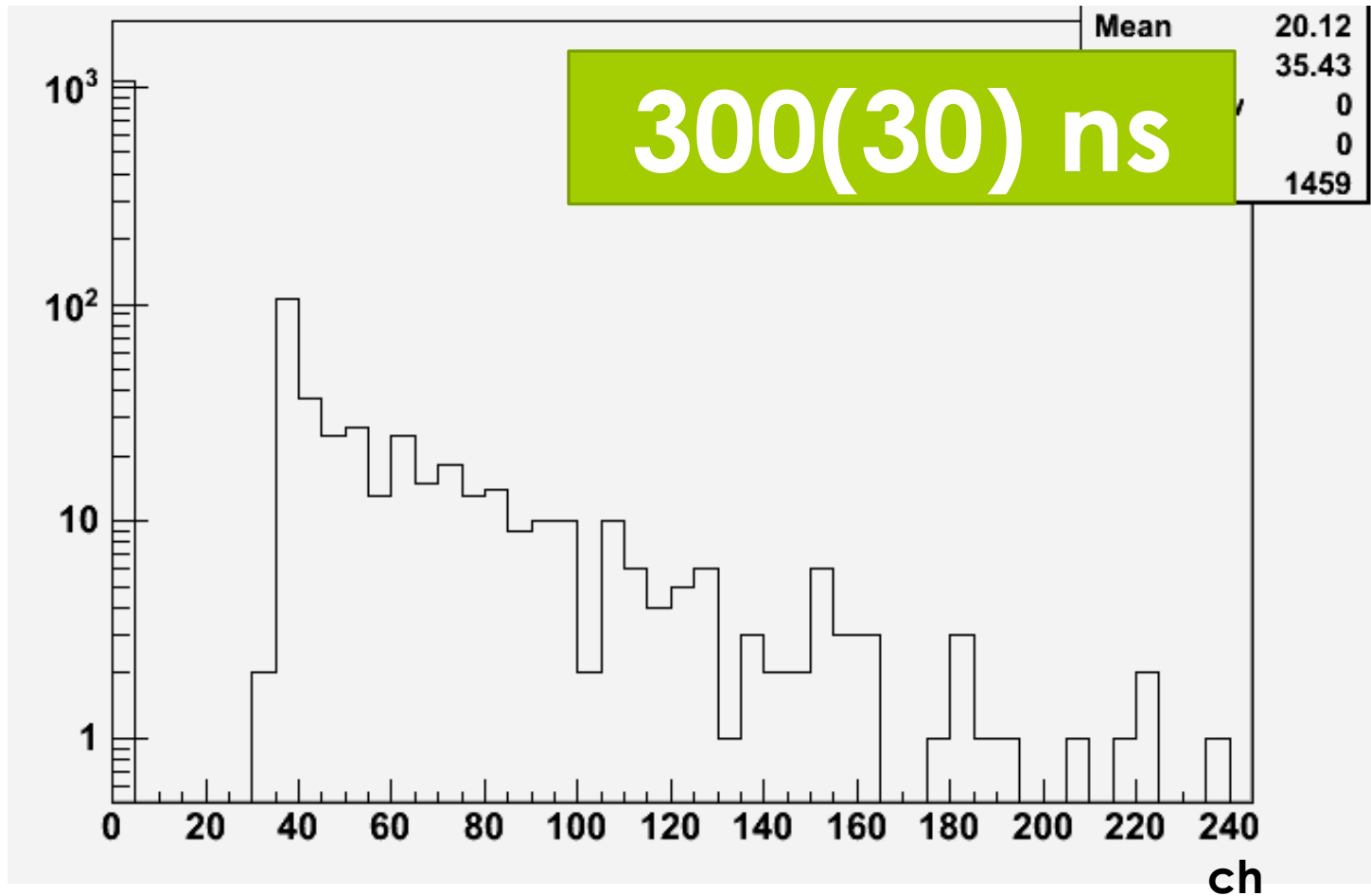
jj44



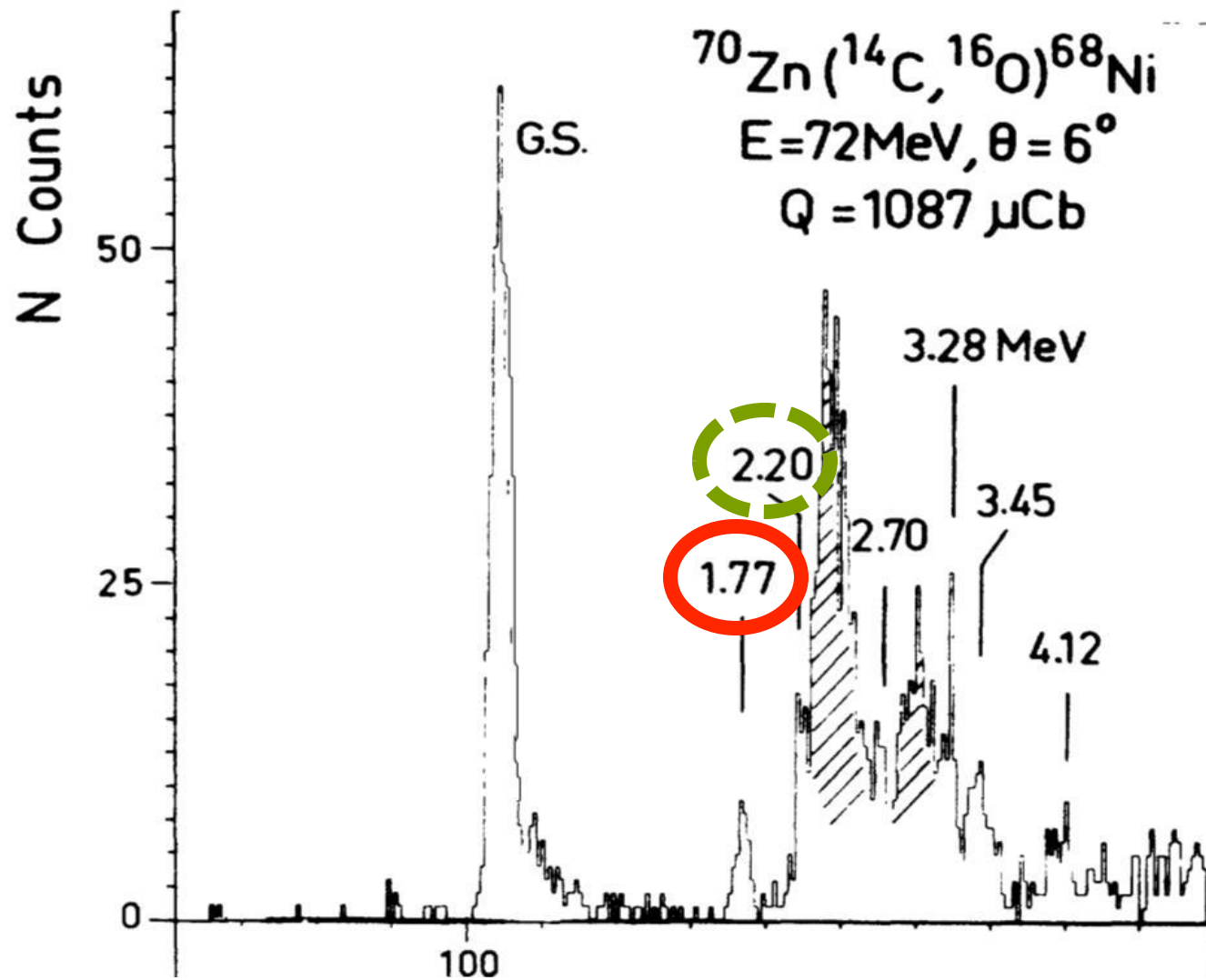
EXP

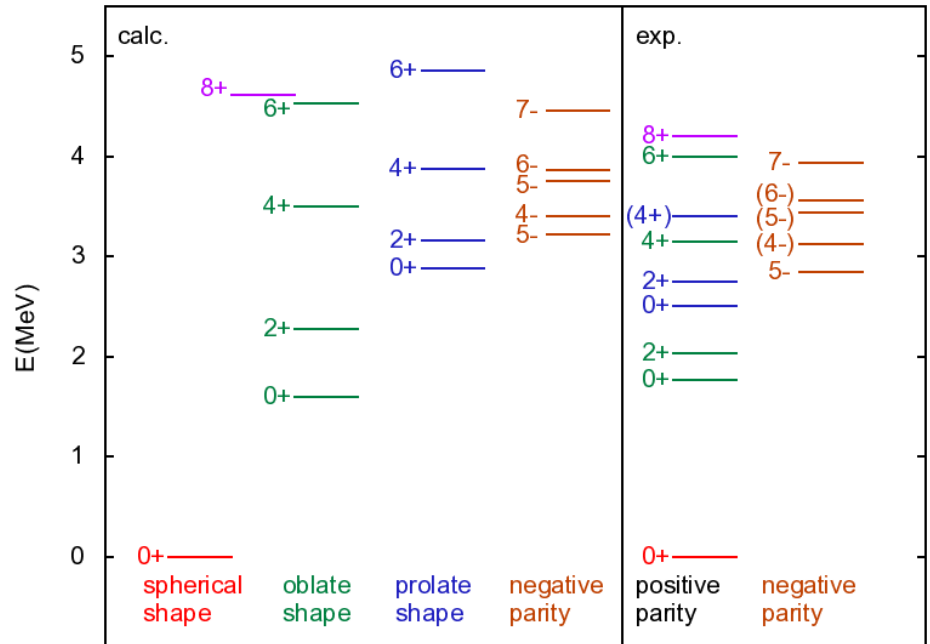
^{68}Ni is produced from ^{70}Ni

Lifetime: O_2^+



GIROD PRC 1988



^{68}Ni 

N. Shimuzu, T. Otsuka et al.
Prog. Theor. Exp. Phys. (2012) 01A205

Thank you!

Experiment:

A. Gade, R.V.F. Janssens, D. Weisshaar, M. Albers,
V. Bader, T. Baugher, D. Bazin, J. Berryman,
C.M. Campbell, M.P. Carpenter, J. Chen,
C.J. Chiara, H. Crawford, C.R. Hoffman,
F.G. Kondev, A. Korichi, C. Langer,
T. Lauritsen, E. Lunderberg, S. Noji, R. Stroberg,
S. Williams, K. Wimmer, S. Zhu

Theory:

B.A. Brown