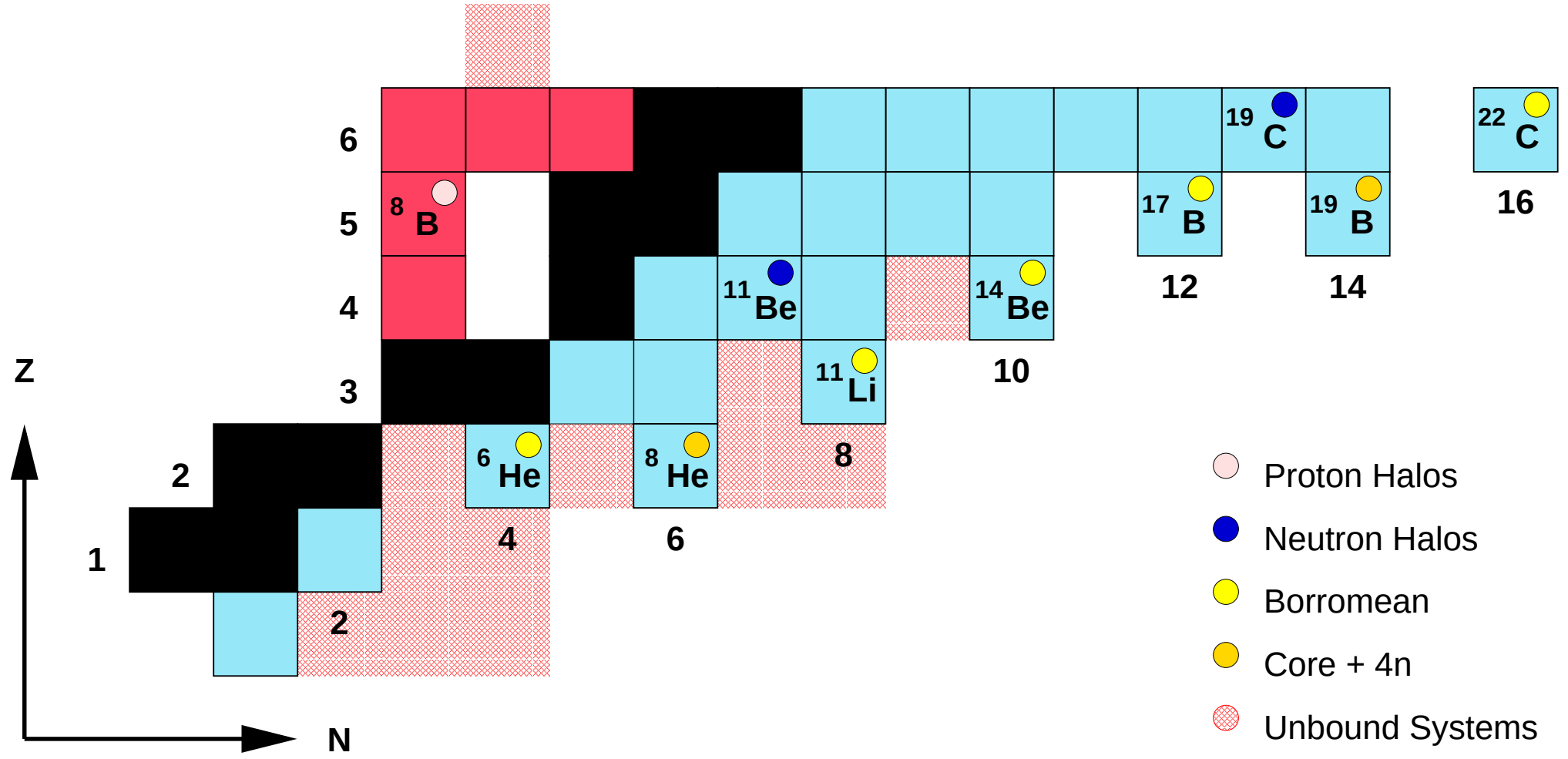
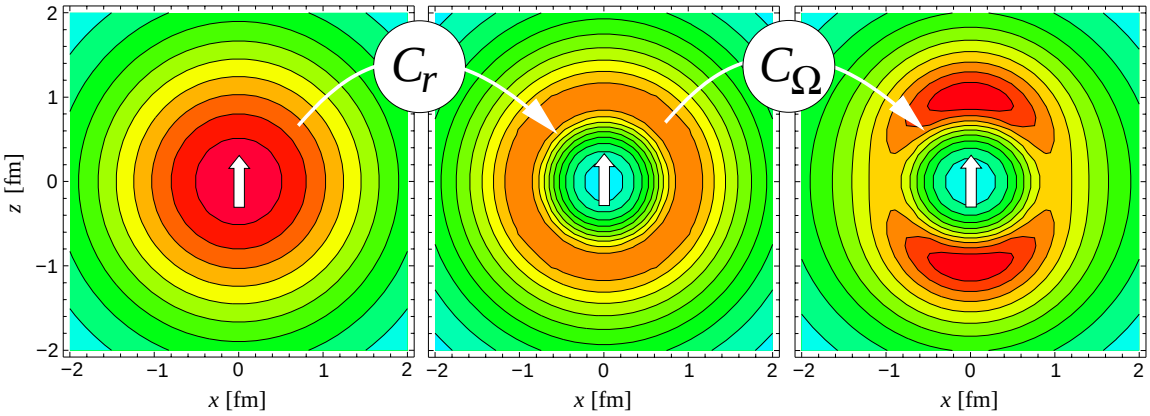
Unbound Nuclei



Short Range Correlations

Theory

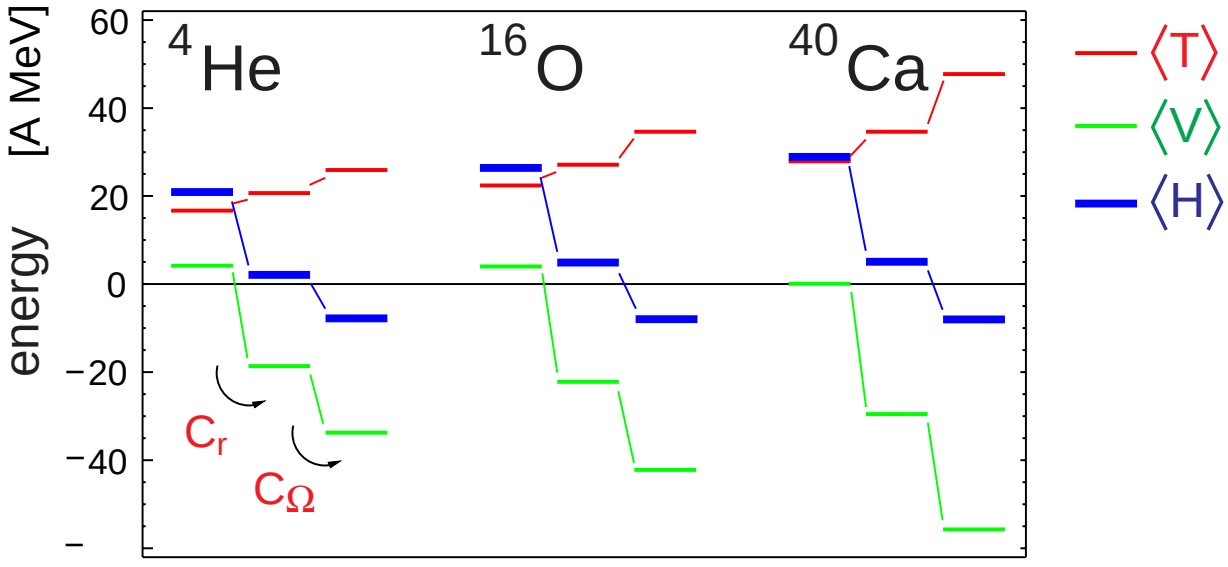
two body density, S=1, M_S=1, T=0, FMD model



C_r: describes repulsive core ⇔ EOS

C_Ω: tensor forces, density distribution

correlated with spin orientation

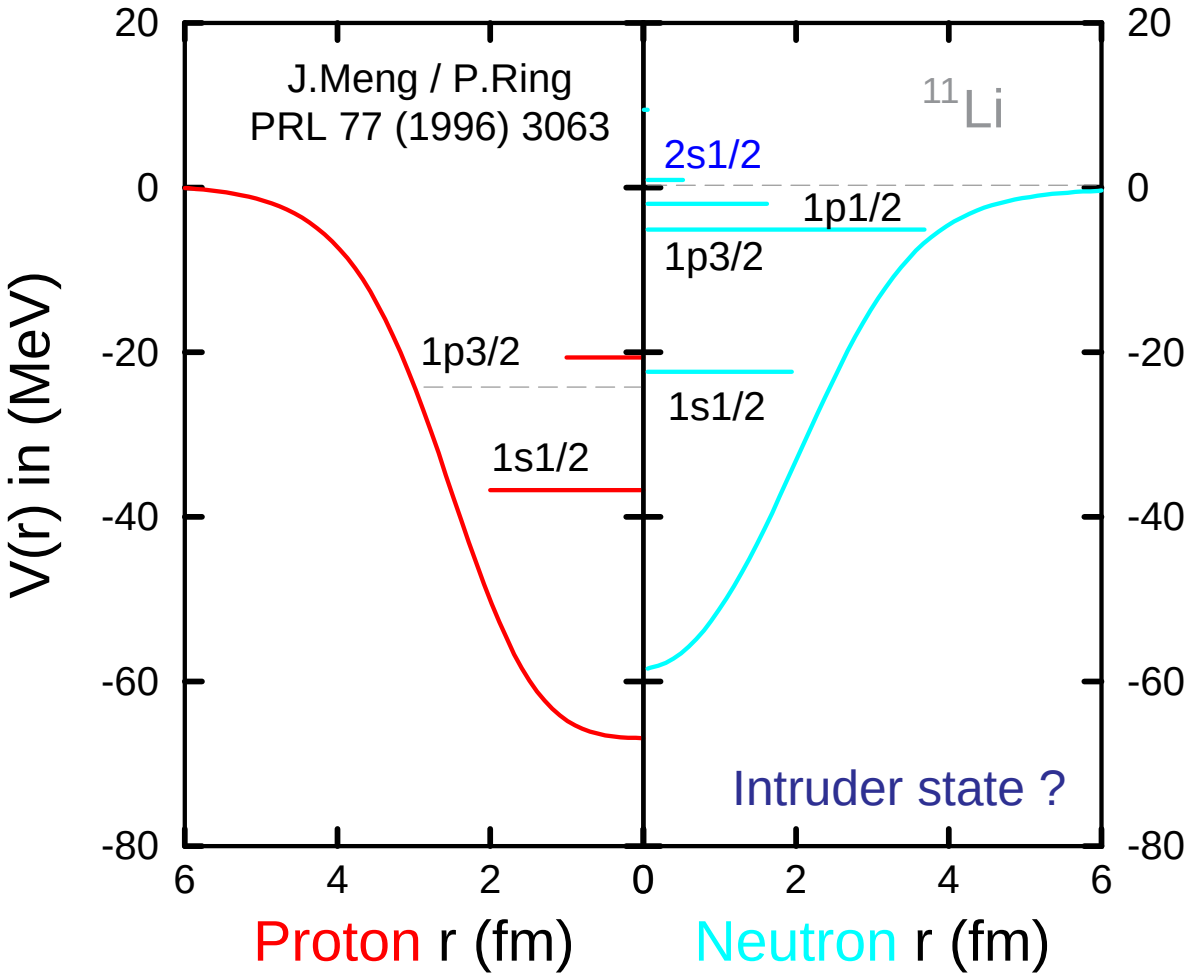


➥ high momenta/short range ⇔ correlations

➥ small momenta/large range ⇔ mean field

H. Feldmeier, T. Neff

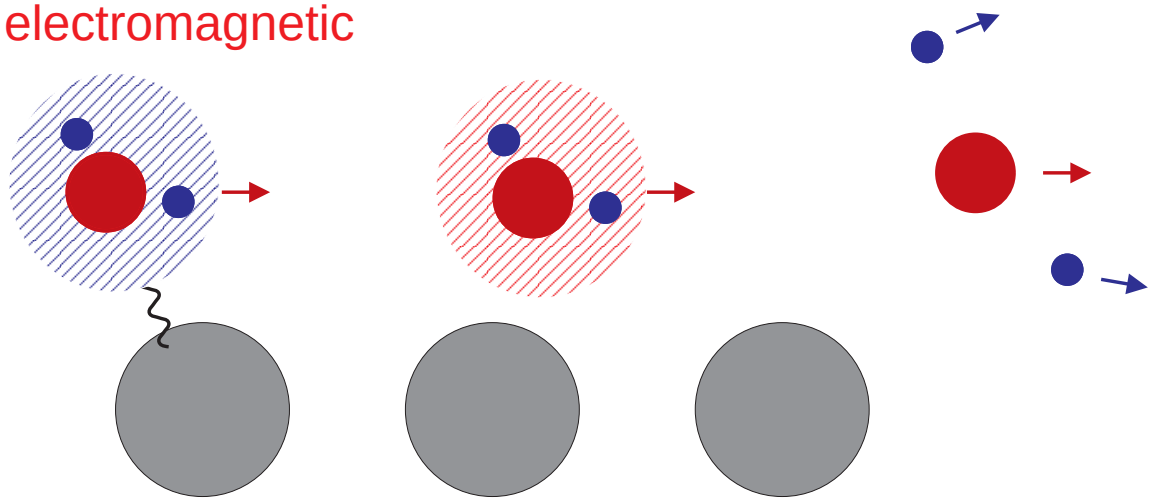
Motivation


J.Meng / P.Ring
PRL 77 (1996) 3063
11Li
2s1/2
1p1/2
1p3/2
1p3/2
1s1/2
1s1/2
Intruder state ?
V(r) in (MeV)
20
0
-20
-40
-60
-80
6
4
2
0
2
4
6
Proton r (fm)
Neutron r (fm)

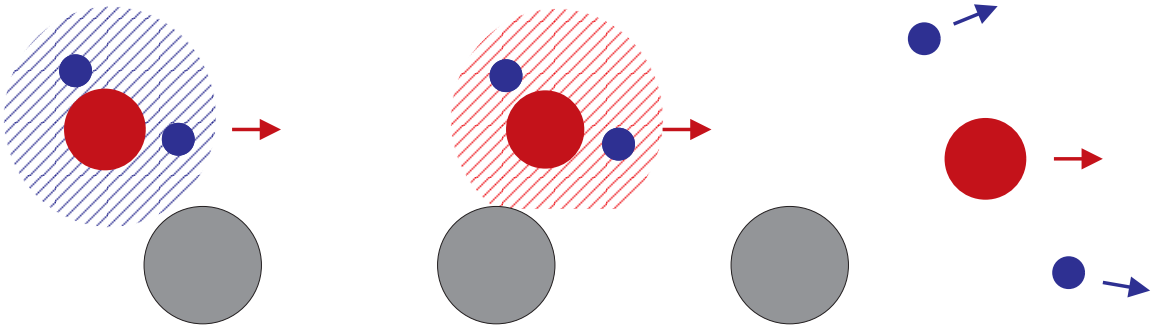
Reaction mechanisms

Inelastic scattering (2n)

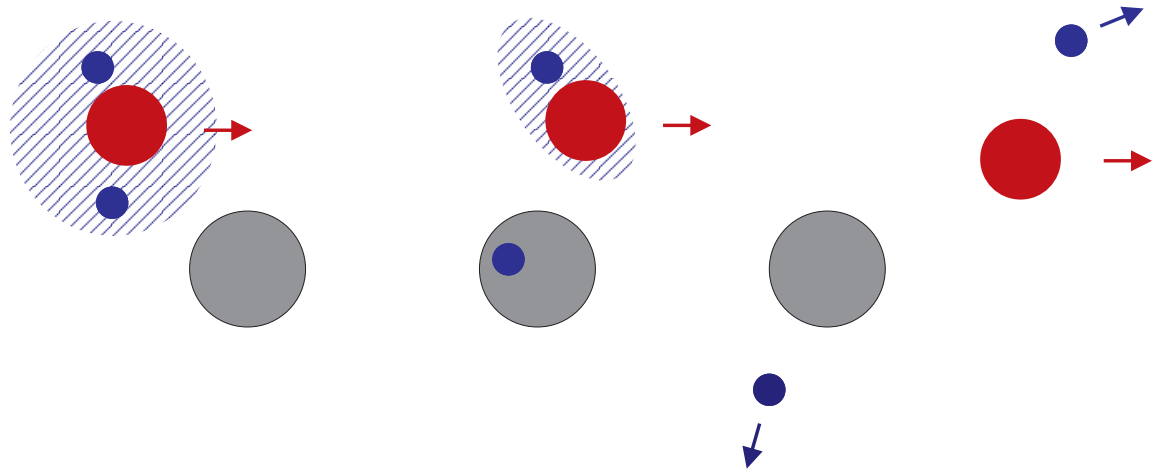
electromagnetic



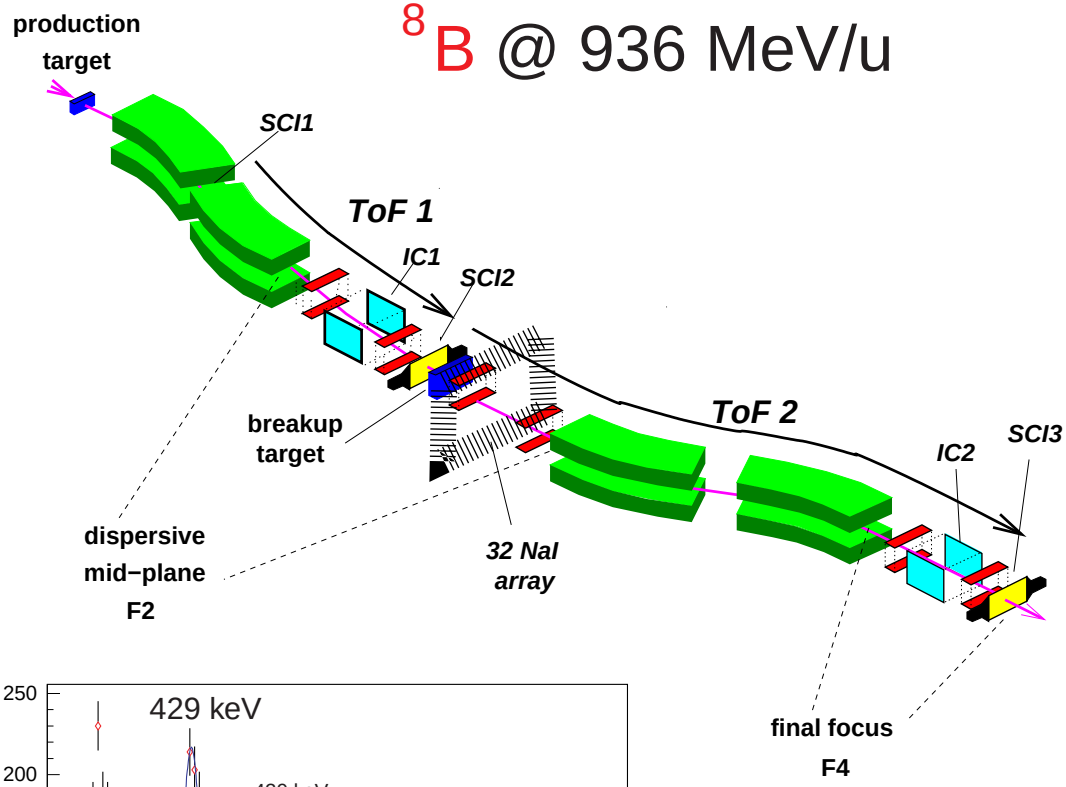
nuclear



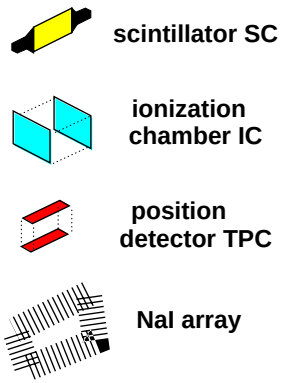
Knockout reaction (1n)



γ gated longitudinal momentum distributions



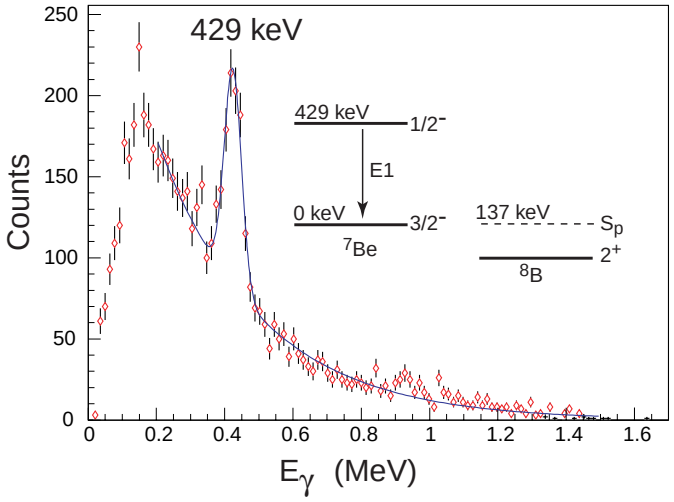
^{8}B @ 936 MeV/u

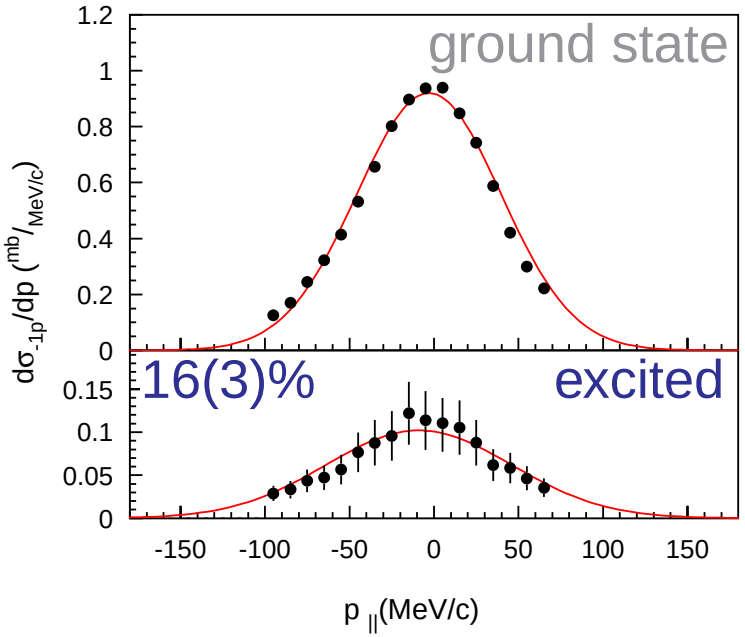


D. Cortina-Gil et al.

PL**B529**(2002)36

$$|^{8}B> = (|^{7}Be> \oplus |^{7}Be^{*}>) \otimes |p>$$

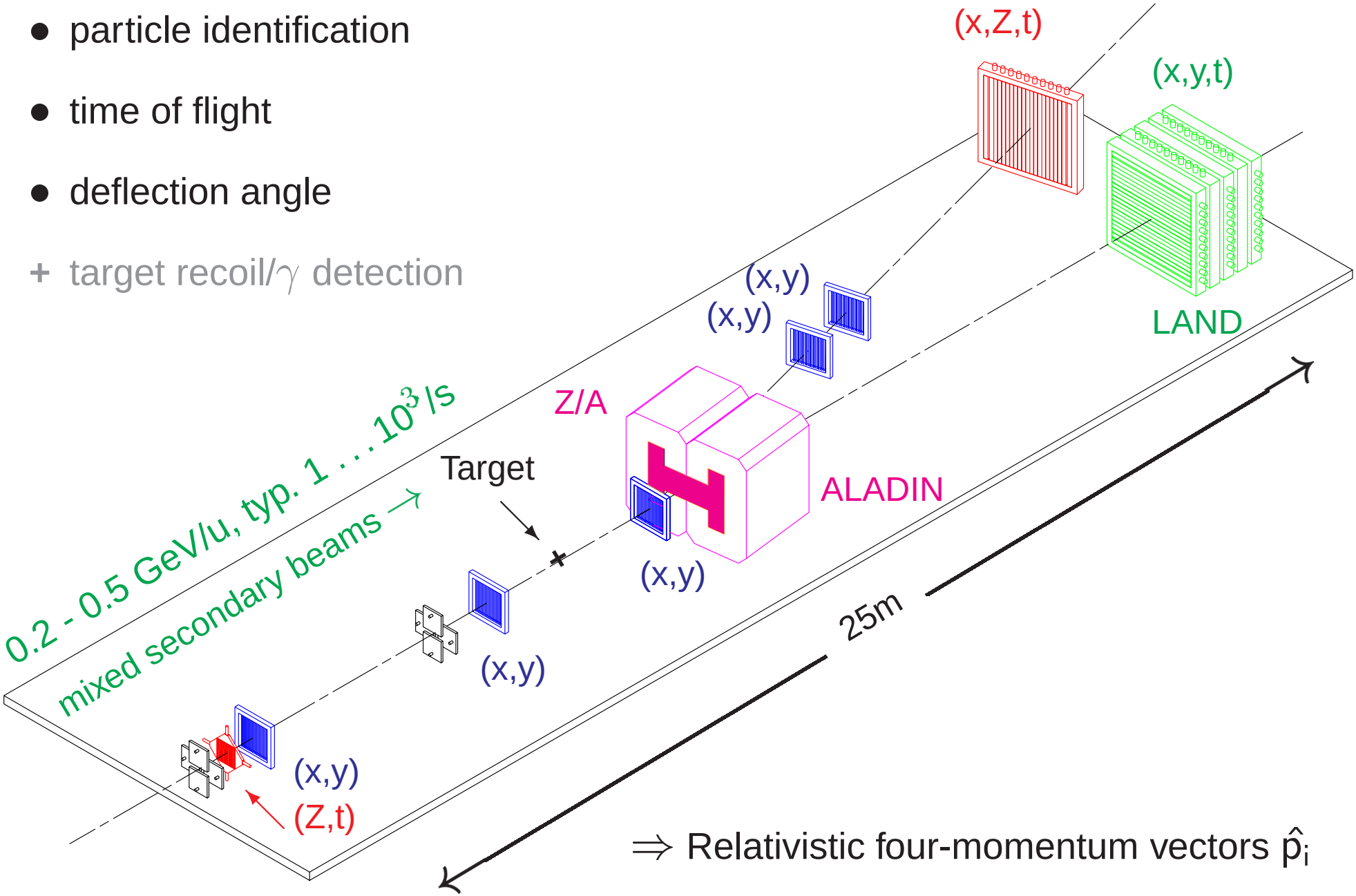




Kinematically complete experiments (GSI)

- particle identification
- time of flight
- deflection angle

\+ target recoil/γ detection



$\Rightarrow$ Relativistic four-momentum vectors $\hat{p}_i$

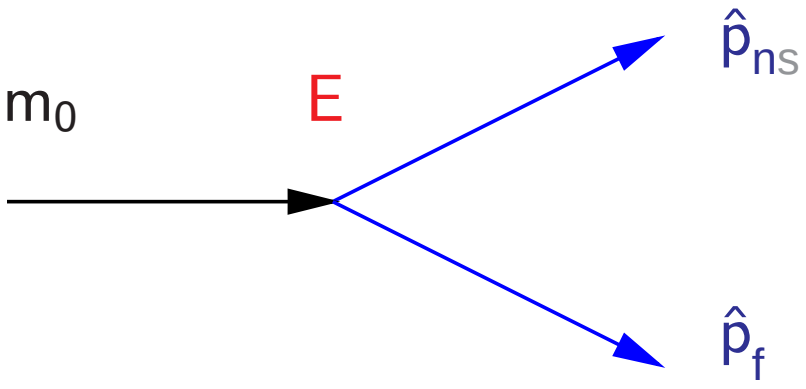
Observables

1. Relative/Internal energy

   - Invariant mass method

$$E = \sqrt{s_f} - m_0 + E_b$$

$$s_f = (\hat{p}_{fragment} + \hat{p}_{neutrons})^2$$

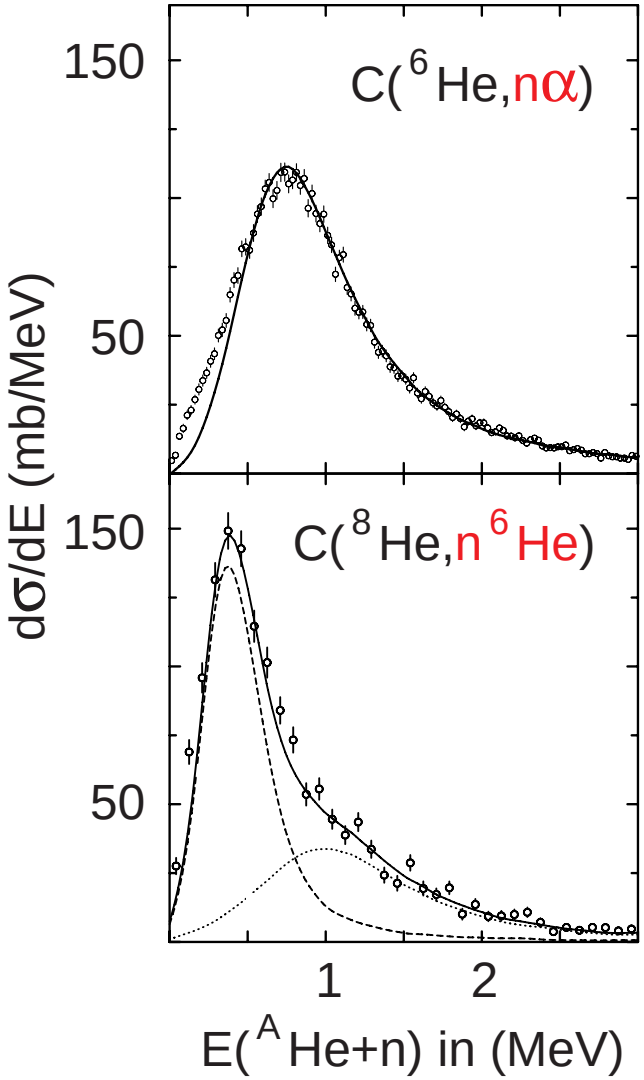


   - Energy correlation function (*event mixing*)

$$\mathcal{W}(E) = \frac{d\sigma/dE}{d\sigma/dE_{mixed}}$$

2. Angular correlations (1n)

Relative energy

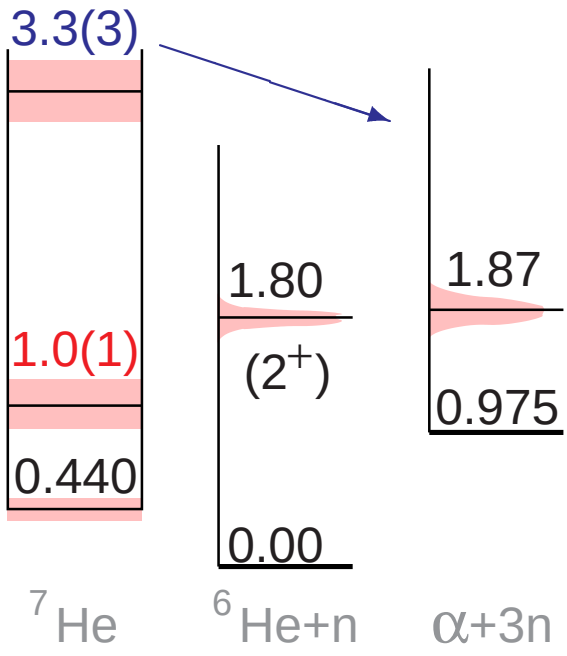


E_0=0.89 MeV, Γ_0=0.6 MeV

F. Ajzenberg-Selove (1988)

A.A. Korsheninnikov et al.

PRL**82**(1999)3581

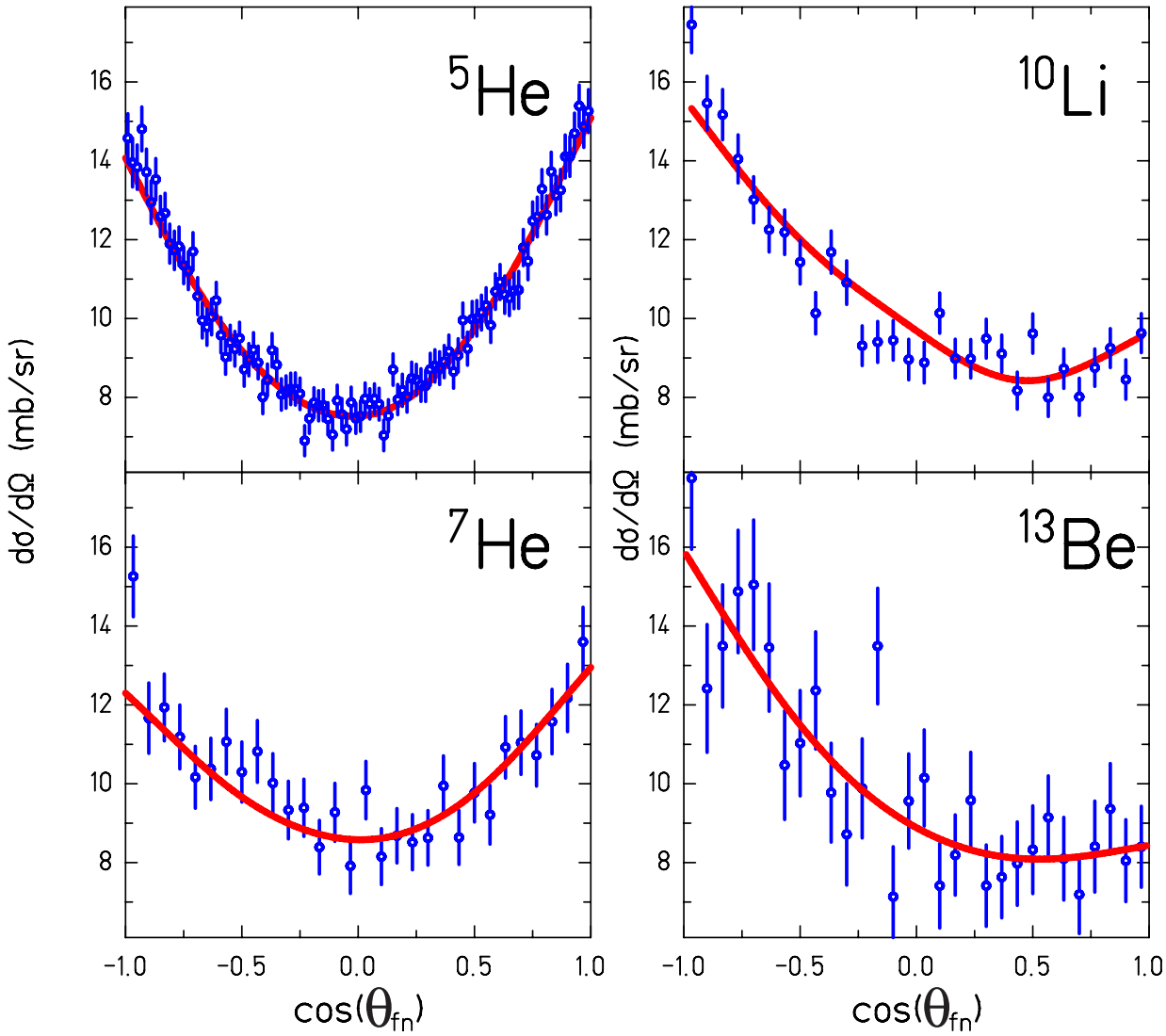


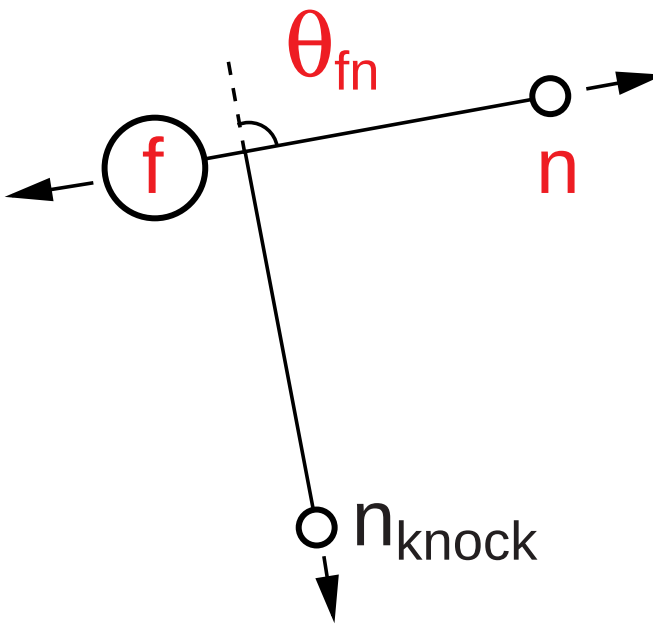
- New state at E_0=1.0(1) MeV, Γ_0=0.75(8) MeV
- Spin orbit partner $J^{\pi}=1/2^{-}$ of the ^{7}He ground state
- SO splitting reduced, ^{5}He: 1.2 MeV, ^{7}He: 0.6 MeV

M. Meister et al.

PRL**88**(2002)102501

Angular correlations

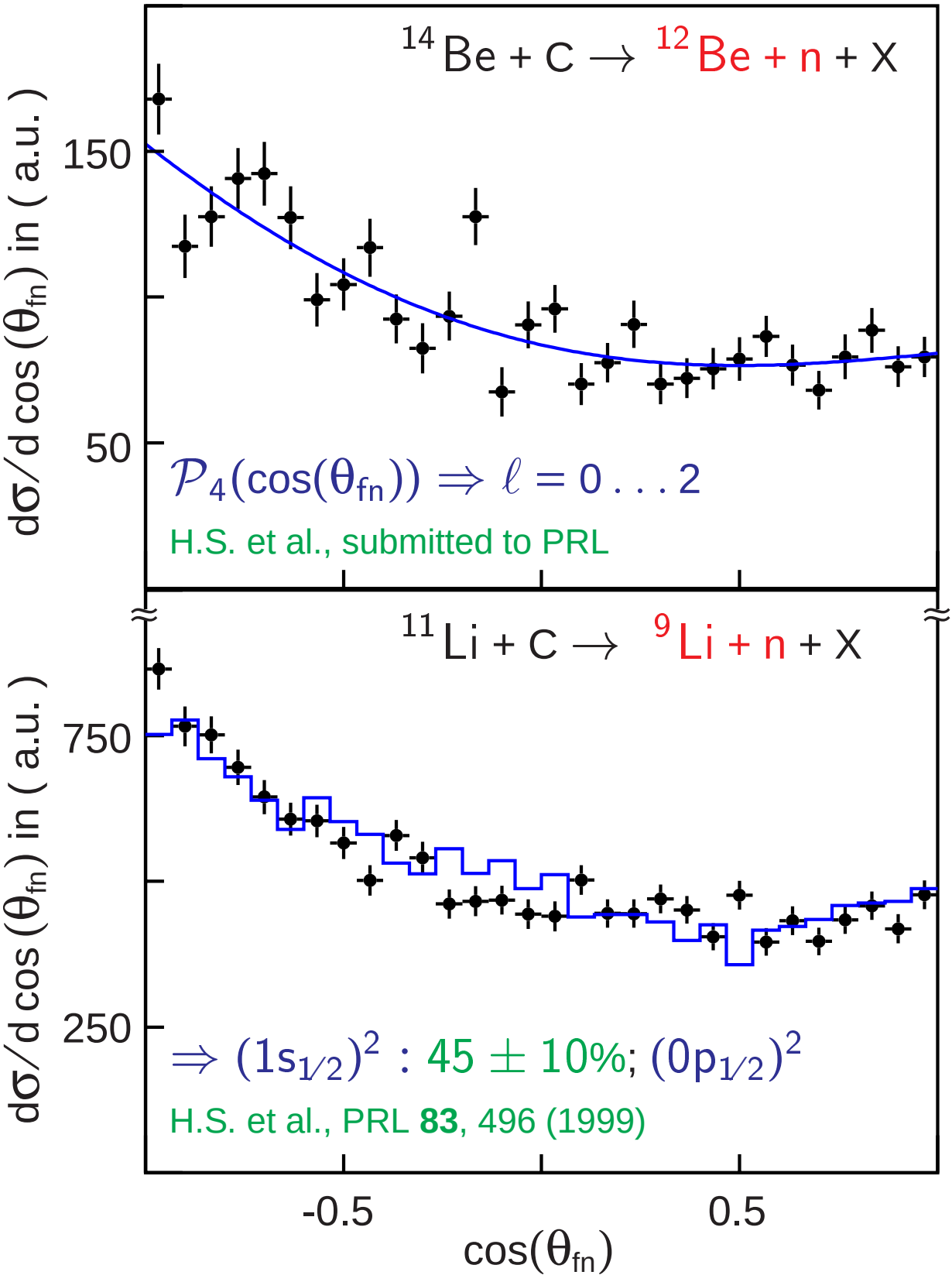




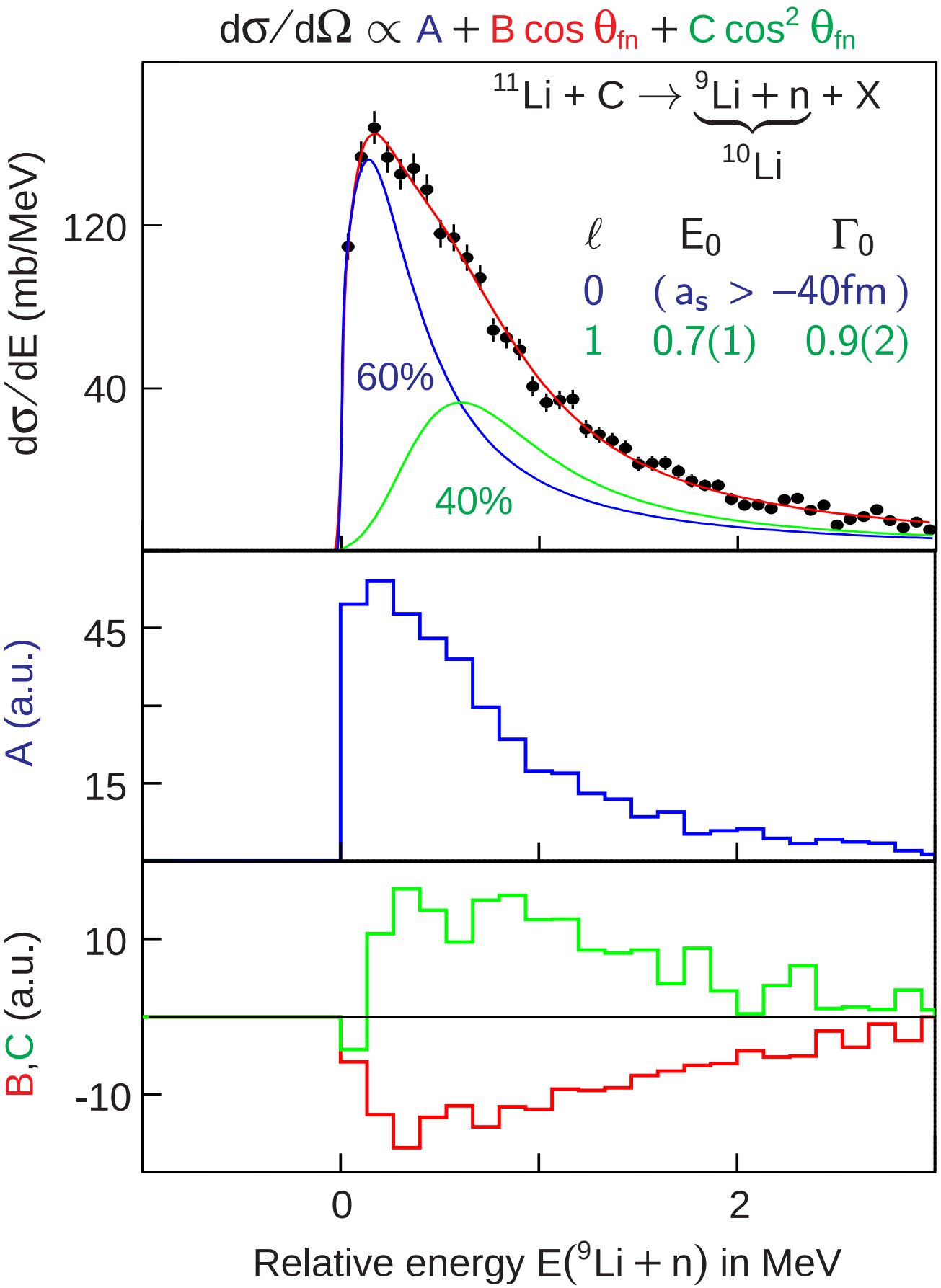
He: p-states

Li/Be: different parity states

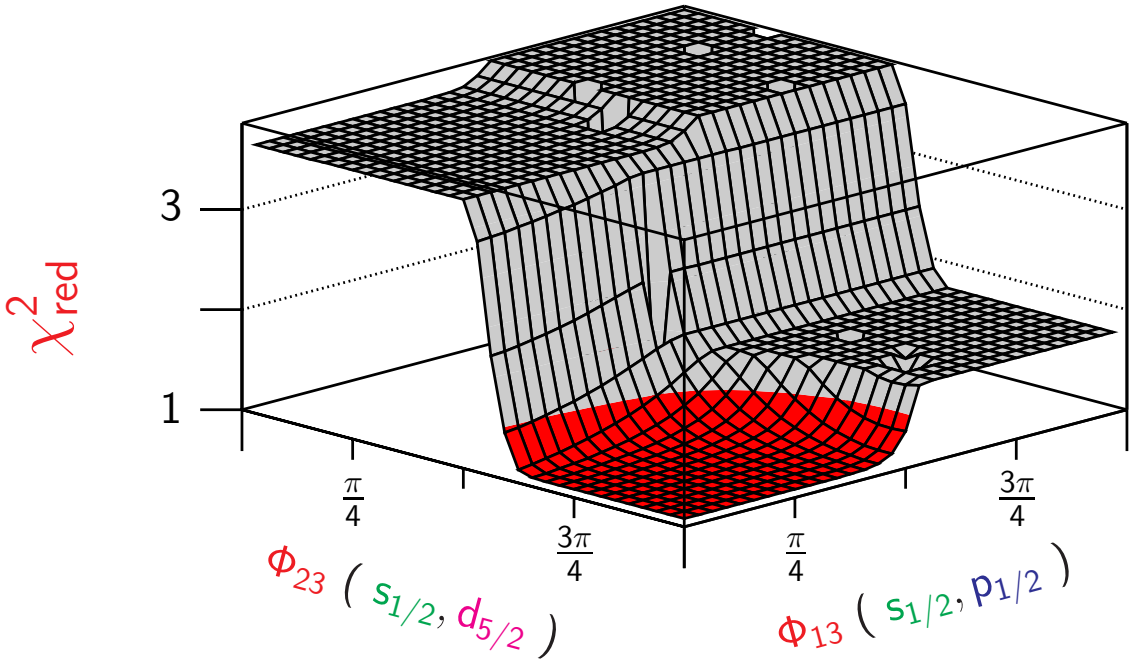
Angular correlation

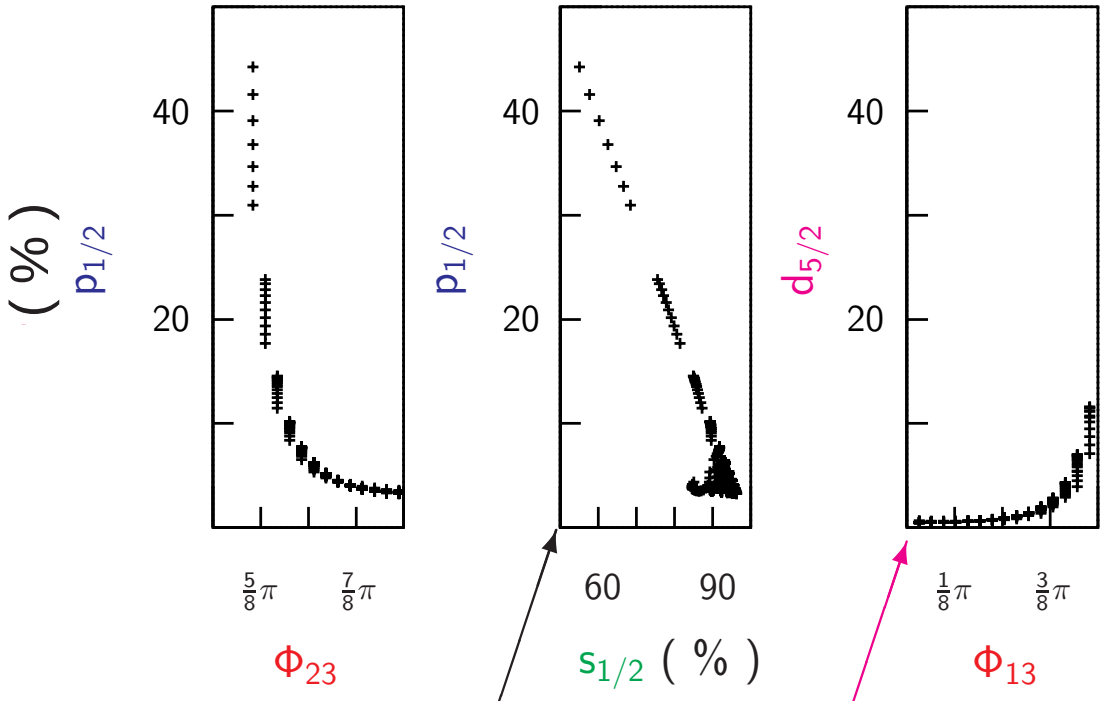


Angular Correlations vs. E



angular correlation (range)



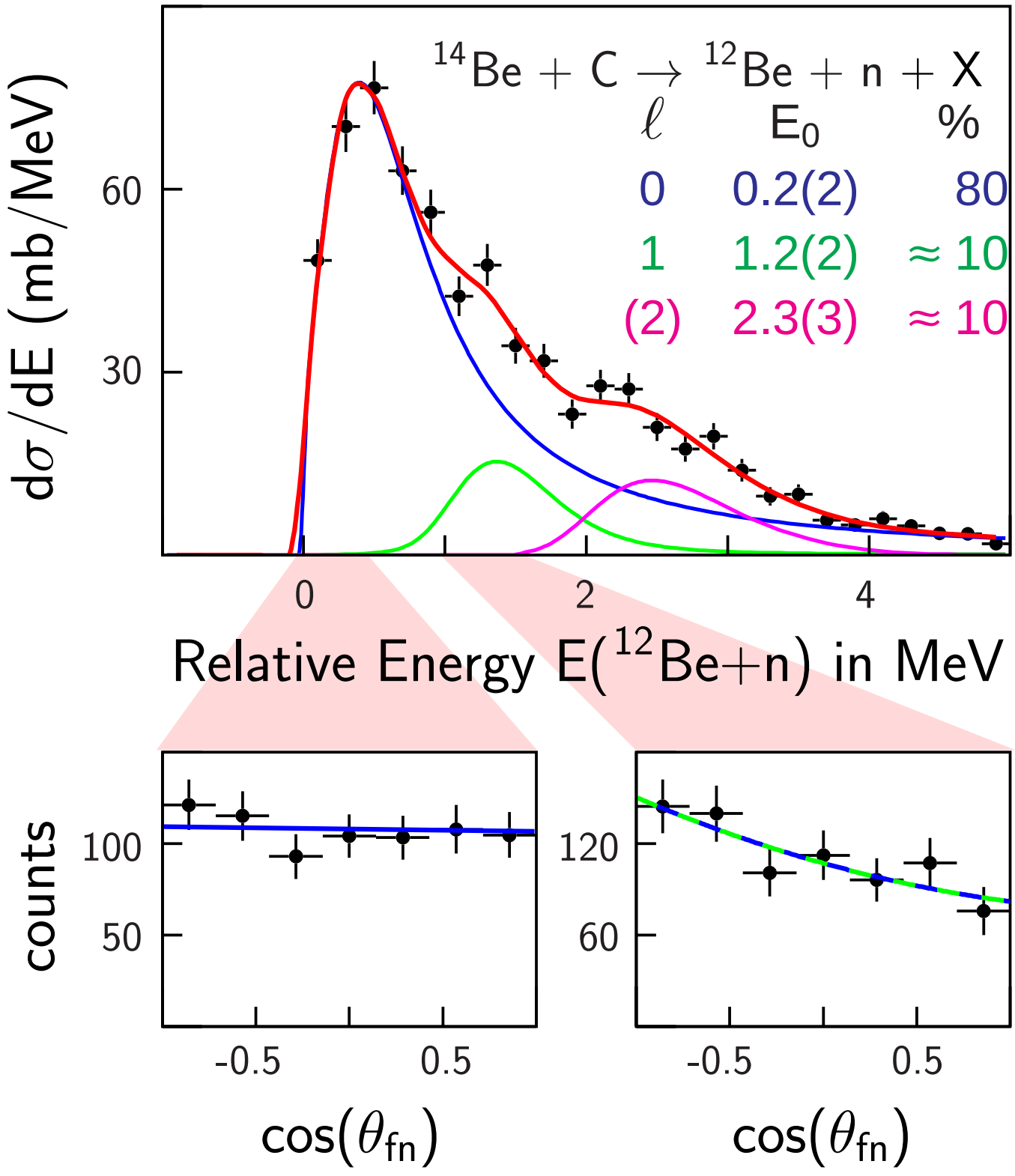


$\Rightarrow$ ratio s,p fixed

$\Rightarrow$ maximum d-admixture

Angular Correlations vs. E

^{14}Be @ 287 AMeV



Conclusion/Outlook

- Groundstate of ^{8}B comprises a 16(3)% admixture of ^{7}Be*
- Spin orbit partner of the ^{7}He g.s. discovered
- Consistent picture for the ^{11,10}Li structure
- New input for the ^{14,13}Be description

- Recent experiment, September 2001 (S245)

  Cluster Structure $\Rightarrow$ Quasilelastic Scattering

Spectroscopic Factors

Exotic Extremes

^{14}Be $\rightarrow$ ^{10}He

^{11}Li $\rightarrow$ ^{7}H

^{8}He $\rightarrow$ ^{4}n

P. Egelhof et al., S174