Search for the giant pairing vibration through (p,t) reactions around 50 and 60 MeV

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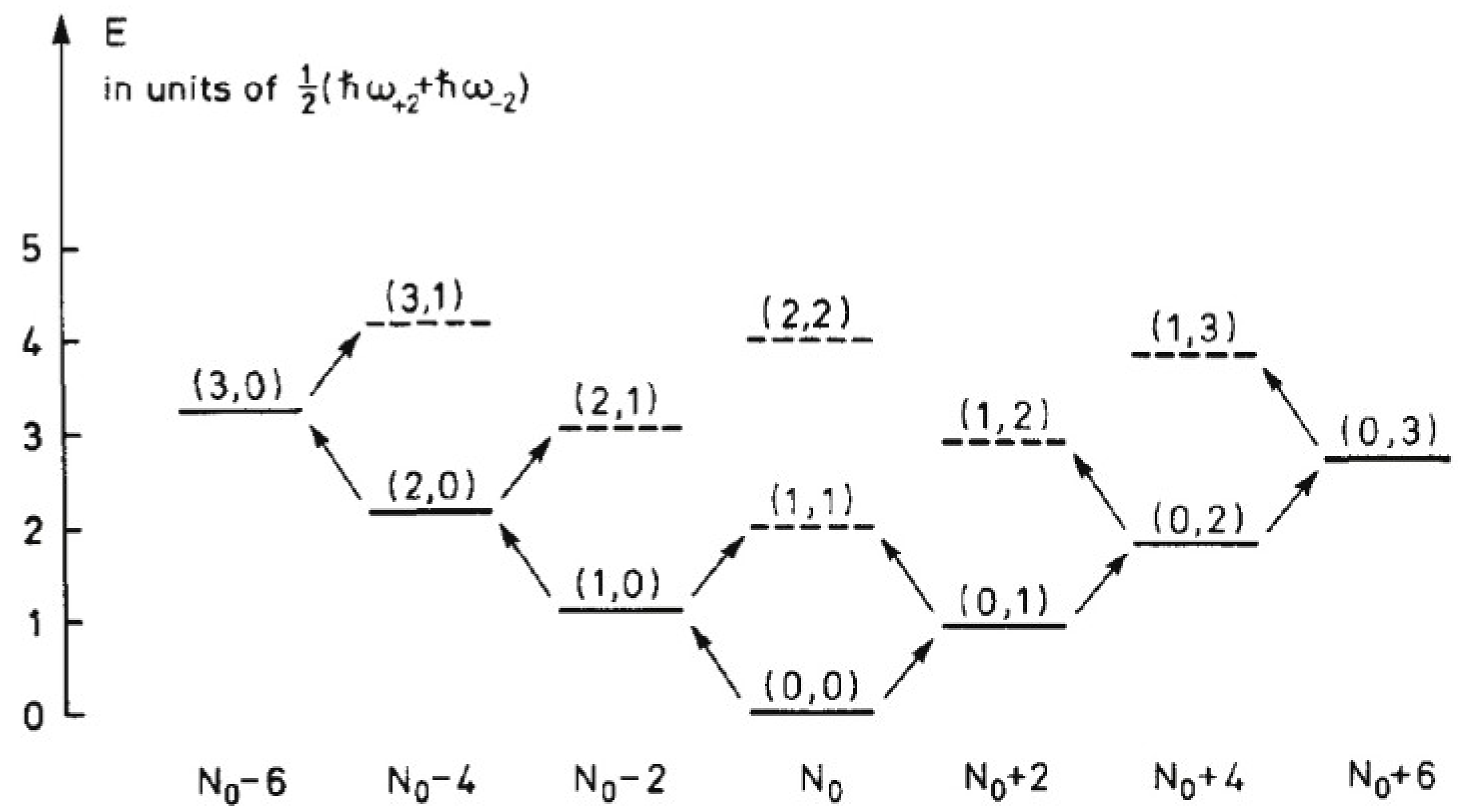
- giant pairing vibration predicted as giant resonance in pp channel
- probe of pairing interaction

Harmonic approximation

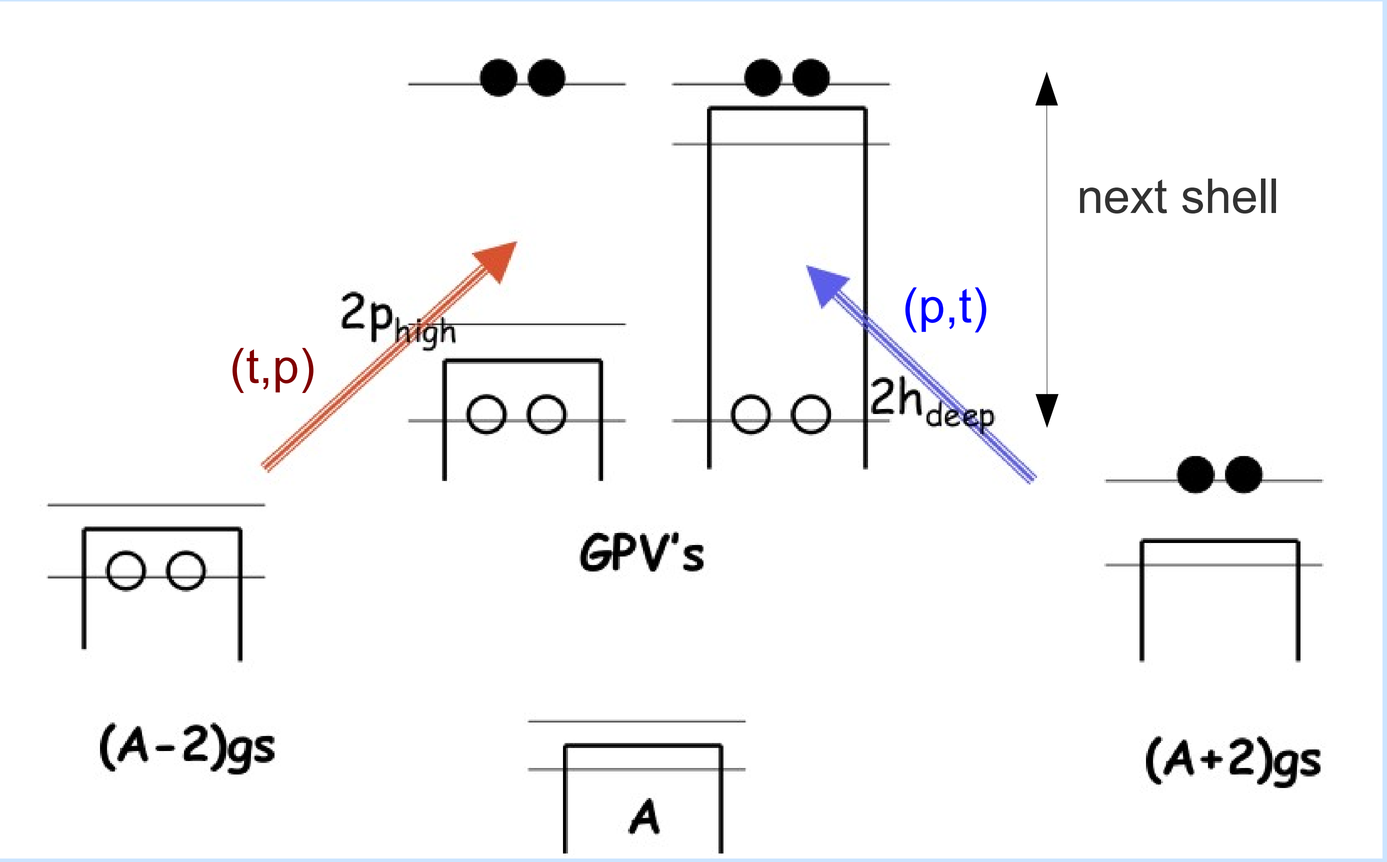
$$E = \hbar\omega_{-2} \cdot n_{\alpha=-2} + \hbar\omega_{+2} \cdot n_{\alpha=+2} \quad (1.1)$$



Motivation

- giant pairing vibration predicted as giant resonance in pp channel
- probe of pairing interaction

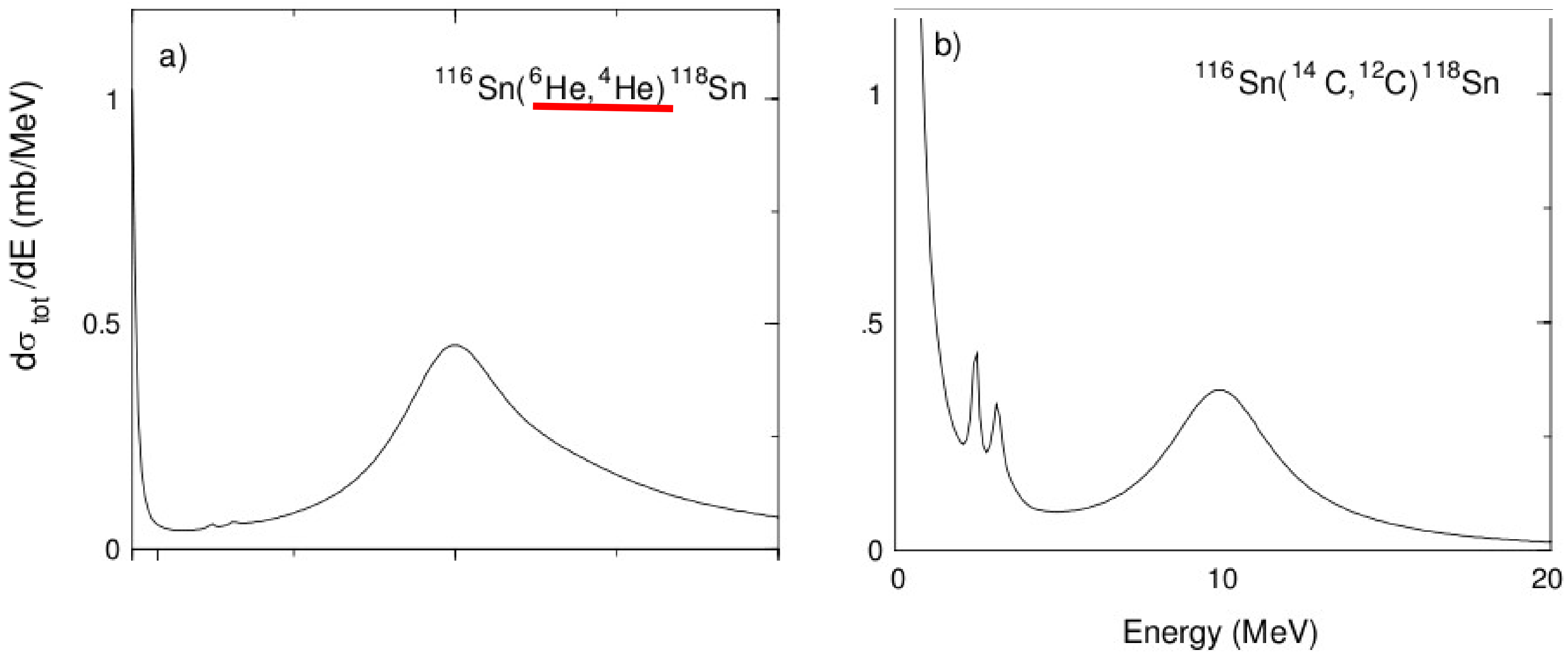
GPV
Broglia & Bes, PLB 69 (1977)
Herzog et al, PRC 31 (1985)



A Vitturi

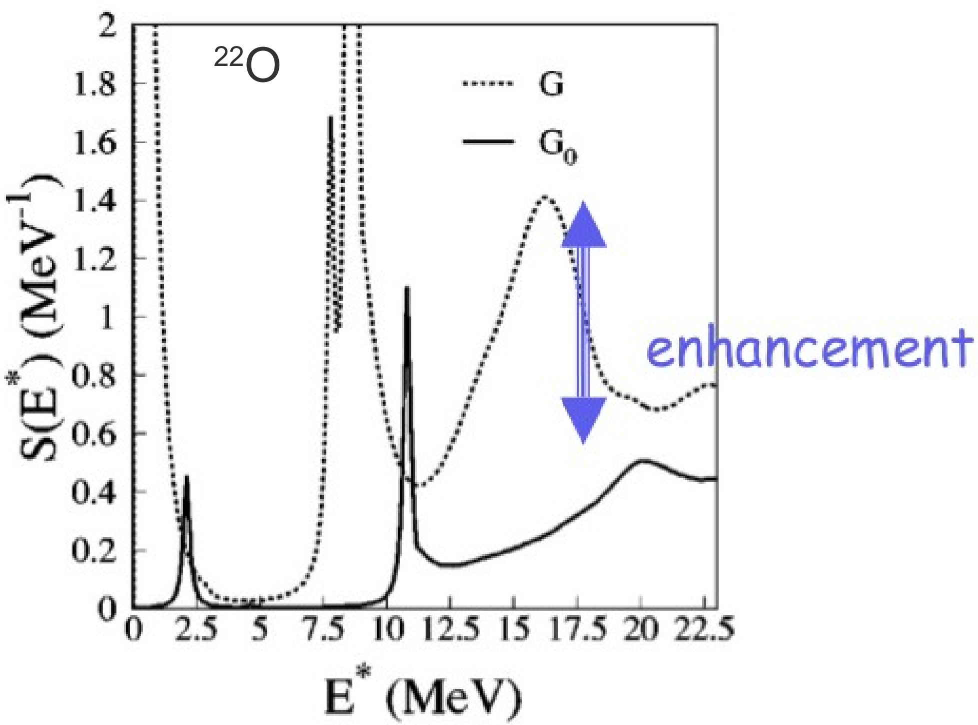
- giant pairing vibration predicted as giant resonance in pp channel
- probe of pairing interaction

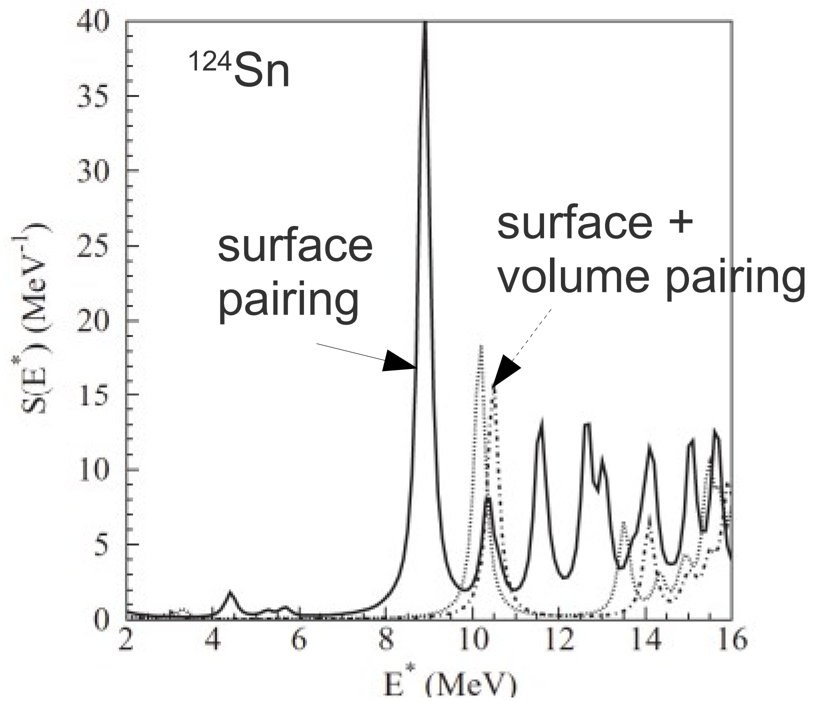
Theoretical predictions
Fortunato et al, EPJA 14 (2002)



- giant pairing vibration predicted as giant resonance in pp channel
- probe of pairing interaction

Theoretical predictions
Khan et al, PRC 69 (2004) & PRC 80 (2009)

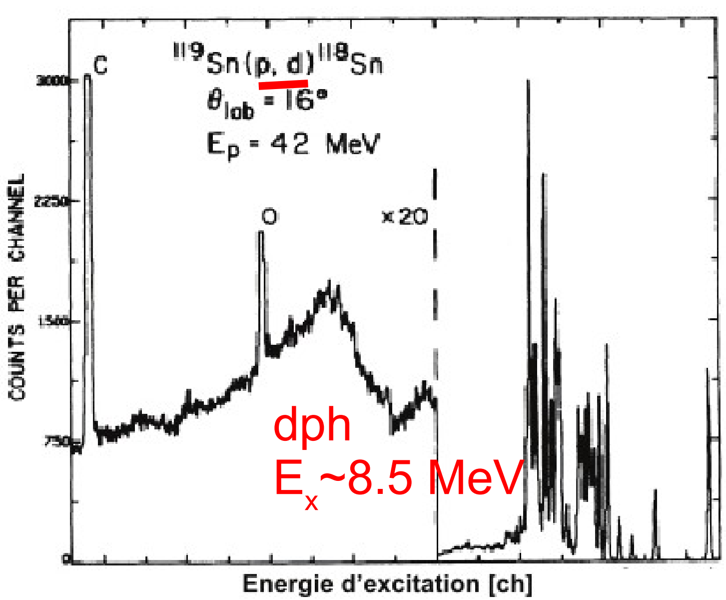


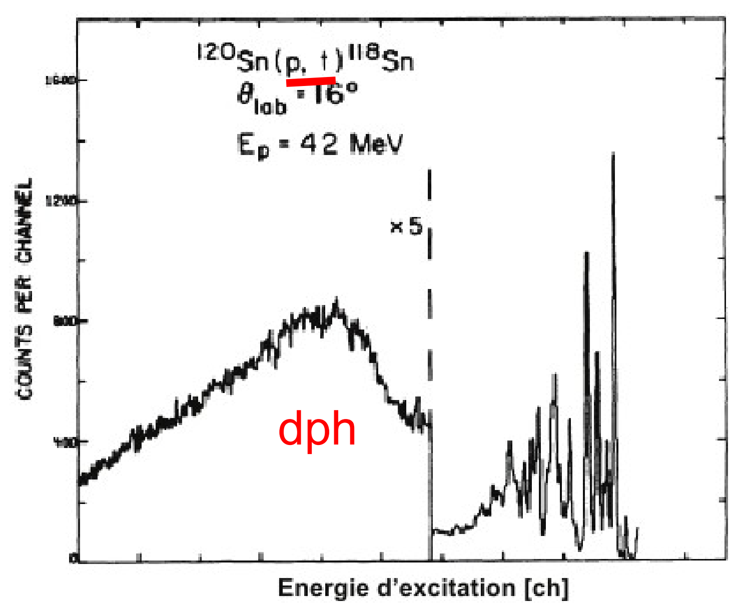


Motivation

- giant pairing vibration predicted as giant resonance in pp channel
- probe of pairing interaction
- but never seen

Earlier experiments
Shepard et al, NPA 322(1979), E*<4 MeV
Crawley et al, PRC 22(1980), E_p=90 MeV
Matoba et al, PRC27(1983), E*<3 MeV
...
Crawley et al, PRL 39 (1977) & PRC 23 (1981), E_p=42 MeV & E*<13.5 MeV





- giant pairing vibration predicted as giant resonance in pp channel
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Broglia & Bes, PLB 69 (1977)
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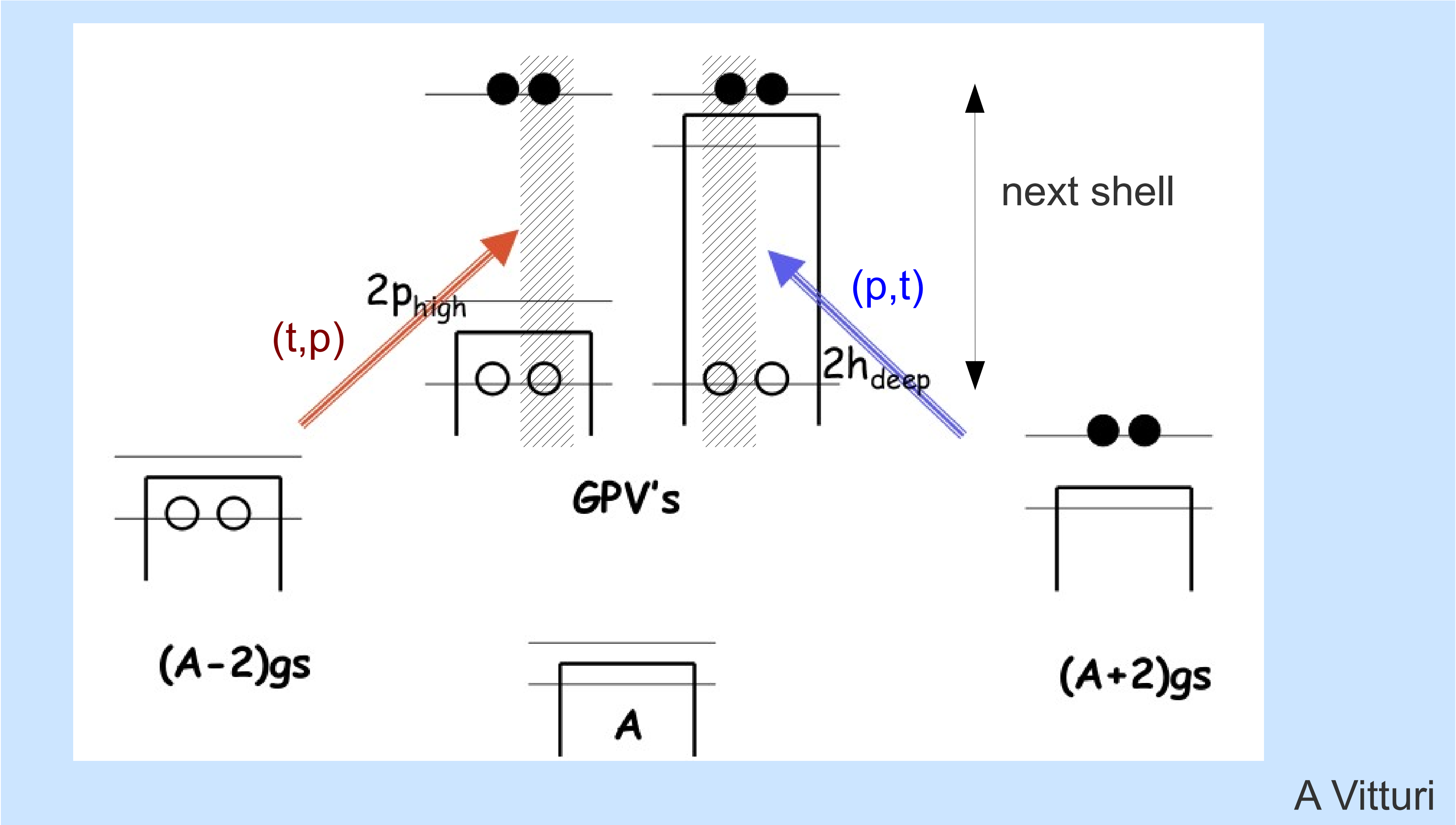


Motivation

L = 0 transition between A and A±2
$E = 70\ A^{-1/3}$ MeV ~ 13 MeV
σ ~ some mb

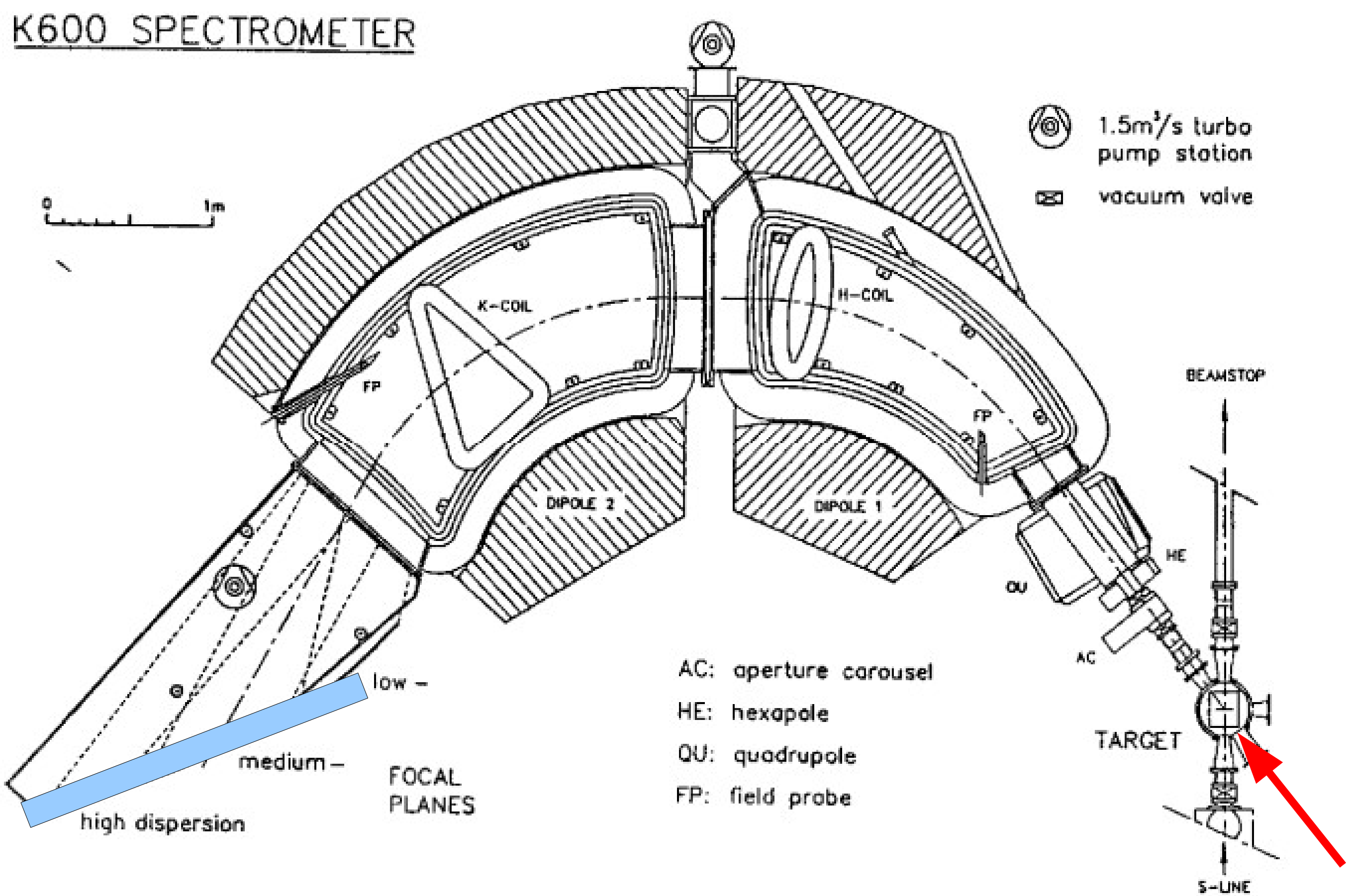
$^{208}Pb(p,t)^{206}Pb$ Q=−5624 keV & $^{120}Sn(p,t)^{118}Sn$ Q=−7110 keV
$E^* = E_p - E_t + Q$
but still need some energy for t identification

=> (p,t) reactions around 50-60 MeV close to 0°
=> magnetic spectrometer

proper conditions present
at iThemba Labs:
K200 SSC
& K600 magnetic spectrometer

K200 SCC & K600 magnetic spectrometer

2-3 mg/cm^2 ^{120}Sn & ^{208}Pb
50 & 60 MeV proton beam
detect tritons at 0° & 7°



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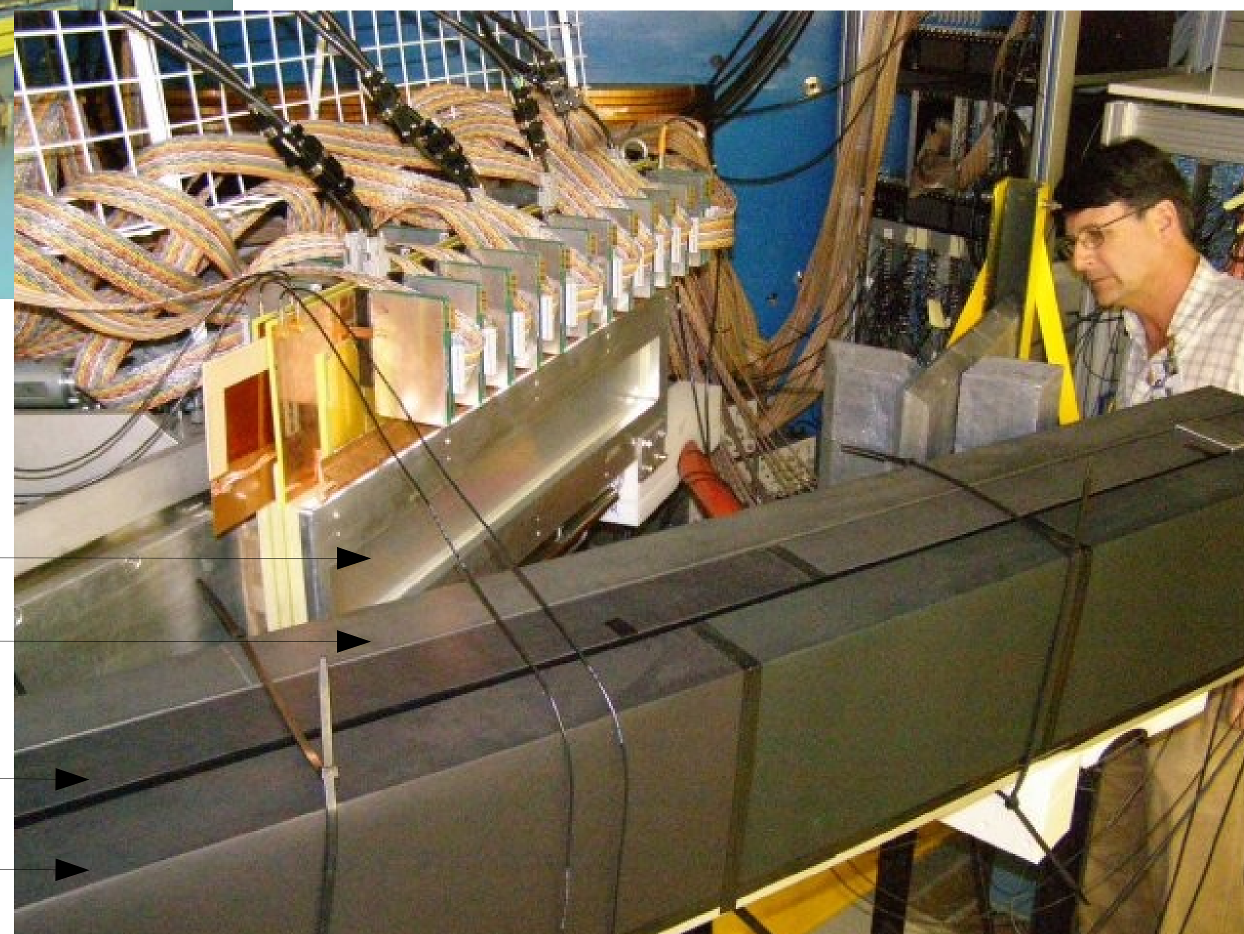
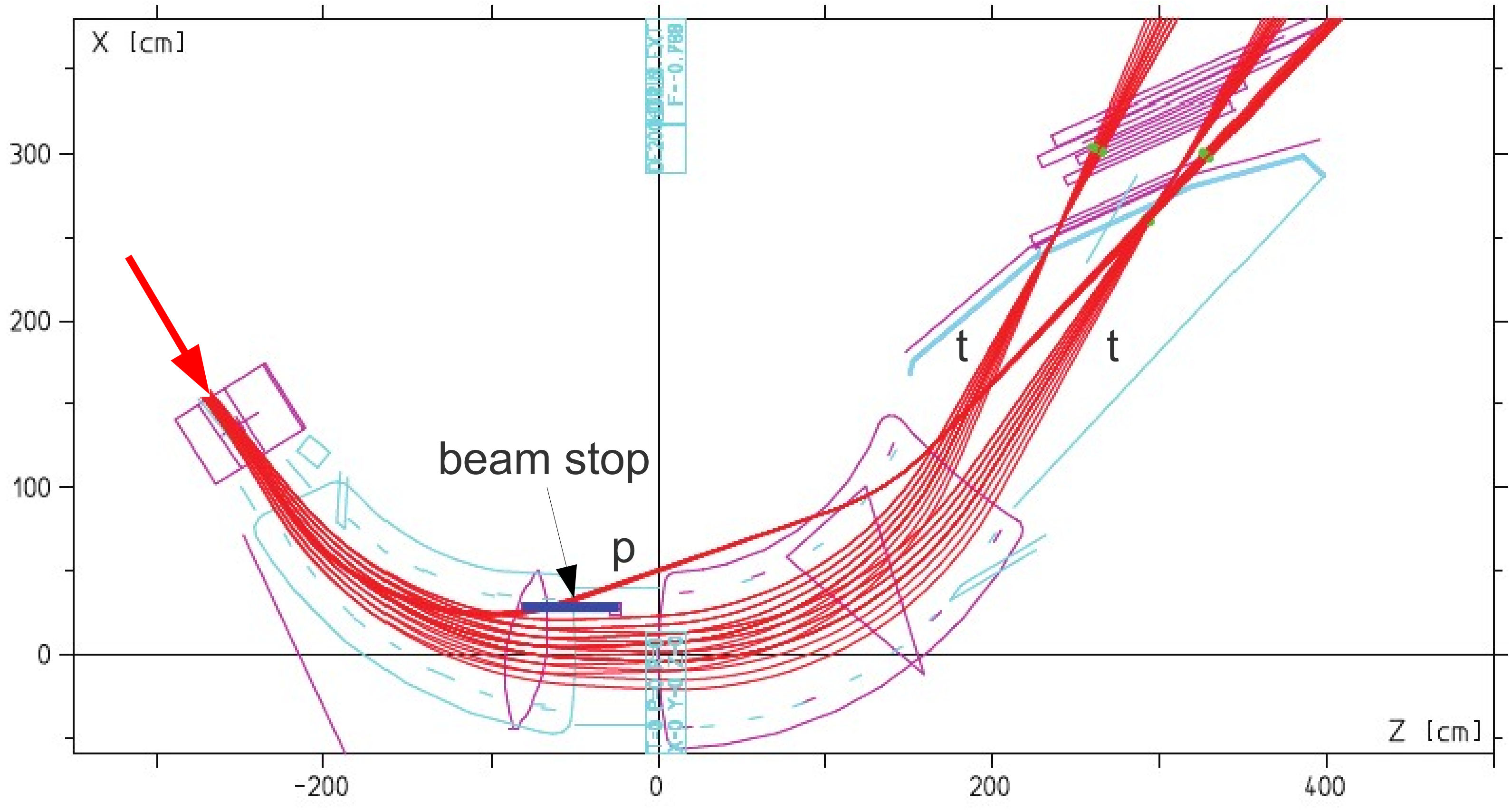


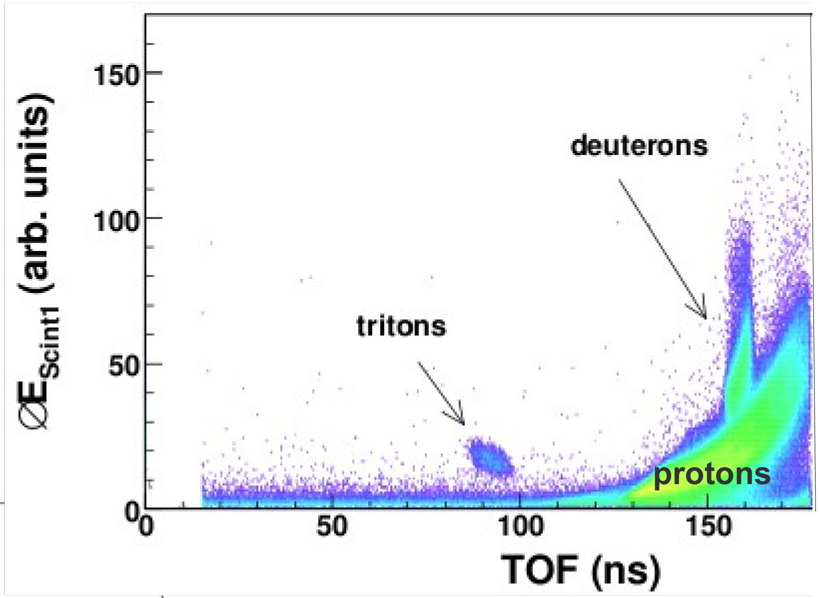
wire chambers

plastic scintillators

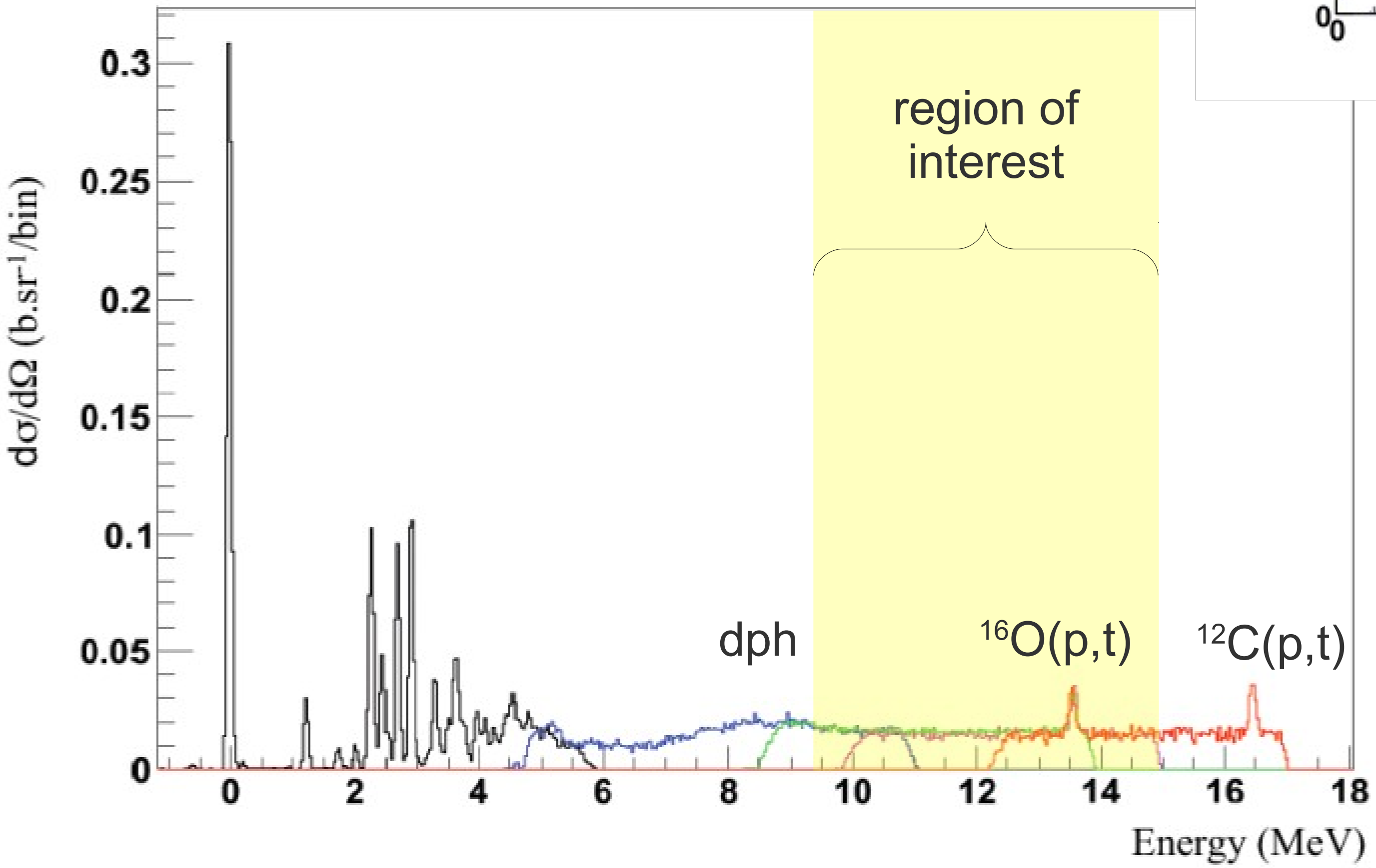
zero degree mode:
internal beam stop available since 2008



- deuterons separated in (TOF,ΔE)
- at 0°, protons scattering off the beam stop

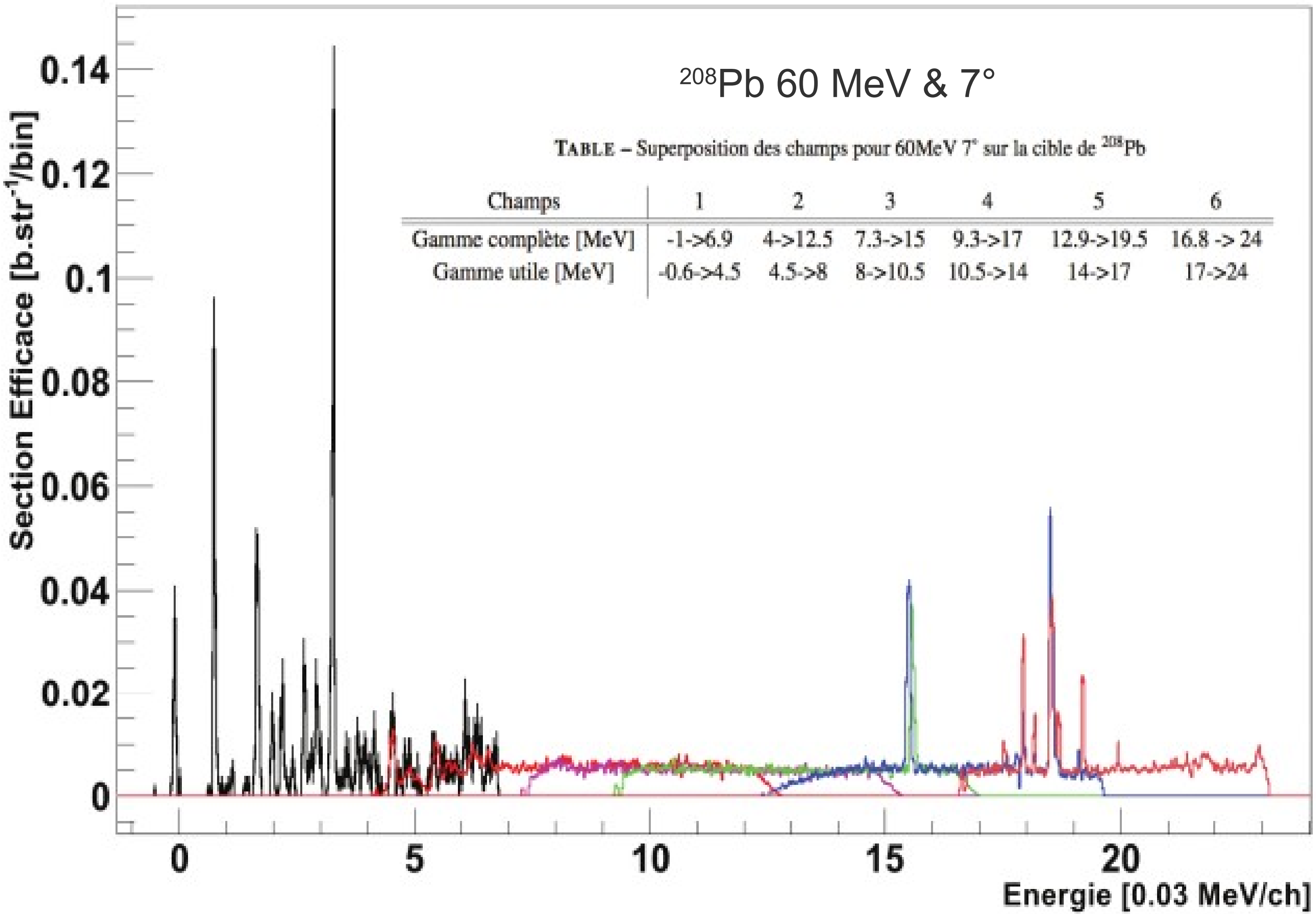


^{120}Sn(p,t) 0° & 50 MeV



Results

- no indication at 7°, neither for ^{120}Sn nor ^{208}Pb

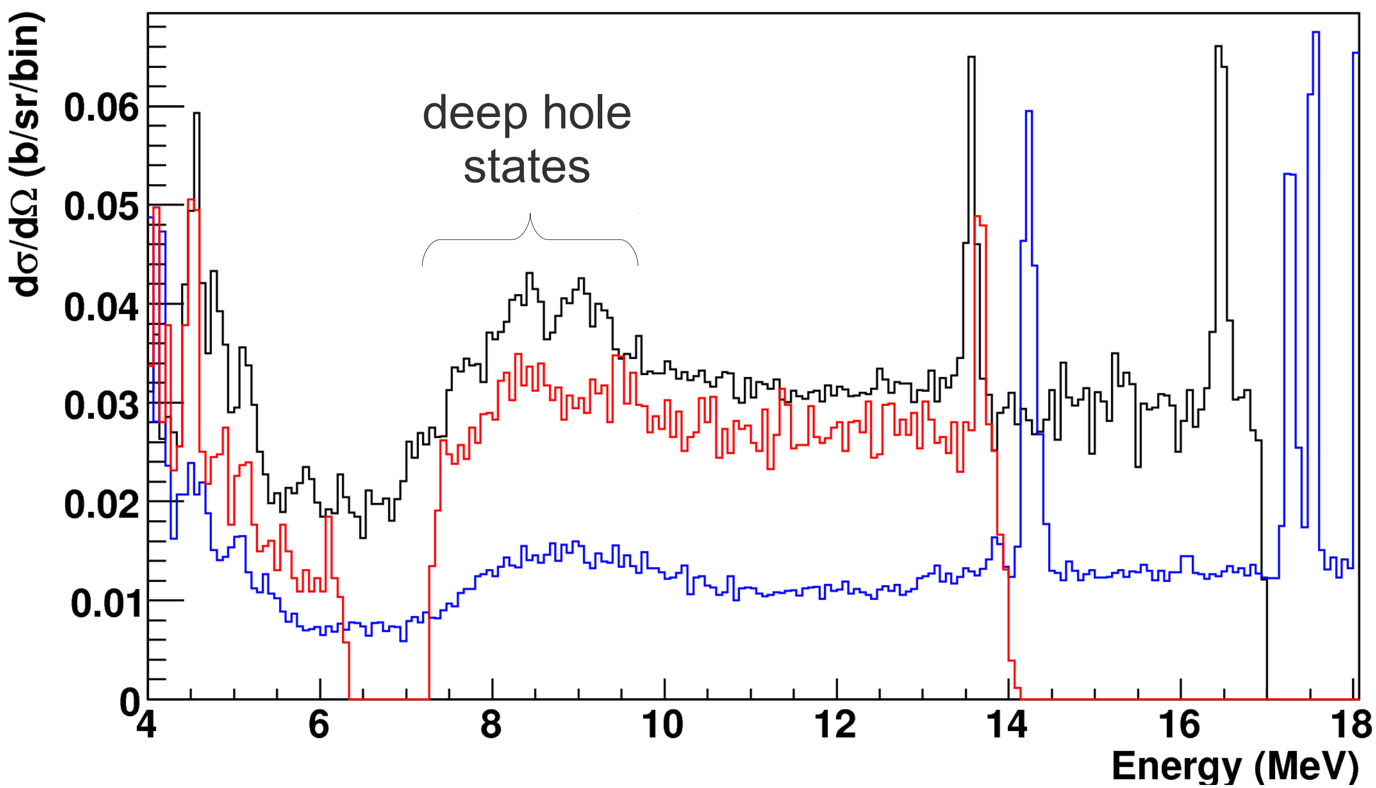


Results

$^{120}Sn(p,t)$

0° & 50 MeV
0° & 60 MeV
7° & 60 MeV

- higher level of "background" at 0°
- structure in the deep hole states?



$^{120}Sn(p,t)$
- 0° & 50 MeV
- 0° & 60 MeV
- 7° & 60 MeV

- higher level of "background" at 0°
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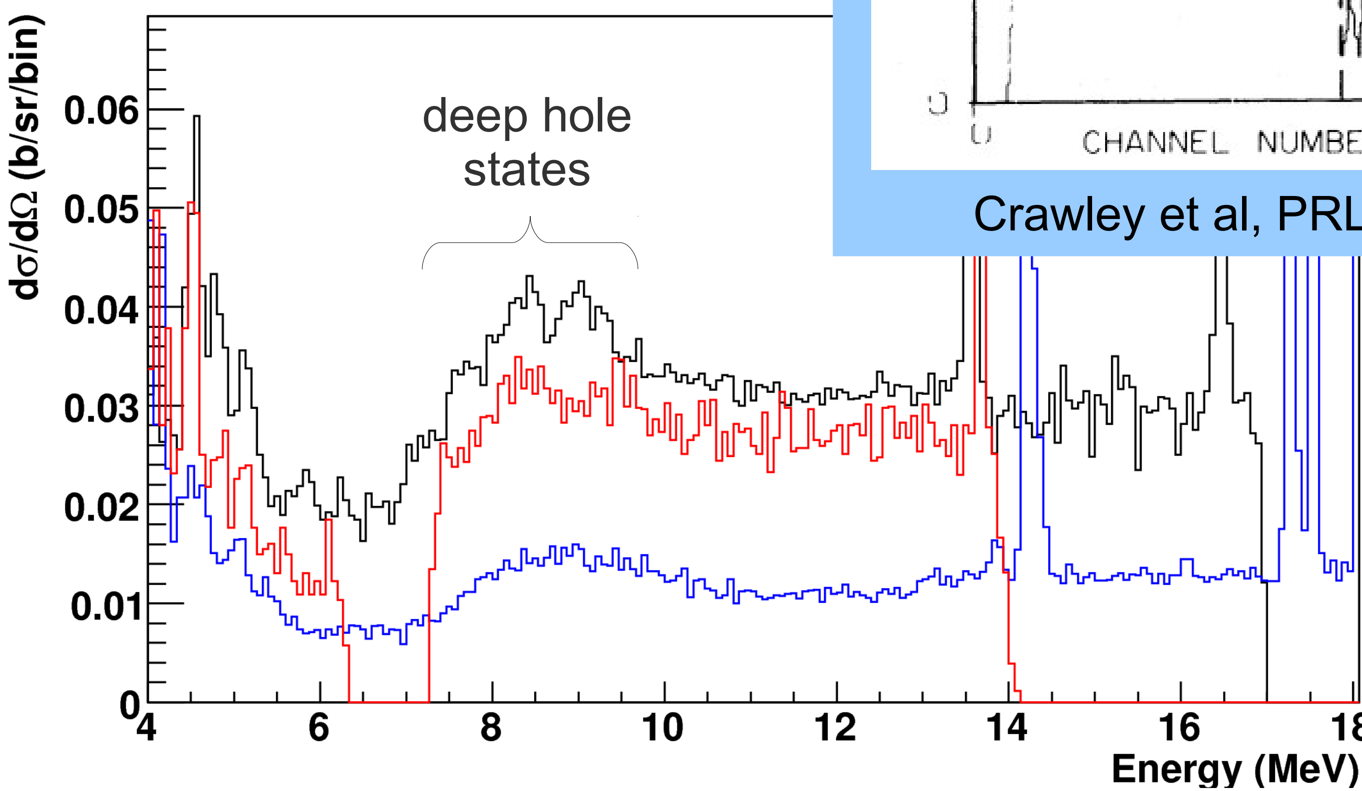
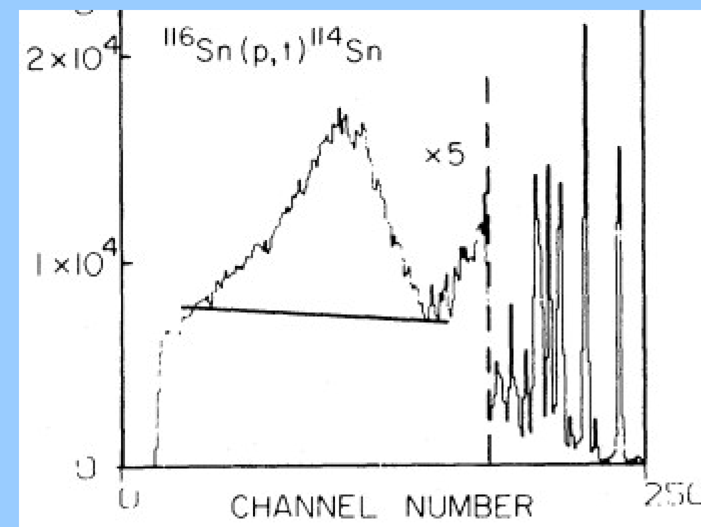




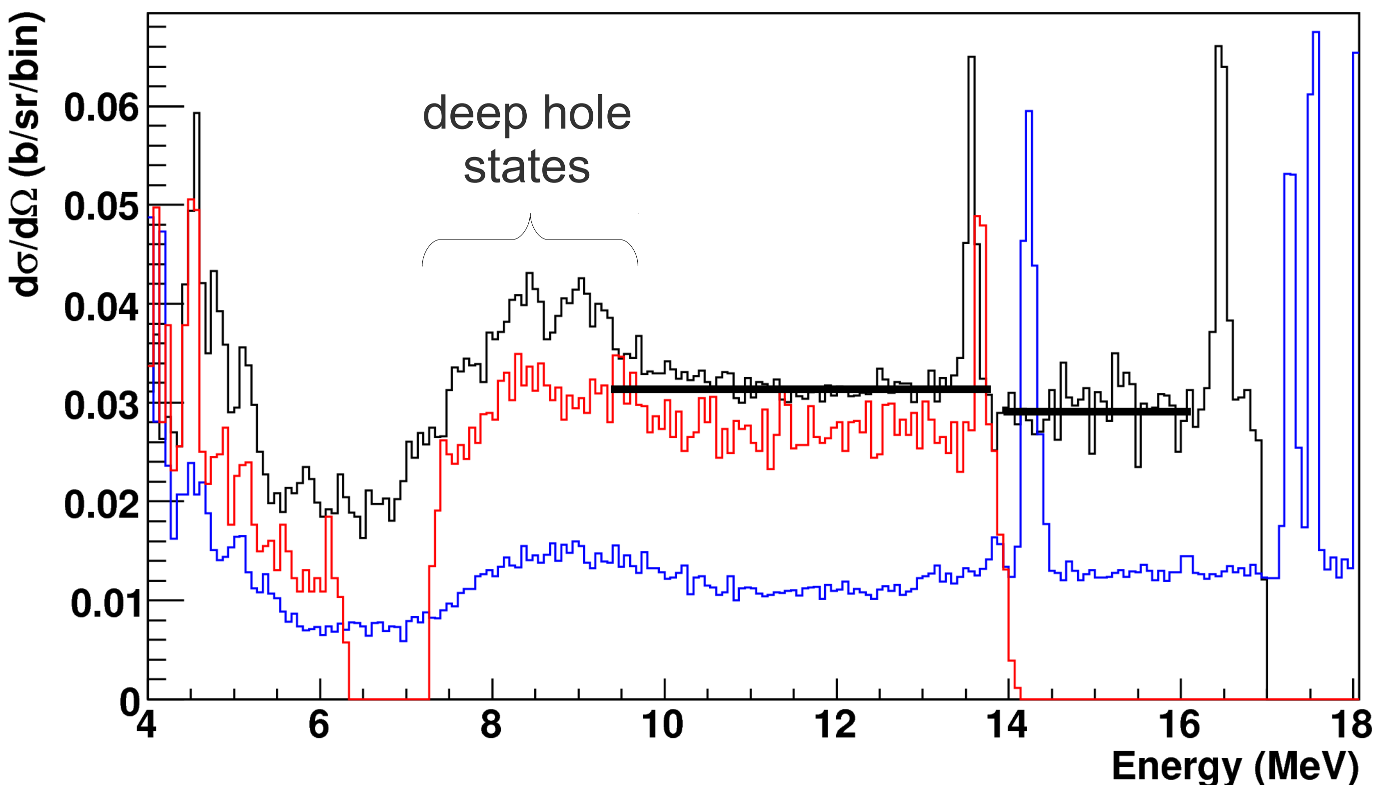
Crawley et al, PRL 39 (1977)

Results

^{120}Sn(p,t)

- 0° & 50 MeV
- 0° & 60 MeV
- 7° & 60 MeV

- higher level of "background" at 0°
- structure in the deep hole states?
- higher count rate between 10 & 14 MeV?



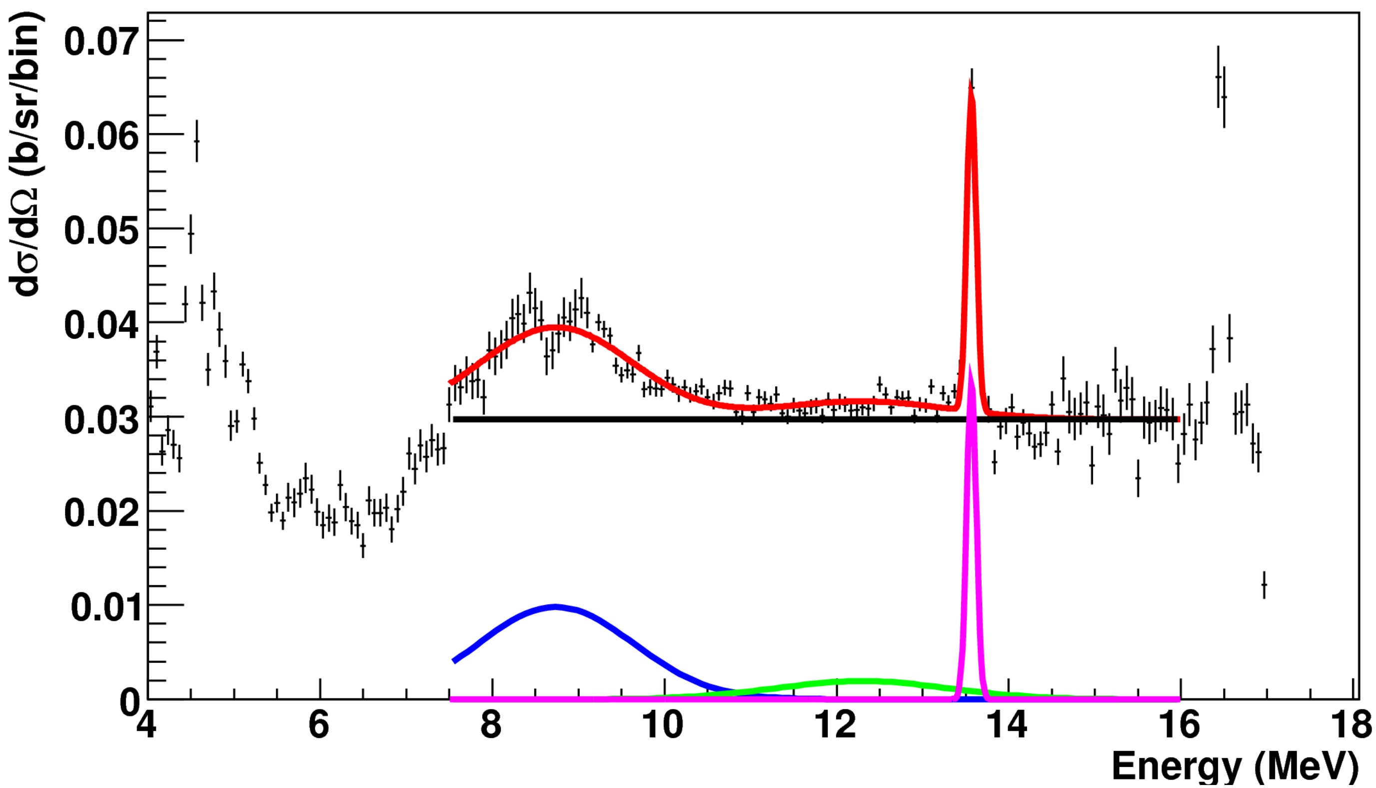
Results

$^{120}Sn(p,t)$ at 0° & 50 MeV

$\Omega = \pm 2°$

σ_{max} = 0.2 mb

width [keV]	σ [mb]
600	0.1286
700	0.1430
800	0.1570
900	0.1709
1000	0.1852



Conclusions

- σ_{max} = 0.2 mb *ie* one order of magnitude lower than predicted
- better understand "background"? angular distribution?
- go to lower beam energy?
- look for 2n emission? high energy γ?
- search for GPV in light nuclei?
- transfer mechanism not adapted for collective modes?
- constraints for pairing?