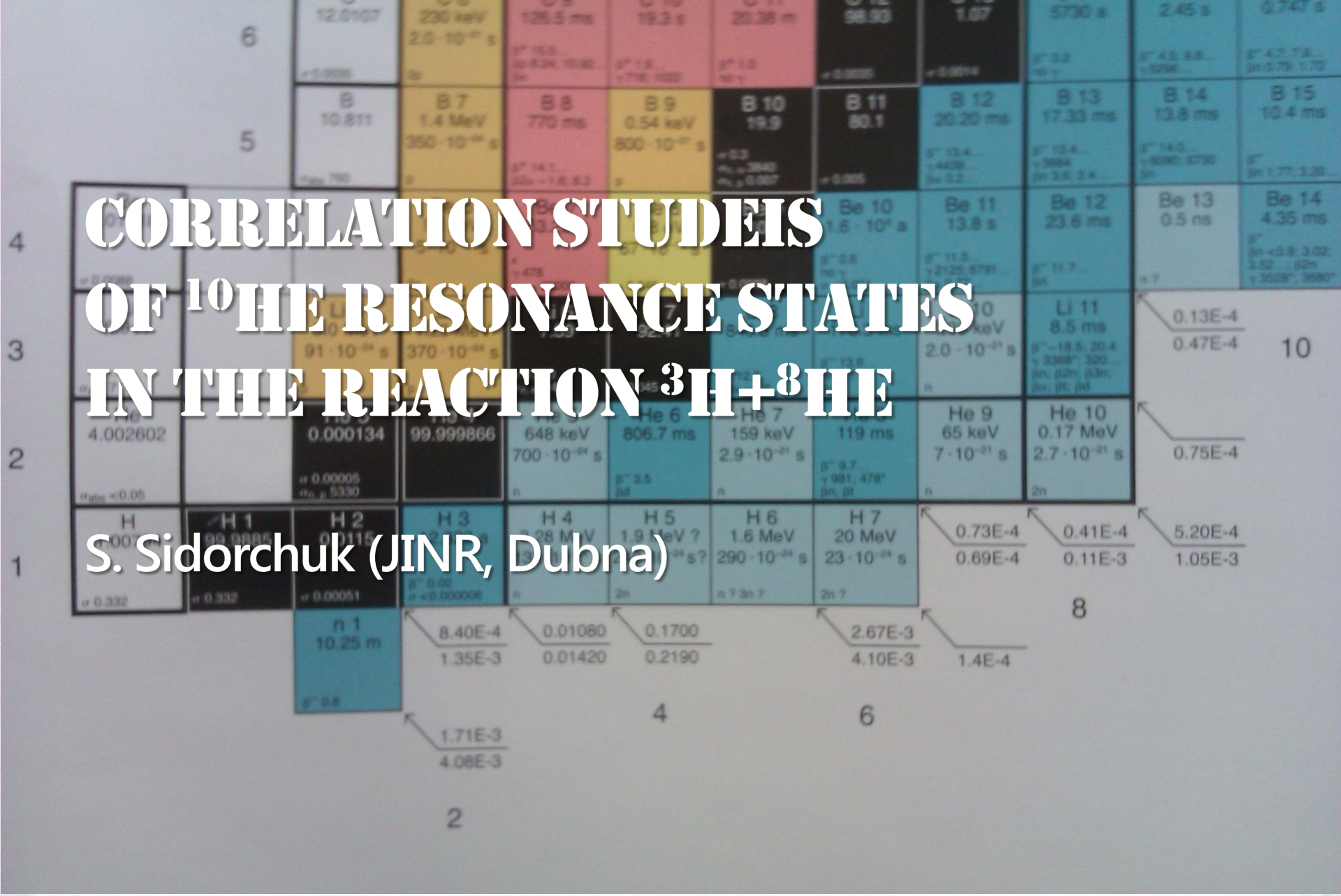
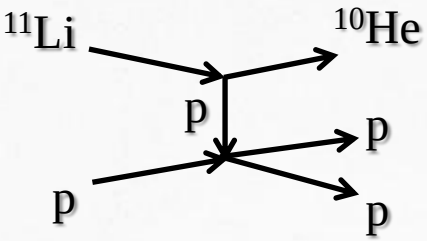


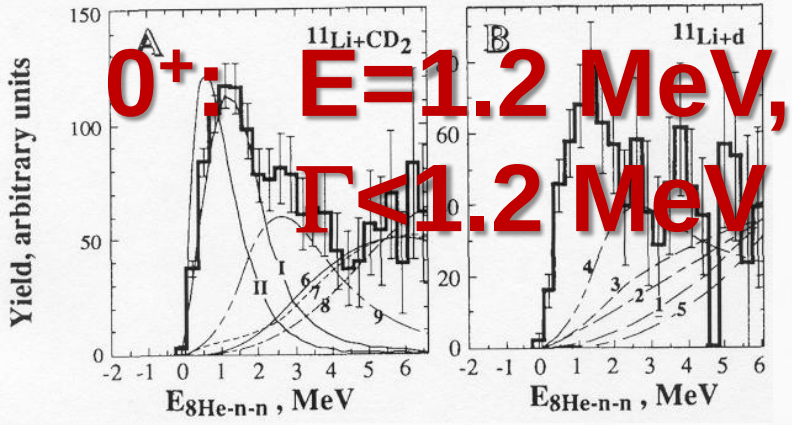
CORRELATION STUDEIS OF ^{10}HE RESONANCE STATES IN THE REACTION ^{3}H+^{8}HE

S. Sidorchuk (JINR, Dubna)

EURORIB'2012, Abano Terme, May 20-25, 2012

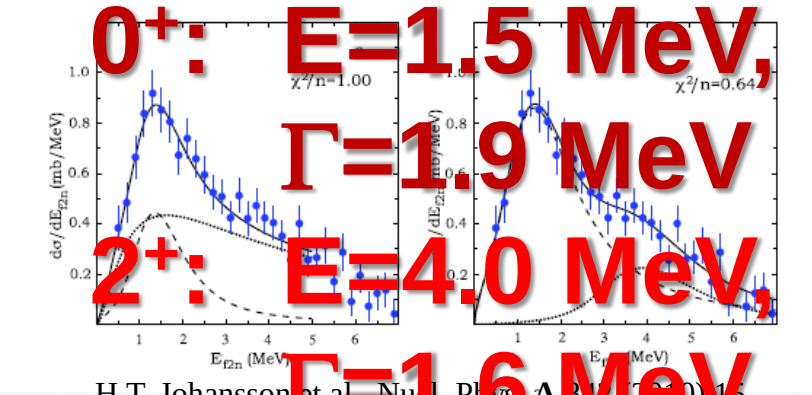
Proton knockout:





0^+: E=1.2 MeV,
Γ<1.2 MeV

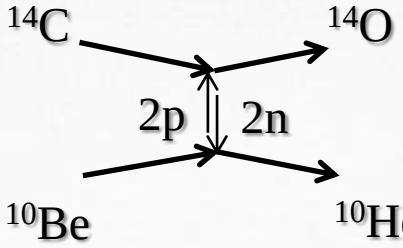
A.A. Korsheninnikov et al., Phys. Lett. **B** 326 (1994) 31

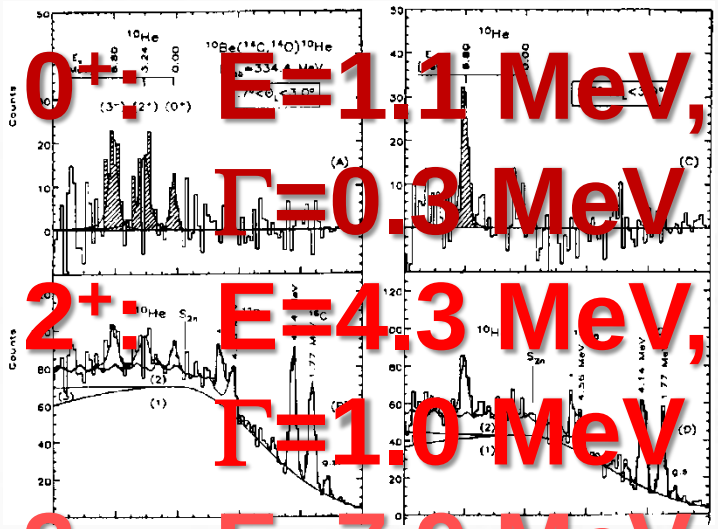


0^+: E=1.5 MeV,
Γ=1.9 MeV
2^+: E=4.0 MeV,
Γ=1.6 MeV

H.T. Johansson et al., Nucl. Phys. **A** 842 (2010) 15

Double charge exchange:

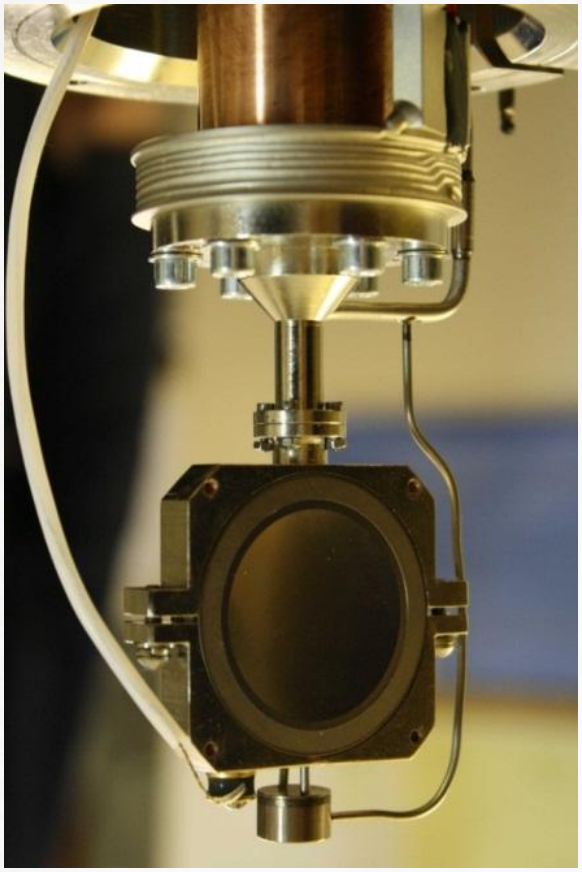


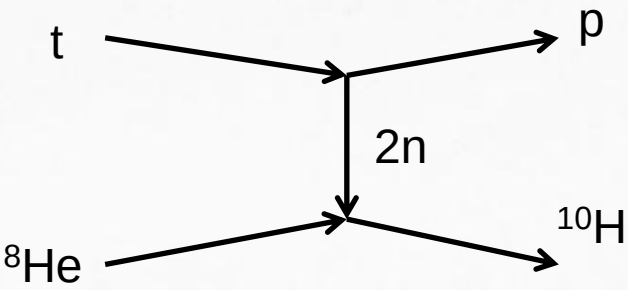


0^+: E=1.1 MeV,
Γ=0.3 MeV
2^+: E=4.3 MeV,
Γ=1.0 MeV
3^-: E=7.9 MeV,
Γ=0.6 MeV

A.N. Ostrowski et al., Phys. Lett. **B** 338 (1994) 13

^{10}He in 2n-transfer reaction ^{3}H(^{8}He,p)^{10}He





ACCULINNA (JINR, Dubna)

^{8}He beam: 1.4×10^{10}

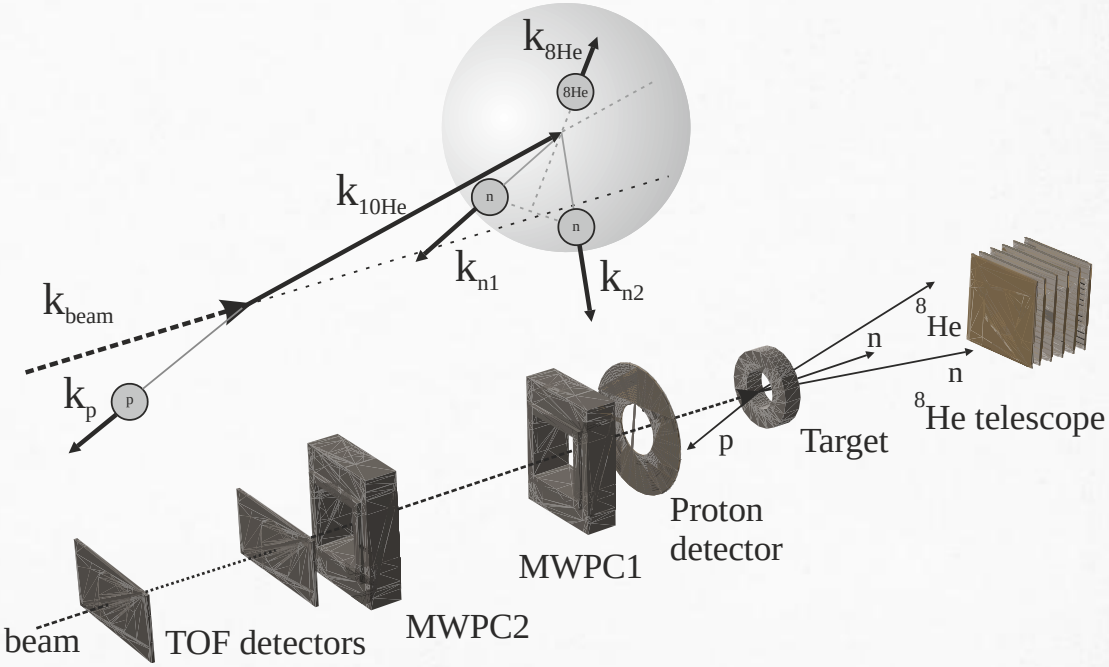
21.5A MeV

Cryogenic tritium target

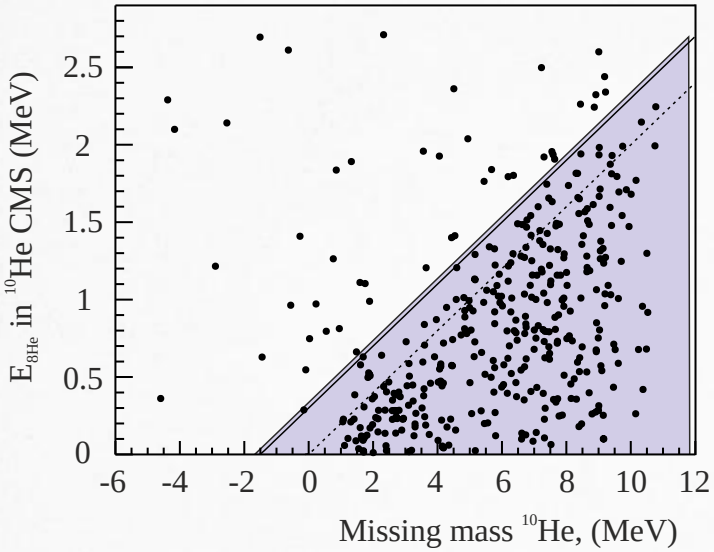
3.4×10^{20} cm^{-2}

T = 26 K

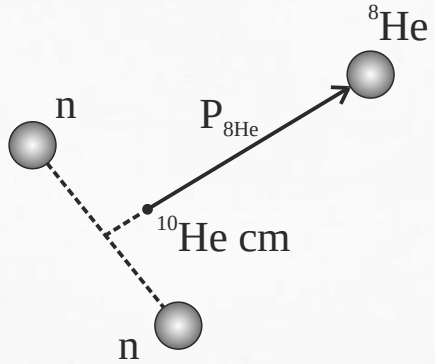
P = 0.9 Atm

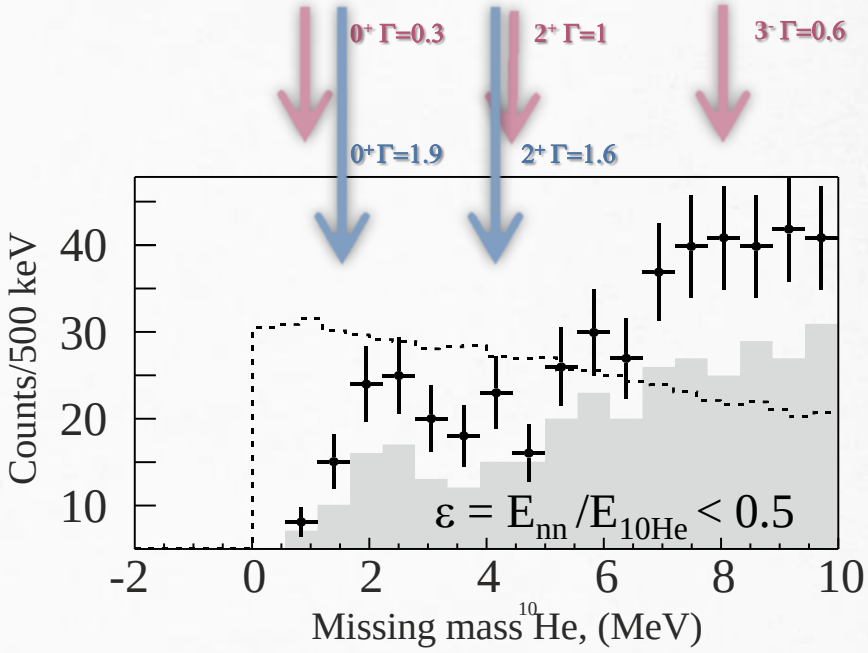


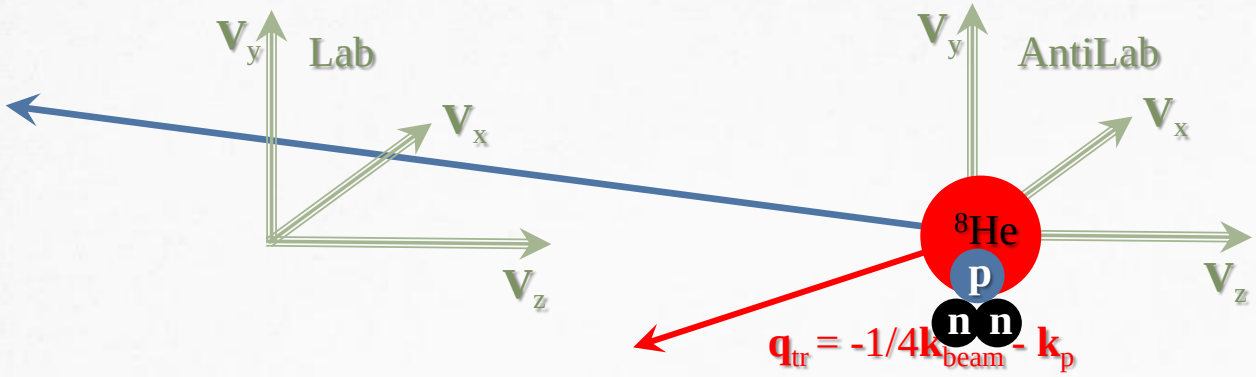
^{10}He spectrum: p-^{8}He coincidences

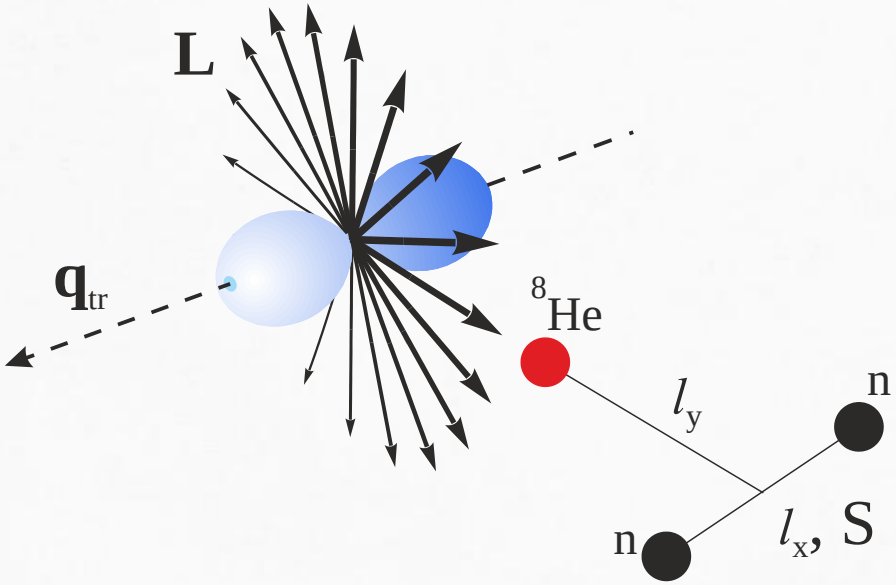


$E_{8He} < E^*_{10He}/5$





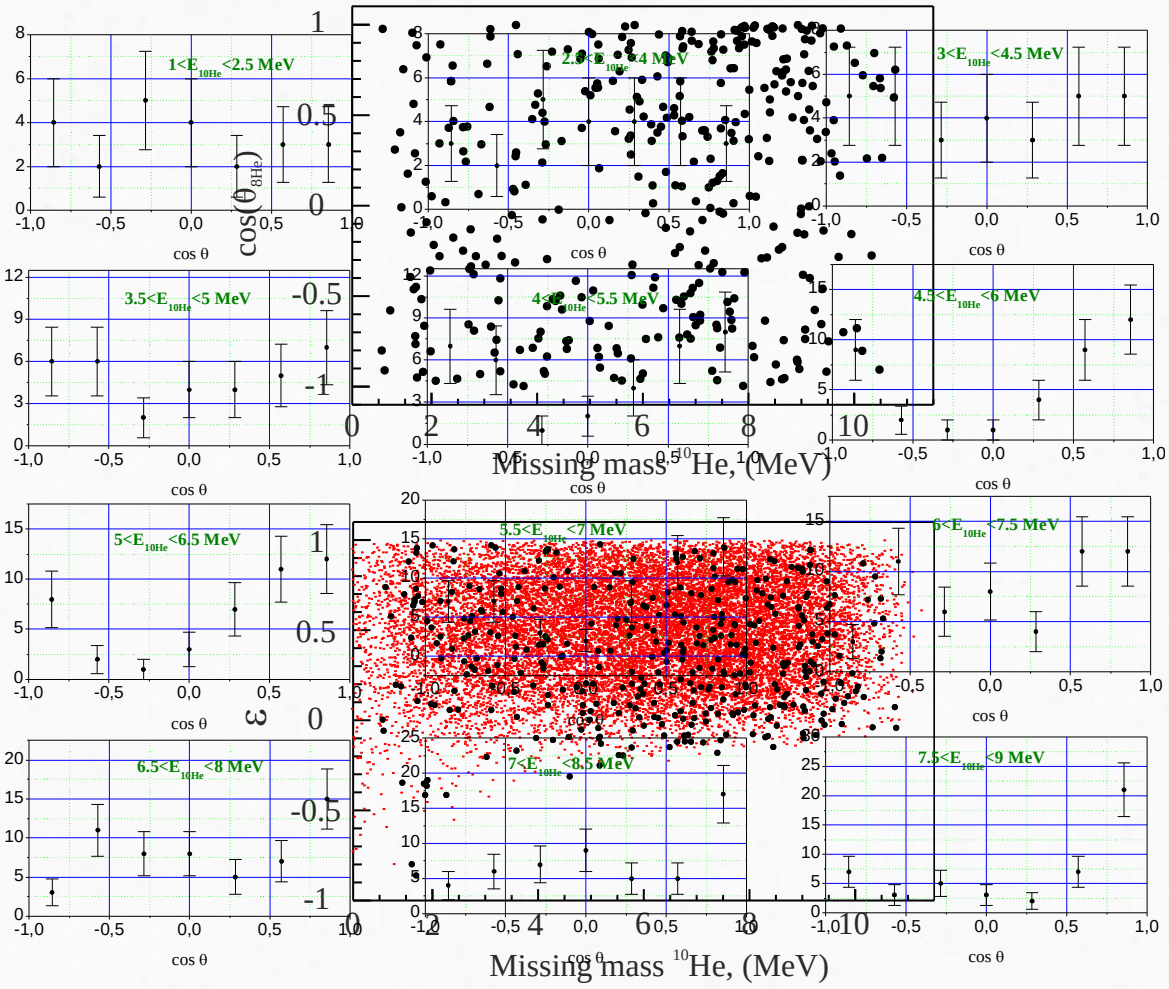




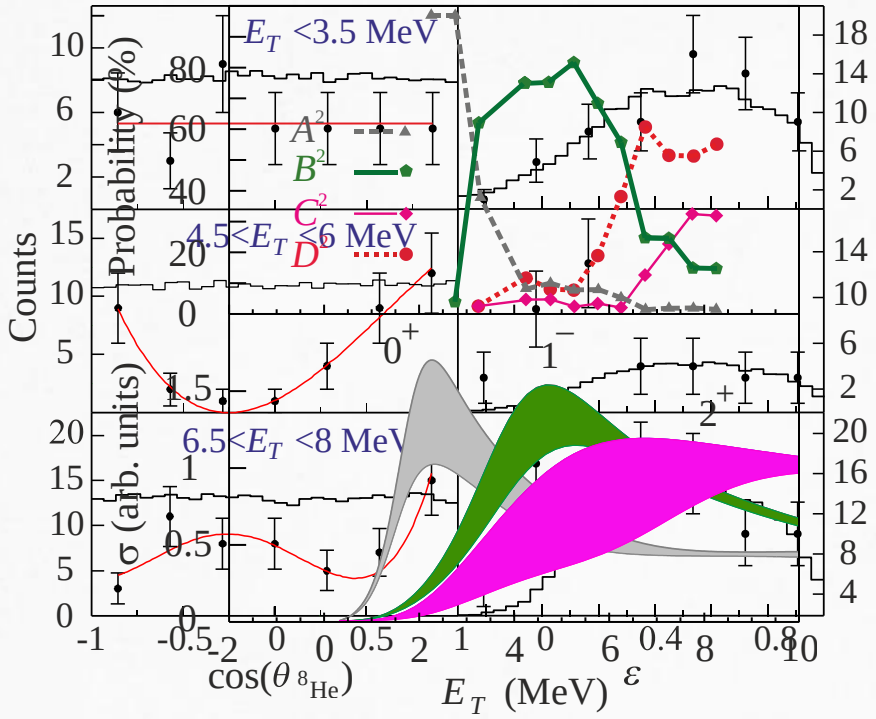
Pronounced angular distribution can be observed in the case of **direct reactions**. The state of interest should be populated and decay by **zero spin particles**. Correlations in such case are observed relative to the direction of momentum transfer.

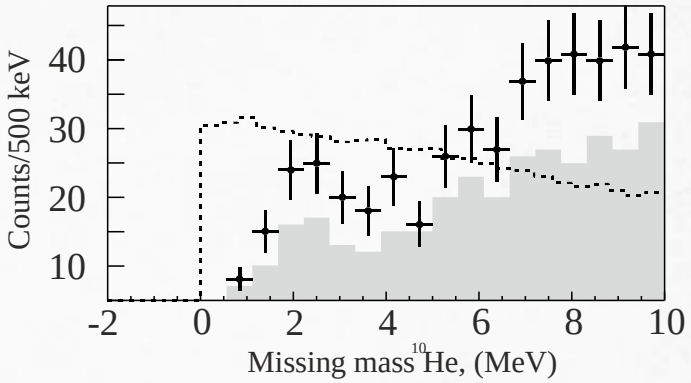
l_x=0, S=0

Angular and energy correlations



Results:





Three-body ^{8}He+n+n calculations:
L.V. Grigorenko and M.V. Zhukov, Phys. Rev. **C** 77 (2008)

M.S. Golovkov et al., Phys. Rev. **C 76** (2007)

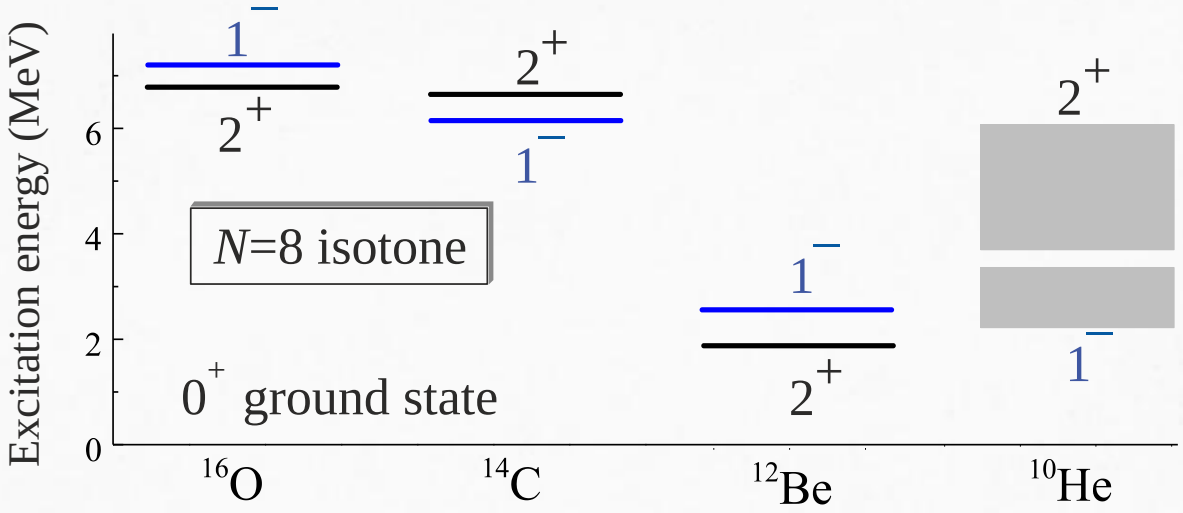
$W = [AP_0(x)+B(3^{1/2})P_1(x)+C(5^{1/2})P_2(x)]^2 + D^2$

$P_l(x)$ – Legendre polinomial, $x = \cos(\theta_{8He})$

A, B and C - amplitudes of coherent s-, p- and d-contributions,

D – decoherent “background”

Breakdown of the N=8 shell



The anomalous level ordering indicates that the breakdown of the N=8 shell known in ^{12}Be thus extends also to the ^{10}He system.

Summary

- *Missing mass spectrum of ^{10}He was measured in the two-neutron transfer reaction **^{3}H(^{8}He,p)^{10}He**.*
- *Angular distribution of ^{8}He in ^{10}He c.m. measured with respect to the transferred momentum vector shows pronounced interference patterns allowing to identify spin-parity of states contributing to the spectrum:*

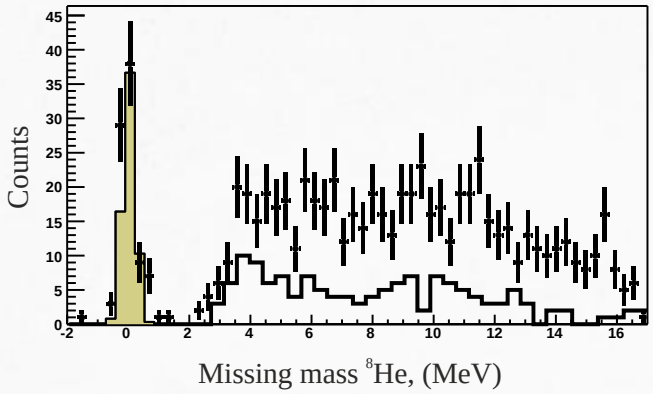
  ***0<E_T<3.5 MeV**: Angular distribution of ^{8}He is uniform, energy distribution is typical for a **0^+ state**. In the missing mass spectrum the ^{10}He g.s manifests itself as a broad peak with a maximum at about **2 MeV**;*

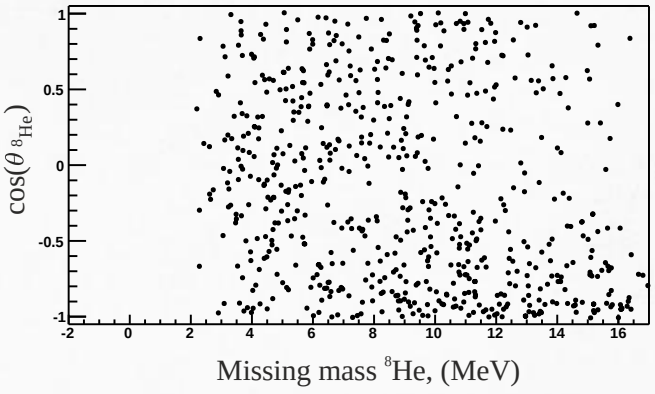
  ***4.5<E_T<6 MeV**: Angular distribution of ^{8}He shows a dominance of a p-wave (l_y=1), while the energy distribution gives the evidence of FSI in the n-n channel (l_x=0, S=0). Thus, the spin-parity of the **first excited state** of ^{10}He is **1^-**;*

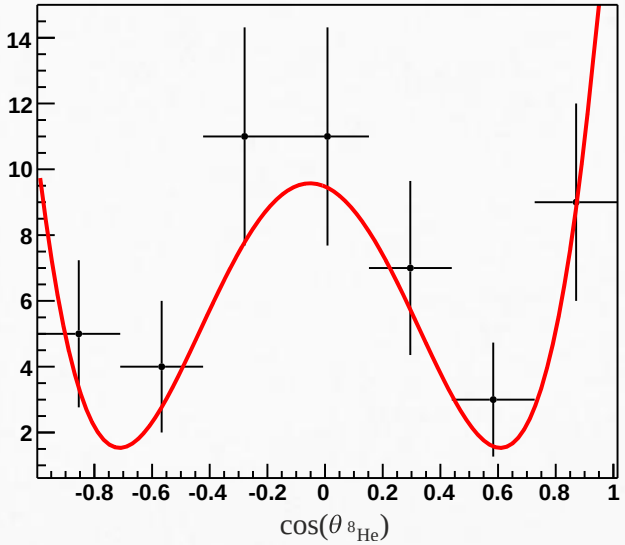
  ***E_T>6 MeV**: Analysis of the angular distribution of ^{8}He above 6 MeV allowed to interpret the ^{10}He spectrum above 6 MeV as a superposition of the 0^+, 1^- and **2^+** states.*
- *The established level sequence shows that ^{10}He is one more dripline nucleus demonstrating the shell structure breakdown.*

Thank you for your attention

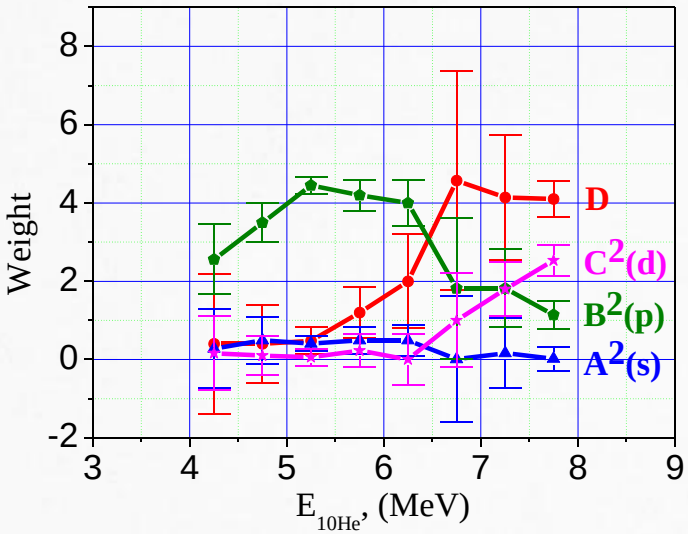
^{8}He in 2n-transfer reaction ^{3}H(^{6}He,p)^{8}He

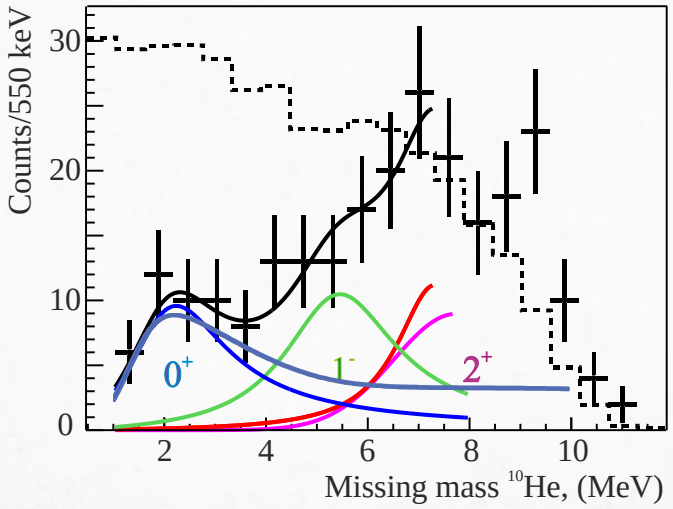




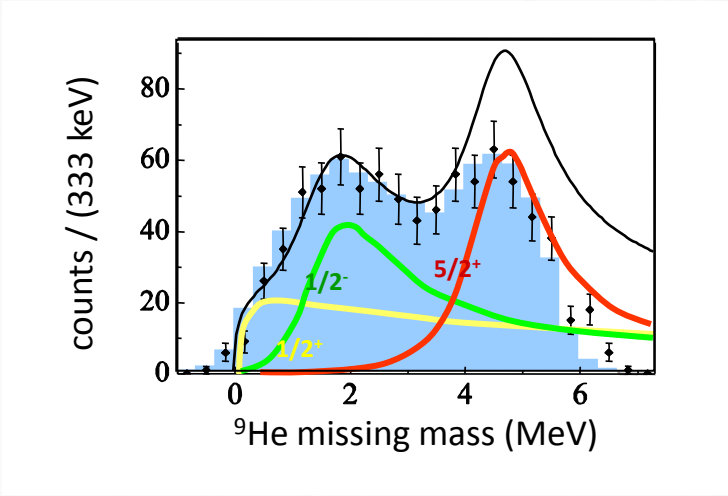


^{10}He





^{9}He



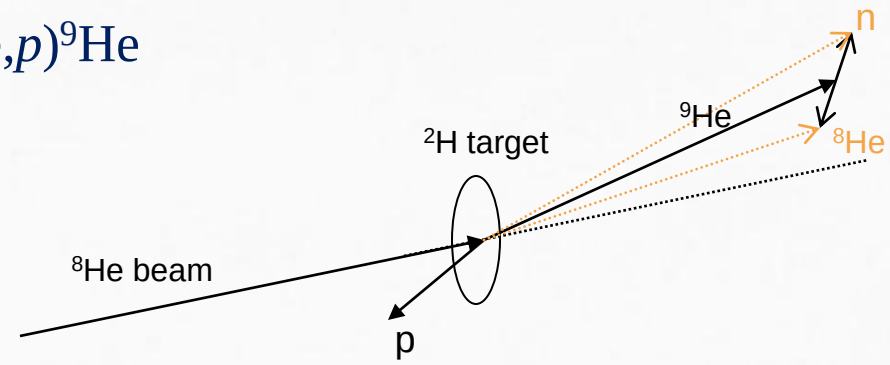
M.S. Golovkov et al., **Phys. Rev. C 76** (2007) 021605(R) 1-5

^{8}He-n:

s-wave
a=+2.9 fm
V=0 MeV
p-wave
V=-4.5 MeV

E_R(MeV) or a_s (fm)	J^π
>-20 fm	$1/2^+$
2 MeV	$1/2^-$
4.5 MeV	$5/2^+$

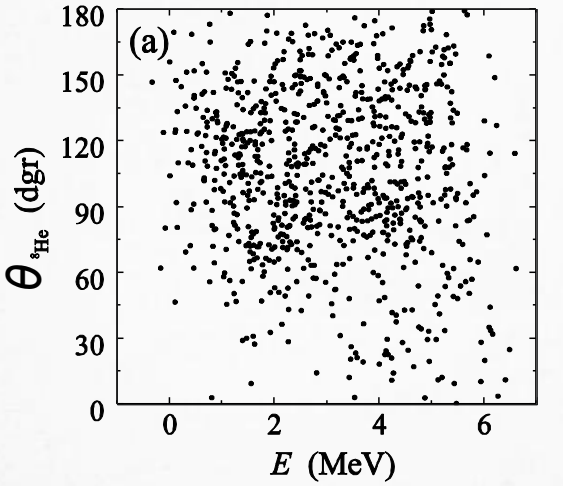
$^{2}H(^{8}He,p)^{9}He$

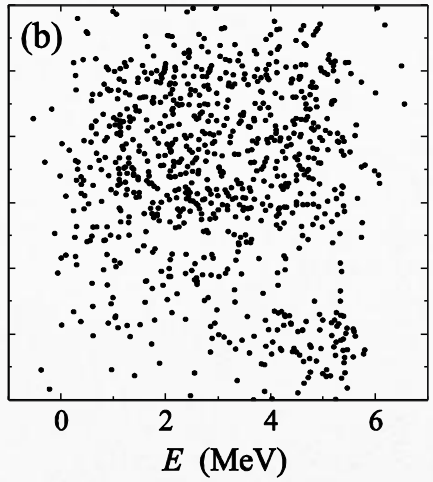


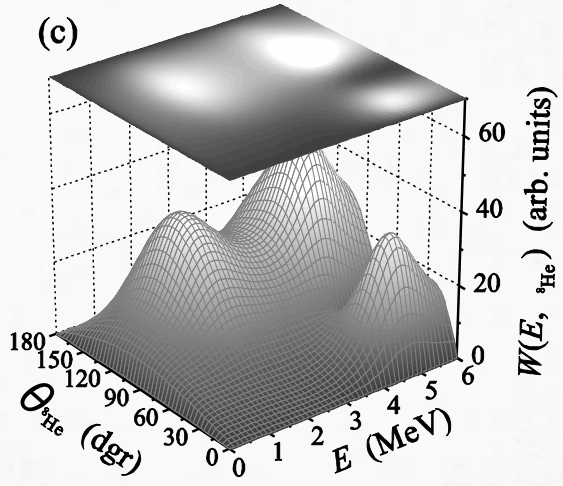
Experimental data

Monte Carlo simulation with the same statistics as experimental data

Reconstructed distributions

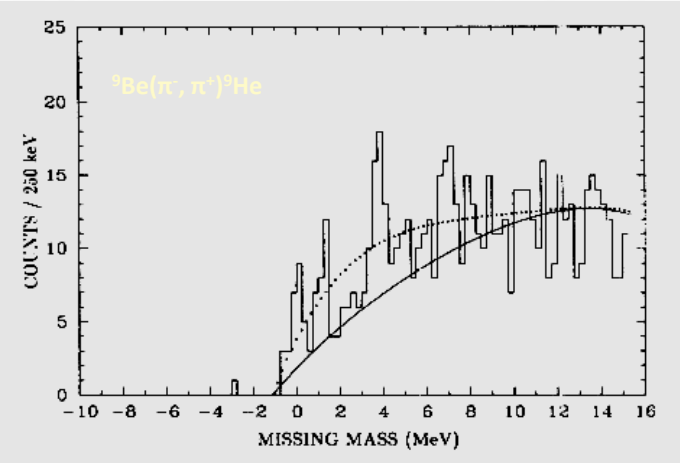






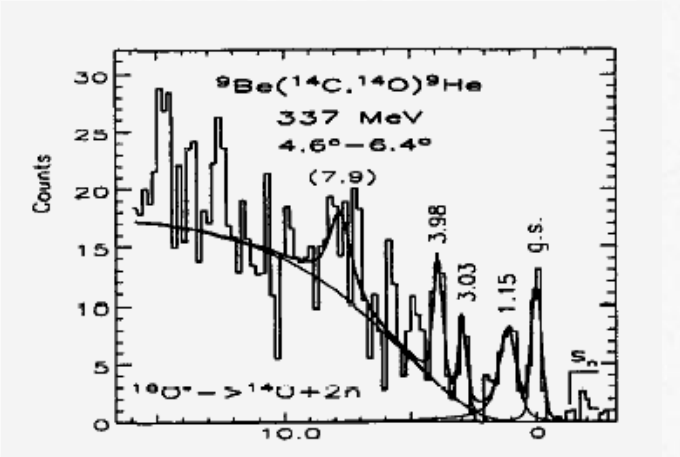
^{9}He: Experimental status

^{9}Be(π^{+},π^{-})^{9}He

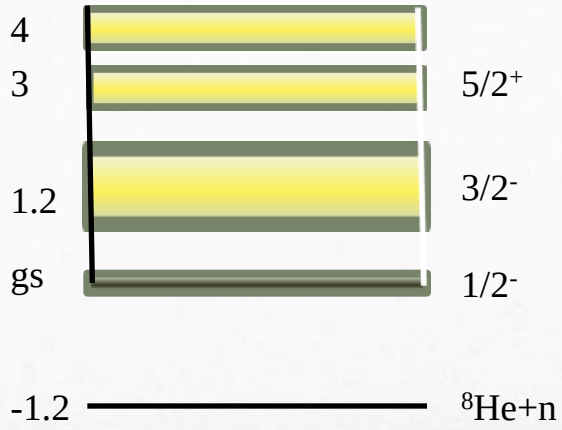


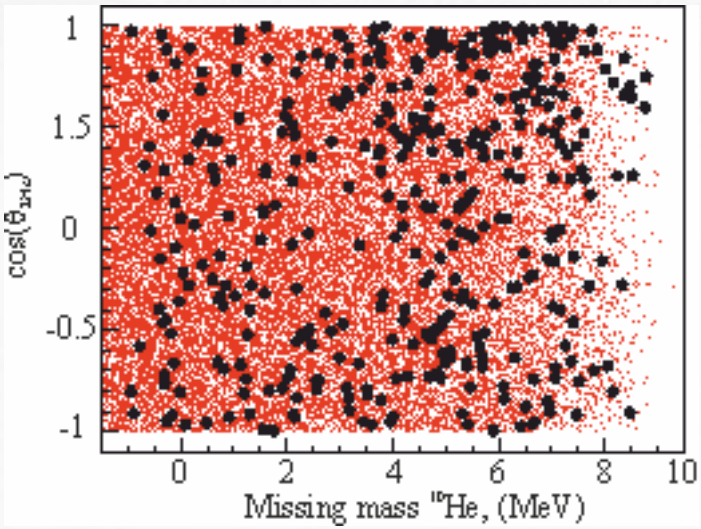
K.Seth, et al., *Exotic Nucleus Helium-9 and Its Excited States*
Phys.Rev.Lett. **58** (1987) 1930-1933

^{9}Be(^{14}C,^{14}O)^{9}He



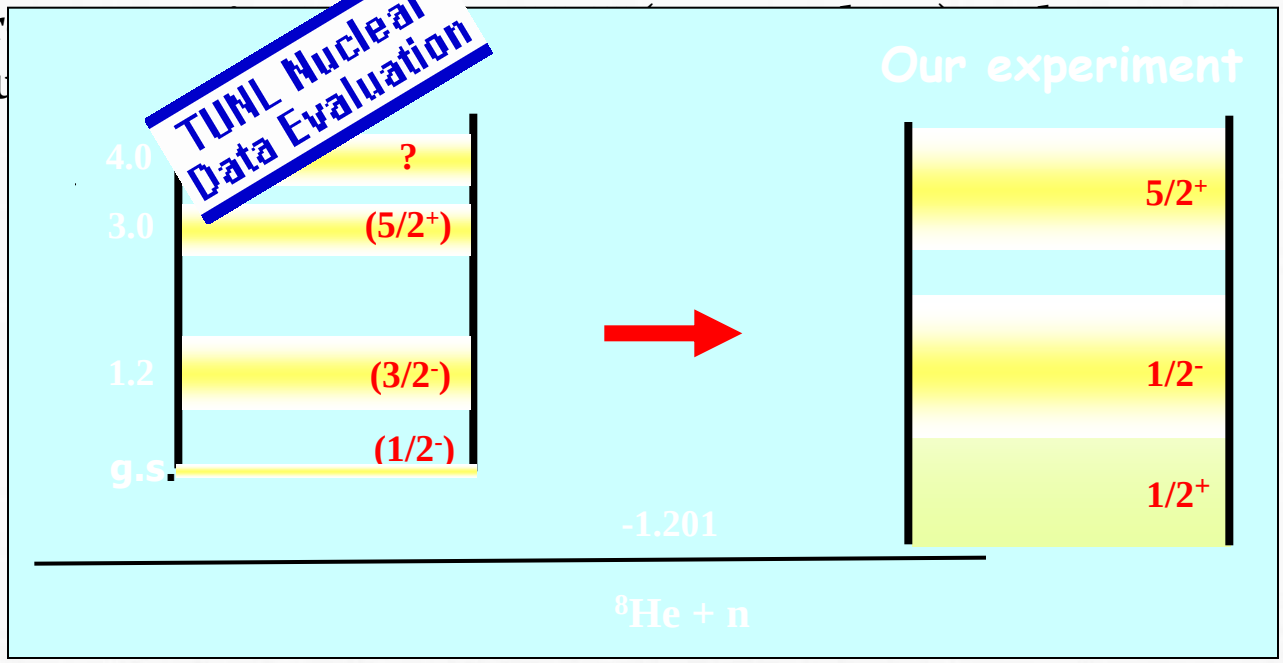
H.G.Bohlen et al., *Nuclear structure studiesof bound and unbound states in drip-line nuclei*
Nuovo Cim. **A 111** (1998) 841-846

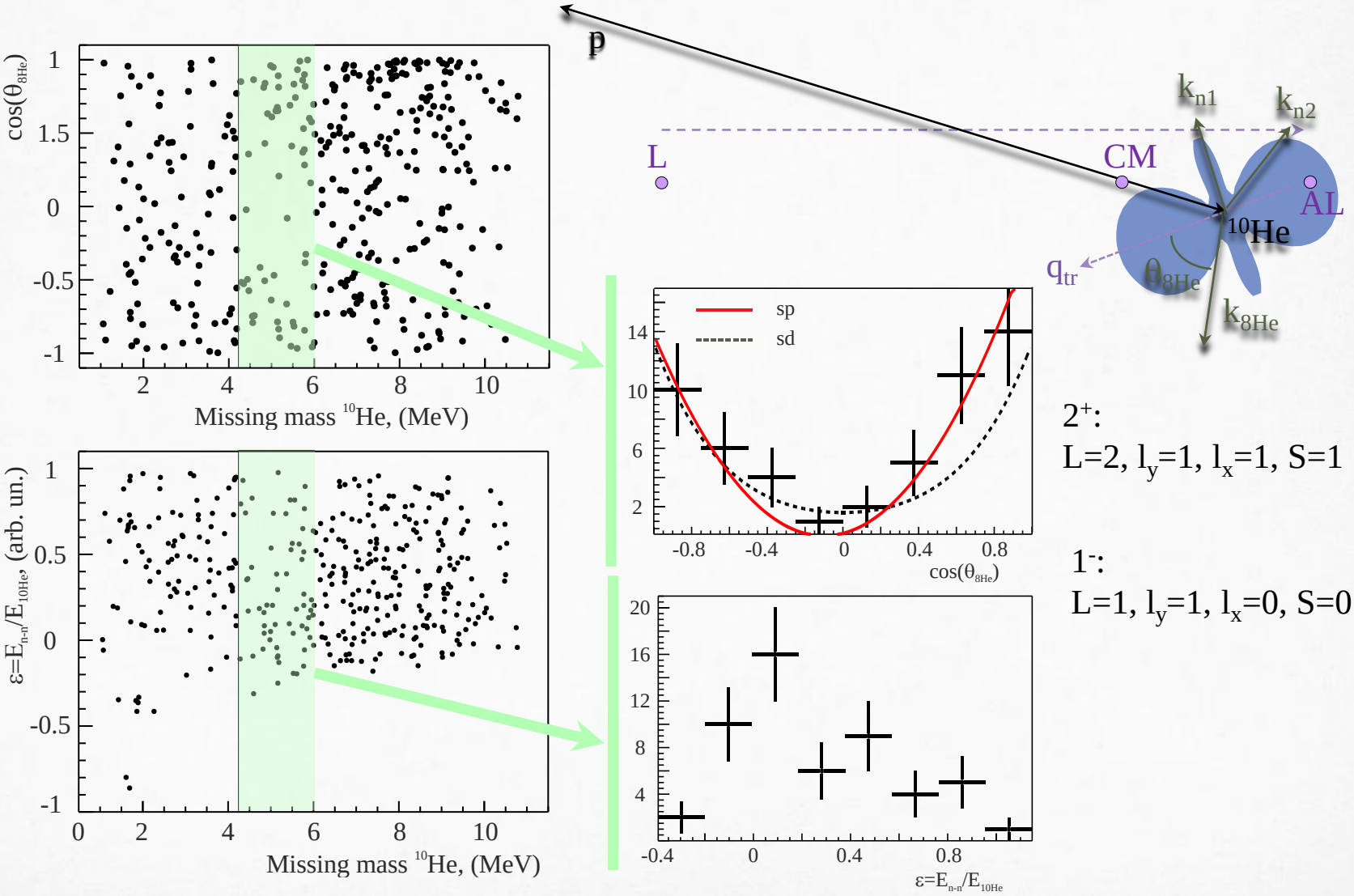



1
1.5
0
-0.5
-1
cos(θ)
0
2
4
6
8
10
Missing mass ⁹He, (MeV)

Conclusions

- Missing mass spectrum of ^{9}He:
  - Broad states are seen at ~2 MeV and at ~4.5 MeV;
  - Threshold behaviour gives evidence for s-wave contribution;
  - Scattering length limit $a > -20$ fm is imposed.
- Angular distribution of ^{8}He in the ^{9}He c.m. system makes possible complete spin-parity identification.
- Narr
(assu





2^+:
$L=2, l_y=1, l_x=1, S=1$

1^-:
$L=1, l_y=1, l_x=0, S=0$