Recent experimental studies of exotic nuclei

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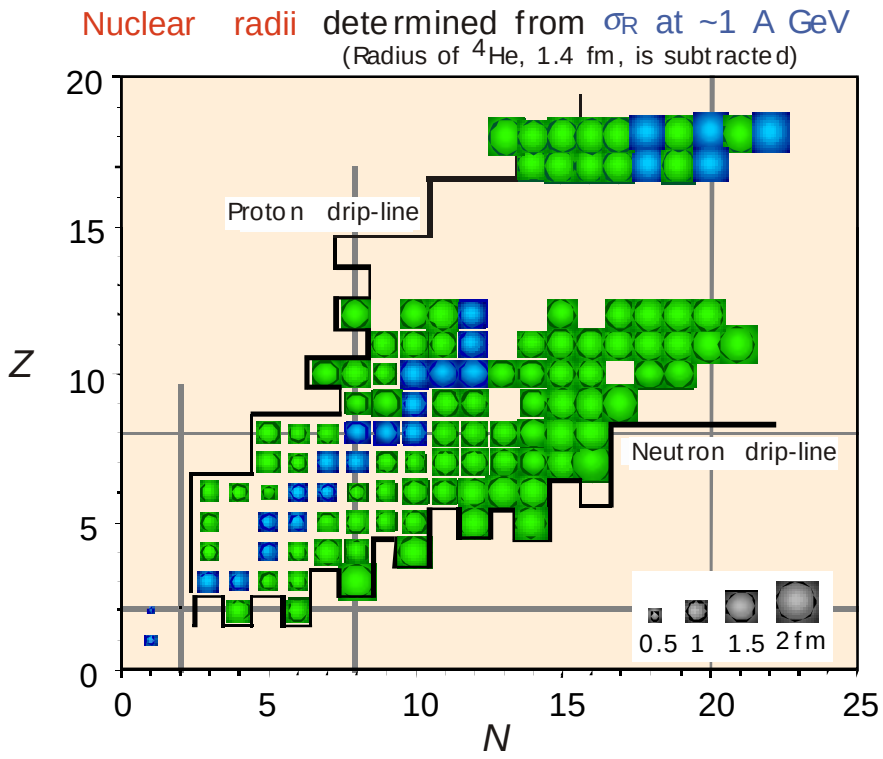
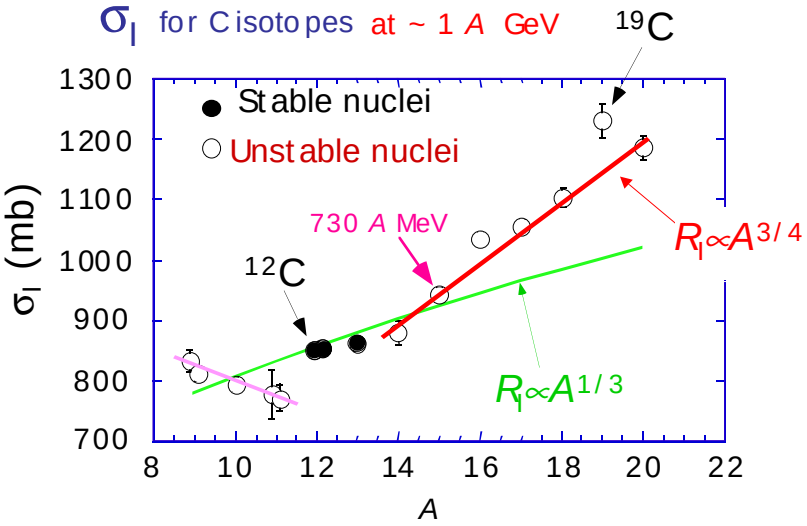
- Reaction cross-sections for C isotopes
- Proton halo in ^{17}Ne
- Two-proton radioactivity
- Correlations in the direct three-body decay of $^{12}C^{*}(1^{+})$
- Studies of ^{4}H
- Studies of ^{5}H
- Search for ^{7}H
- Structure of the ^{8}He ground state
- Spectroscopy of ^{7}He

I. Tanihata *et al.*, Phys. Rev. Lett. **55** (1985) 2676
^{11}Li - secondary beams of radioactive nuclei
- transmission method

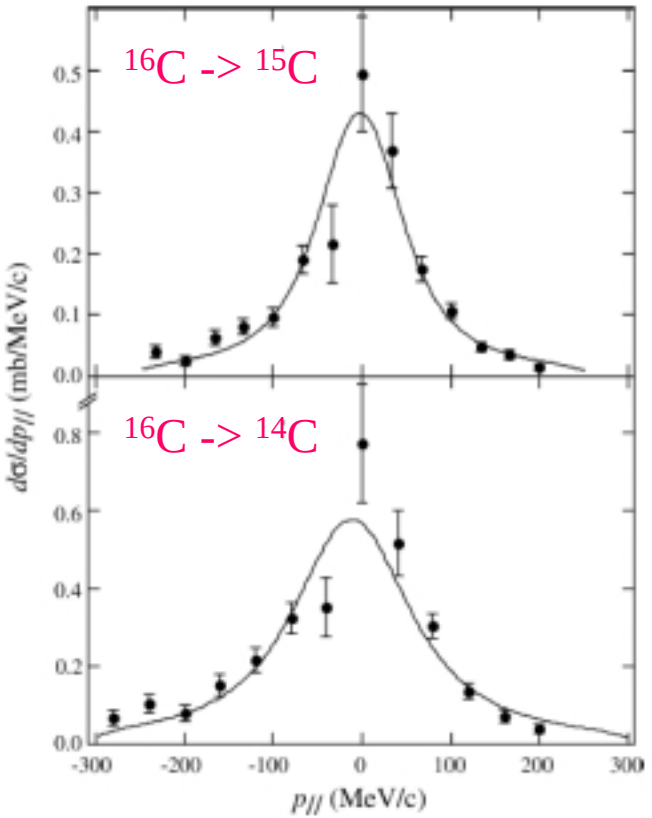
By Ozawa *et al.*:



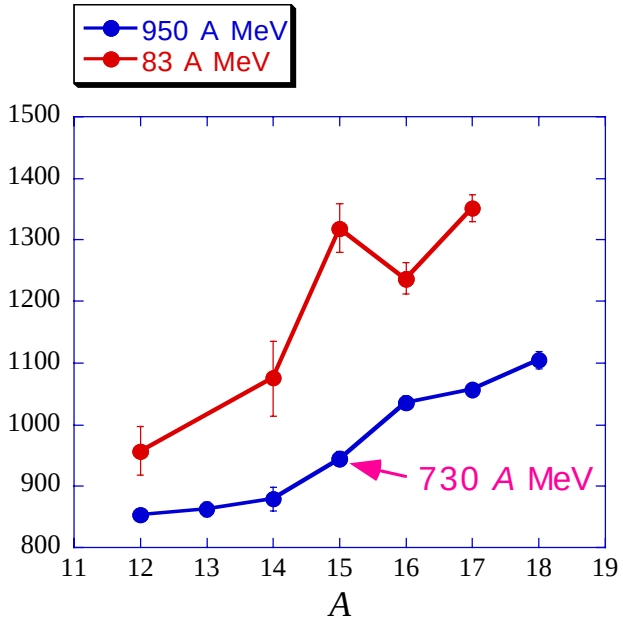
Reaction cross-sections for C isotopes



A. Ozawa *et al.*, Nucl. Phys. **A691** (2001) 599.



T. Yamaguchi *et al.*, Nucl. Phys. **A724** (2003) 3.



^{16}C pure s-wave configuration from the cross-section measurements at 1 *A* GeV and *A* 80 MeV;

S(s-wave) = 0.3 from the longitudenal momentum distribution at *A* 80 MeV.

Proton halo in ^{17}Ne

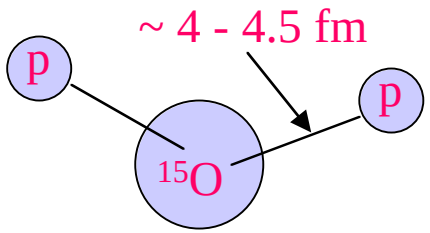
Experiment: R. Kanungo *et al.*, Phys. Lett. **B571** (2003) 21.

S(s-wave) = 0.9 $^{+0.1}_{-0.25}$

^{17}Ne dramatically different from ^{17}N

Theory: M.V. Zhukov and I.J. Thompson,
Phys. Rev. **C52** (1995) 3505.

FWHM = 140, 165 MeV/c



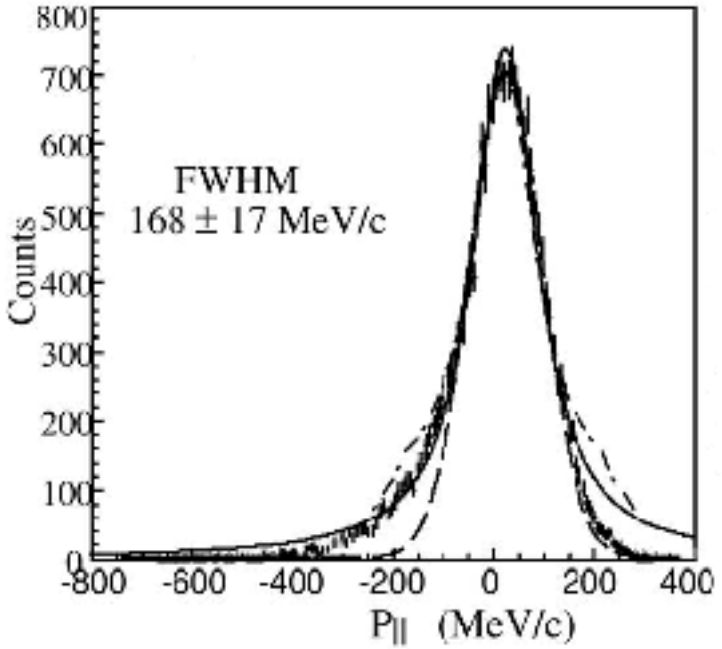
R_{mat}~2.5 fm

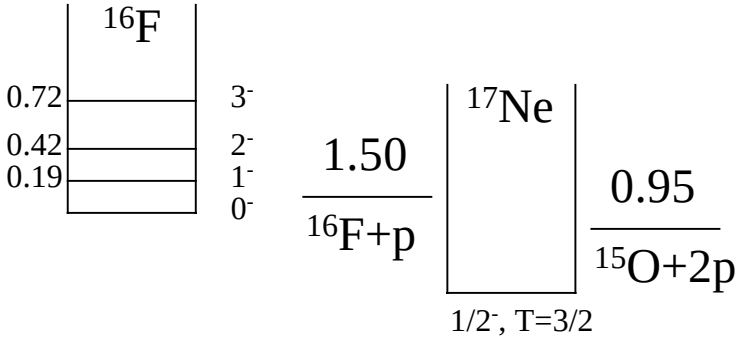
L.V. Grigorenko *et al.*, Nucl. Phys. **A713** (2003) 372

^{17}Ne s 48.1% d 47.8%

^{17}N s 39.8% d 55.6%

^{17}Ne -> ^{15}O @ 66 *A* MeV





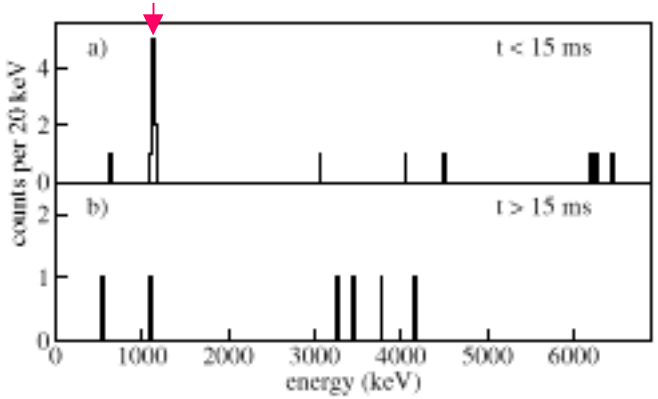
Two-proton radioactivity, ^{45}Fe

GSI: M. Pfutzner, *et al.*, Eur. Phys. J. **A14** (2002) 279

GANIL: J. Giovinazzo *et al.*, Phys. Rev. Lett. **89** (2002) 102501

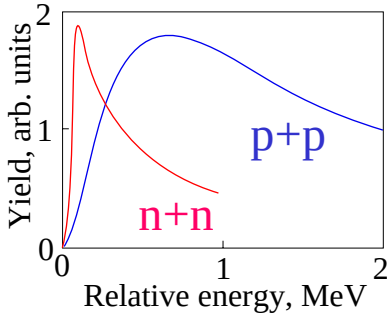
Theory: L.V. Grigorenko *et al.*, Phys. Rev. **C64** (2001) 054002

^{58}Ni -> ^{45}Fe



(i) three-body decay as a three-body phase space

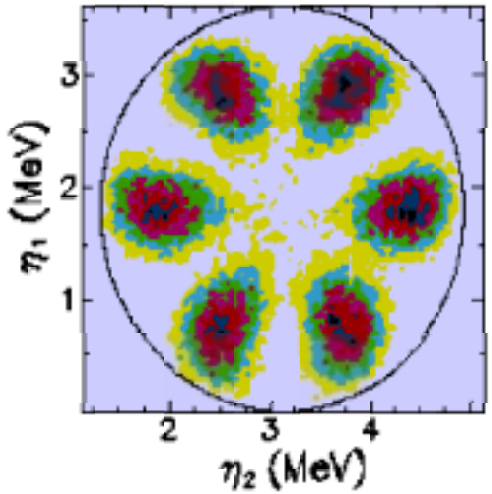
(ii) escape of «the ^{2}He resonance» producing strongly correlated two protons

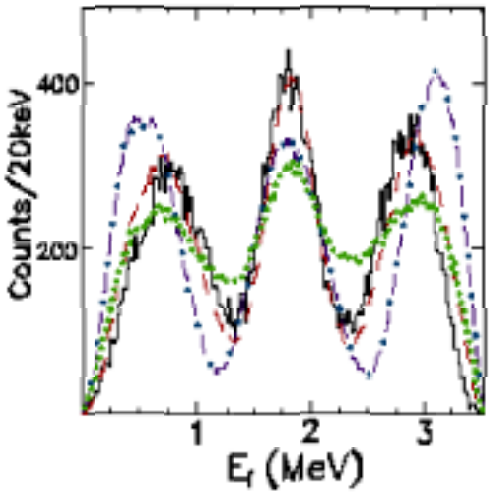


Correlations in the direct three-body decay of ^{12}C*(1^{+})

H.O.U. Fynbo *et al.*, Phys. Rev. Lett. **91** (2003) 082502 IGISOL, Jyvaskyla, Finland

^{12}C(p,n)^{12}N -> β -> ^{12}C*(1^{+};12.71 MeV) -> 3α





Studies of ^{4}H

Previous experiments since sixties:

E_{res} relative to the t+n threshold: from 1.7 to 8 MeV

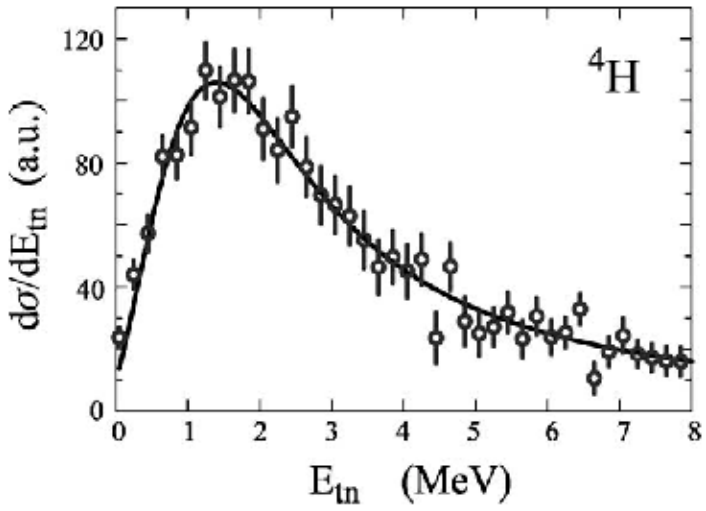
Γ from 1 to 4.7 MeV

Charge-symmetric reflection of the R-matrix parameters for the isobar analog states in ^{4}Li, D.R. Tilley *et al.*, Nucl. Phys. **A541** (1992) 1:

^{4}H	E_{res}, MeV	Γ, MeV
2^-	3.19	5.42
1^-	3.5	6.73
0^-	5.27	8.92
1^-	6.02	12.99

GSI: ^{6}He + C -> t +n

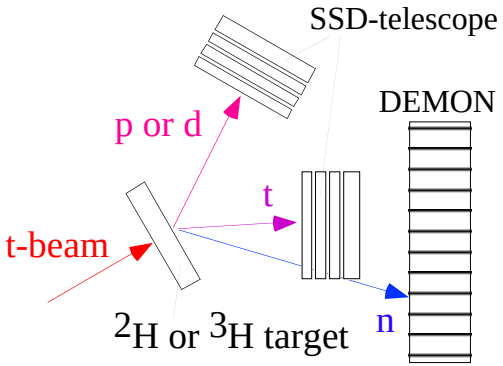
M. Meister *et al.*, Nucl. Phys. **A723** (2003) 13

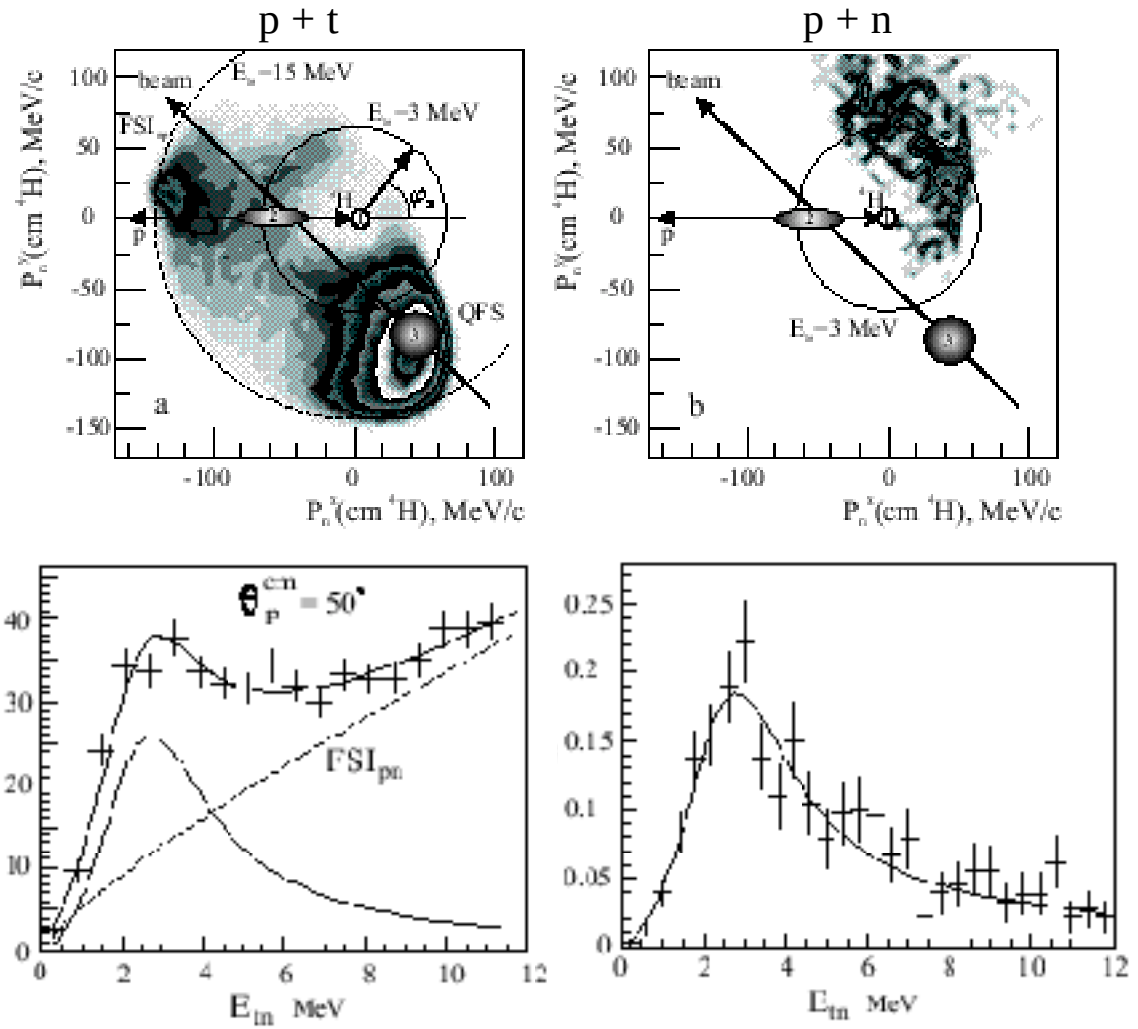


Studies of ^{4}H

Dubna, Russia: S. Sidortchuk *et al.*

^{2}H(t,p)^{4}H and ^{3}H(t,d)^{4}H





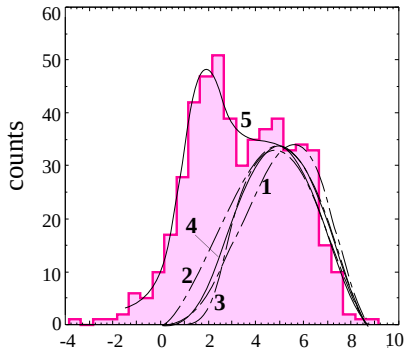
E_{res}	Γ	Γ_{obs}	E_0	Γ_0
3.05	**5.14**	**4.18**	**1.99**	**2.85**
±0.19	**±1.38**	**±1.02**	**±0.37**	**±0.3**

From ^{4}Li, D.R. Tilley *et al.*, Nucl. Phys. **A541** (1992)

^{4}H	E_{res}, MeV	Γ, MeV
2^-	3.19	5.42

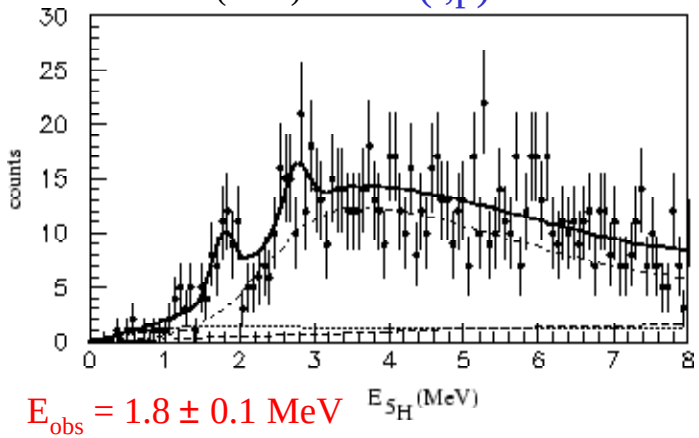
Studies of ^{5}H

A.K. *et al.*, Phys. Rev. Lett. **87** (2001) 092501 $p(^{6}He,^{2}He)^{5}H$



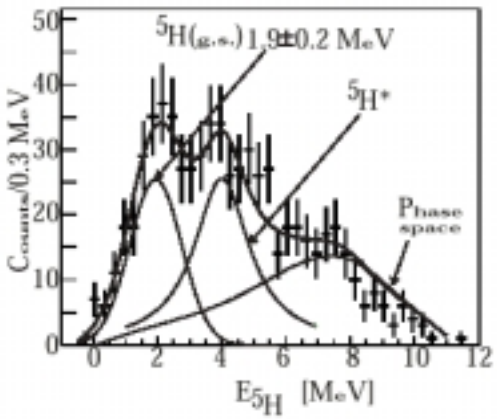
E_{obs} = 1.7 ± 0.3 MeV

M.S. Golovkov *et al.*, Phys. Lett. **B566** (2003) 70 $^{3}H(t,p)^{5}H$



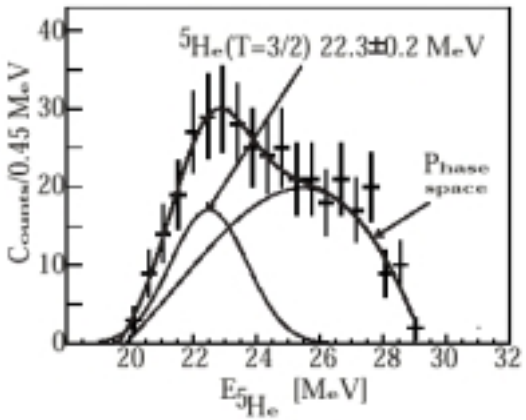
E_{obs} = 1.8 ± 0.1 MeV

S. Stepantsov *et al.*, unpublished $d(^{6}He,^{3}He)^{5}H$



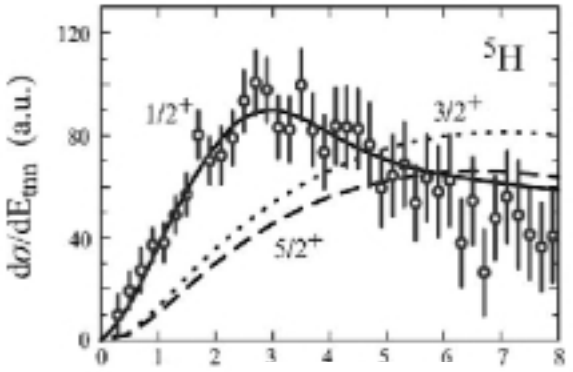
E_{obs} = 1.9 ± 0.2 MeV

S. Stepantsov *et al.*, unpublished $d(^{6}He,^{3}H)^{5}He(T=3/2)$



^{5}He(T=3/2)

M. Meister *et al.*, Nucl. Phys. **A723** (2003) 13 $^{12}C(^{6}He,nnt)$



E_{obs} ~ 3 MeV

M.G. Gornov *et al.*, JETP Lett. **77** (2003) 344 $^{9}Be(\pi^{-},pt)$ $^{9}Be(\pi^{-},dd)$

E_{obs} = 5.5 ± 0.2 MeV

P. Roussel-Chomaz, private communication

GANIL: experiment is planned

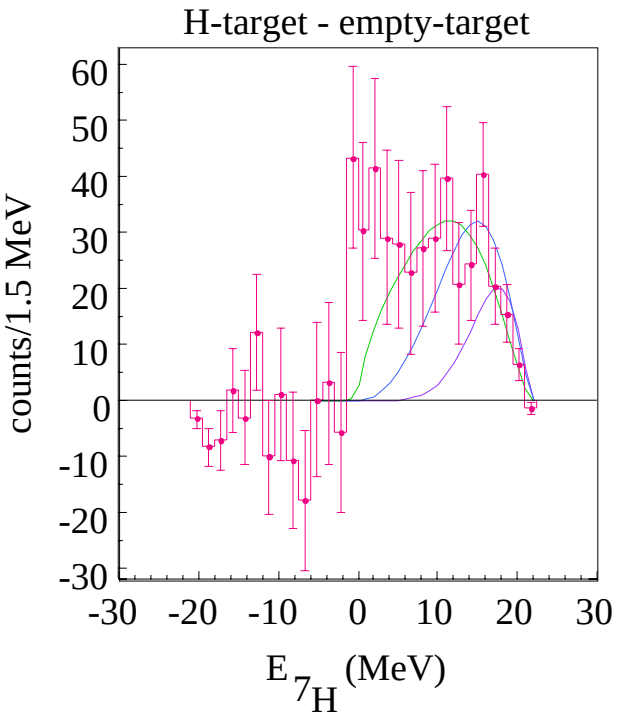
$p(^{8}He,\alpha)^{5}H$

at 4 MeV/nucl

Search for ^{7}H

A.K. *et al.*, Phys. Rev. Lett. **90** (2003) 082501

$p(^{8}He,^{2}He)^{7}H$

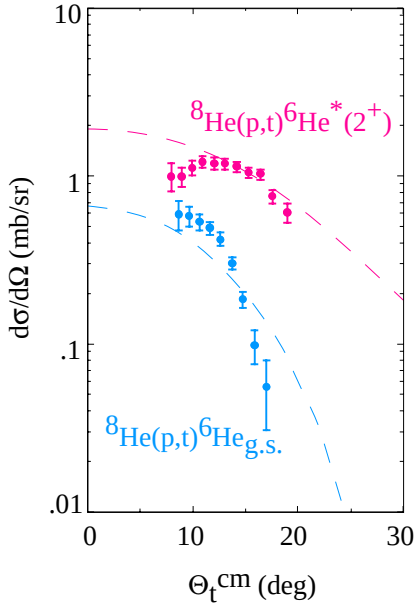


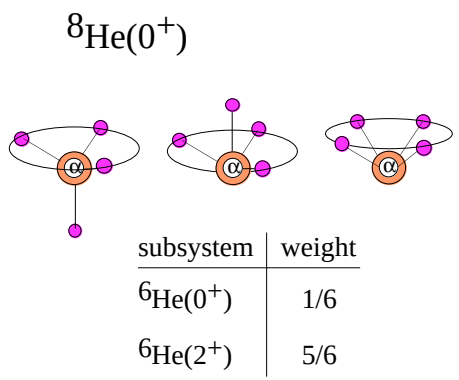
Futher study of ^{7}H:

$^{2}H(^{8}He,^{3}He)^{7}H$

Structure of the ^{8}He ground state

$p(^{8}He,t)^{6}He$





0^{+}: 1/6 * 2/3 * 1/2

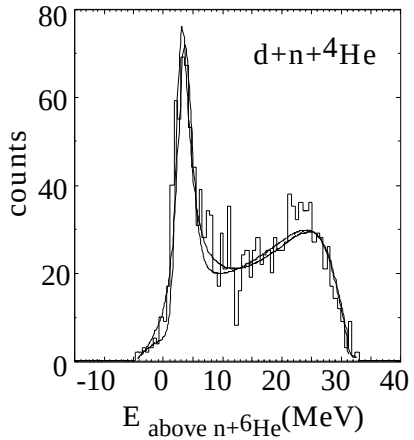
2^{+}: 5/6 * 1/3 * 1/2 * 1/3

transfer of singlet di-neutron

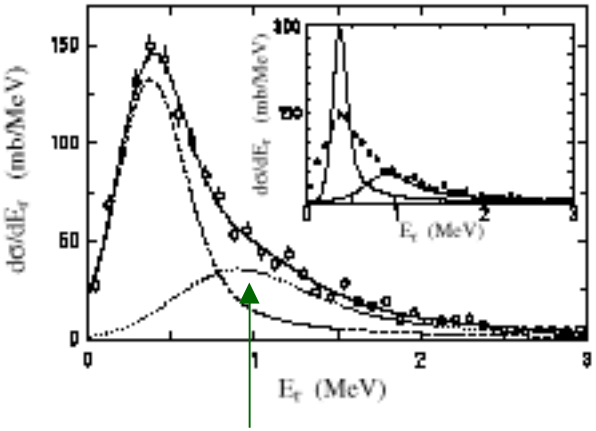
weight of $j_{3/2}j_{3/2}$ in $^{6}He^{*}(2^{+})$

Spectroscopy of ^{7}He

A.K. *et al.*, Phys. Rev. Lett. **82**
(1999) 3581 $p(^{8}He,d)^{7}He$

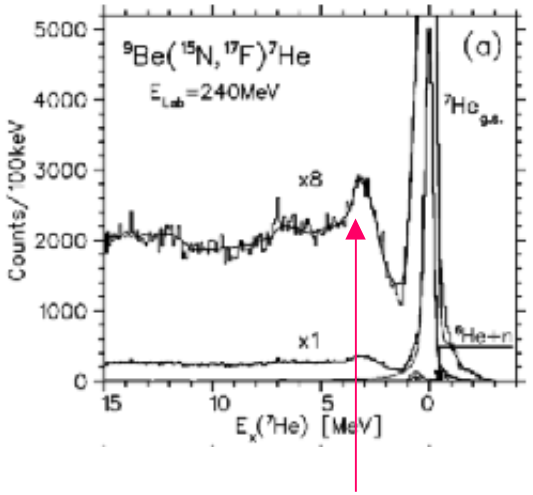


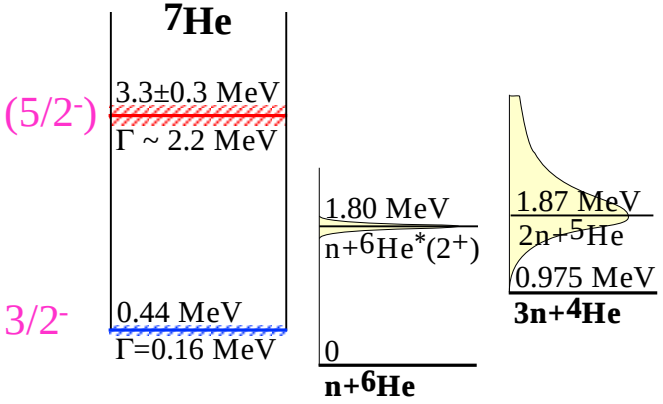
M. Meister *et al.*, Phys. Rev. Lett. **88**
(2002) 102501 $C(^{8}He,n^{6}He)$



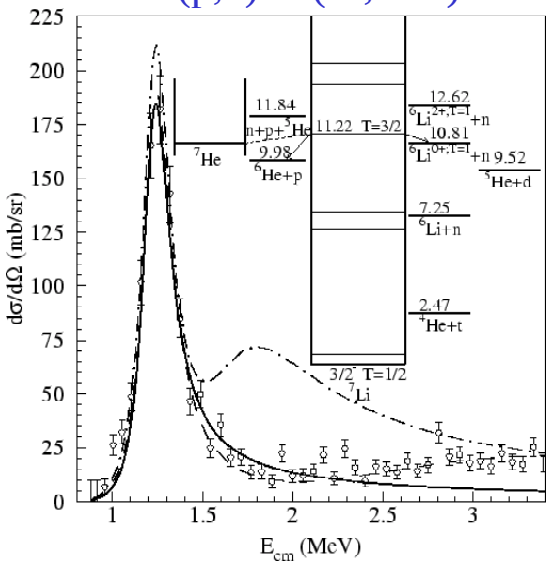
$^{7}He^{*}(1/2^{-})$

H.G. Bohlen *et al.*, Phys. Rev. **C64**
(2001) 024312 $^{9}Be(^{15}N,^{17}F)^{7}He$





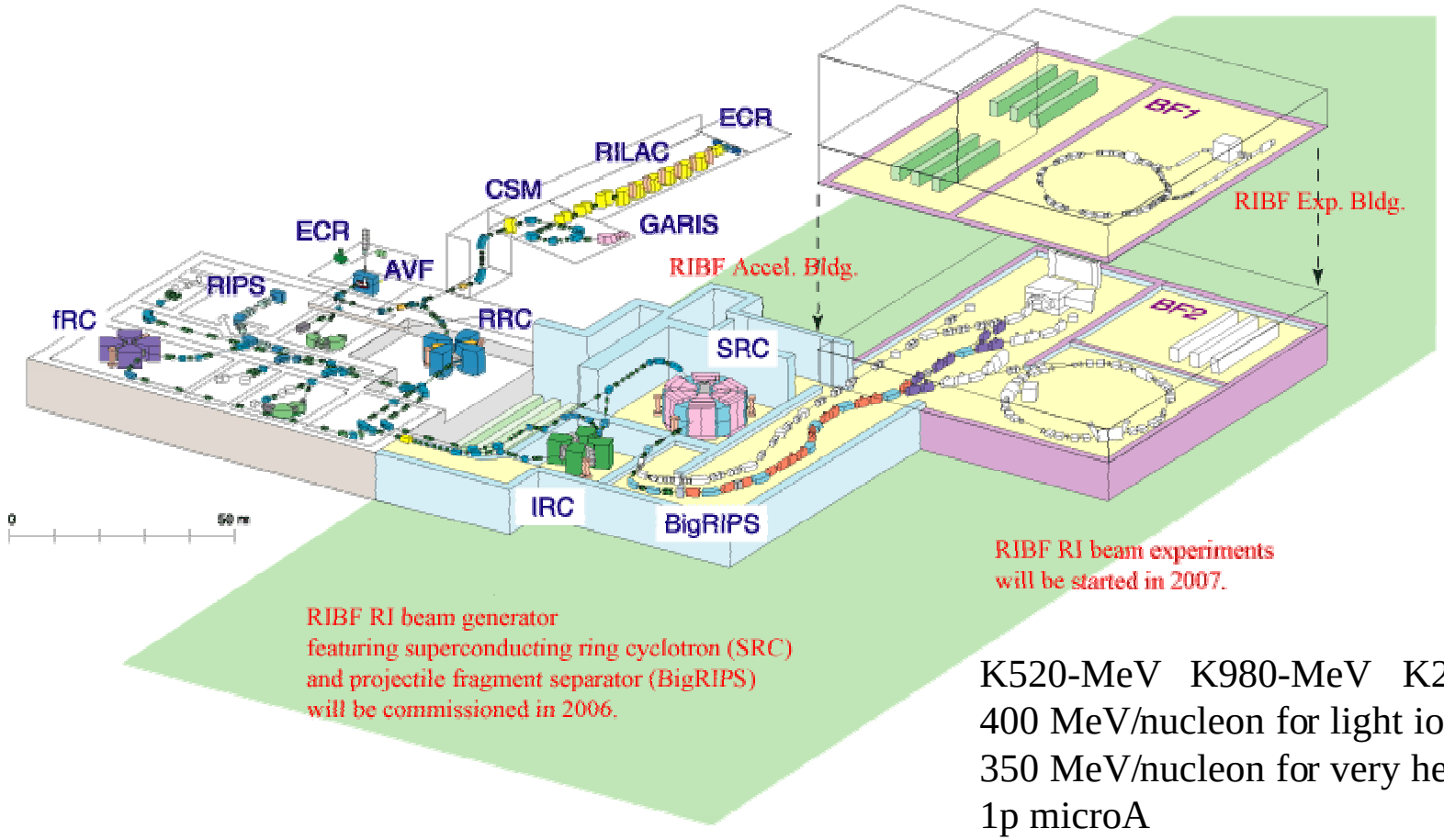
G.V. Rogachev *et al.*, Notre Dame
$^{6}He(p,n)^{6}Li(0^{+},T=1)$



Theory predicts $^{7}H^{*}(5/2^{-})$:
J. Wurzer and H.M. Hofmann, Phys. Rev. **C55** (1997) 688;
S.C. Pieper *et al.*, Phys. Rev. **C64** (2001) 014001

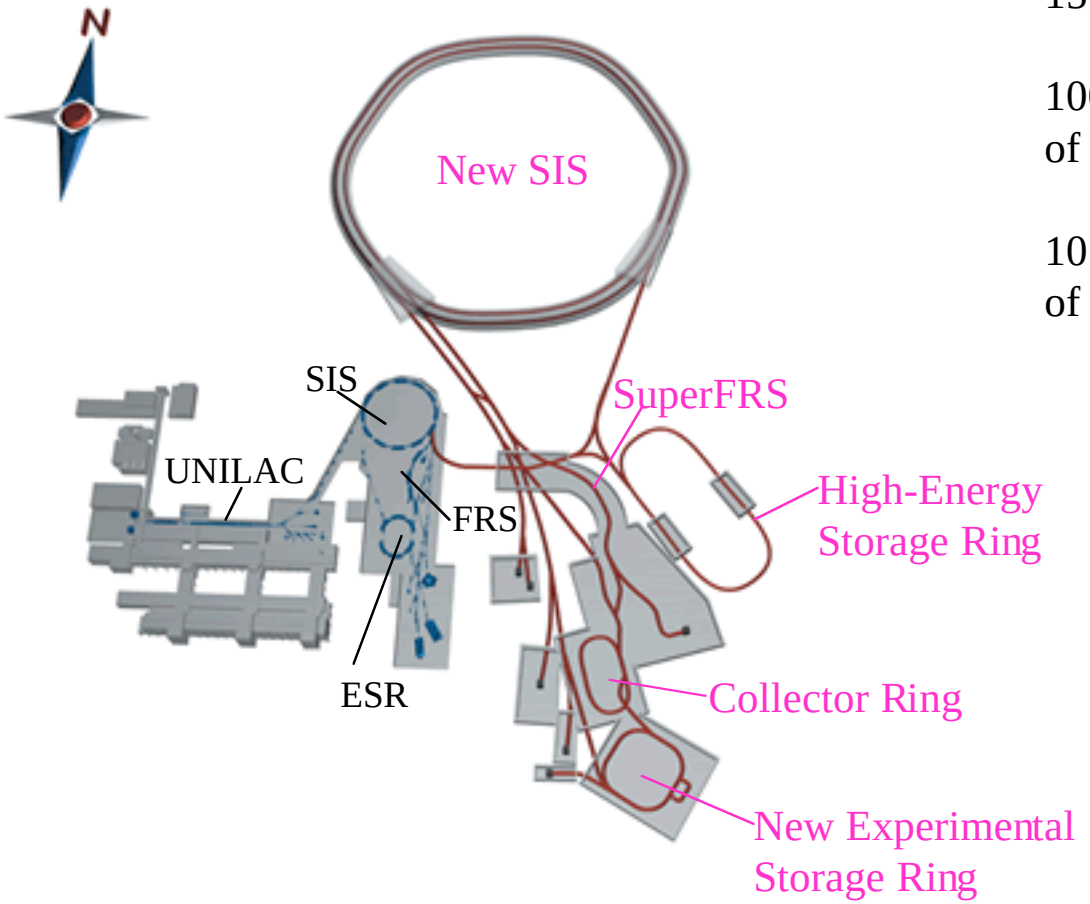
Paths in future: RI Beam Factory in RIKEN

RI Beam Factory (RIBF):
Upgrading project of RIKEN Accelerator Research Facility (RARF)



K520-MeV K980-MeV K2500-MeV
400 MeV/nucleon for light ions
350 MeV/nucleon for very heavy ions
1p microA
BigRIPS

Paths in future: International Accelerator Facility in GSI



15 times higher energy

100 times higher intensity
of primary beam

10 000 times higher intensity
of secondary beam