Studies of the reference and satellite nuclear reactions in search for light neutron-rich nuclear systems

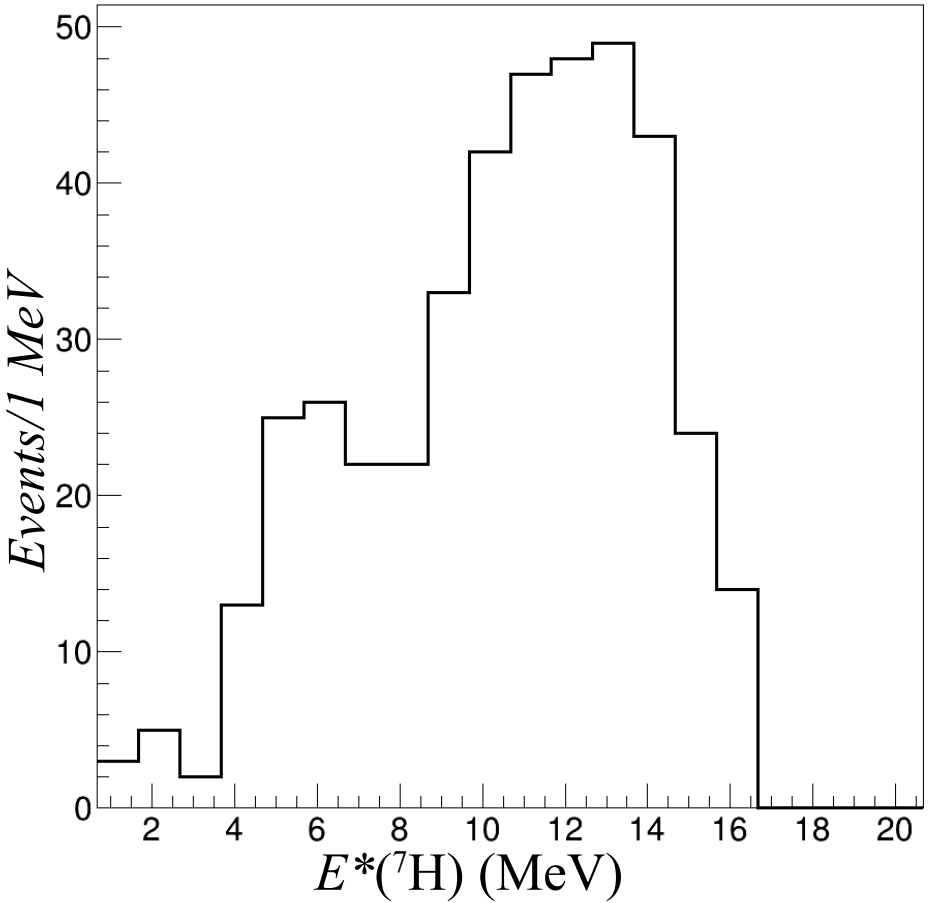
Muzalevskii Ivan
for ACCULINNA-2 collaboration

Exotic nuclei studies

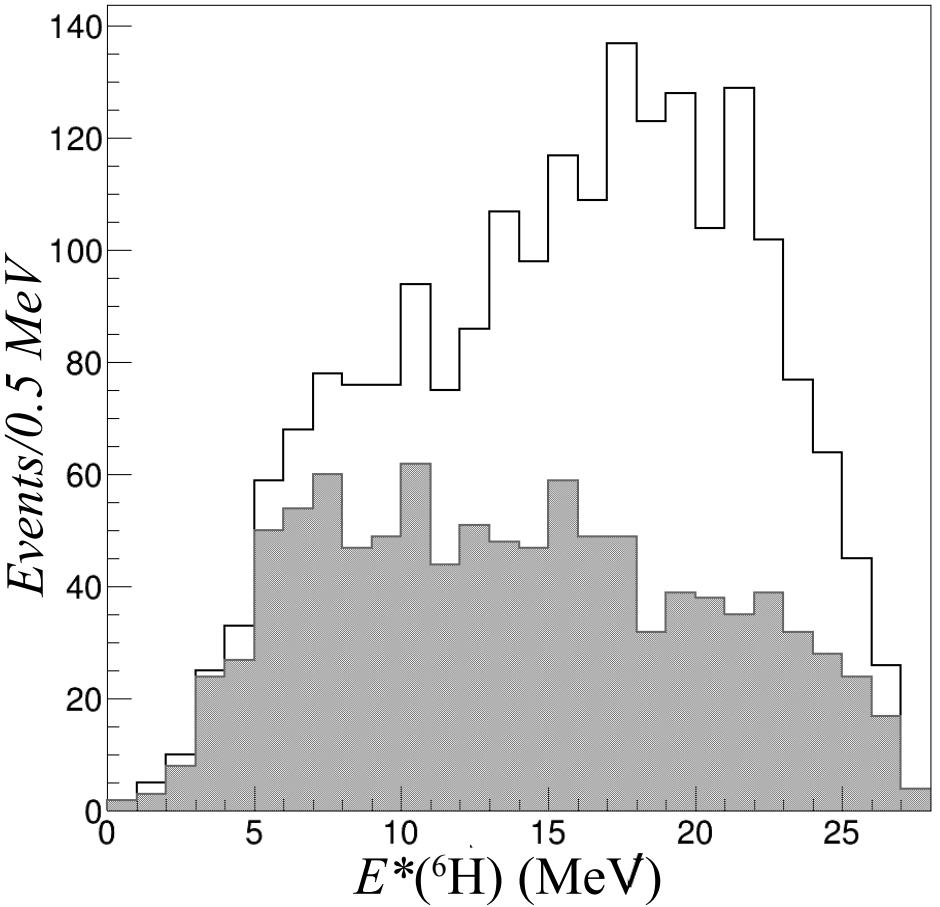
- Search for new short-lived nuclear systems
- Methodological and technical challenge
  - Radioactive beams; low intensity
  - Low reaction cross section
  - Reaction channel identification
  - Complex background conditions

Problem

^{7}H spectrum

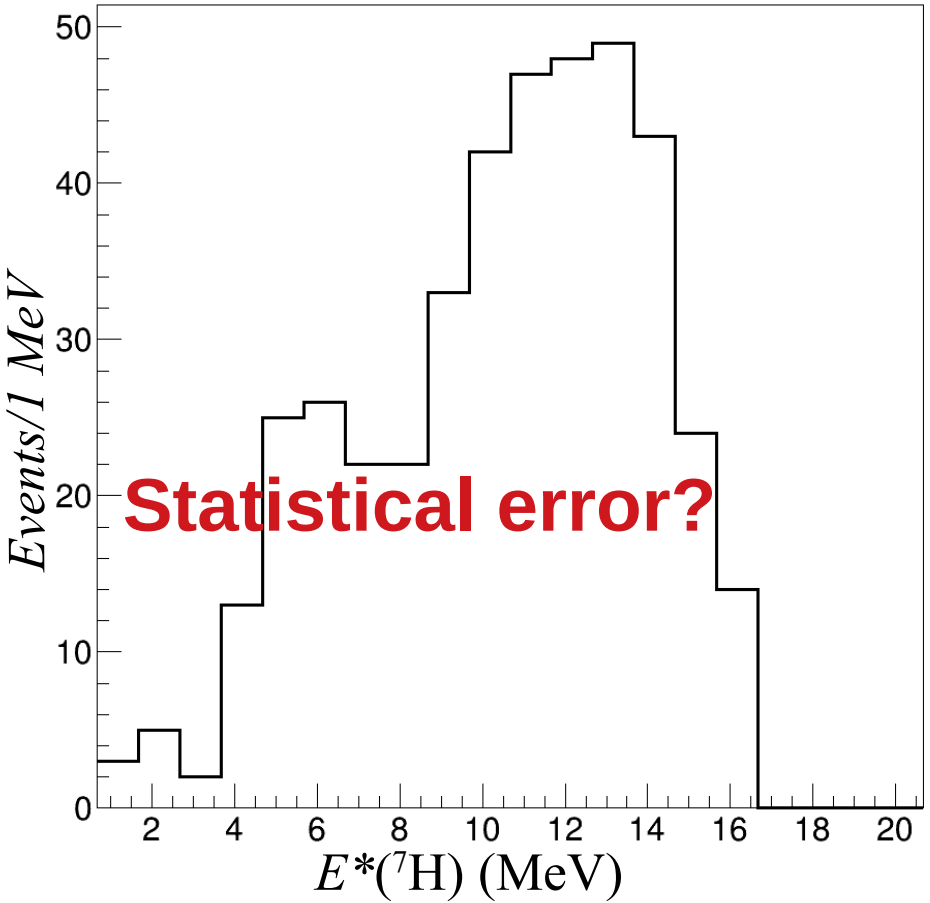


^{6}H spectrum

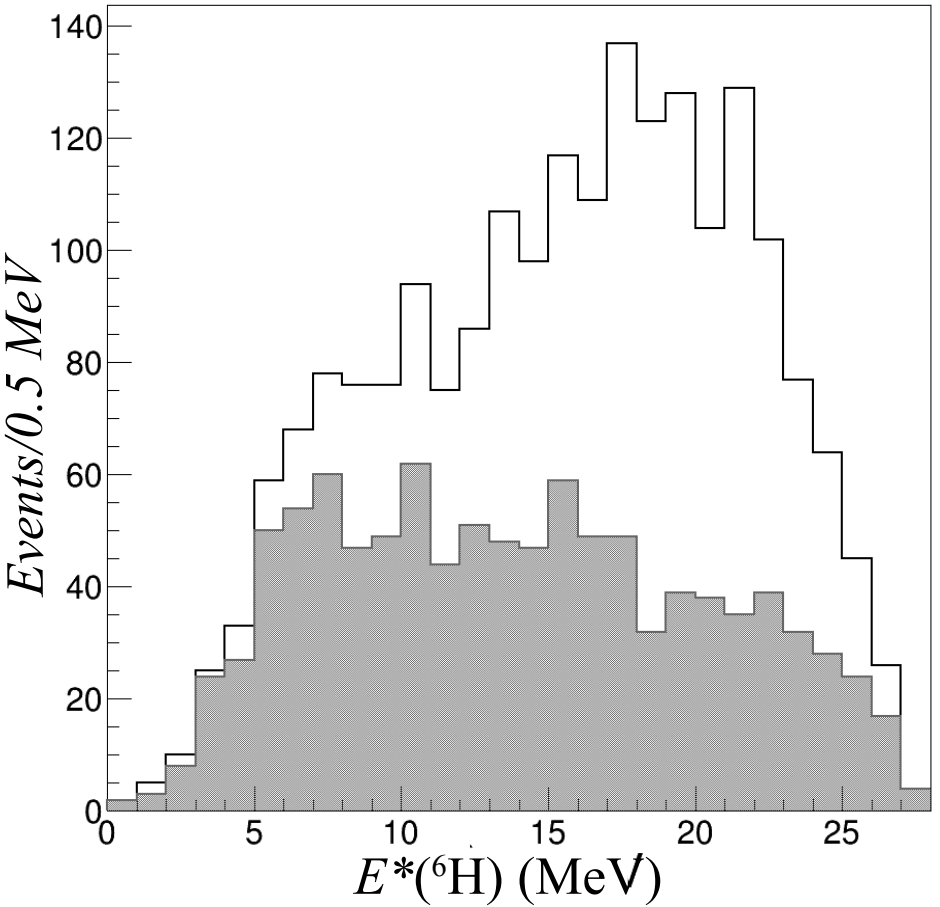


Problem

^{7}H spectrum

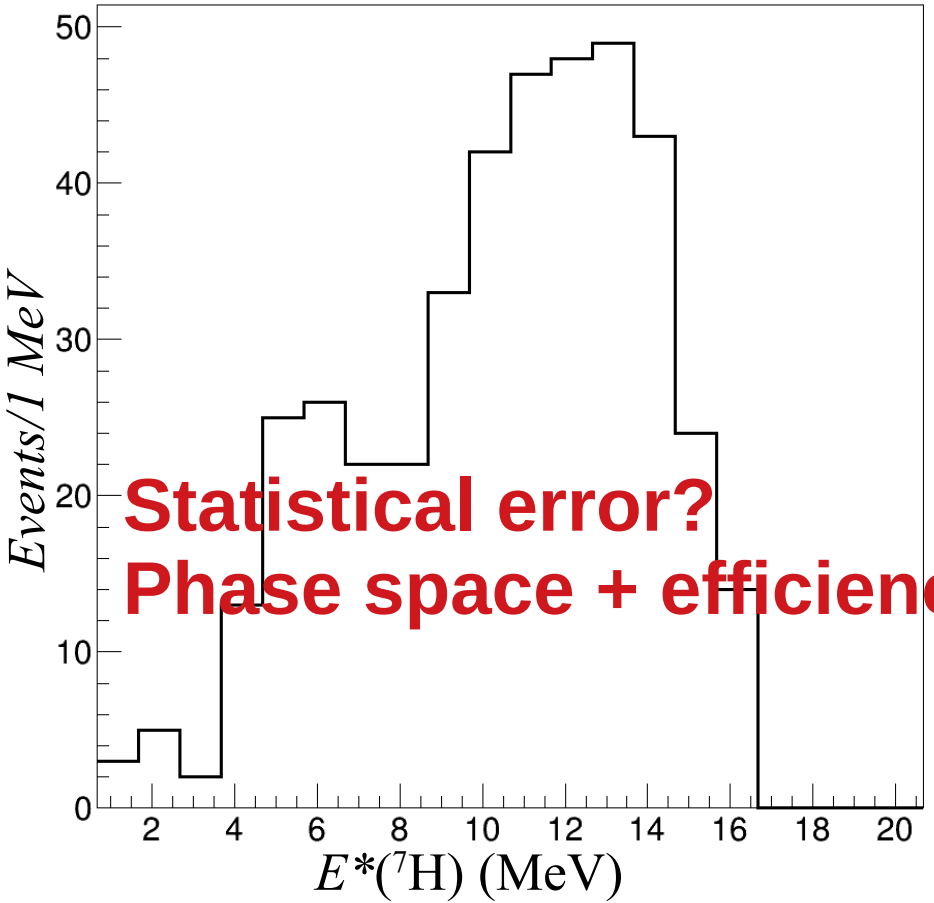


^{6}H spectrum



Problem

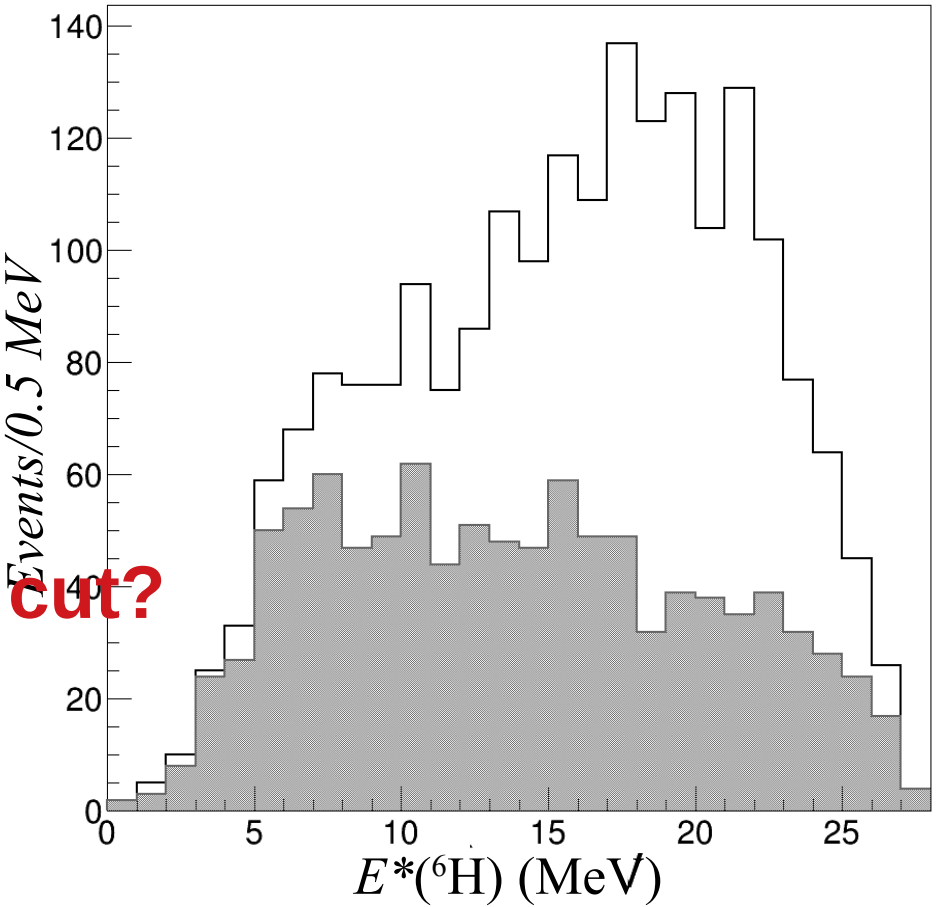
^{7}H spectrum



Statistical error?

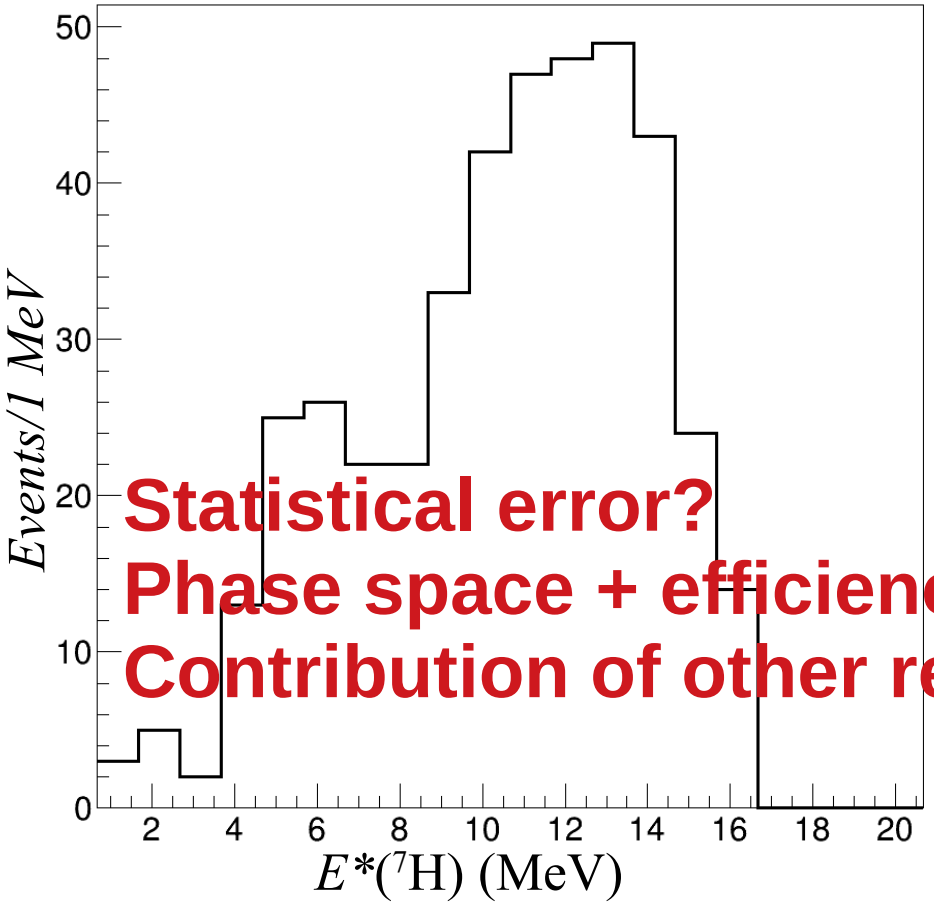
Phase space + efficiency cut?

^{6}H spectrum

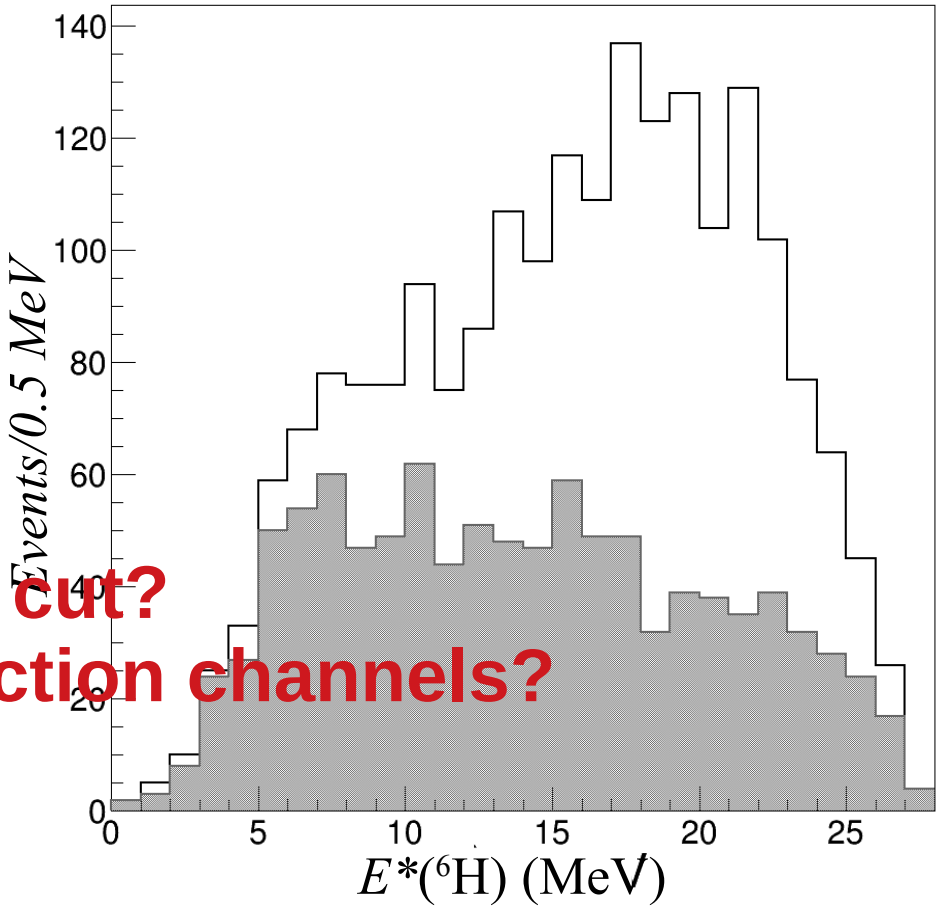


Problem

^{7}H spectrum



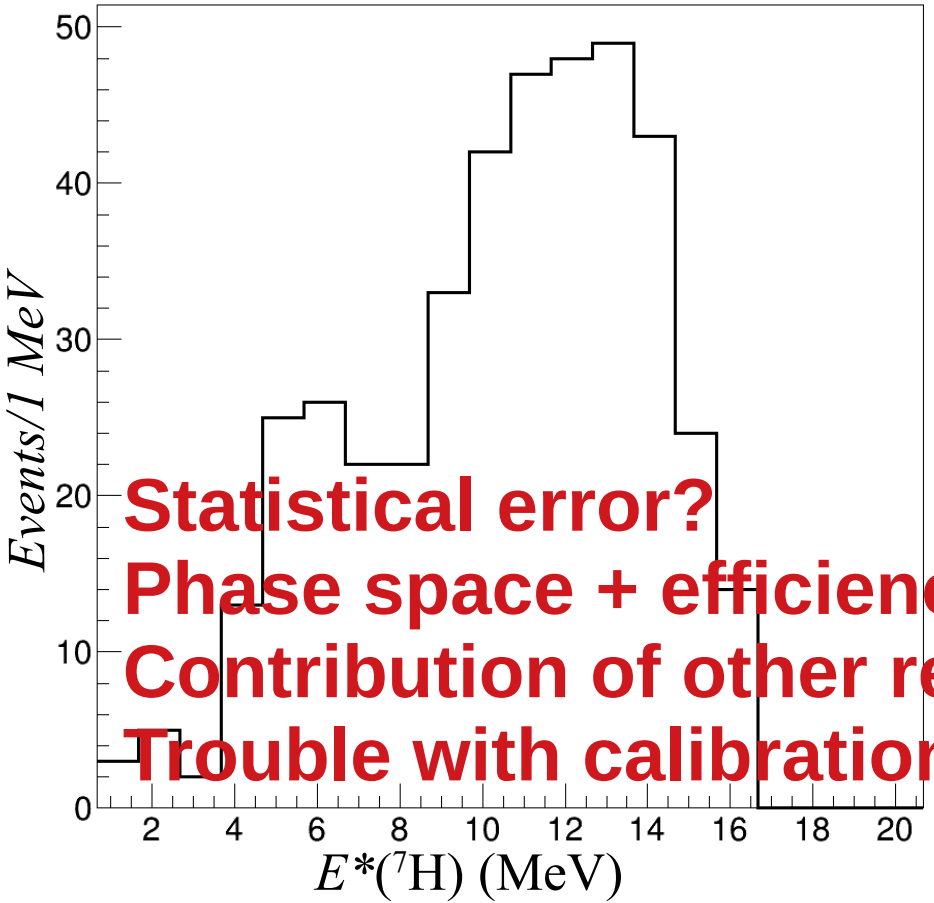
^{6}H spectrum



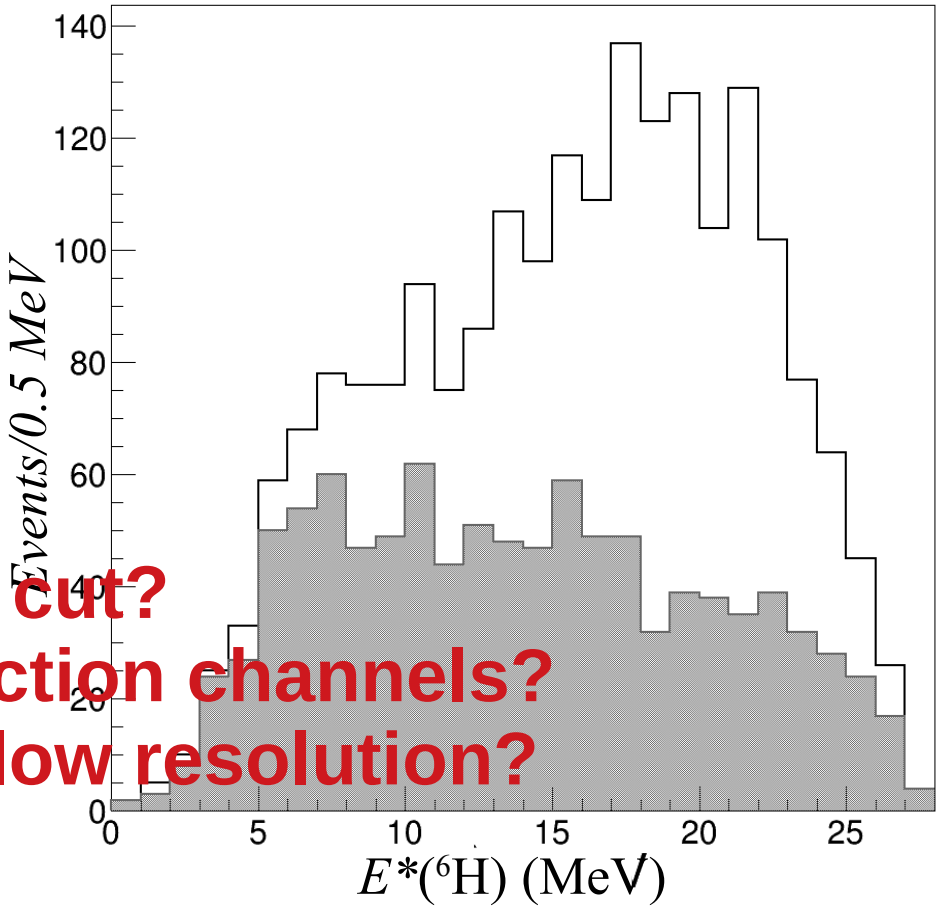
Statistical error?
Phase space + efficiency cut?
Contribution of other reaction channels?

Problem

^{7}H spectrum



^{6}H spectrum



Statistical error?
Phase space + efficiency cut?
Contribution of other reaction channels?
Trouble with calibration, low resolution?

Fresh achievements of ACCULINNA group

^{6,7}H - problems of the last 40 years solved

^{7}H population in ^{2}H(^{8}He,^{3}He)^{7}H reaction

[I. A. Muzalevskii, et al., "Resonant states in ^{7}H: Experimental studies of the ^{2}H(^{8}He,^{3}He) reaction", Phys. Rev. C 103, 044313 (2021)]

[A.A. Bezbakh, et al., "Evidence for the First Excited State of ^{7}H", Phys. Rev. Lett. 124, 022502 (2020)]

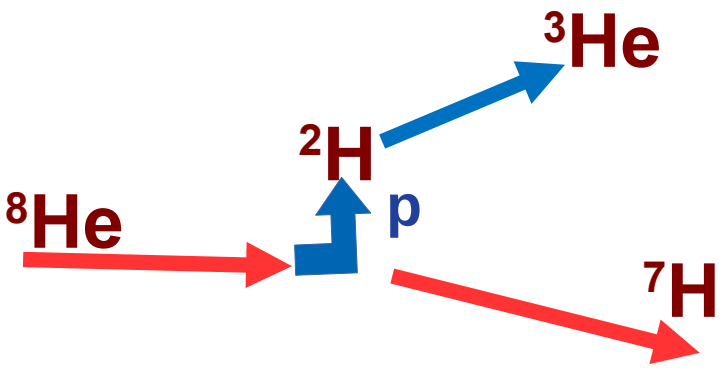
^{6}H population in ^{2}H(^{8}He,^{4}He)^{6}H reaction

[E. Y. Nikolskii, et al., "The ^{6}H states studied in the d(^{8}He,α) reaction and evidence of extremely correlated character of the ^{5}H ground state", accepted to Phys. Rev. C (2022)]

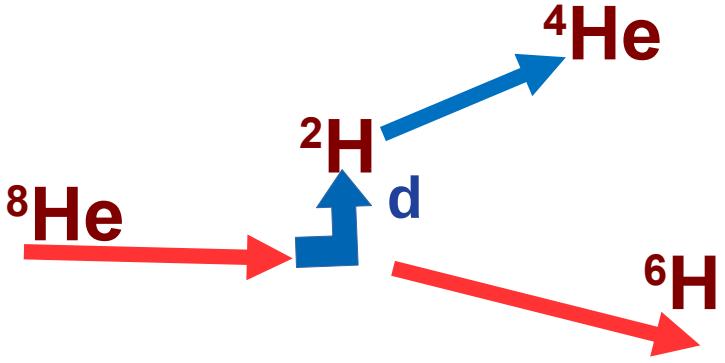
Reference measurements

Main run; missing-mass method

Proton transfer



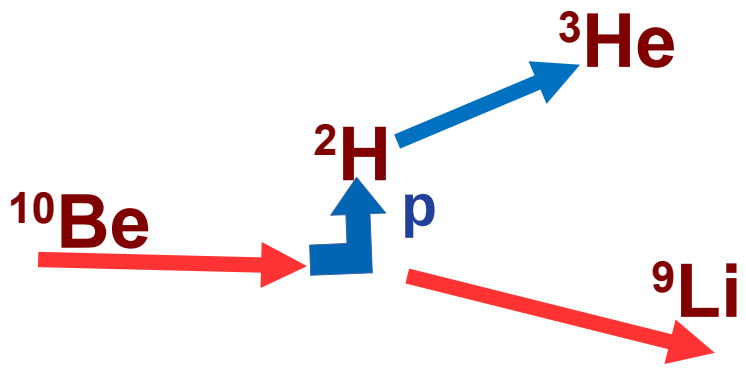
Deutron transfer



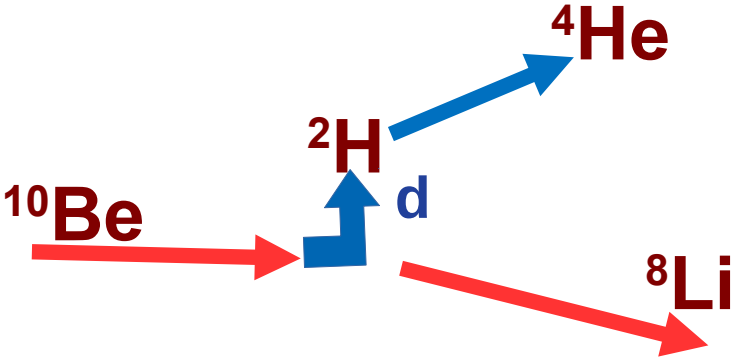
Reference measurements

Reference run; missing-mass method

Proton transfer



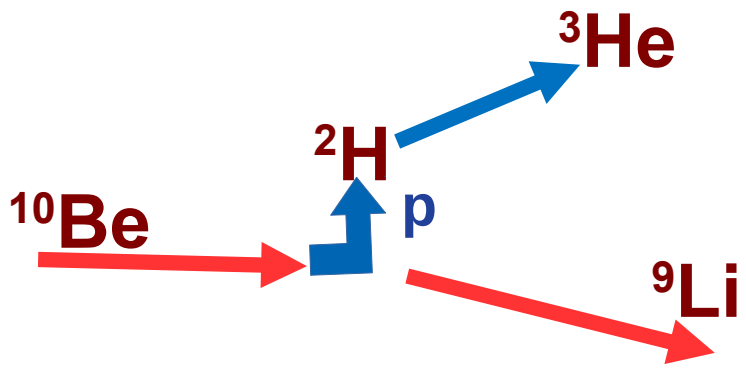
Deutron transfer



Reference measurements

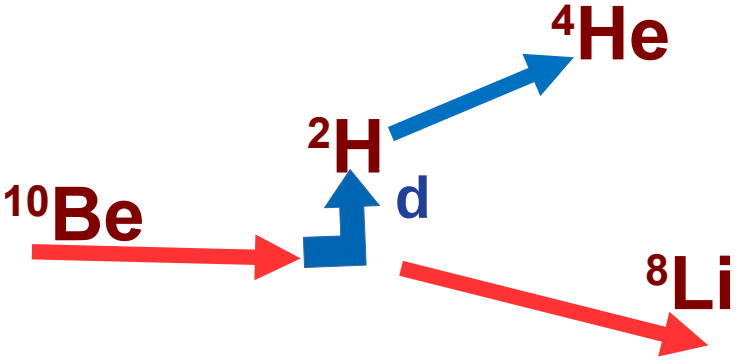
Reference run; missing-mass method

Proton transfer

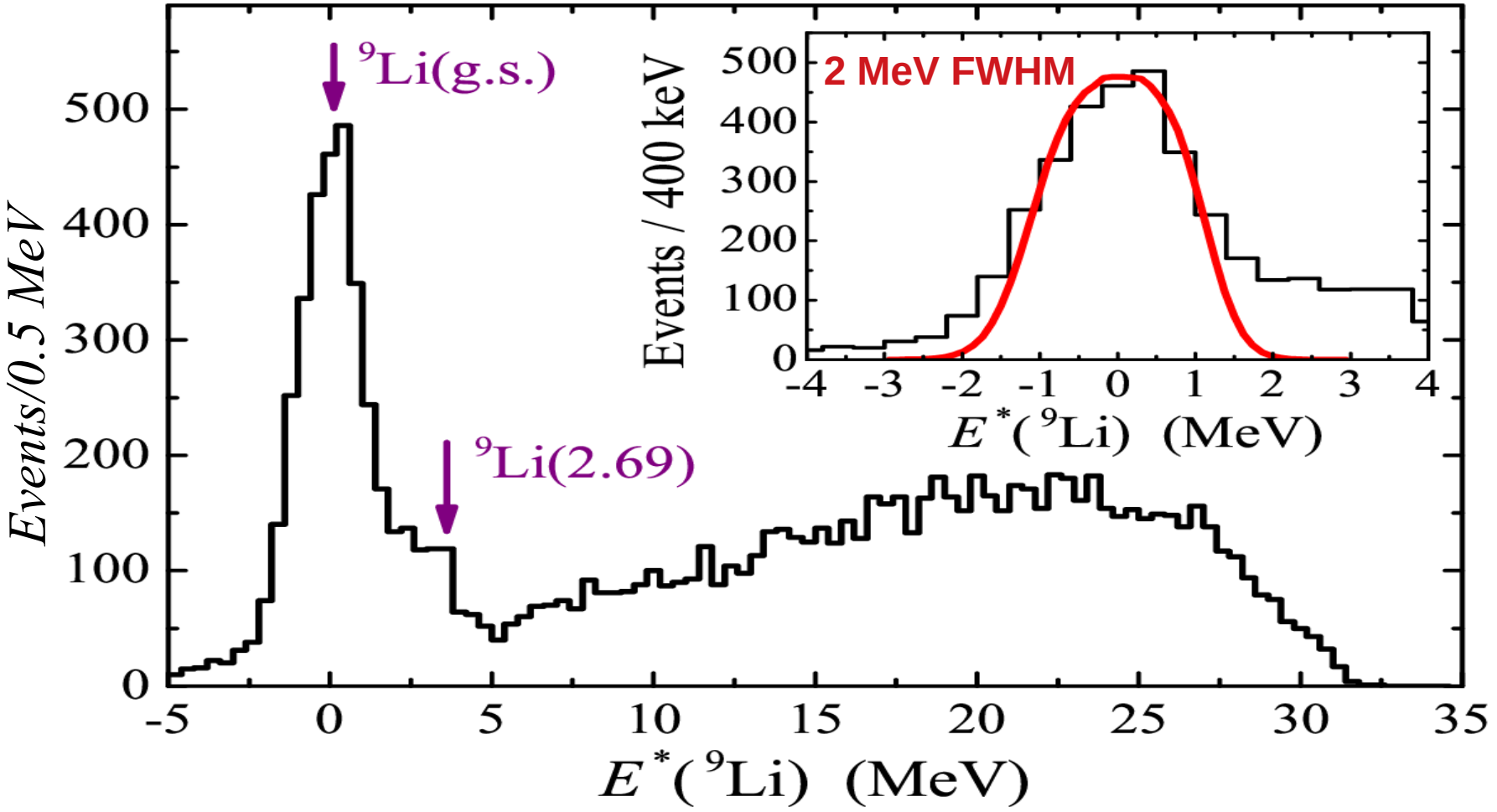


- Stable long-lived reaction products
- Registration of all reaction products

Deutron transfer

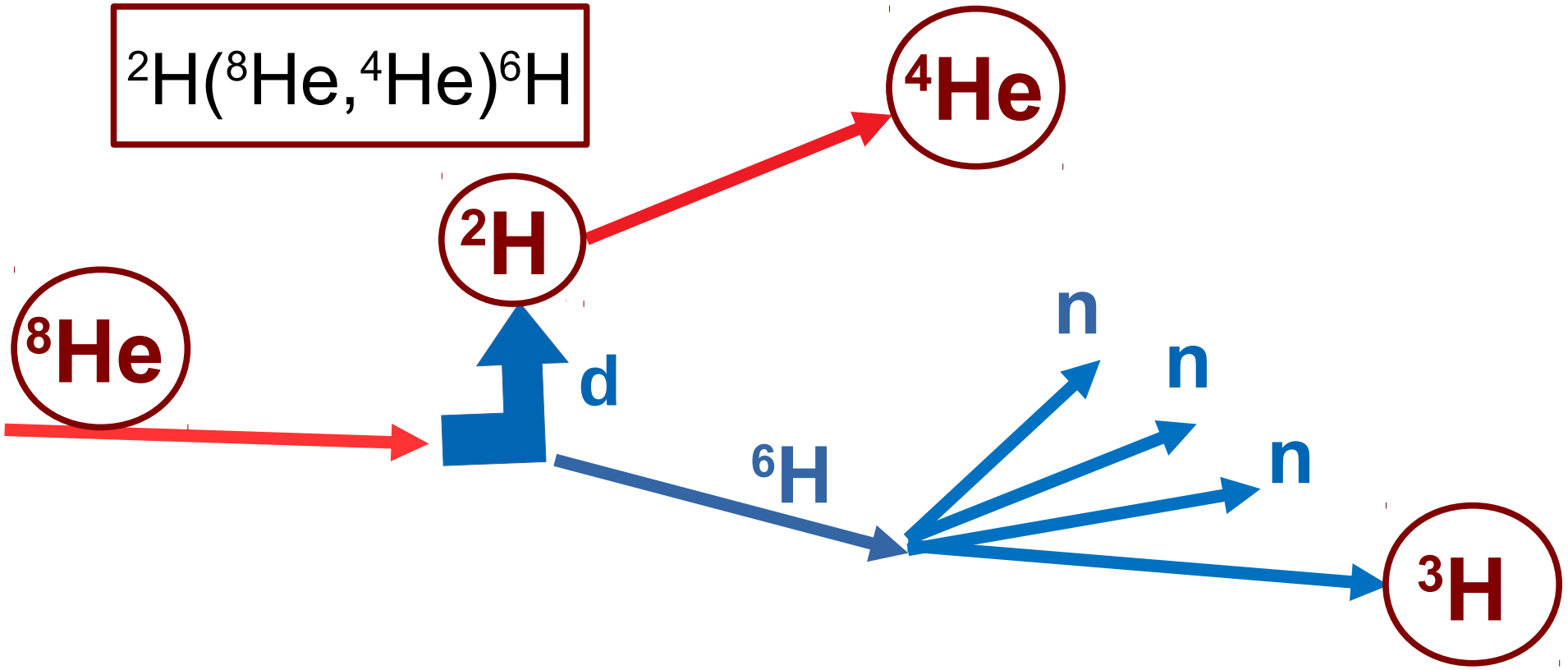


- Well-known structure
- High cross section; high statistics

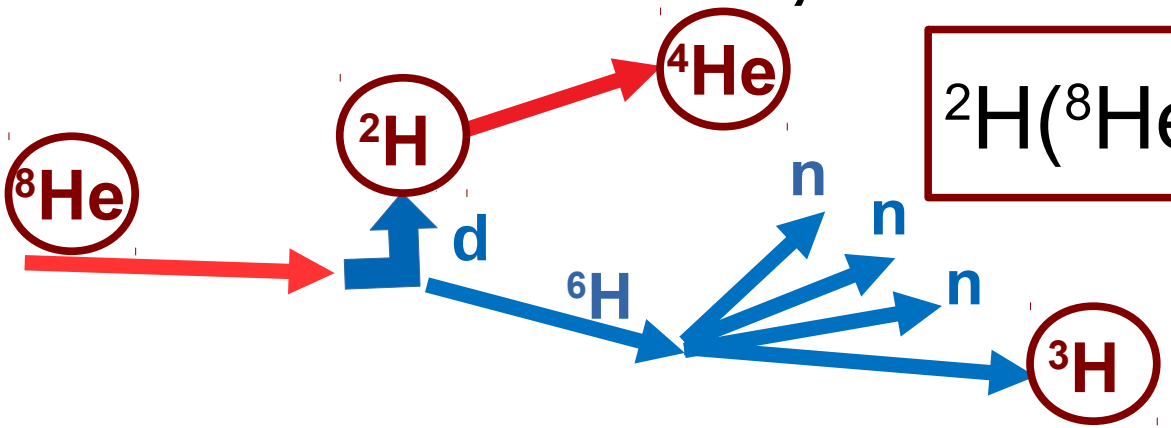


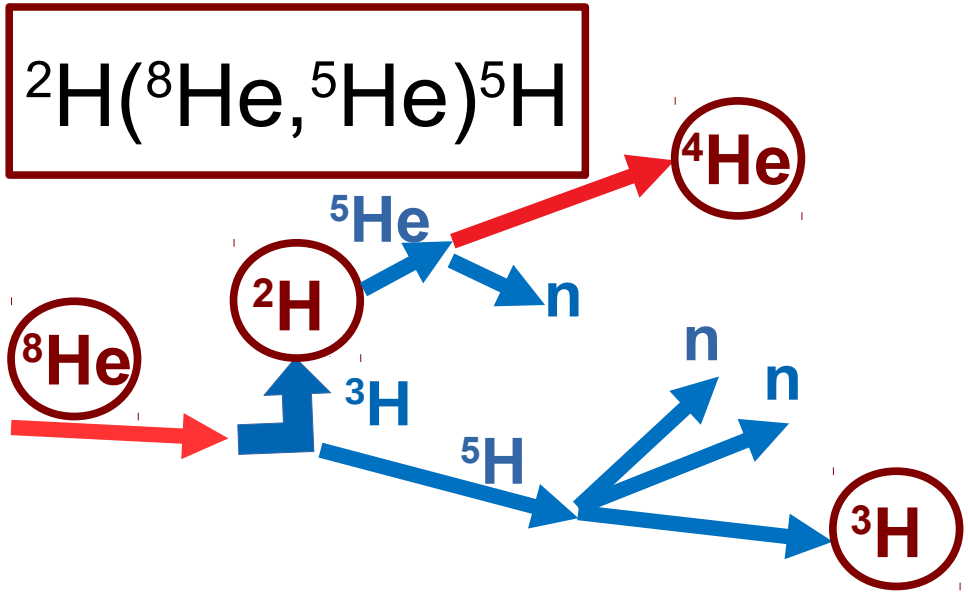
- Calibration of all detectors
- Estimation of the MM resolution
- Test of the experimental methodics
- **Verification of the main run results**

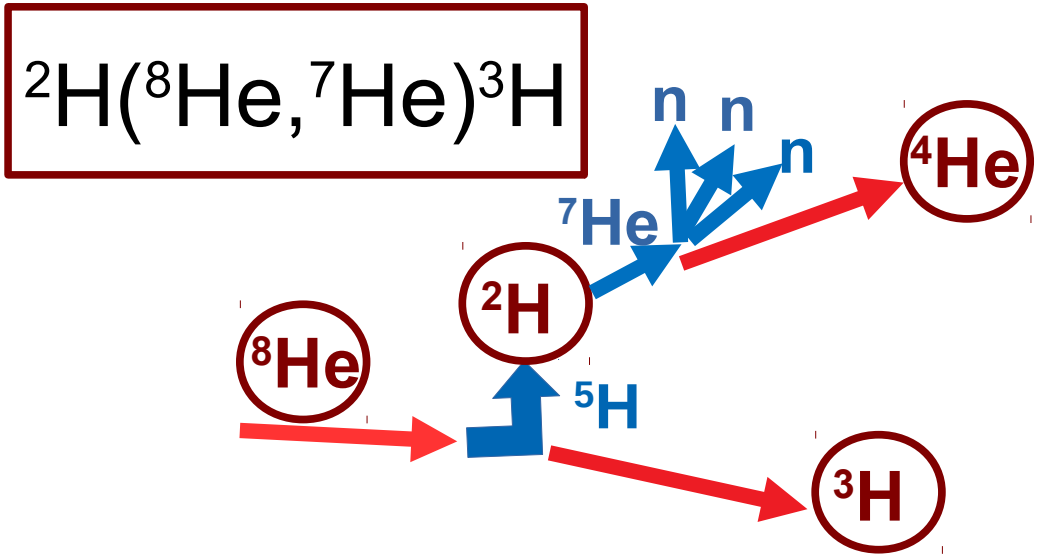
Correlations channels; ^{6}H example



Correlations channels; ^{6}H example

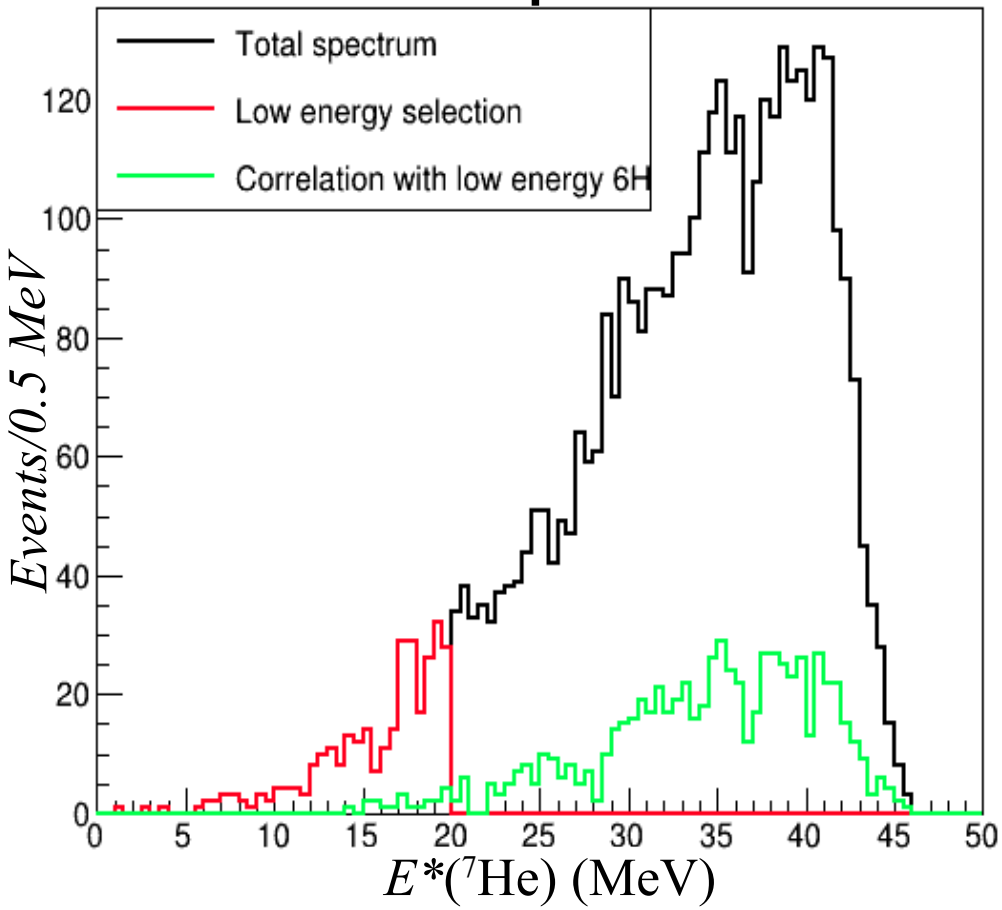




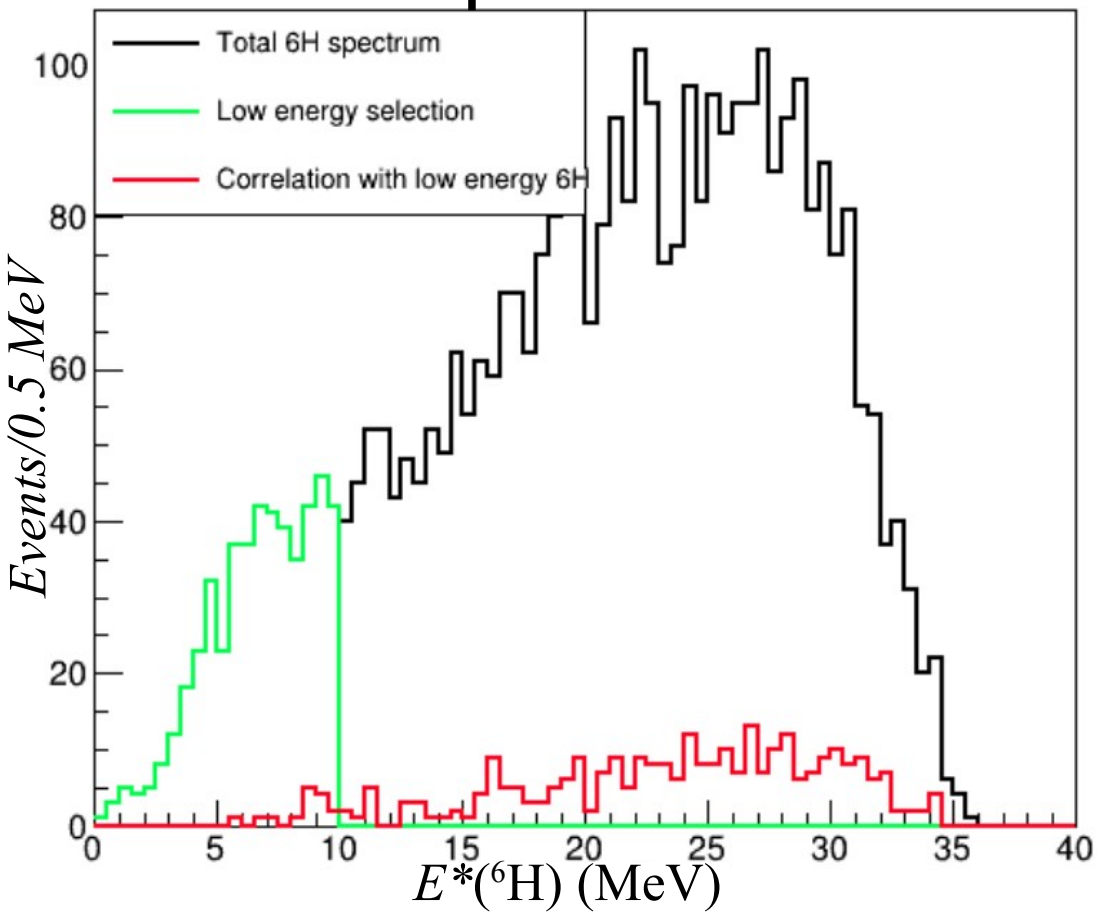


$^{2}H(^{8}He,^{7}He)^{3}H$ correlation with $^{2}H(^{8}He,^{4}He)^{6}H$

^{7}He spectrum

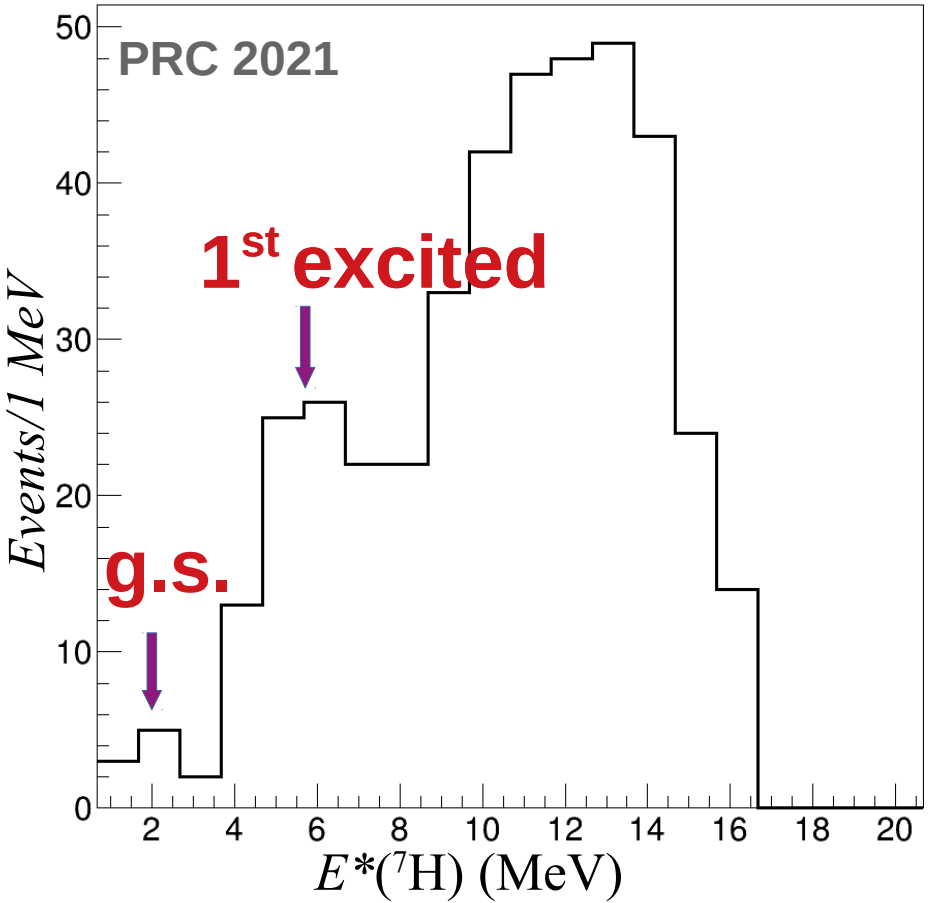


^{6}H spectrum

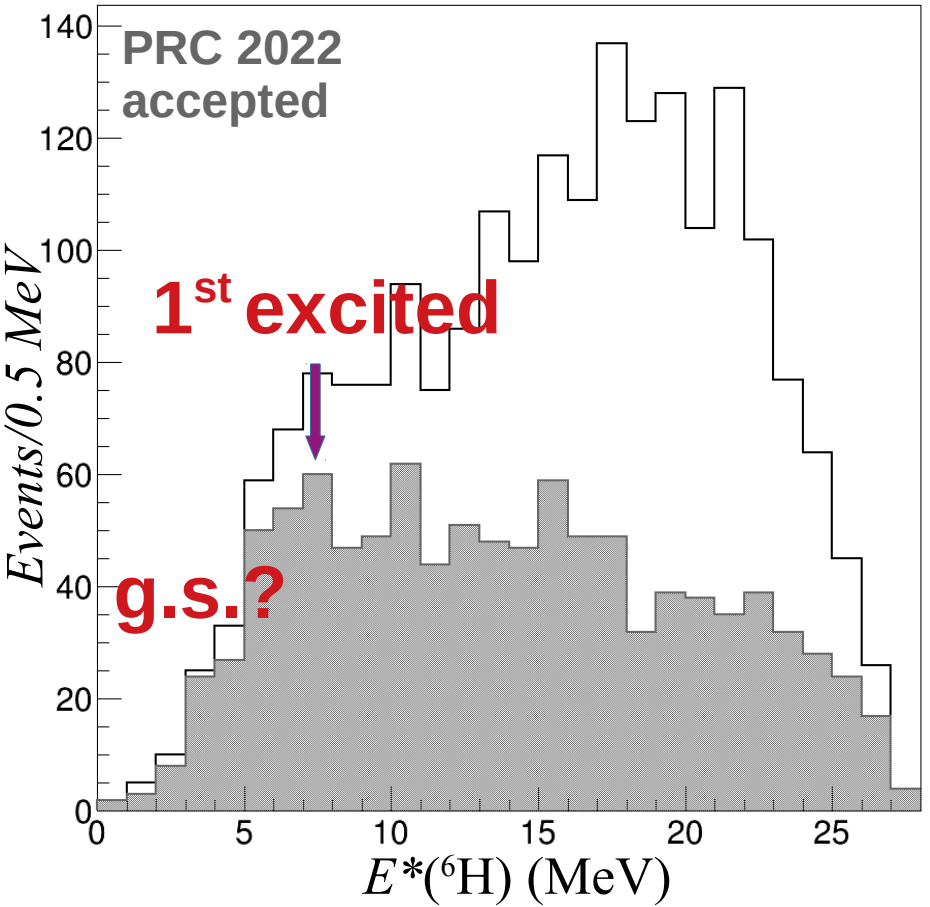


Fresh achievements of ACCULINNA group

^{7}H spectrum



^{6}H spectrum



PHYSICAL REVIEW LETTERS **124,** 022502 (2020)

Thanks for attention

Evidence for the First Excited State of ^{7}H

A. A. Bezbakh,[1,2] V. Chudoba,[1,2,*] S. A. Krupko,[1,3] S. G. Belogurov,[1,4] D. Biare,[1] A. S. Fomichev,[1,5] E. M. Gazeeva,[1] A. V. Gorshkov,[1] L. V. Grigorenko,[1,4,6] G. Kaminski,[1,7] O. A. Kiselev,[8] D. A. Kostyleva,[8,9] M. Yu. Kozlov,[10] B. Mauyey,[1,11] I. Mukha,[8] I. A. Muzalevskii,[1,2] E. Yu. Nikolskii,[6,1] Yu. L. Parfenova,[1] W. Piatek,[1,7] A. M. Quynh,[1,12] V. N. Schetinin,[10] A. Serikov,[1] S. I. Sidorchuk,[1] P. G. Sharov,[1,2] R. S. Slepnev,[1] S. V. Stepantsov,[1] A. Swiercz,[1,13] P. Szymkiewicz,[1,13] G. M. Ter-Akopian,[1,5] R. Wolski,[1,14] B. Zalewski,[1,7] and M. V. Zhukov[15]

PHYSICAL REVIEW C **103**, 044313 (2021)

Resonant states in ^{7}H: Experimental studies of the ^{2}H(^{8}He, ^{3}He) reaction

I. A. Muzalevskii,[1,2,*] A. A. Bezbakh,[1,2] E. Yu. Nikolskii,[3,1] V. Chudoba,[1,2] S. A. Krupko,[1] S. G. Belogurov,[1,4] D. Biare,[1] A. S. Fomichev,[1,5] E. M. Gazeeva,[1] A. V. Gorshkov,[1] L. V. Grigorenko,[1,4,3] G. Kaminski,[1,6] O. Kiselev,[7] D. A. Kostyleva,[7,8] M. Yu. Kozlov,[9] B. Mauyey,[1,10] I. Mukha,[7] Yu. L. Parfenova,[1] W. Piatek,[1,6] A. M. Quynh,[1,11] V. N. Schetinin,[9] A. Serikov,[1] S. I. Sidorchuk,[1] P. G. Sharov,[1,2] N. B. Shulgina,[3,12] R. S. Slepnev,[1] S. V. Stepantsov,[1] A. Swiercz,[1,13] P. Szymkiewicz,[1,13] G. M. Ter-Akopian,[1,5] R. Wolski,[1,14] B. Zalewski,[1,6] and M. V. Zhukov[15]

The ^{6}H states studied in the $d(^{8}\mathrm{He},\alpha)$ reaction and evidence of extremely correlated character of the ^{5}H ground state

Accepted to Phys. Rev. C

E.Yu. Nikolskii,[1,2,*] I.A. Muzalevskii,[2,3] A.A. Bezbakh,[2,3] V. Chudoba,[2,3] S.A. Krupko,[2] S.G. Belogurov,[2,4] D. Biare,[2] A.S. Fomichev,[2,5] E.M. Gazeeva,[2] A.V. Gorshkov,[2] L.V. Grigorenko,[2,4,1] G. Kaminski,[2,6] O. Kiselev,[7] D.A. Kostyleva,[7,8] M.Yu. Kozlov,[9] B. Mauyey,[2,10] I. Mukha,[7] Yu.L. Parfenova,[2] W. Piatek,[2,6] A.M. Quynh,[2,11] V.N. Schetinin,[9] A. Serikov,[2] S.I. Sidorchuk,[2] P.G. Sharov,[2,3] N.B. Shulgina,[1,12] R.S. Slepnev,[2] S.V. Stepantsov,[2] A. Swiercz,[2,13] P. Szymkiewicz,[2,13] G.M. Ter-Akopian,[2,5] R. Wolski,[2,14] B. Zalewski,[2,6] and M.V. Zhukov[15]