^{55}Mn中子俘获截面测量

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实验回顾

Isotope	Det	Ref.
^{165}Ho	GTAF	Eur. Phys. J. A 2026, 62, 49.
^{159}Tb	GTAF	Acta Phys. Sin., 2026, 75(12): 120101.
^{165}Ho	C_6D_6	Nucl. Sci. Tech., 2025, 36(9): 168
^{139}La	C_6D_6	Nucl. Sci. Tech., 2025, 36(10): 179
^{147,149}Sm	C_6D_6	Nucl. Sci. Tech., 2025, 36(10): 178
^{168}Yb	C_6D_6	Phys. Rev. C, 2025, 111(5): 054607
^{159}Tb	C_6D_6	Nucl. Sci. Tech., 2025, 36(3): 43
^{91}Zr	C_6D_6	Phys. Rev. C, 2024, 110(2): 025802
^{nat}Re	C_6D_6	Phys. Rev. Res., 2024, 6(1): 013225
^{197}Au	GTAF	Acta Phys. Sin., 2024, 73(7): 072801
^{181}Ta	C_6D_6	Sci. Rep., 2023, 13(1): 12657
^{141}Pr	C_6D_6	Phys. Rev. C, 2023, 108(3): 035802
^{159}Tb	C_6D_6	Phys. Rev. C, 2023, 107(4): 045809
^{232}Th	C_6D_6	Eur. Phys. J. A, 2023, 59(10): 224

Isotope	Det	Ref.
^{nat}Se	C_6D_6	Chin. Phys. B, 2022, 31(8): 080101
^{nat}Eu	C_6D_6	Eur. Phys. J. A, 2022, 58(12): 251
^{162}Er	C_6D_6	Phys. Rev. C, 2022, 106(6): 065804
^{107}Ag	C_6D_6	Chin. Phys. B, 2022, 31(3): 038204
^{169}Tm	C_6D_6	Chin. Phys. C, 2022, 46(4): 044002
^{nat}Lu	C_6D_6	Acta Phys. Sin., 2022, 71(7): 072901
^{232}Th	C_6D_6	Chin. Phys. B, 2022, 31(6): 060101
^{nat}Er	C_6D_6	Phys. Rev. C, 2021, 104(5): 054302
^{232}Th	C_6D_6	Nucl. Instrum. Methods Phys. Res. A, 2021, 1013: 165677
^{197}Au	C_6D_6	Nucl. Tech., 2020, 43(8): 80501
^{nat}Re	C_6D_6	Atom. Energy Sci. Technol., 2024, 58(11): 2262–2268
^{232}Th	C_6D_6	EPJ Web Conf., 2020, 239: 06002
…	…	…

实验回顾

Eur. Phys. J. Plus (2016) **131**: 371
DOI 10.1140/epjp/i2016-16371-4

THE EUROPEAN PHYSICAL JOURNAL PLUS

Review

Nuclear data activities at the n_TOF facility at CERN*

Table 1. The measurements performed at n_TOF during phase-I from 2001–2004.

Nucleus	Reaction	Detector	ref.	Nucleus	Reaction	Detector	ref.
^{24}Mg	(n,γ)	C_6D_6	[46]	^{209}Bi	(n,γ)	C_6D_6	[65]
^{26}Mg	(n,γ)	C_6D_6	[46]	^{209}Bi	(n,f)	PPAC	[64]
^{90}Zr	(n,γ)	C_6D_6	[47]	^{232}Th	(n,γ)	C_6D_6	[66, 67]
^{91}Zr	(n,γ)	C_6D_6	[48]	^{233}U	(n,γ)	TAC	
^{92}Zr	(n,γ)	C_6D_6	[49]	^{233}U	(n,f)	FIC	[68, 69]
^{94}Zr	(n,γ)	C_6D_6	[50]	^{234}U	(n,γ)	TAC	
^{96}Zr	(n,γ)	C_6D_6	[51]	^{234}U	(n,f)	FIC	[70]
^{129}La	(n,γ)	C_6D_6	[52]	^{234}U	(n,f)	PPAC	[71, 72]
^{151}Sm	(n,γ)	C_6D_6	[53–55]	^{236}U	(n,f)	FIC	[73]
^{186}Os	(n,γ)	C_6D_6	[56, 57]	^{238}U	(n,f)	FIC/PPAC	[74, 75]
^{187}Os	(n,γ)	C_6D_6	[56, 57]	^{237}Np	(n,γ)	TAC	[76]
^{188}Os	(n,γ)	C_6D_6	[56, 57]	^{237}Np	(n,f)	FIC	[77]
^{197}Au	(n,γ)	C_6D_6/TAC	[58, 59]	^{237}Np	(n,f)	PPAC	[71]
^{204}Pb	(n,γ)	C_6D_6	[60]	^{240}Pu	(n,γ)	TAC	
^{206}Pb	(n,γ)	C_6D_6	[61, 62]	^{241}Am	(n,f)	FIC	[78]
^{207}Pb	(n,γ)	C_6D_6	[63]	^{243}Am	(n,γ)	TAC	[79]
^{208}Pb	(n,γ)	C_6D_6		^{243}Am	(n,f)	FIC	[80]
^{nat}Pb	(n,f)	PPAC	[64]	^{245}Cm	(n,f)	FIC	[81]

Table 2. The measurements performed at n_TOF during phase-II from 2009–2012.

Nucleus	Reaction	Detector	ref.	Nucleus	Reaction	Detector	ref.
^{12}C	(n,p) activation	C_6D_6	[90, 91]	^{232}Th	(n,f) FFAD	PPAC	[89, 102]
^{25}Mg	(n,γ)	C_6D_6	[92, 93]	^{234}U	(n,f) FFAD	PPAC	[72]
^{33}S	(n,α)	MGAS	[94]	^{235}U	(n,f) FFAD	PPAC	[103]
^{54}Fe	(n,γ)	C_6D_6	[95]	^{235}U	$(n,\gamma)/(n,f)$	TAC/MGAS	[87]
^{56}Fe	(n,γ)	C_6D_6		^{235}U	(n,f)	PPAC	[104]
^{57}Fe	(n,γ)	C_6D_6	[95]	^{236}U	(n,γ)	C_6D_6	[105]
^{58}Ni	(n,γ)	C_6D_6	[96]	^{238}U	(n,f) FFAD	PPAC	[103]
^{59}Ni	(n,α)	CVD	[97]	^{238}U	(n,γ)	C_6D_6	[106]
^{62}Ni	(n,γ)	C_6D_6	[98]	^{238}U	(n,γ)	TAC	[107]
^{63}Ni	(n,γ)	C_6D_6	[99]	^{242}Pu	(n,f)	MGAS	[108]
^{87}Sr	(n,γ) spin	TAC	[100]	^{241}Am	(n,γ)	C_6D_6	[109]
^{92}Zr	(n,γ)	C_6D_6		^{241}Am	(n,γ)	TAC	[110]
^{93}Zr	(n,γ)	C_6D_6	[101]				

Table 3. The nuclear data measurements performed at n_TOF during phase-III in 2014 and 2015 for both EAR1 and EAR2.

Nucleus	Reaction	Detector	EAR	ref.
^{7}Be	(n,α)	SILI	EAR2	[115, 129]
^{33}S	(n,α)	MGAS	EAR2	
^{70}Ge	(n,γ)	C_6D_6	EAR1	
^{73}Ge	(n,γ)	C_6D_6	EAR1	
^{74}Ge	(n,γ)	C_6D_6	EAR1	
^{76}Ge	(n,γ)	C_6D_6	EAR1	
^{147}Pm	(n,γ)	C_6D_6	EAR2	
^{171}Tm	(n,γ)	C_6D_6	EAR1, EAR2	
^{204}Tl	(n,γ)	C_6D_6	EAR1	
^{235}U	(n,f)FF	STEFF	EAR2	
^{237}Np	(n,f)	PPAC	EAR1	
^{240}Pu	(n,f)	MGAS	EAR2	[116]
^{242}Pu	(n,γ)	C_6D_6	EAR1	[117]

实验回顾

universe

Universe **2025**, *11*, 329

MDPI

Article

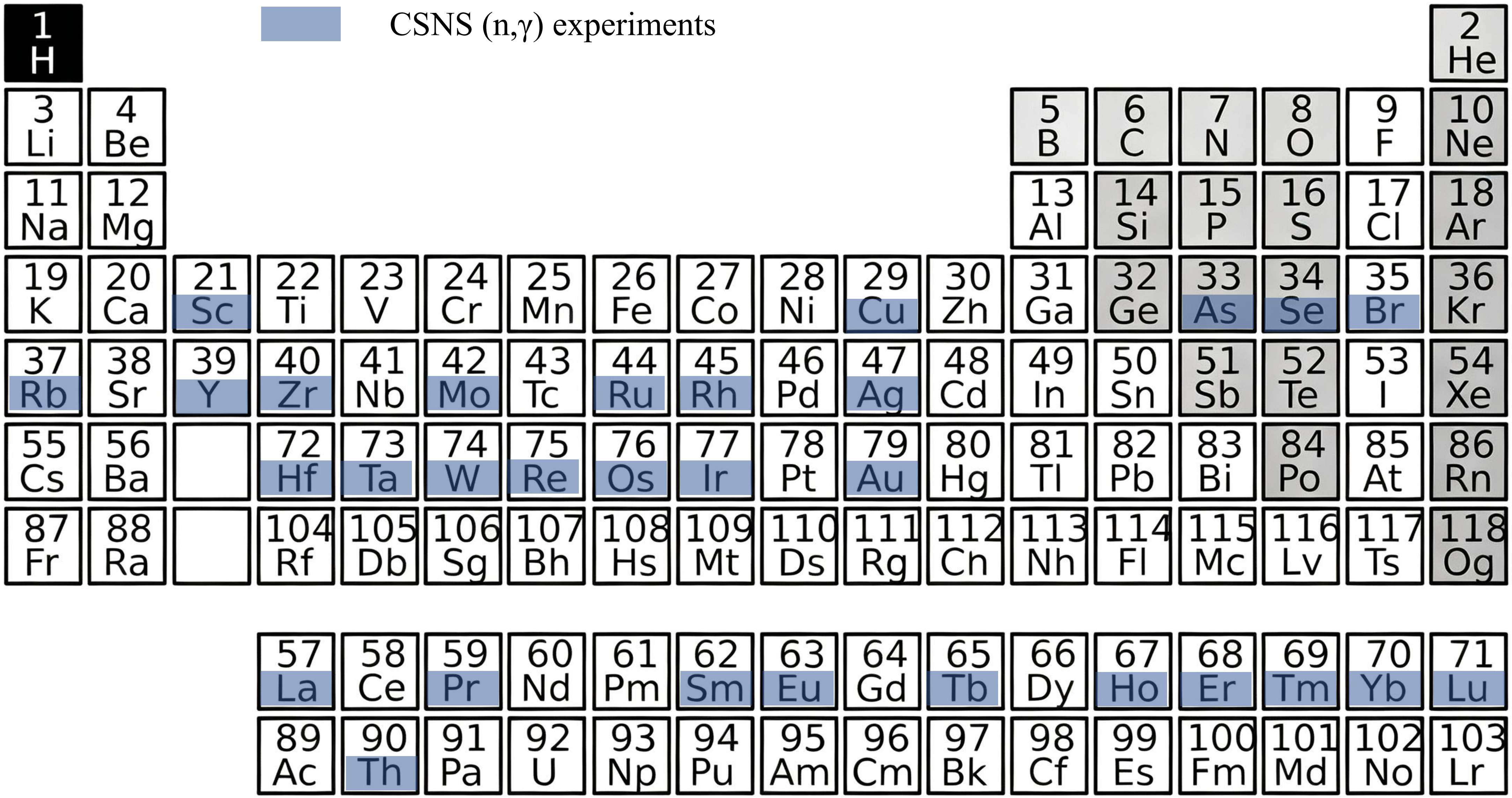
The Nuclear Astrophysics Program at the CERN n_TOF Facility: Results and Perspectives

P. M. Milazzo [1,2,*], C. Lederer-Woods [3] and A. Mengoni [2,4,†] on behalf of The n_TOF Collaboration

Table 1. List of isotopes relevant for nuclear astrophysics for which (n, γ) measurements have been performed at n_TOF since its inception.

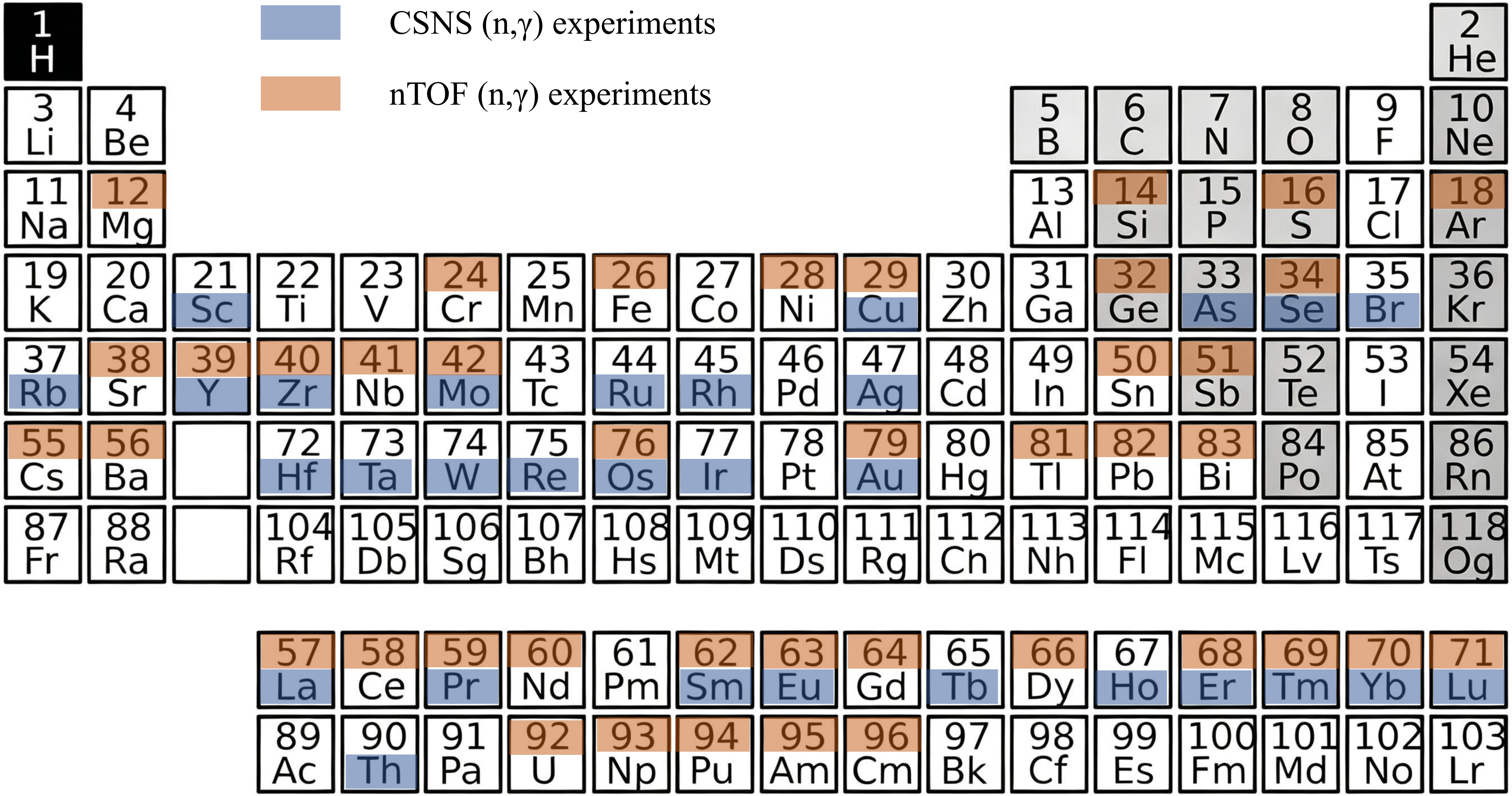
Isotope	Astrophysical Implications	Measured Energy Range	Detectors Used	Ref.
^{24}Mg	Impact on abundance of cosmic gamma ray emitter ^{26}Al	0–700 keV	C_6D_6	[23]
^{25}Mg	Constraints for the ^{22}Ne(α, n), neutron poison	0–550 keV	C_6D_6	[23]
^{26}Mg	Neutron poison	0–500 keV	C_6D_6	[23,24]
^{28}Si	Isotopic abundances in presolar grains, nucleosynthesis in massive stars	Under Analysis	C_6D_6, STED	[25]
^{29}Si	Isotopic abundances in presolar grains, nucleosynthesis in massive stars	Under Analysis	C_6D_6, STED	[25]
^{30}Si	Isotopic abundances in presolar grains, nucleosynthesis in massive stars	Under Analysis	C_6D_6, STED	[25]
^{40}Ar	Nucleosynthesis processes involving noble gases	Under Analysis	C_6D_6, STED	[26]
^{54}Fe	Seeds of the s-process nucleosynthesis path	0–400 keV	C_6D_6	[27]
^{57}Fe	Seeds of the s-process nucleosynthesis path	0–400 keV	C_6D_6	[27]
^{58}Ni	s-process nucleosynthesis in massive stars	0–400 keV	C_6D_6	[28]
^{62}Ni	s-process nucleosynthesis in massive stars	0–200 keV	C_6D_6	[29]
^{63}Ni	Branching point	0–270 keV	C_6D_6	[29,30]
^{64}Ni	s-process nucleosynthesis in massive stars	Under Analysis	C_6D_6	[31]
^{70}Ge	s-Only isotope, test for s-process nucleosynthesis	0–300 keV	C_6D_6	[32]
^{72}Ge	s-process nucleosynthesis in massive stars	0–300 keV	C_6D_6	[33]
^{73}Ge	s-process nucleosynthesis in massive stars	0–300 keV	C_6D_6	[34]
^{74}Ge	s-process nucleosynthesis in massive stars	0–70 keV	C_6D_6	[35]
^{76}Ge	s-process nucleosynthesis in massive stars	0–52 keV	C_6D_6	[36]
^{77}Se	s-process nucleosynthesis in massive stars	0–51 keV	C_6D_6	[37]
^{78}Se	s-process nucleosynthesis in massive stars	0–70 keV	C_6D_6	[38]
^{79}Se	Branching point	Under Analysis	STED	[39]
^{80}Se	s-process nucleosynthesis in massive stars	0–70 keV	C_6D_6	[40]
^{87}Sr	^{87}Rb/^{87}Sr cosmochronometer	Under Analysis	C_6D_6, STED	[41]
^{89}Y	Bottleneck around N = 50	0–95 keV	C_6D_6	[42]
^{90}Zr	Bottleneck at N = 50	0–70 keV	C_6D_6	[43]
^{91}Zr	Bottleneck at N = 50	0–26 keV	C_6D_6	[44]
^{92}Zr	Bottleneck at N = 50	0–81 keV	C_6D_6	[45,46]
^{93}Zr	Bottleneck at N = 50	0–8 keV	C_6D_6	[47]
^{94}Zr	Bottleneck at N = 50	0–60 keV	C_6D_6	[48]
^{96}Zr	Branching at ^{95}Zr	0–40 keV	C_6D_6	[49]
^{94}Nb	Branching point	Under Analysis	C_6D_6, STED	[50]
^{92}Mo	Disentangling s-, r-, p-process contributions to Mo isotopes	Under Analysis	C_6D_6, STED	[51]
^{94}Mo	Mo abundances in presolar grains	Under Analysis	C_6D_6, STED	[52]
^{95}Mo	s-process nucleosynthesis in AGB stars	Under Analysis	C_6D_6, STED	[52]
^{96}Mo	Disentangling s-, r-, p-process contributions to Mo isotopes	Under Analysis	C_6D_6, STED	[51]
^{97}Mo	Disentangling s-, r-, p-process contributions to Mo isotopes	Under Analysis	C_6D_6, STED	[51]
^{98}Mo	Disentangling s-, r-, p-process contributions to Mo isotopes	Under Analysis	C_6D_6, STED	[51]
^{100}Mo	Disentangling s-, r-, p-process contributions to Mo isotopes	Under Analysis	C_6D_6, STED	[51]
^{121}Sb	Constraints on the s-nucleosynthesis path	Under Analysis	C_6D_6	[53]
^{122}Sb	Constraints on the s-nucleosynthesis path	Under Analysis	C_6D_6	[53]
^{139}La	Bottleneck at N = 82	0–9 keV	C_6D_6	[54]
^{140}Ce	Bottleneck around N = 82	0–65 keV	C_6D_6	[55,56]
^{146}Nd	s-process nucleosynthesis in AGB stars	Under Analysis	STED	[57]
^{151}Sm	Branching point	0–1 MeV	C_6D_6	[58,59]
^{154}Gd	s-only isotope, test for s-process nucleosynthesis	0–300 keV	C_6D_6	[60]
^{160}Gd	s-process nucleosynthesis in AGB stars	Under Analysis	C_6D_6	[61]
^{164}Er	s-only isotope, test for s-process nucleosynthesis	Under Analysis	C_6D_6	[62]
^{171}Tm	Branching point	0–1 keV	C_6D_6	[63]
^{176}Yb	s-process nucleosynthesis in AGB stars	0–21 keV	C_6D_6	[64]
^{186}Os	^{187}Re/^{187}Os cosmochronometer	0–1 MeV	C_6D_6	[65,66]
^{187}Os	^{187}Re/^{187}Os cosmochronometer	0–1 MeV	C_6D_6	[65,66]
^{188}Os	^{187}Re/^{187}Os cosmochronometer	0–1 MeV	C_6D_6	[65,66]
^{197}Au	Standard (n, γ) cross section	0–400 keV	C_6D_6, TAC	[67,68]
^{204}Tl	Branching point	0–1 keV	C_6D_6	[69]
^{205}Tl	Part of branching point at A = 204	0–100 keV	C_6D_6	[70]
^{204}Pb	Termination of s-nucleosynthesis path	0–440 keV	C_6D_6	[71]
^{206}Pb	Termination of s-nucleosynthesis path	0–620 keV	C_6D_6	[72]
^{207}Pb	Termination of s-nucleosynthesis path	3–320 keV	C_6D_6	[73]
^{209}Bi	Termination of s-nucleosynthesis path	0–23 keV	C_6D_6	[74]

实验回顾

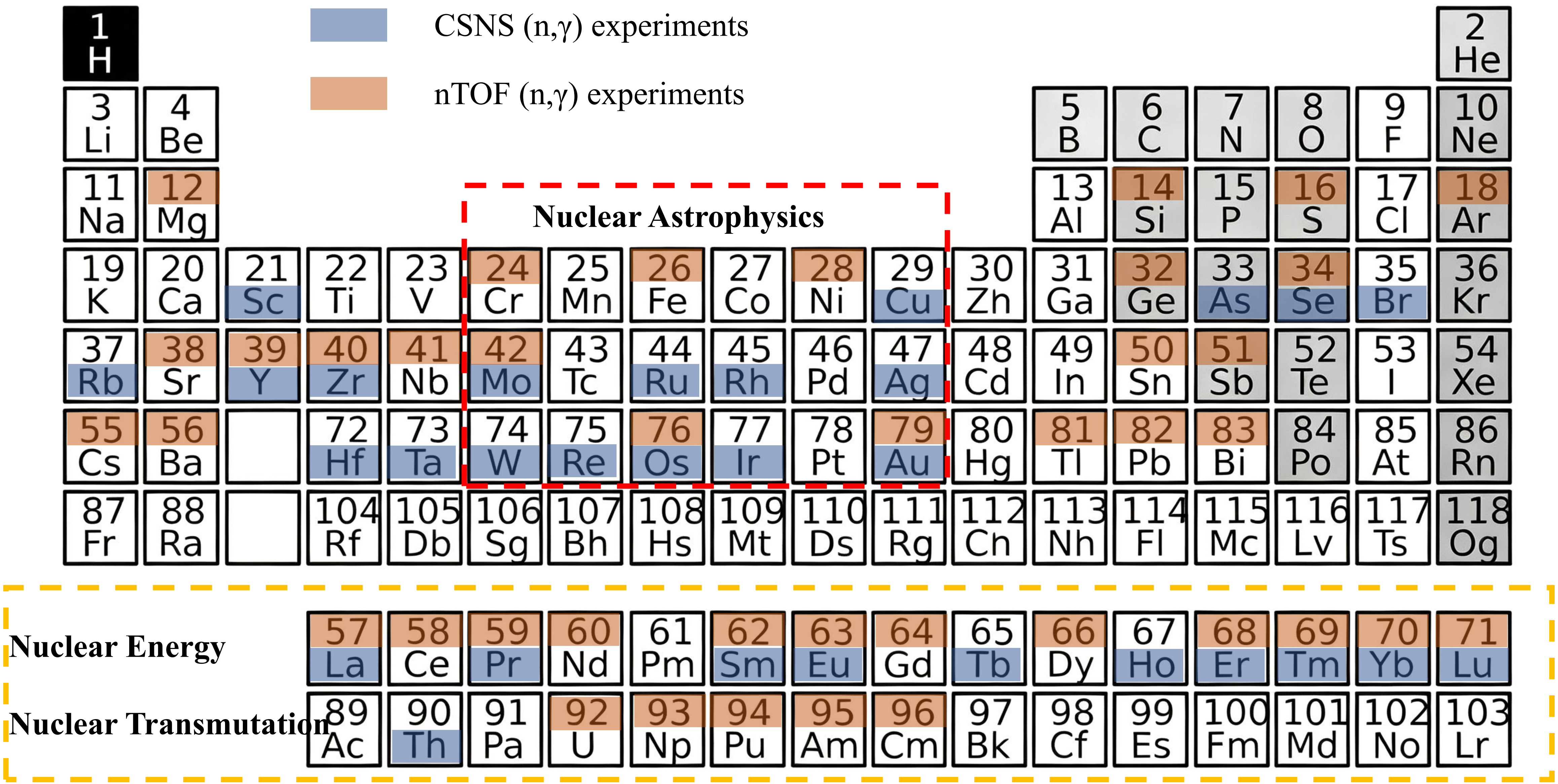


CSNS (n,γ) experiments
1 H
2 He
3 Li 4 Be 5 B 6 C 7 N 8 O 9 F 10 Ne
11 Na 12 Mg 13 Al 14 Si 15 P 16 S 17 Cl 18 Ar
19 K 20 Ca 21 Sc 22 Ti 23 V 24 Cr 25 Mn 26 Fe 27 Co 28 Ni 29 Cu 30 Zn 31 Ga 32 Ge 33 As 34 Se 35 Br 36 Kr
37 Rb 38 Sr 39 Y 40 Zr 41 Nb 42 Mo 43 Tc 44 Ru 45 Rh 46 Pd 47 Ag 48 Cd 49 In 50 Sn 51 Sb 52 Te 53 I 54 Xe
55 Cs 56 Ba 72 Hf 73 Ta 74 W 75 Re 76 Os 77 Ir 78 Pt 79 Au 80 Hg 81 Tl 82 Pb 83 Bi 84 Po 85 At 86 Rn
87 Fr 88 Ra 104 Rf 105 Db 106 Sg 107 Bh 108 Hs 109 Mt 110 Ds 111 Rg 112 Cn 113 Nh 114 Fl 115 Mc 116 Lv 117 Ts 118 Og
57 La 58 Ce 59 Pr 60 Nd 61 Pm 62 Sm 63 Eu 64 Gd 65 Tb 66 Dy 67 Ho 68 Er 69 Tm 70 Yb 71 Lu
89 Ac 90 Th 91 Pa 92 U 93 Np 94 Pu 95 Am 96 Cm 97 Bk 98 Cf 99 Es 100 Fm 101 Md 102 No 103 Lr

实验回顾



实验回顾



CSNS (n,γ) experiments
nTOF (n,γ) experiments
Nuclear Astrophysics
Nuclear Energy
Nuclear Transmutation
1 H
2 He
3 Li 4 Be 5 B 6 C 7 N 8 O 9 F 10 Ne
11 Na 12 Mg 13 Al 14 Si 15 P 16 S 17 Cl 18 Ar
19 K 20 Ca 21 Sc 22 Ti 23 V 24 Cr 25 Mn 26 Fe 27 Co 28 Ni 29 Cu 30 Zn 31 Ga 32 Ge 33 As 34 Se 35 Br 36 Kr
37 Rb 38 Sr 39 Y 40 Zr 41 Nb 42 Mo 43 Tc 44 Ru 45 Rh 46 Pd 47 Ag 48 Cd 49 In 50 Sn 51 Sb 52 Te 53 I 54 Xe
55 Cs 56 Ba 72 Hf 73 Ta 74 W 75 Re 76 Os 77 Ir 78 Pt 79 Au 80 Hg 81 Tl 82 Pb 83 Bi 84 Po 85 At 86 Rn
87 Fr 88 Ra 104 Rf 105 Db 106 Sg 107 Bh 108 Hs 109 Mt 110 Ds 111 Rg 112 Cn 113 Nh 114 Fl 115 Mc 116 Lv 117 Ts 118 Og
57 La 58 Ce 59 Pr 60 Nd 61 Pm 62 Sm 63 Eu 64 Gd 65 Tb 66 Dy 67 Ho 68 Er 69 Tm 70 Yb 71 Lu
89 Ac 90 Th 91 Pa 92 U 93 Np 94 Pu 95 Am 96 Cm 97 Bk 98 Cf 99 Es 100 Fm 101 Md 102 No 103 Lr

^{55}Mn 截面测量的科学意义

REVIEW OF MODERN PHYSICS, VOLUME 83, JANUARY–MARCH 2011

The *s* process: Nuclear physics, stellar models, and observations

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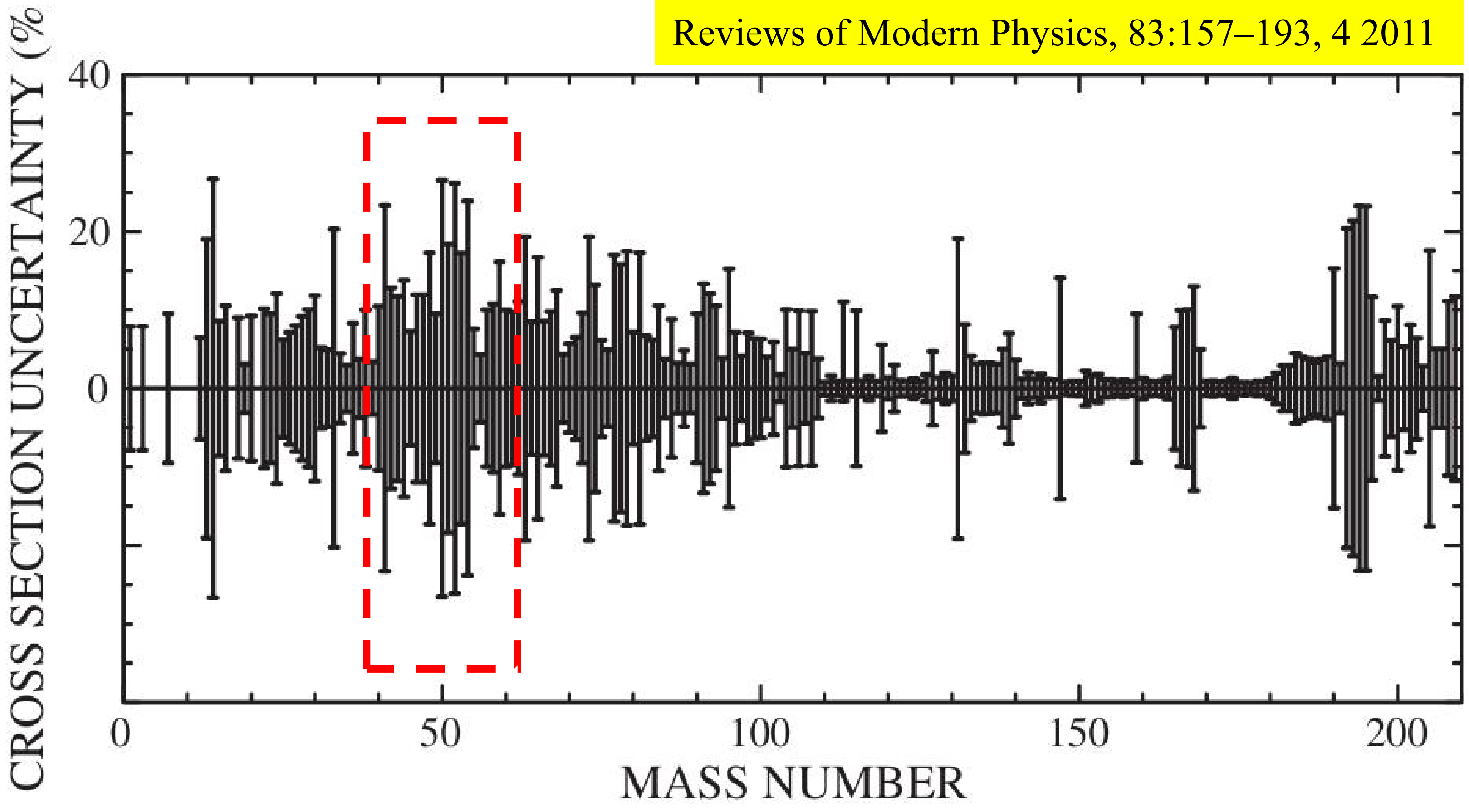
Reviews of Modern Physics, 83:157–193, 4 2011

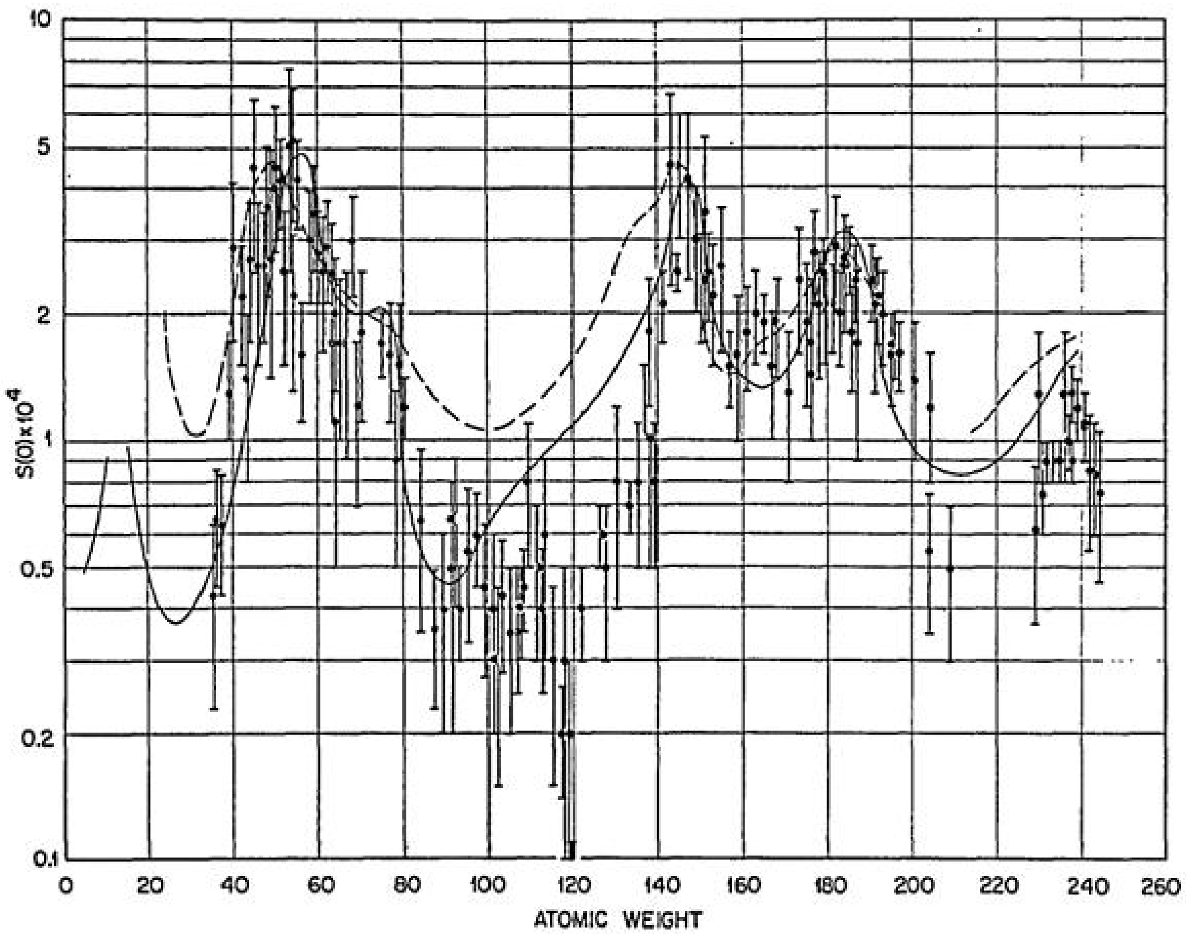


s过程核合成中恒星的(n,γ)截面不确定性。这些数值指的是 kT=30 keV 的热能水平，但在较低和较高温度下可能显著增大。

缺乏准确数据对于研究大质量恒星中的弱s过程尤为重要，这一过程负责生成大部分从Cu到 Sr之间的s元素丰度。由于弱s过程所承受的中子辐射量不足以达到流体平衡状态，因此截面不确定性可能会影响一系列较重同位素元素的丰度

共振能量较高，共振截面低

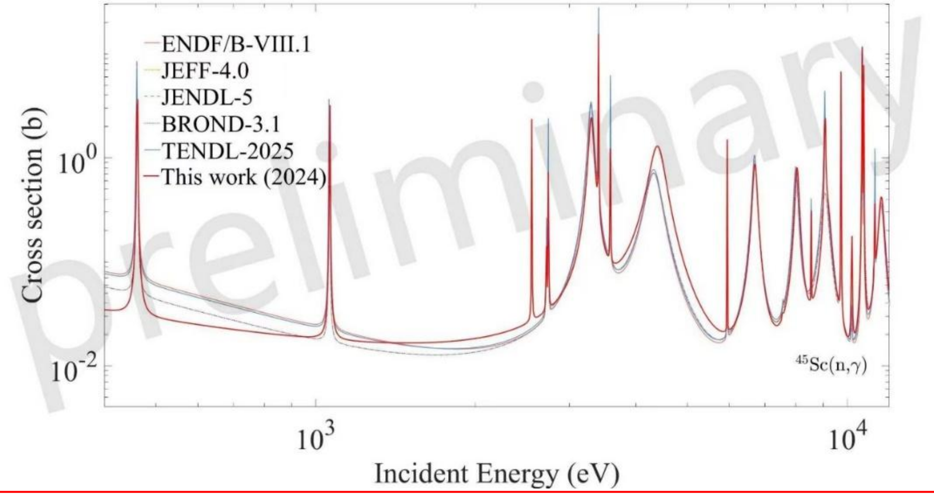
^{55}Mn 截面测量的科学意义

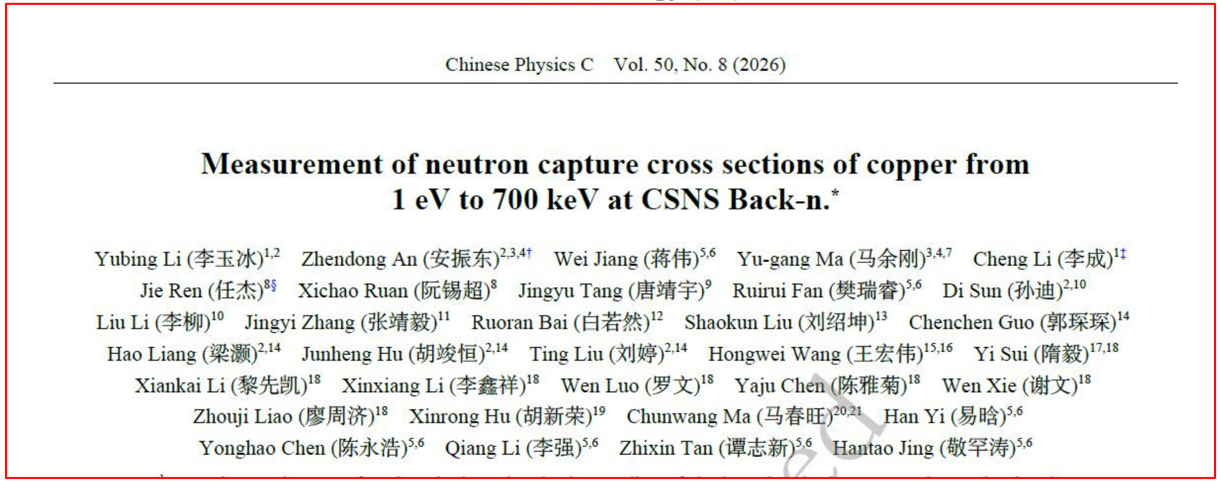


S波中子强度函数与原子量A的关系图。

Nuclear Data Sheets. Section A, 1966, 2(3): 299-332.

中子共振（主要是s波，l=0）截面的大小与中子强度函数 S_0 = / D 密切相关





Chinese Physics C Vol. 50, No. 8 (2026)

Measurement of neutron capture cross sections of copper from 1 eV to 700 keV at CSNS Back-n.*

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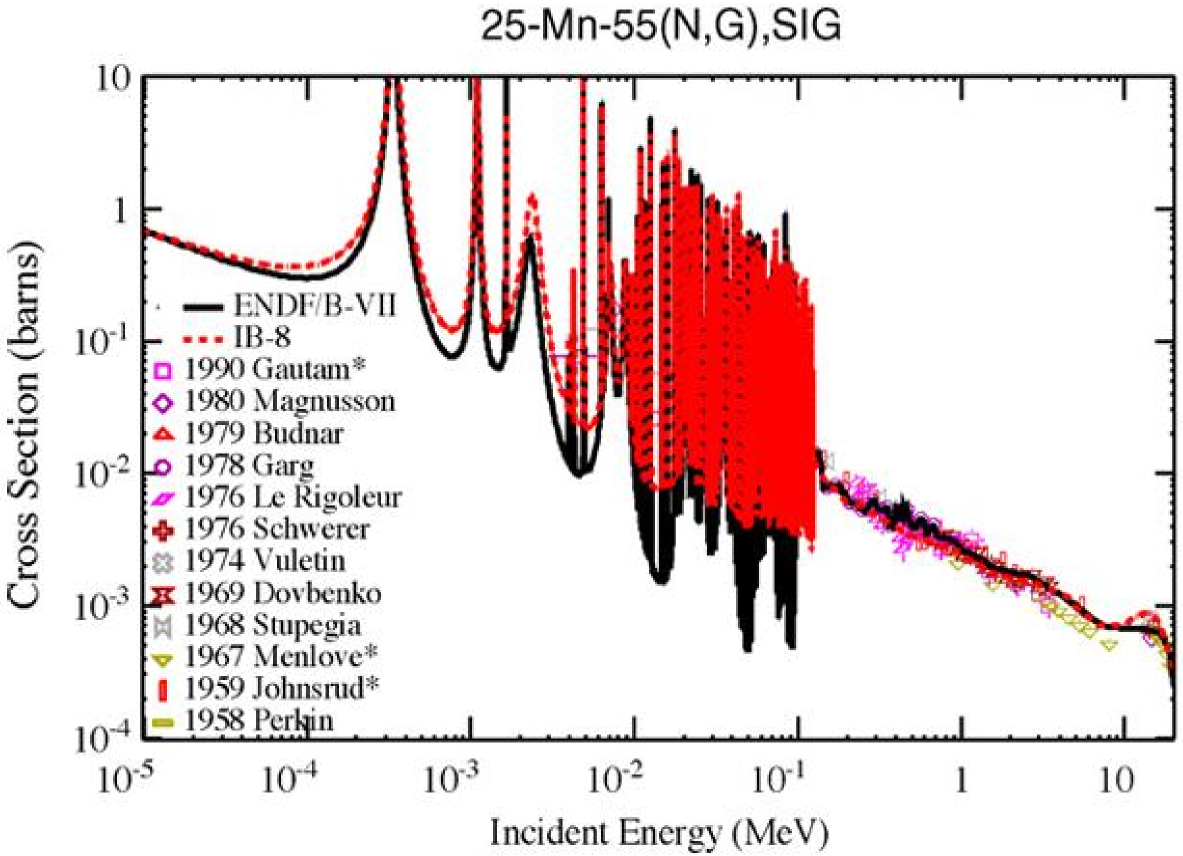
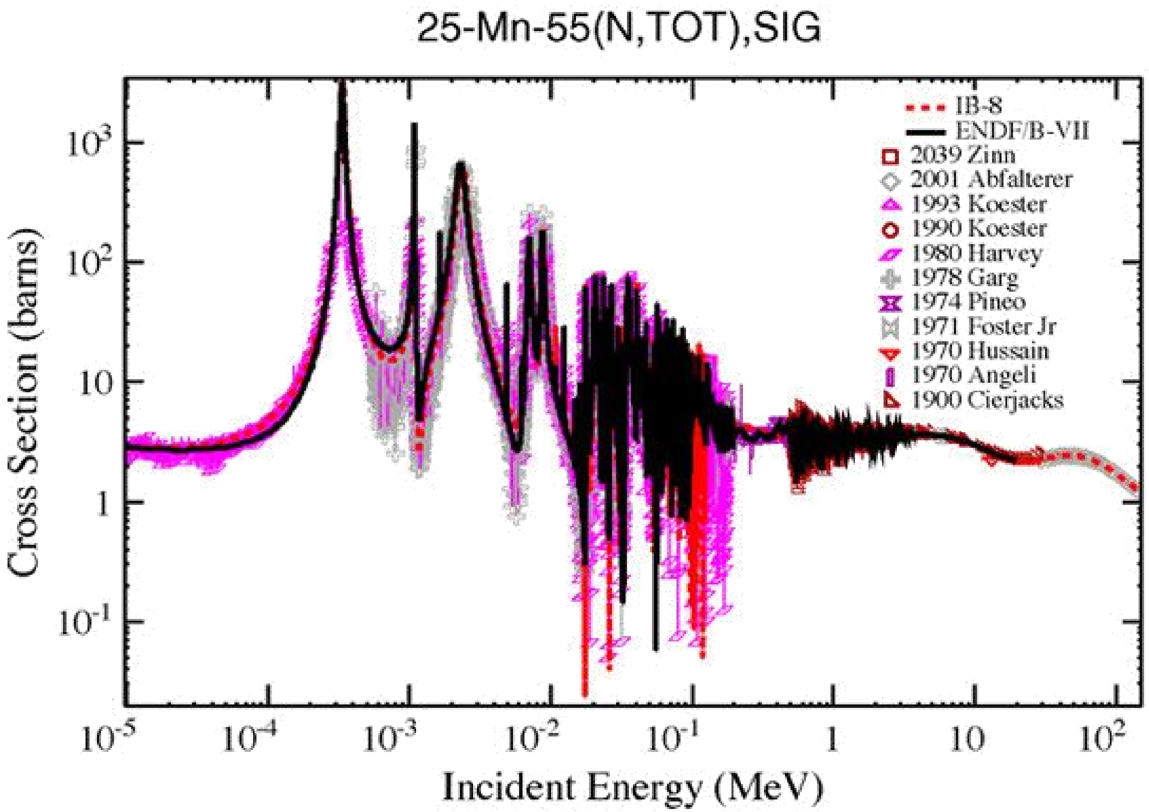
^{55}Mn 中子数据实验测量研究现状



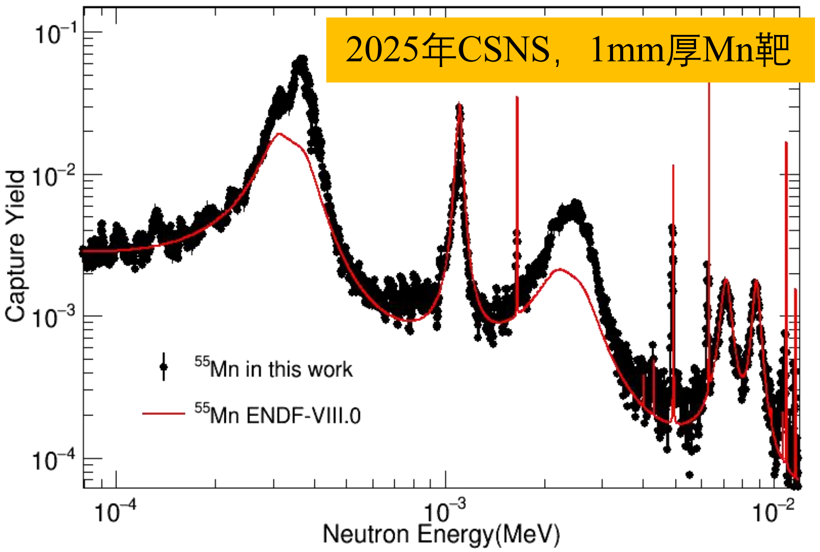


从^{55}Mn评价库与EXFOR数据可见，共振区的**中子俘获实验数据非常少**。由于^{55}Mn截面相对较低且第一个共振峰位于100eV之后，因此实验中常采用较厚靶材，通过透射率实验测量共振参数，包括：1978 年 J. B. Garg等，2mm厚靶；1985 年 R.L.Macklin等，3.8mm厚靶；1947 年 L. J. RAINWATER 等，2.185mm 厚靶。

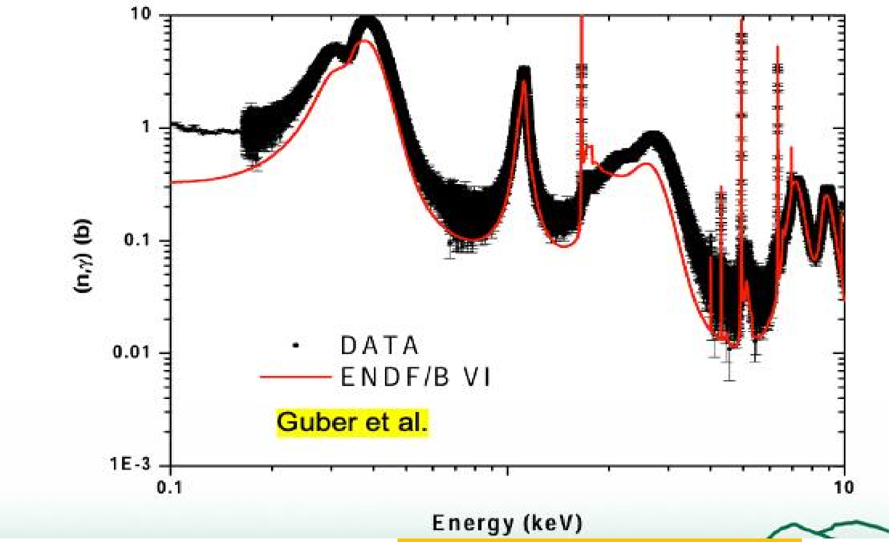
^{55}Mn CSNS-Backn实验情况

Fe、Ho、Mn元素中子俘获反应截面实验数据记录表

厅2	Cs137	2025/5/12 11:09:00	2025/5/12 12:45:00	19805	1	9	9	1小时36分00秒
	Eu152	2025/5/12 12:48:00	2025/5/12 13:18:00	19806	1	10	10	0小时30分00秒
	Co60	2025/5/12 13:20:00	2025/5/12 13:50:00	19807	1	8	8	0小时30分00秒
	Na22	2025/5/12 14:04:00	2025/5/12 14:37:00	19809	1	18	18	0小时33分00秒
	Empty	2025/5/12 14:49:00	2025/5/12 16:25:00	19810	1	7	7	1小时36分00秒
	Empty	2025/5/12 19:14:00	2025/5/12 23:00:00	19822	1	16	16	3小时46分00秒
	Au+Cd	2025/5/13 8:59:00	2025/5/13 17:14:00	19827	1	218	218	8小时15分00秒
	Au+Ag+Co+Cd	2025/5/13 17:19:00	2025/5/14 1:20:00	19832	1	195	195	8小时01分00秒
	C+Cd	2025/5/14 1:55:00	2025/5/14 9:51:00	19833	1	151	151	7小时56分00秒
	C+Ag+Co+Cd	2025/5/14 9:58:00	2025/5/14 18:00:00	19835	1	150	150	8小时02分00秒
	Empty+Cd	2025/5/14 19:07:00	2025/5/15 3:00:00	19839	1	136	136	7小时53分00秒
	Empty+Ag+Co+Cd	2025/5/15 3:06:00	2025/5/15 11:00:00	19841	1	135	135	7小时54分00秒
	Fe+Ag+Co+Cd	2025/5/15 11:29:00	2025/5/15 19:29:00	19842	1	167	167	8小时00分00秒
	Ho+Cd	2025/5/15 20:03:00	2025/5/16 12:59:00	19845	1	414	414	16小时56分00秒
	Ho+Ag+Co+Cd	2025/5/16 13:03:00	2025/5/16 18:00:00	19848	1	116	116	4小时57分00秒
	生物+Cd	2025/5/16 18:37:00	2025/5/16 20:30:00	19849	1	55	55	1小时53分00秒
	Pb+Cd	2025/5/17 1:13:00	2025/5/17 8:35:00	19856	1	165	165	7小时22分00秒
	Mn+Ag+Co+Cd	2025/5/17 17:50:00	2025/5/17 21:50:00	19859	1	86	86	4小时00分00秒
	Mn+Cd	2025/5/17 21:56:00	2025/5/18 12:12:00	19860	1	316	316	14小时16分00秒
	正在进行测量	计划测量	测量完毕	放弃测量		文件 总数	837	155小时26分00秒

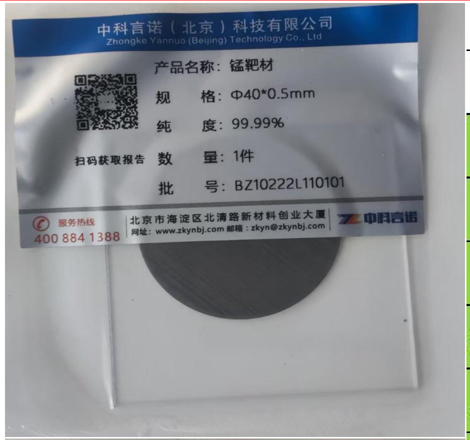


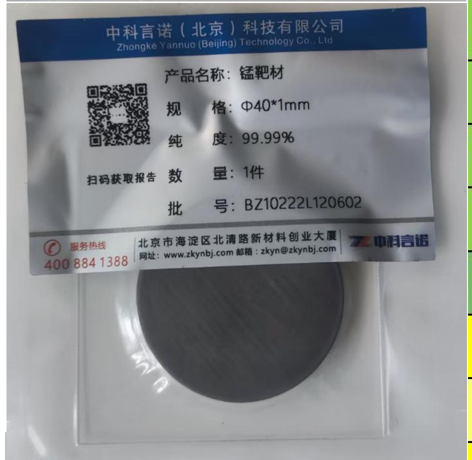
Very thick sample used, multiple scattering effect enormous



2007年3.17mm厚Mn靶

^{55}Mn CSNS-Backn实验情况

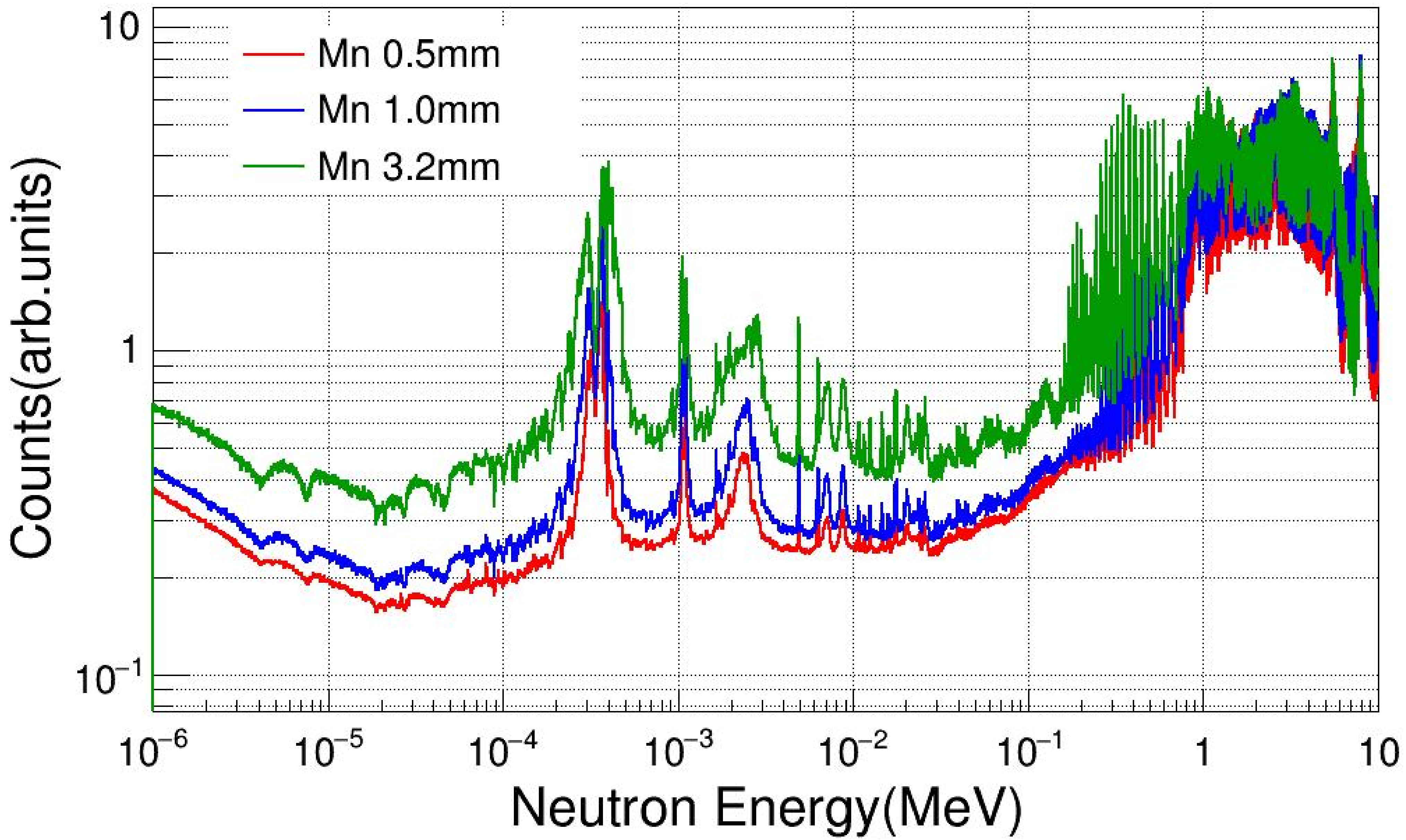




2026年Mn元素中子俘获反应截面实验数据记录表

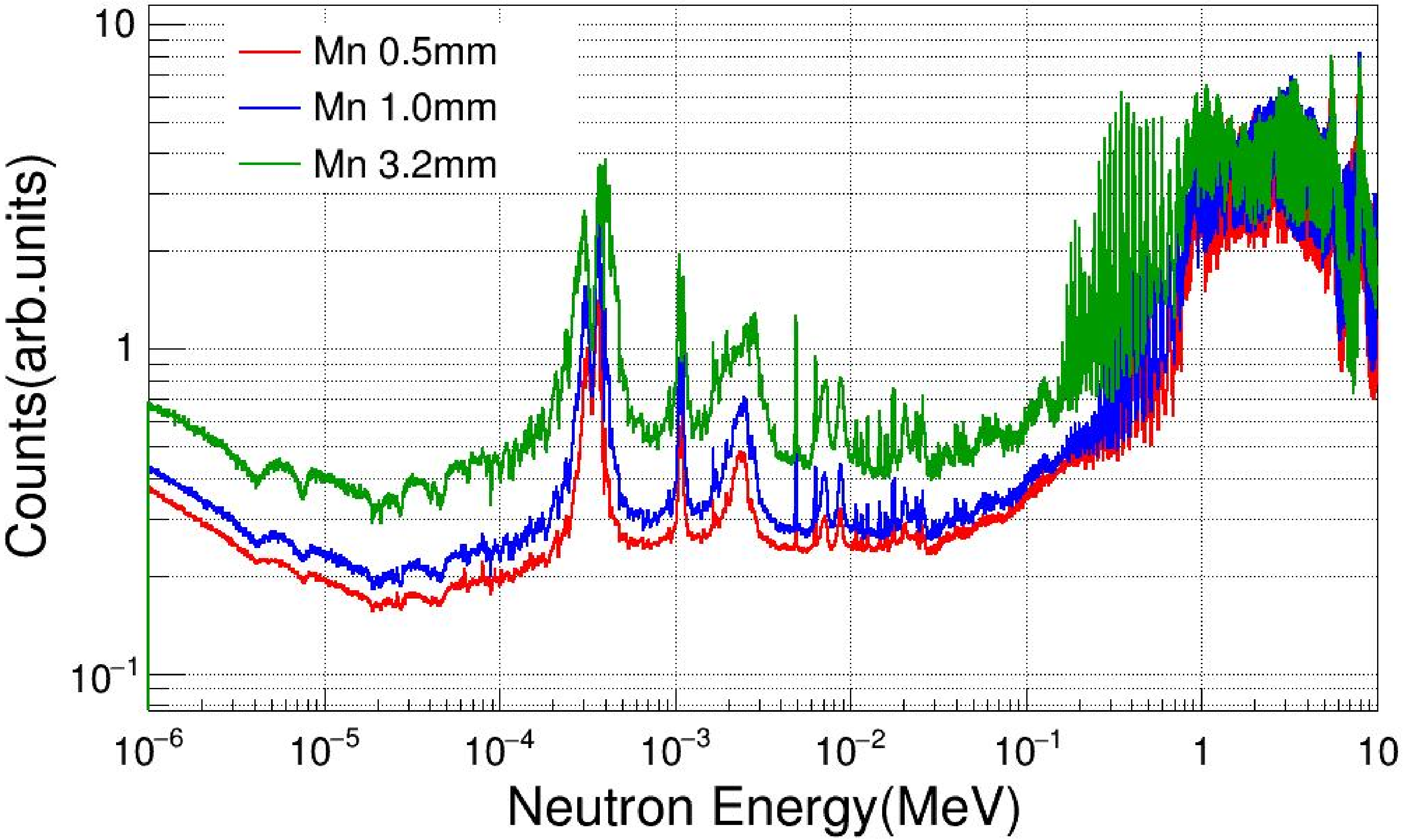
测量目标	起始测量时间	结束测量时间	数据编号	起始编号	结束编号	文件个数	总计测量时间	备注
60Co	2026/4/7 19:49:58	2026/4/8 0:10:21	20712	1	91	90	4小时20分23秒	
137Cs	2026/4/8 0:11:25	2026/4/8 8:31:00	20713	1	107	106	8小时19分35秒	
Pb-50x0.2mm	2026/4/9 17:29:00	2026/4/9 22:42:00	20725	1	105	104	5小时13分00秒	
Pb+filter-50x0.2mm	2026/4/9 22:44:00	2026/4/10 2:16:00	20726	1	68	67	3小时32分00秒	
Au+Filter-50x0.2mm	2026/4/10 2:52:00	2026/4/10 5:02:00	20727	1	58	57	2小时10分00秒	
Au-50x0.2mm	2026/4/10 5:04:00	2026/4/10 8:00:00	20728	1	93	92	2小时56分00秒	
Empty+无束流	2026/4/10 10:07:00	2026/4/10 16:26:43	20729	1		-1	6小时19分43秒	
C+Filter-50x0.2mm	2026/4/11 15:17:00	2026/4/11 18:40:00	20733	1	58	57	3小时23分00秒	
C+Filter	2026/4/11 18:44:00	2026/4/11 23:44:00	20734	1	91	90	5小时00分00秒	
Empty	2026/4/12 0:15:00	2026/4/12 4:26:00	20735	1	74	73	4小时11分00秒	
Pb				1				
Mn-3.2mm	2026/4/12 4:57:21	2026/4/12 8:00:00	20736	1			3小时02分39秒	
Mn-3.2mm+Filter	2026/4/12 8:00:00	2026/4/12 9:00:00	-	1			1小时00分00秒	
Mn-1.0mm	2026/4/12 9:20:00	2026/4/12 16:20:00	-	1			7小时00分00秒	
Mn-1.0mm+Filter	2026/4/12 16:20:00	2026/4/12 17:20:00	-	1			1小时00分00秒	
Mn-0.5mm	2026/4/12 17:40:00	2026/4/13 13:40:00	-	1			20小时00分00秒	
Mn-0.5mm+Filter	2026/4/13 13:40:00	2026/4/13 17:00:00	-	1			3小时20分00秒	
正在进行测量	计划测量	测量完毕	放弃测量		文件 总数	0	35小时22分39秒	

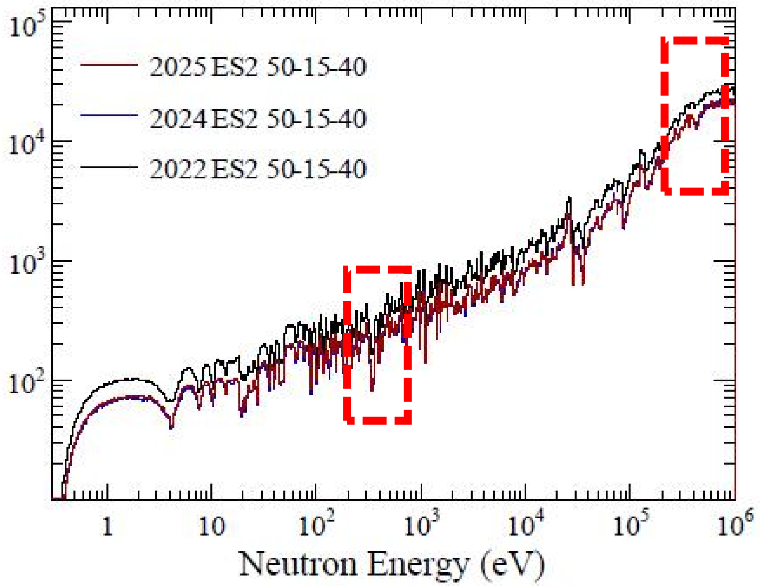
^{55}Mn CSNS-Backn实验数据分析进展

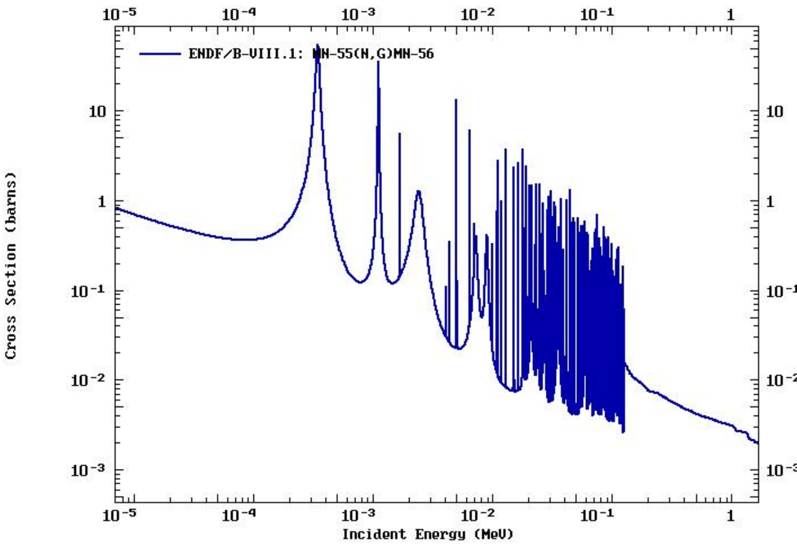


^{55}Mn CSNS-Backn实验数据分析进展

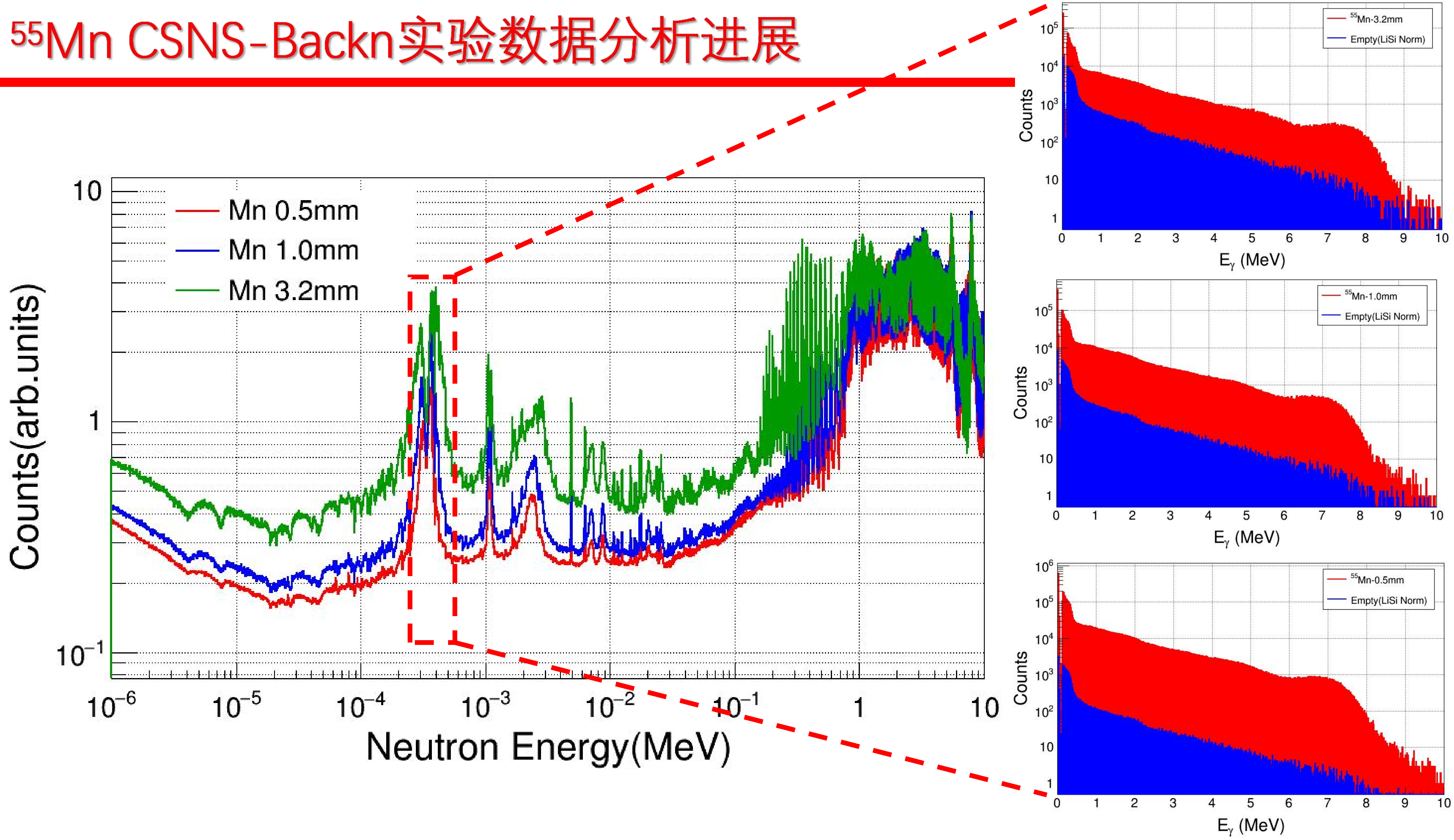
Acta Physica Sinica, 2026, 75(2): 020115



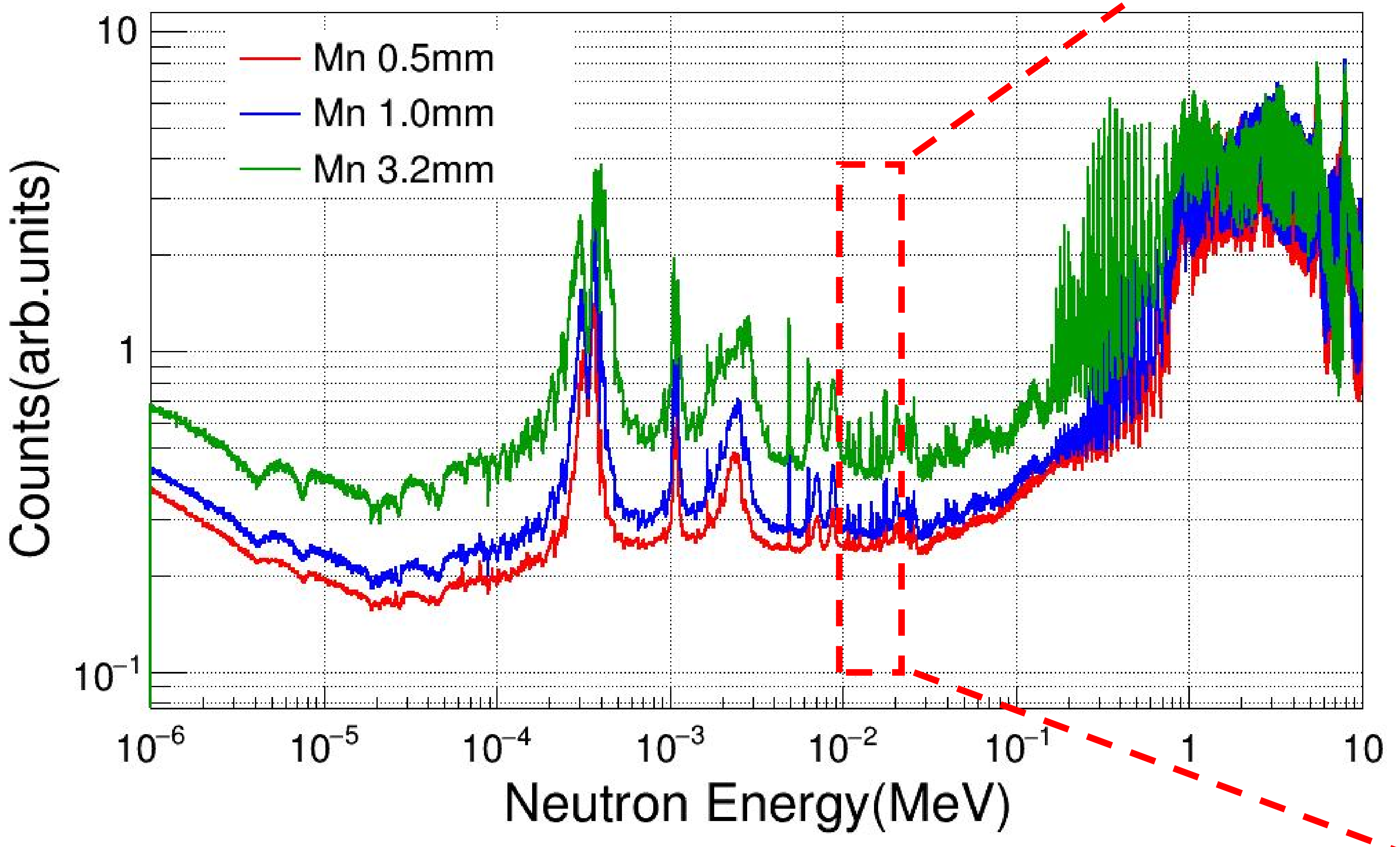


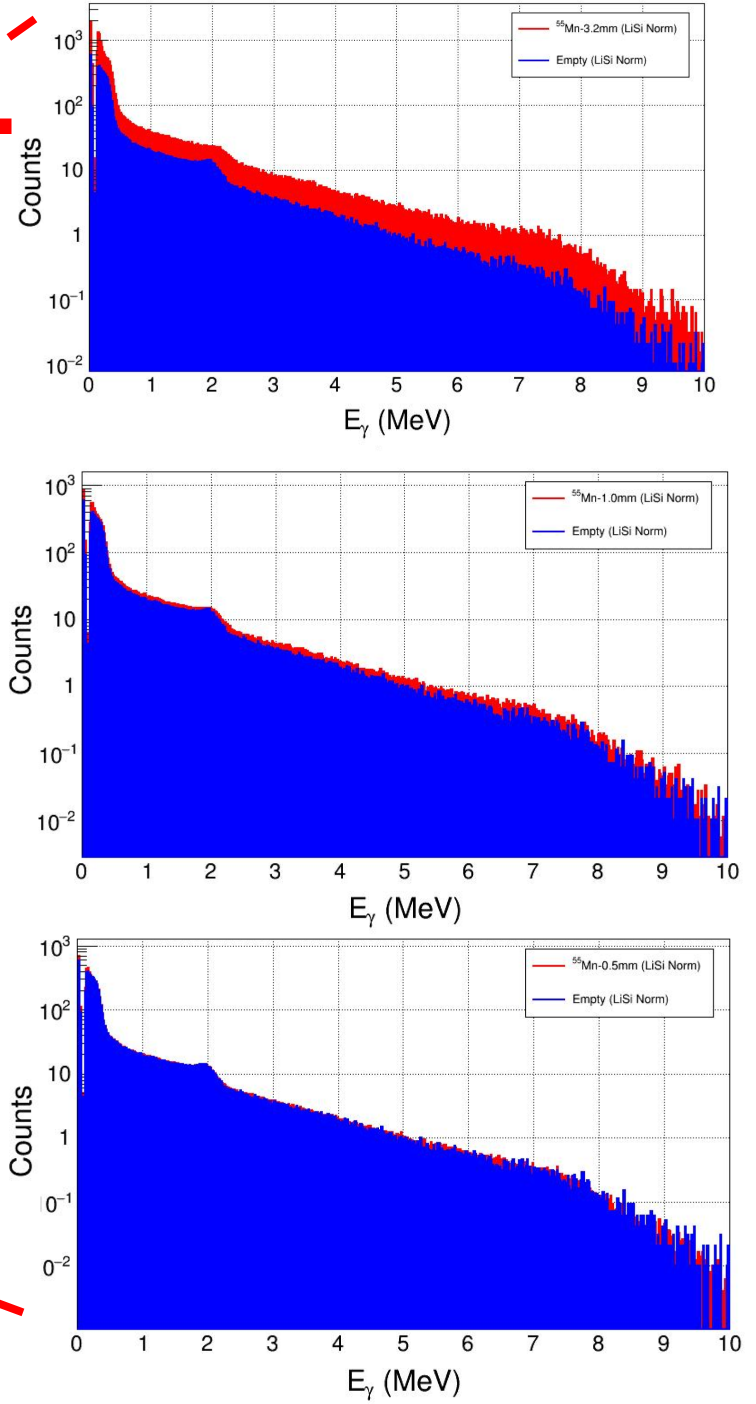


^{55}Mn CSNS-Backn实验数据分析进展

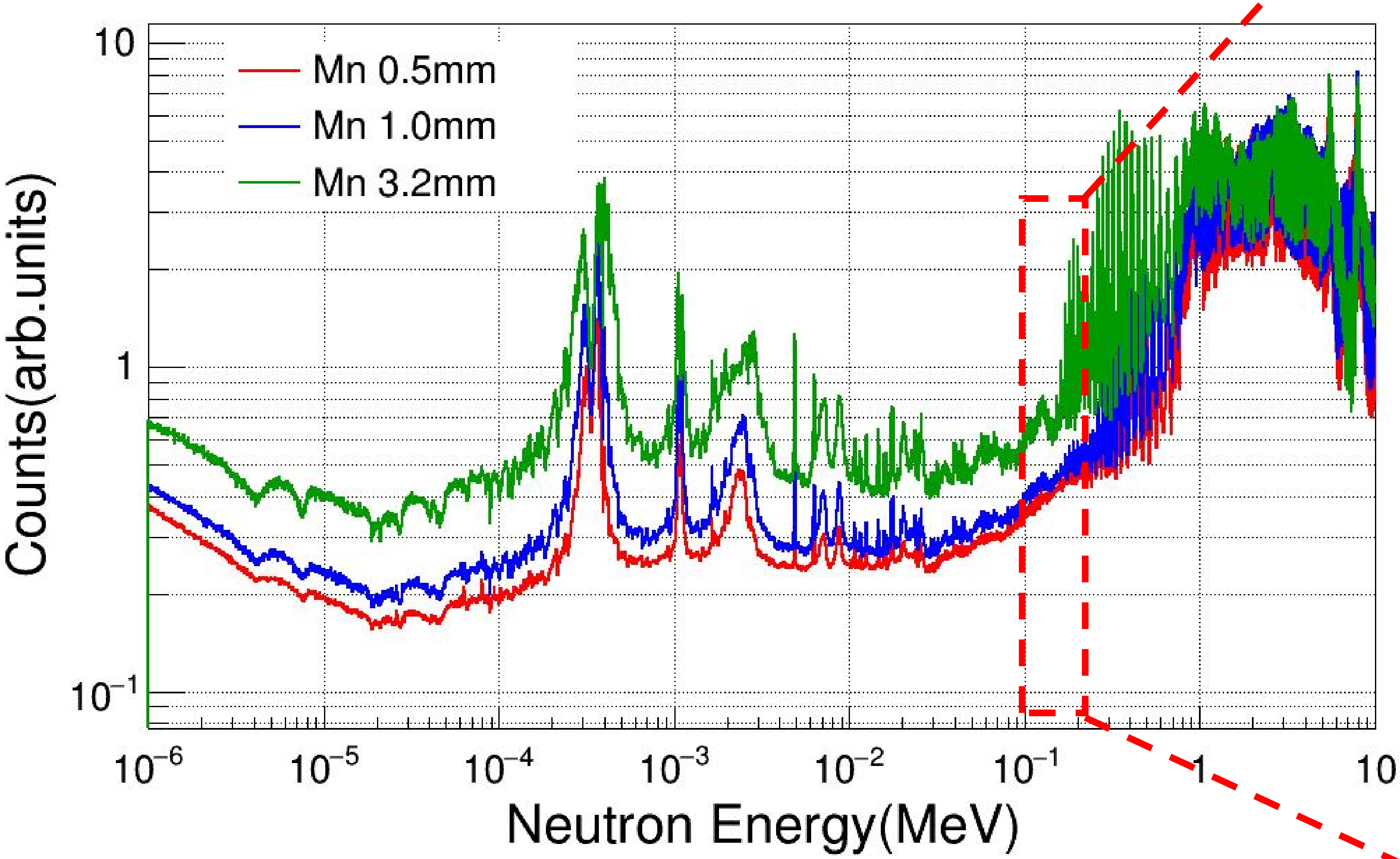


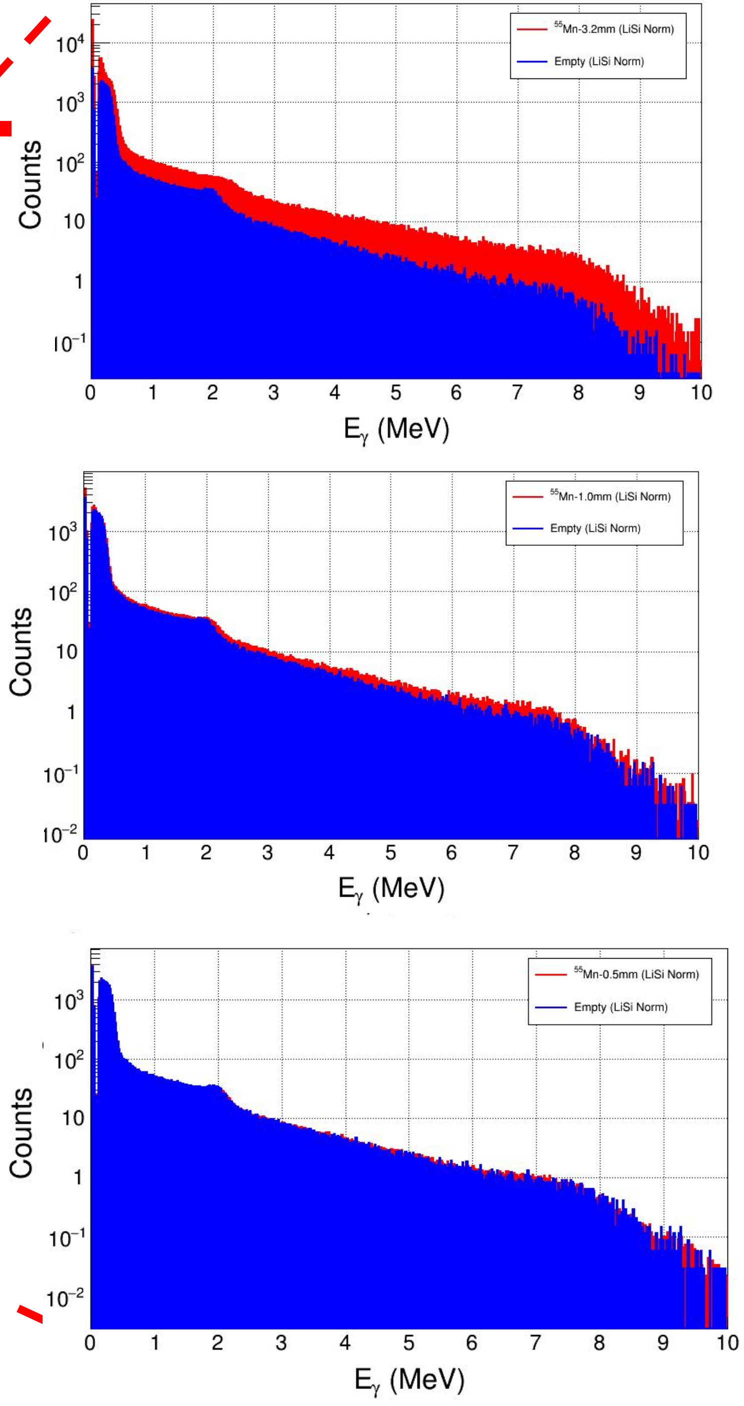
^{55}Mn CSNS-Backn实验数据分析进展



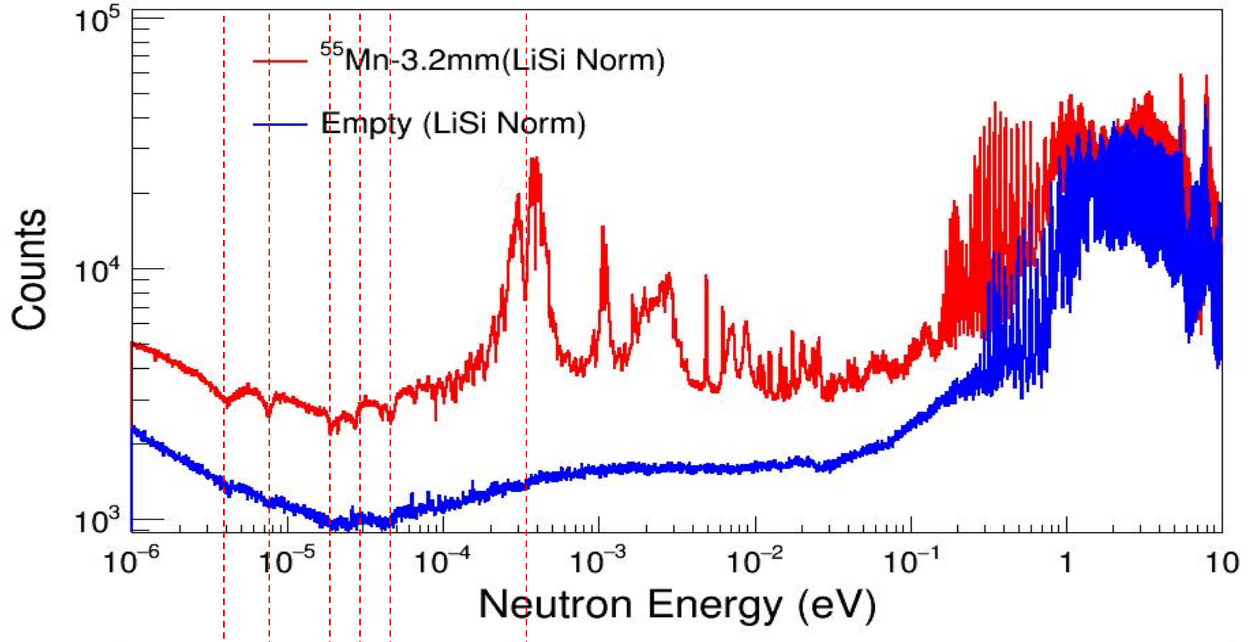


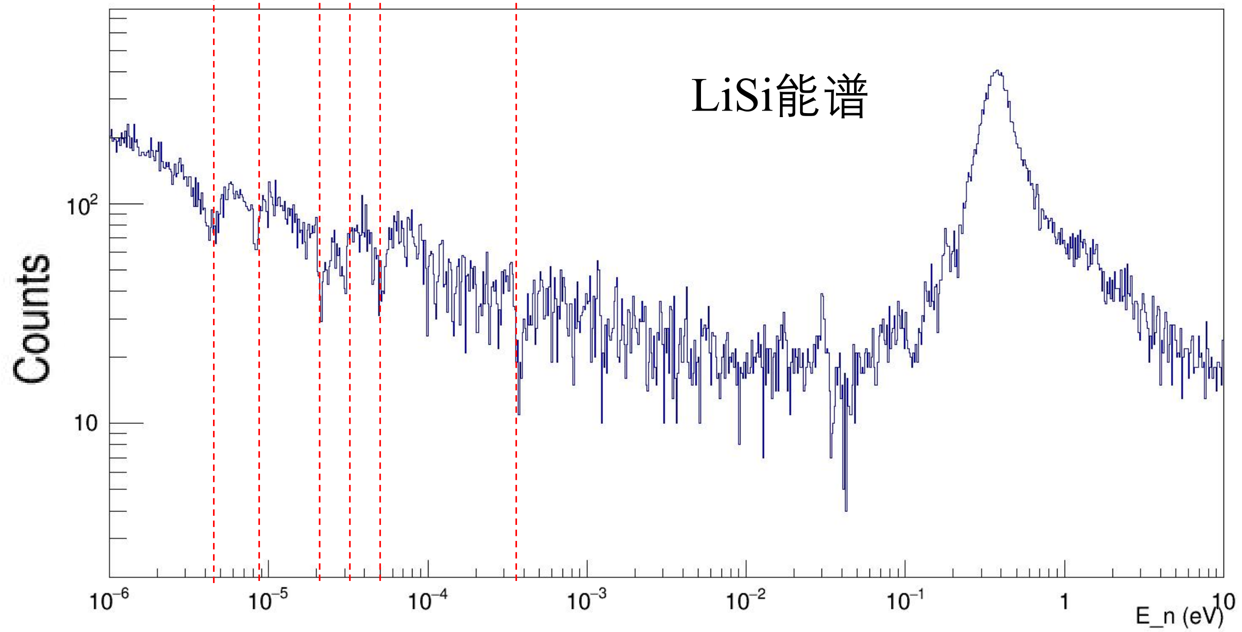
^{55}Mn CSNS-Backn实验数据分析进展





^{55}Mn CSNS-Backn实验数据分析进展





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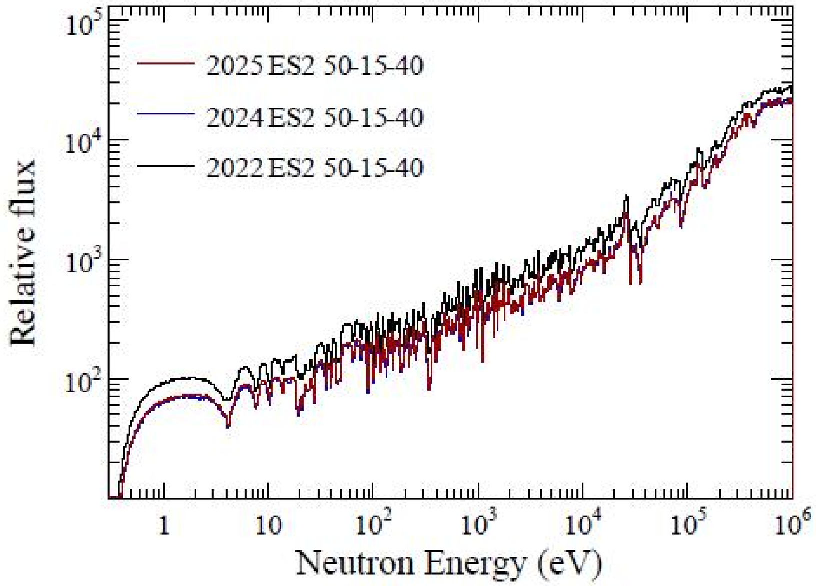
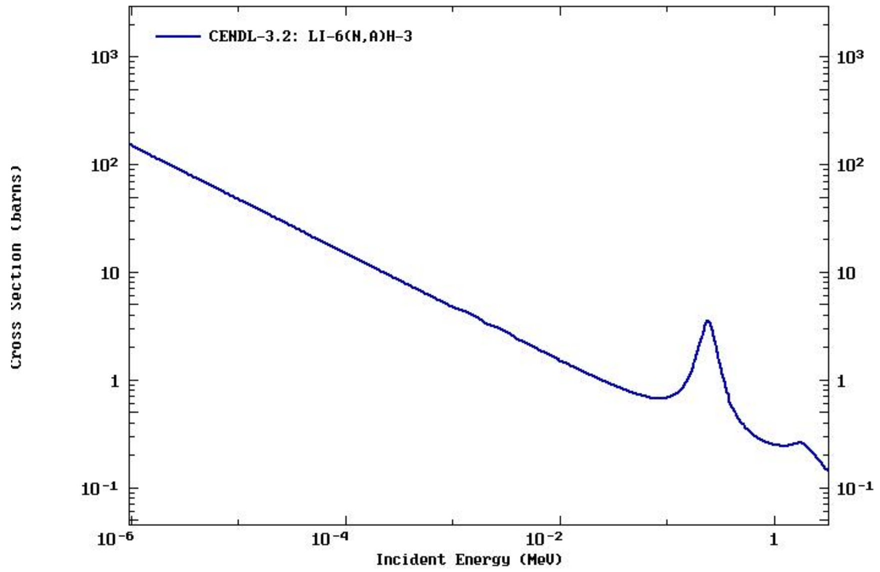
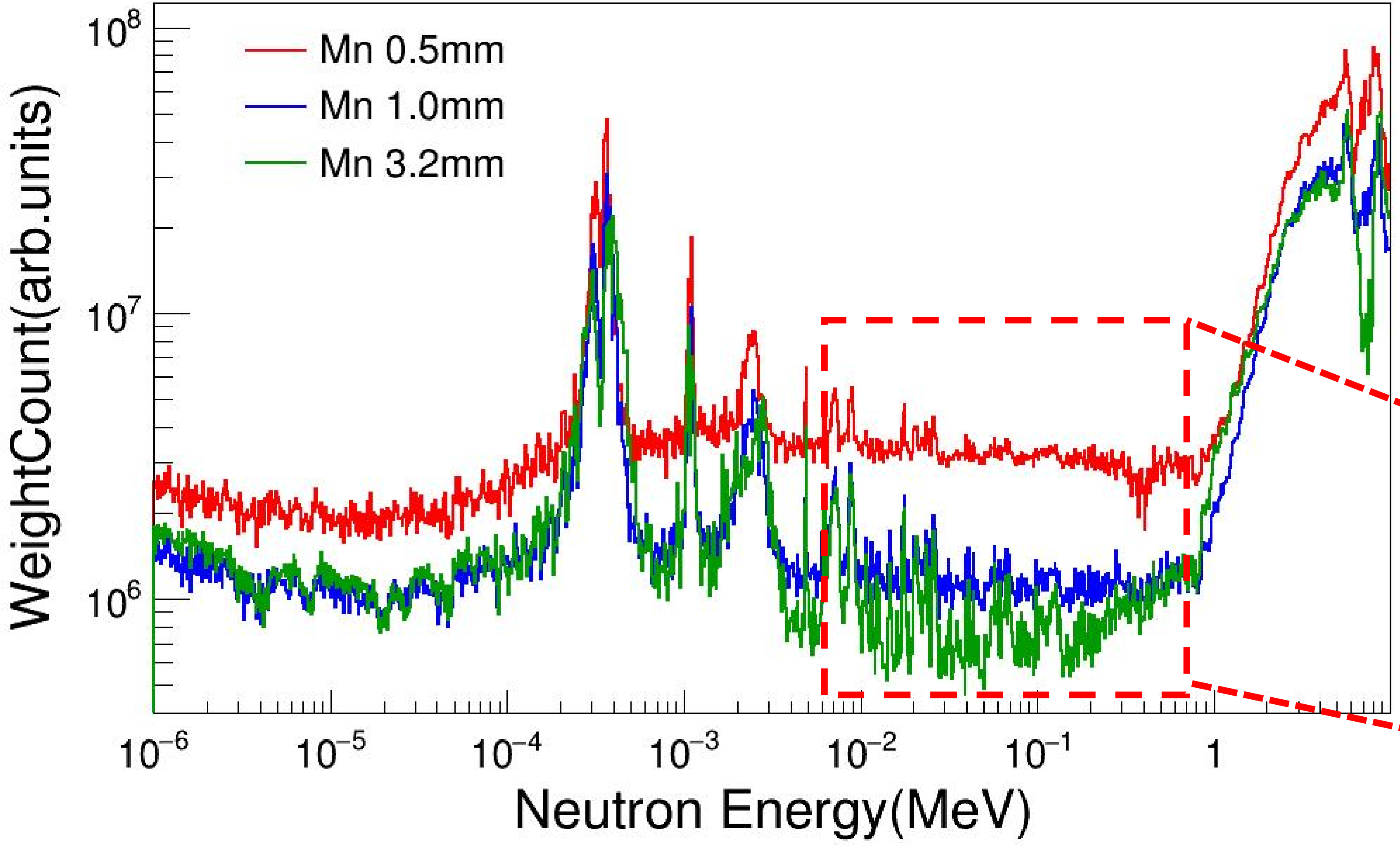
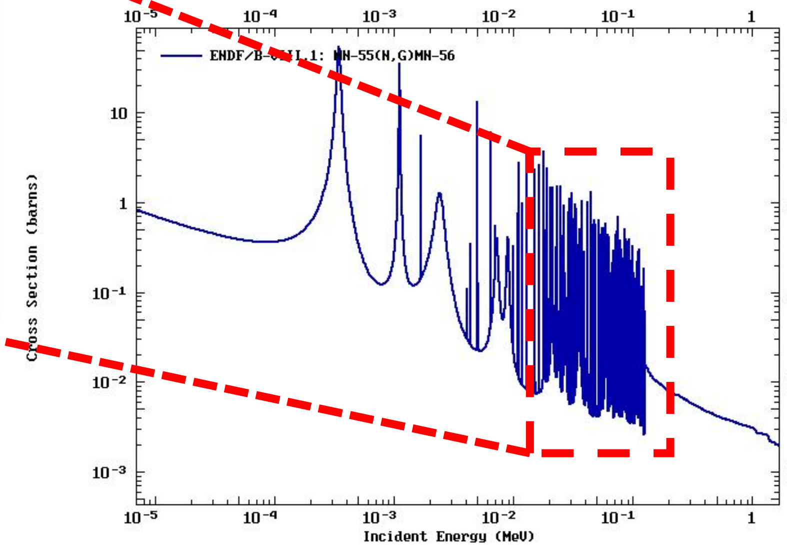




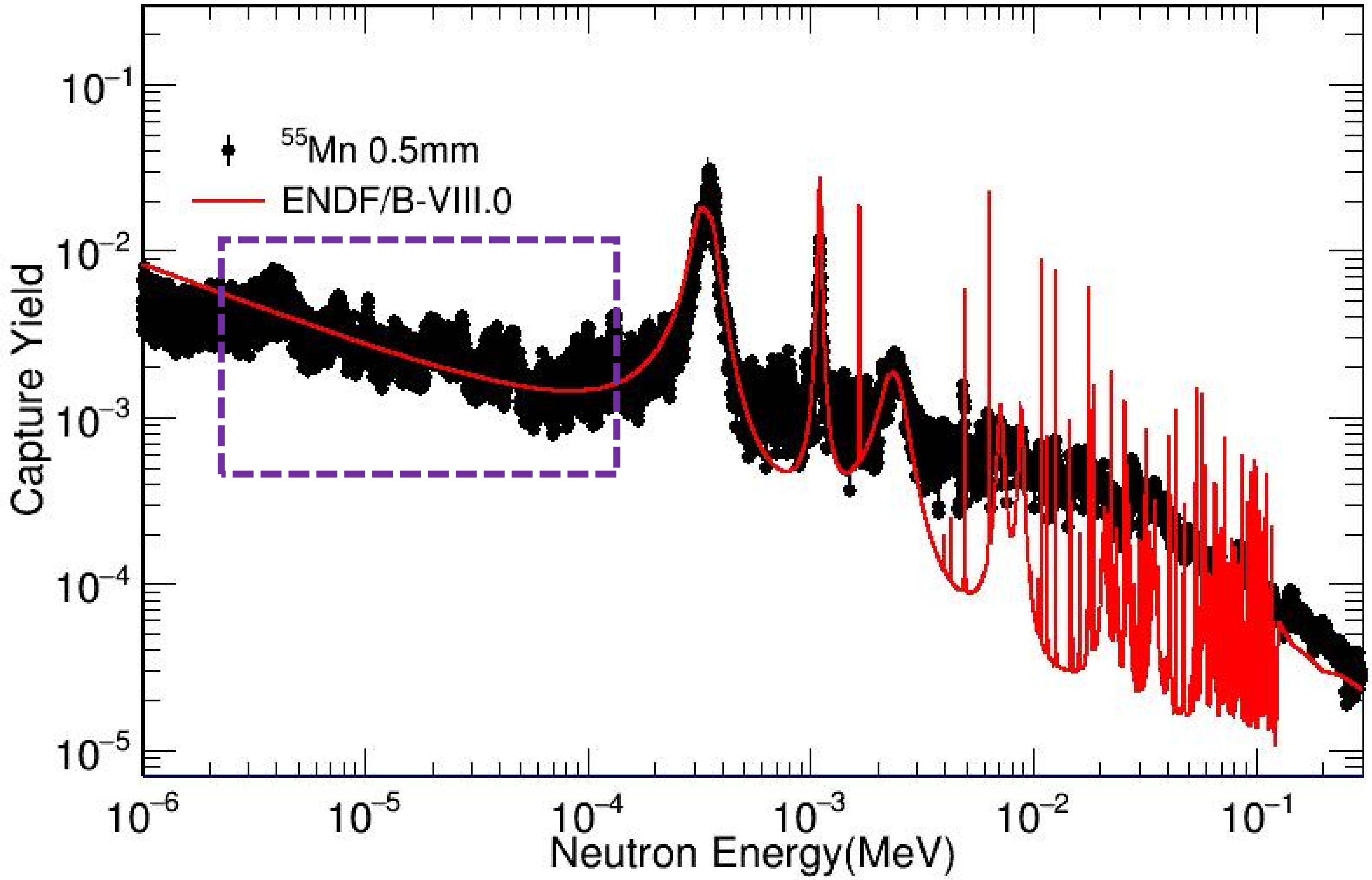
^{55}Mn CSNS-Backn实验数据分析进展



1MeV后面的共振结构都已经消除了，但是1eV-100eV之间的能谱结构还是存在，虽然有所减弱。

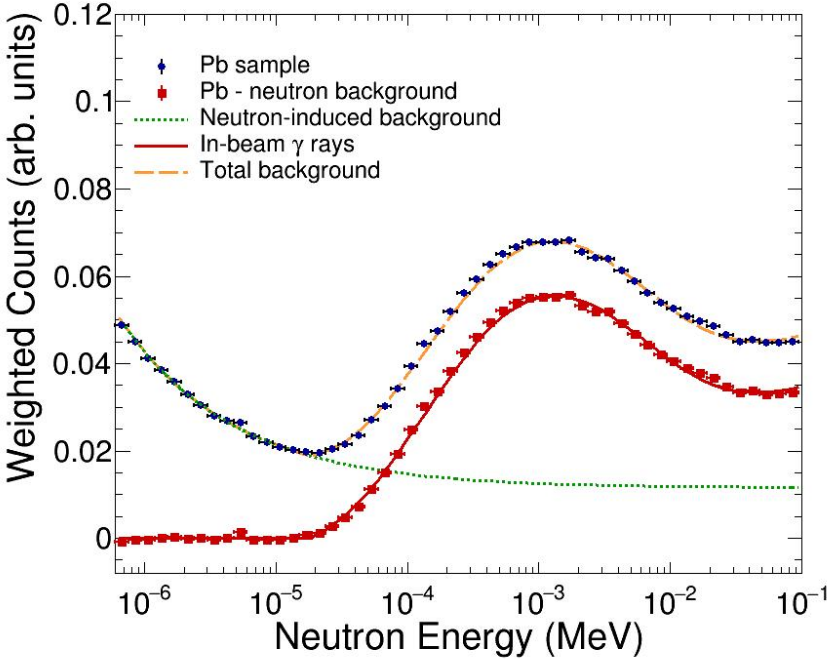


^{55}Mn CSNS-Backn实验数据分析进展

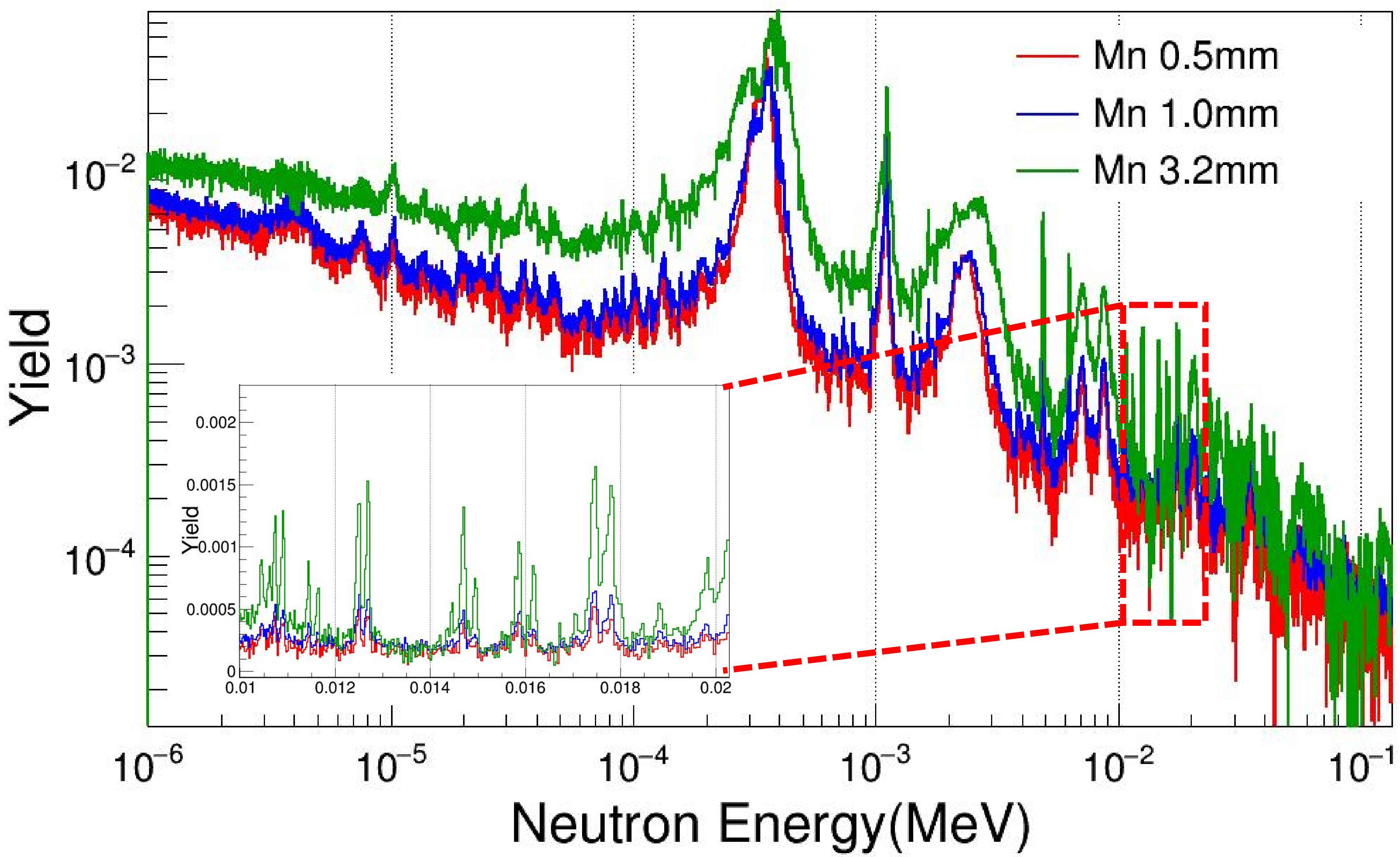


$$Y_{\mathrm{exp}}(E_n) = \frac{1}{f}\frac{C^w(E_n) - B^w(E_n)}{\Phi(E_n) \times E_c}$$

$$\varepsilon_\gamma = \sum_{i=1}^{n} WF_i(E_d)R(E_d, E_\gamma) = \alpha E_\gamma,$$



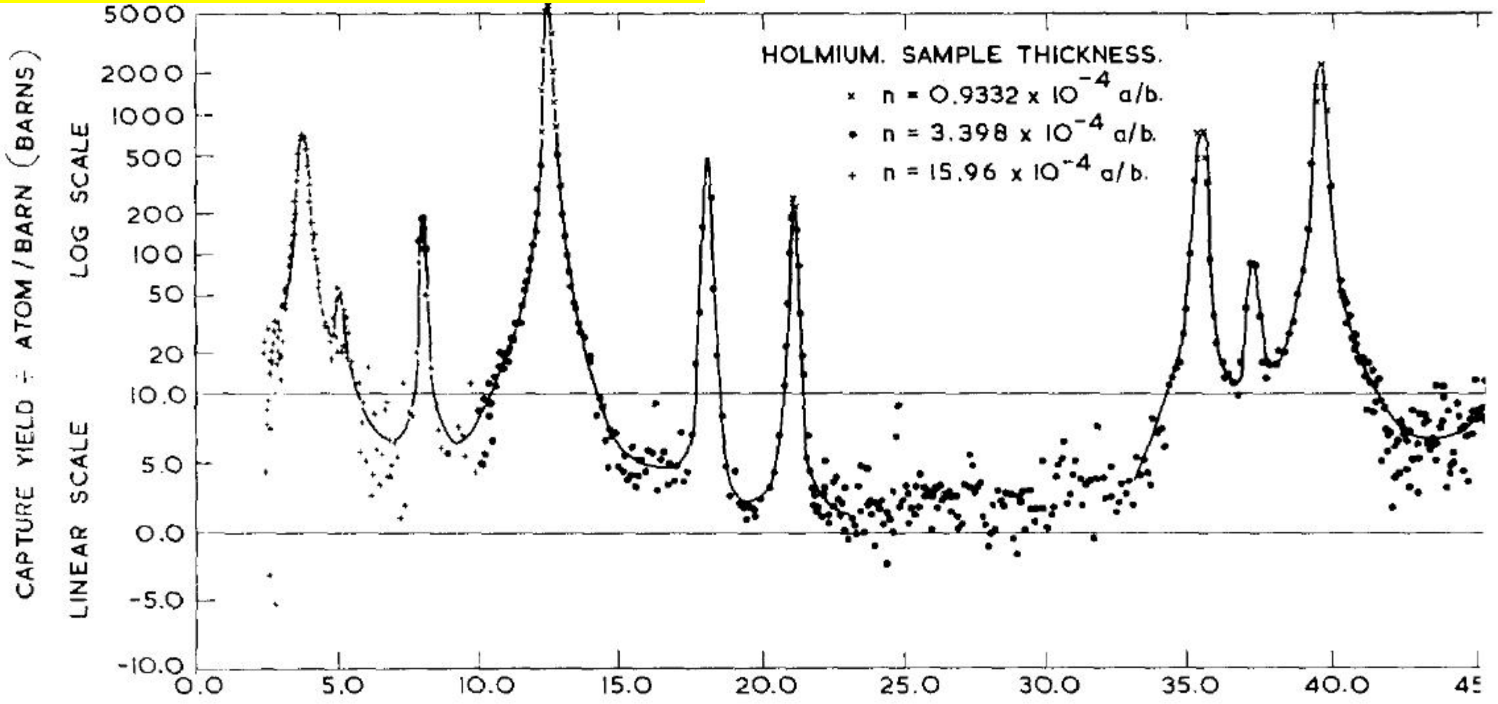
^{55}Mn CSNS-Backn实验数据分析进展

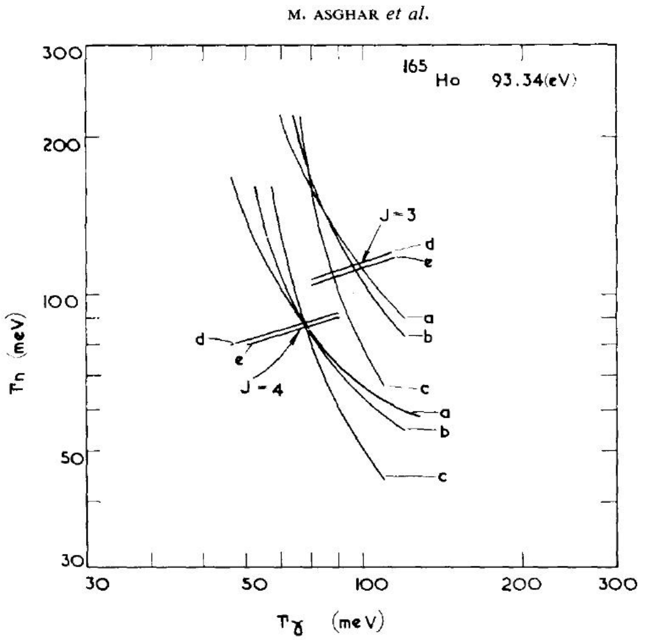


怎么样才能消除厚靶中能谱的影响呢?

^{55}Mn 接下来分析计划

Nuclear Physics A,108(1968)535-546

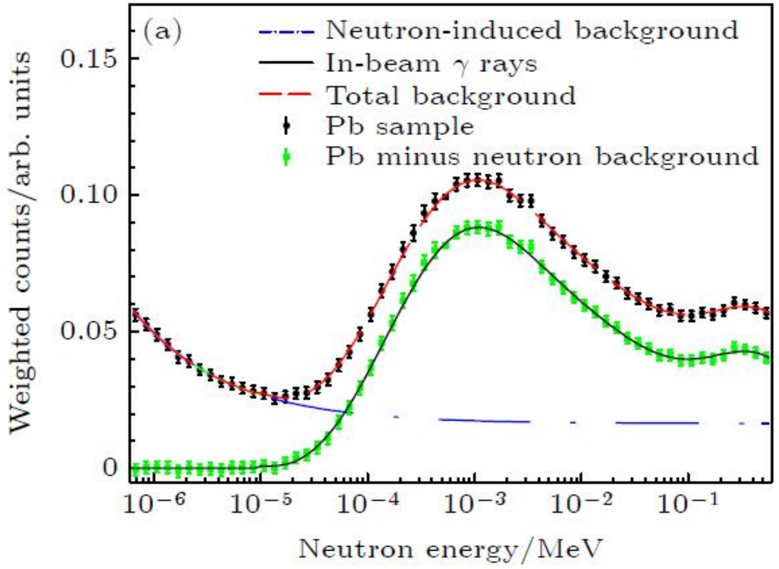


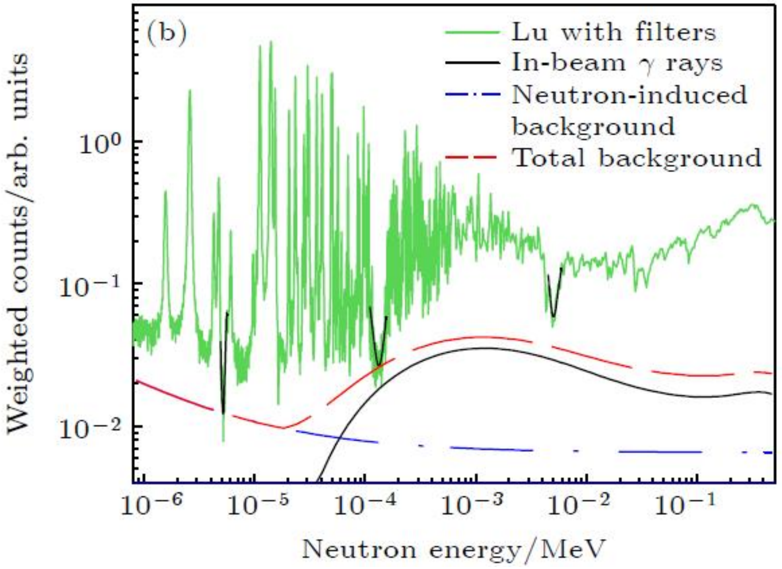


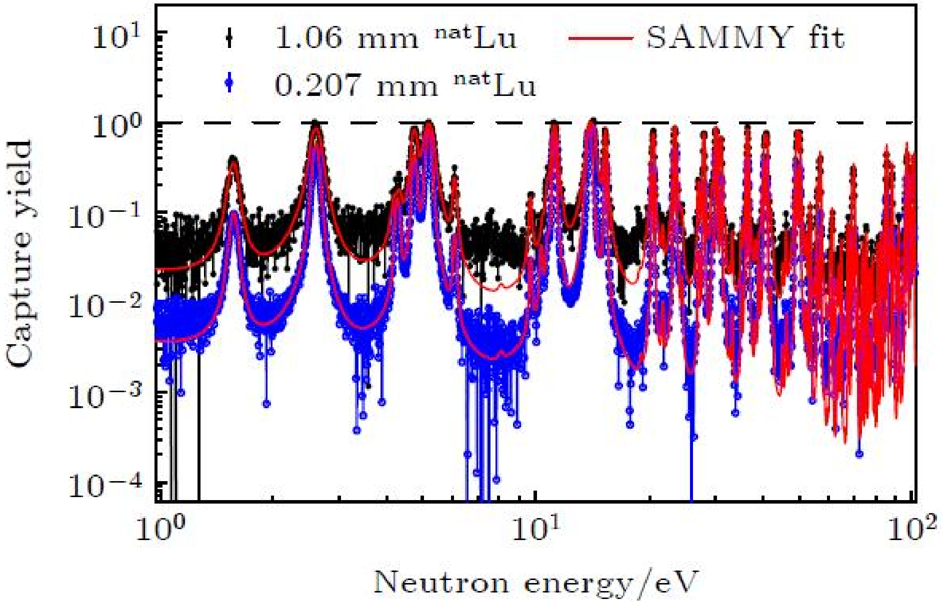
- 靶越厚，俘获信号（计数率）越强，统计误差越小，适合弱信号/谷底区域；
- 靶越厚，共振峰处的**自屏蔽（self-shielding）和多次散射修正**越严重——强共振处中子几乎被前层原子吸收完，峰形失真、饱和，这时候薄靶反而更接近真实截面。

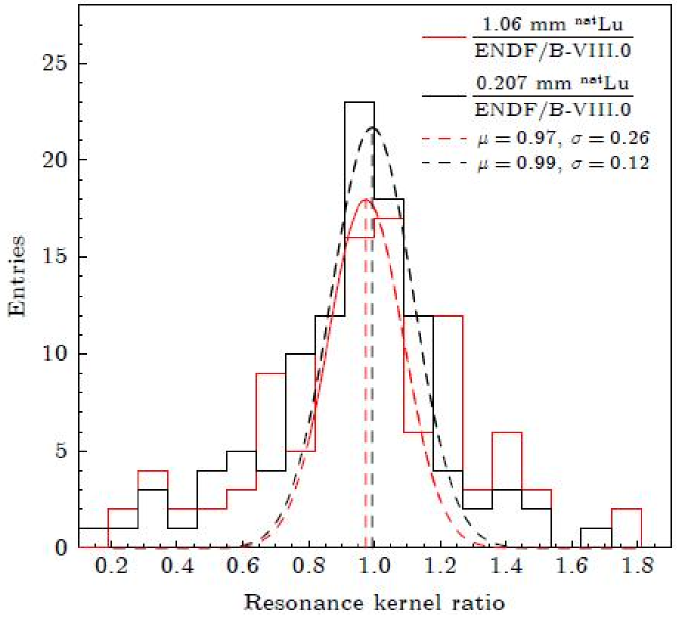
对同一个共振，分别测量不同厚度靶下的“共振面积”（俘获产额对能量积分），面积随厚度按已知的自屏蔽函数非线性增长/饱和，两个不同厚度的面积数据联立即可同时解出 Γ_n 和 Γ_γ。

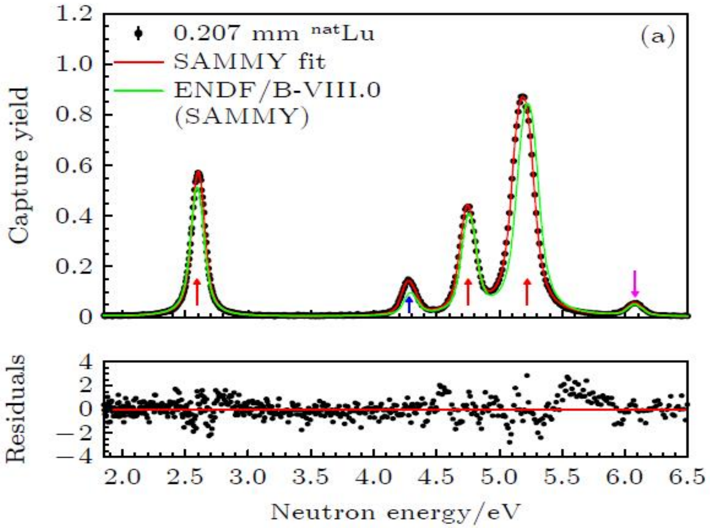
中子俘获反应实验研究

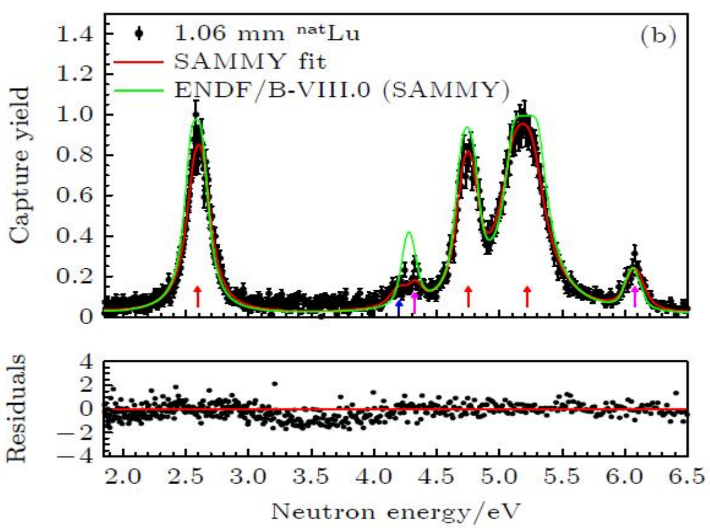






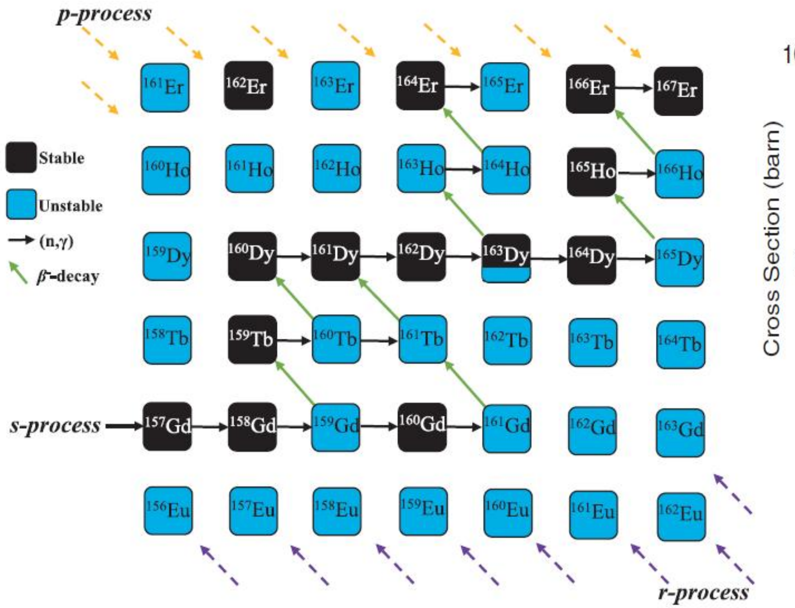


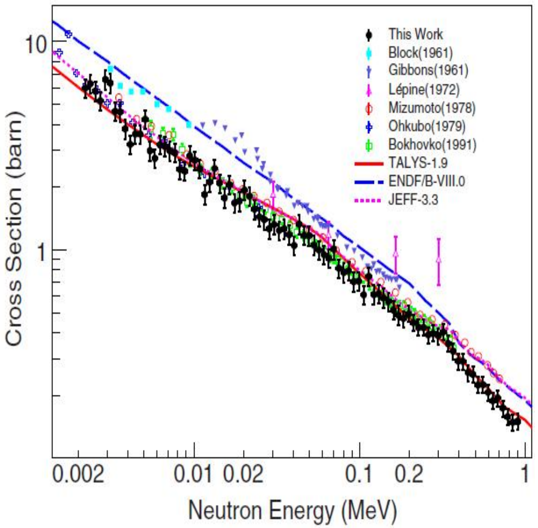


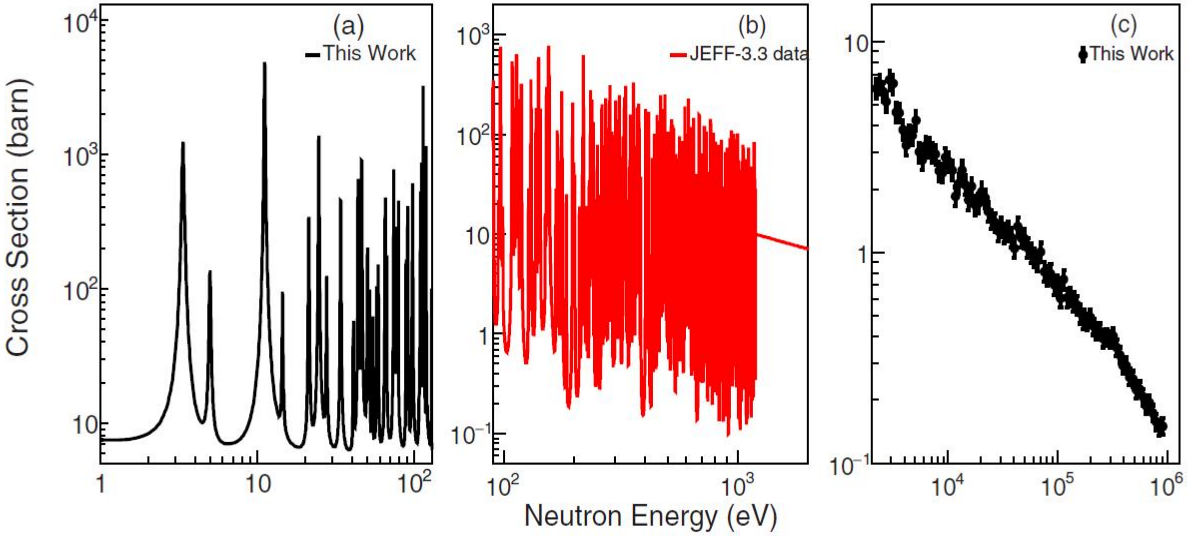


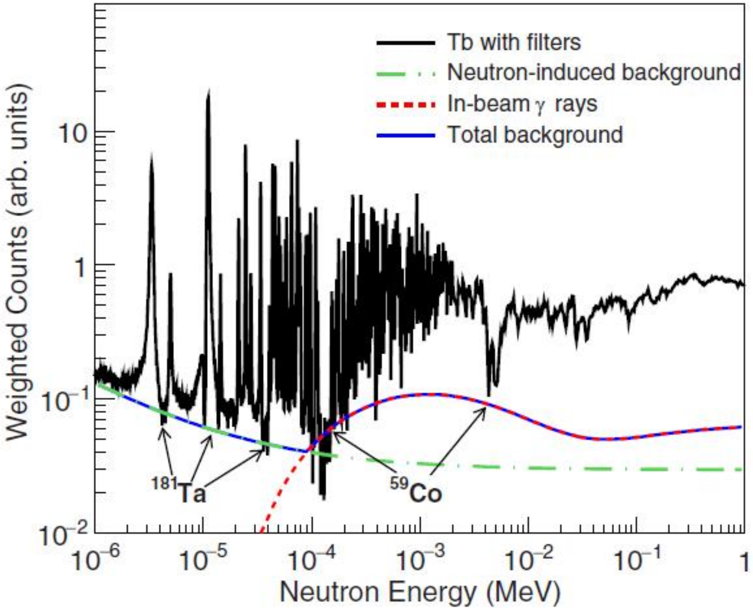
Wang De-Xin, et al., Acta Physica Sinica, 2022, 71(7): 072901.

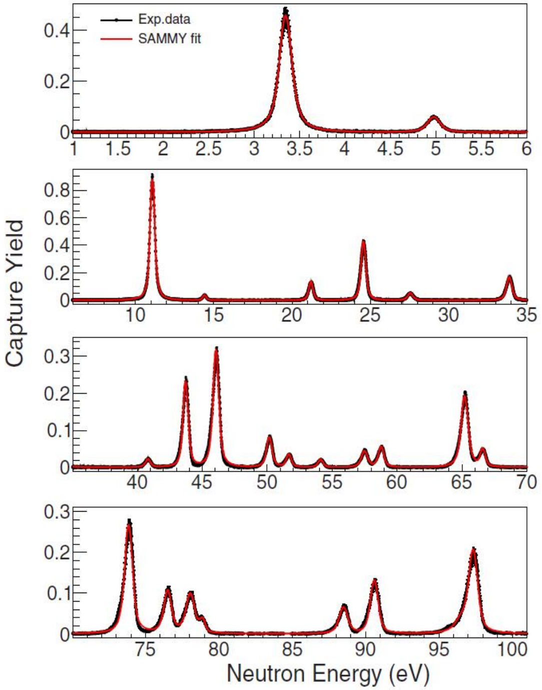
中子俘获反应实验研究

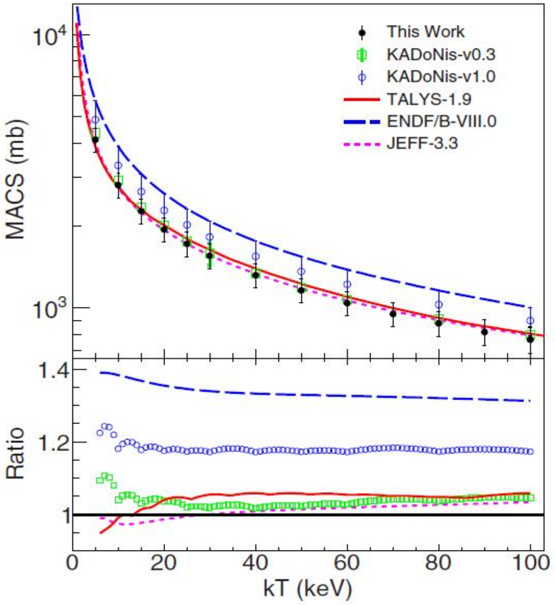

p-process
Stable
Unstable
(n,γ)
β⁻-decay
s-process
r-process
161Er 162Er 163Er 164Er 165Er 166Er 167Er
160Ho 161Ho 162Ho 163Ho 164Ho 165Ho 166Ho
159Dy 160Dy 161Dy 162Dy 163Dy 164Dy 165Dy
158Tb 159Tb 160Tb 161Tb 162Tb 163Tb 164Tb
157Gd 158Gd 159Gd 160Gd 161Gd 162Gd 163Gd
156Eu 157Eu 158Eu 159Eu 160Eu 161Eu 162Eu

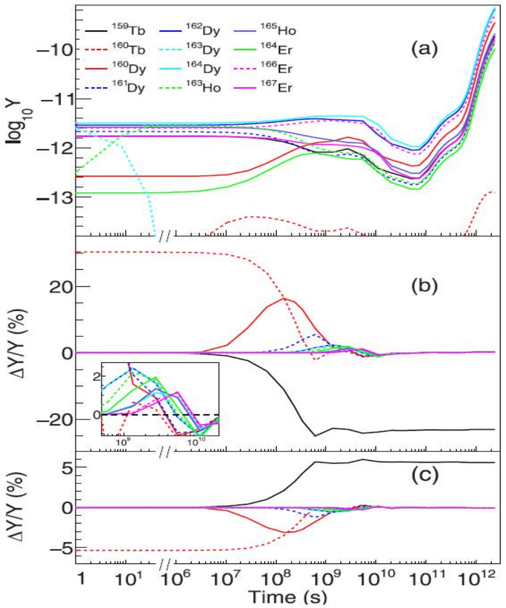

This Work
Block(1961)
Gibbons(1961)
Lépine(1972)
Mizumoto(1978)
Ohkubo(1979)
Bokhovko(1991)
TALYS-1.9
ENDF/B-VIII.0
JEFF-3.3
Cross Section (barn)
Neutron Energy (MeV)


(a)
This Work
(b)
JEFF-3.3 data
(c)
This Work
Cross Section (barn)
Neutron Energy (eV)

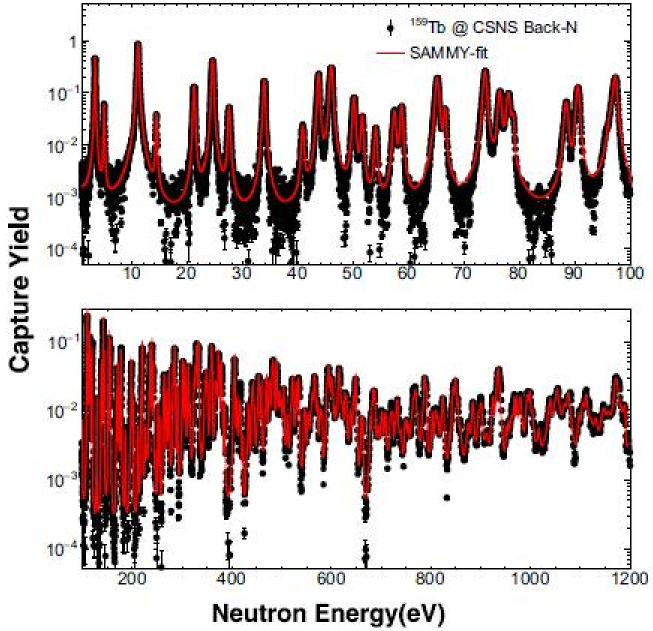

Tb with filters
Neutron-induced background
In-beam γ rays
Total background
Weighted Counts (arb. units)
Neutron Energy (MeV)
181Ta
59Co

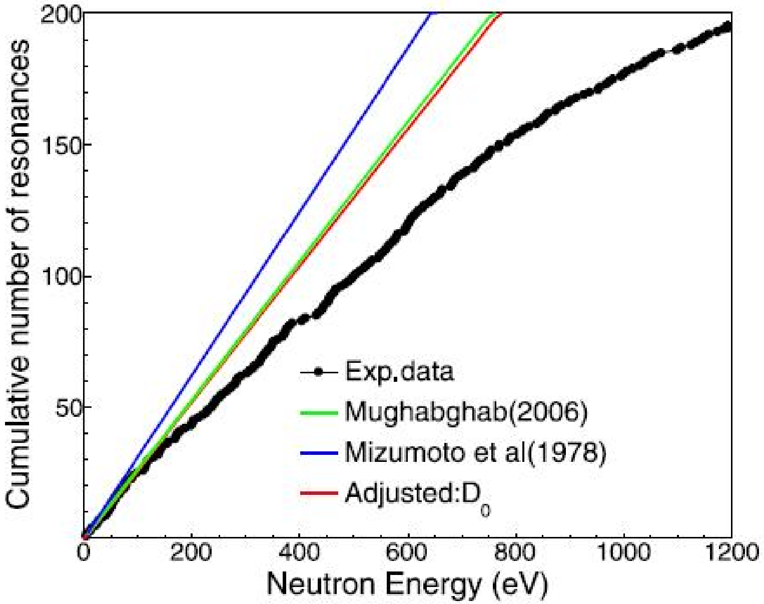

Exp.data
SAMMY fit
Capture Yield
Neutron Energy (eV)

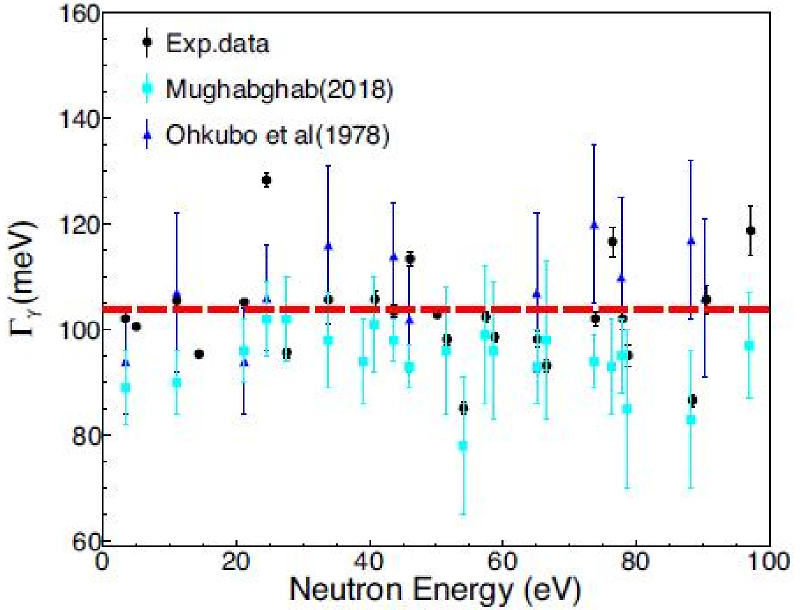

This Work
KADoNis-v0.3
KADoNis-v1.0
TALYS-1.9
ENDF/B-VIII.0
JEFF-3.3
MACS (mb)
Ratio
kT (keV)

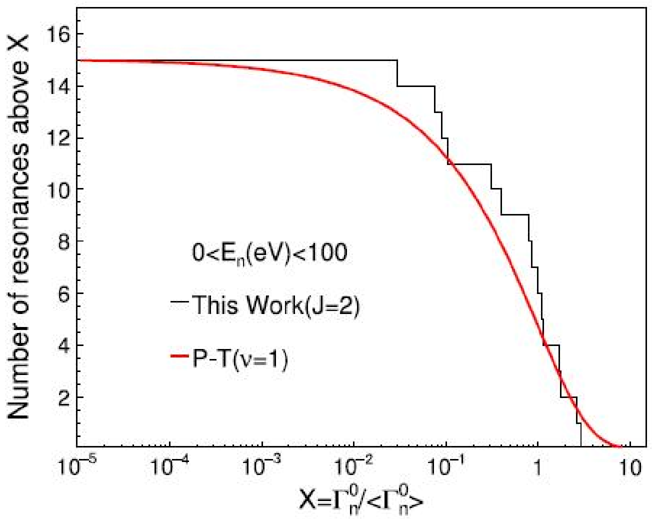

(a)
(b)
(c)
log10 Y
ΔY/Y (%)
Time (s)

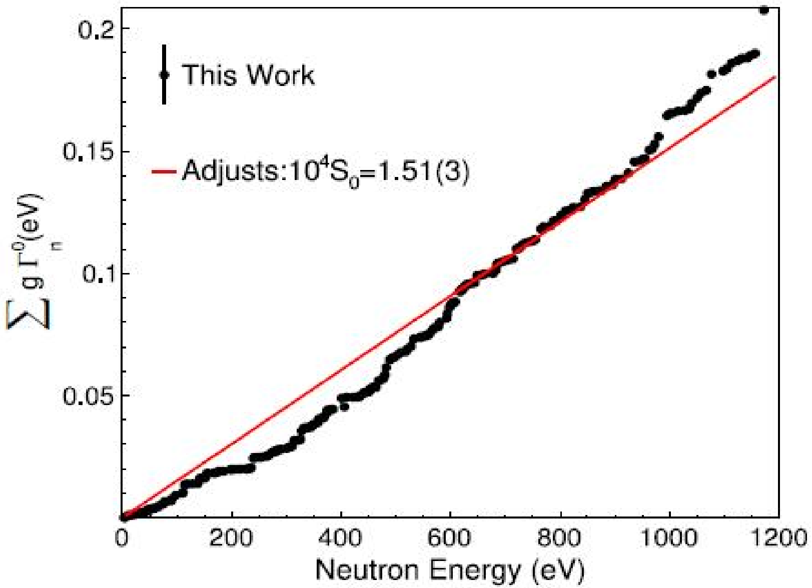
中子俘获反应实验研究

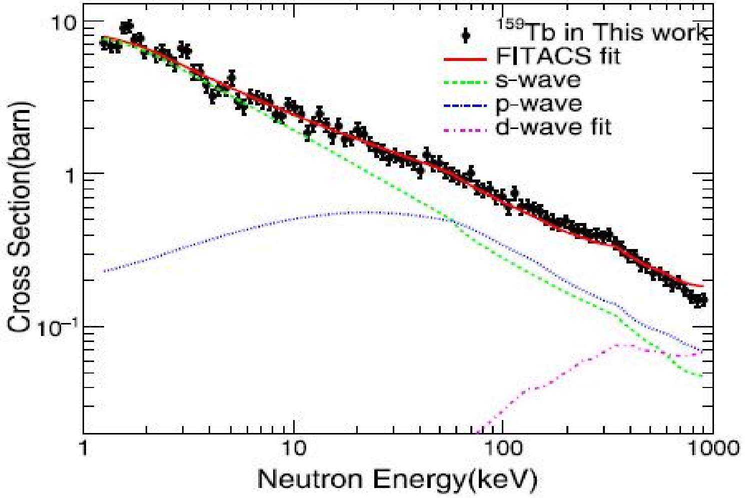






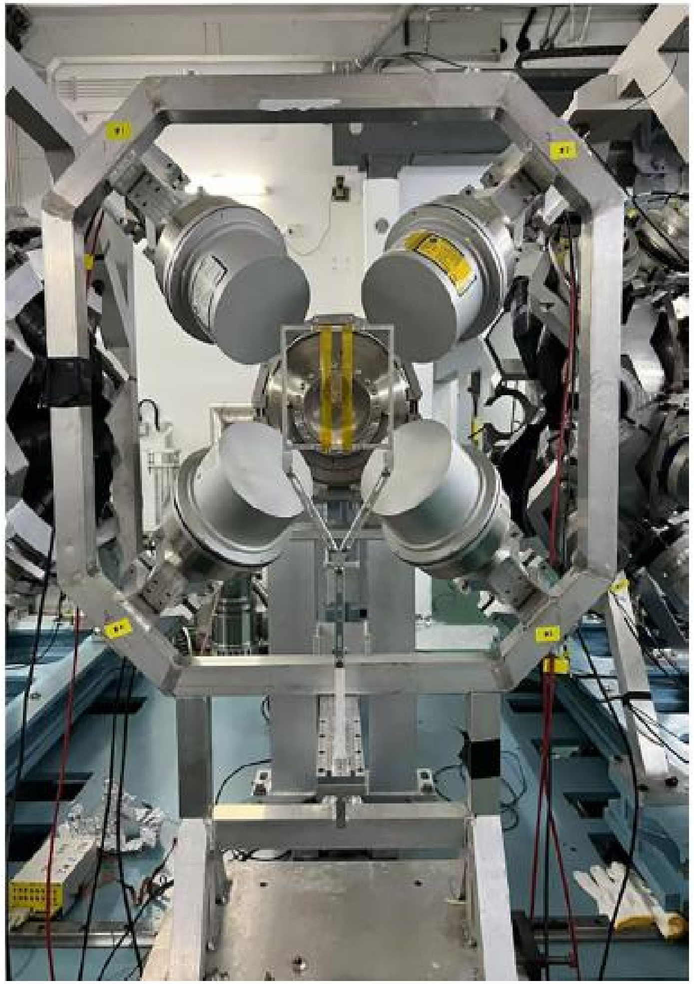


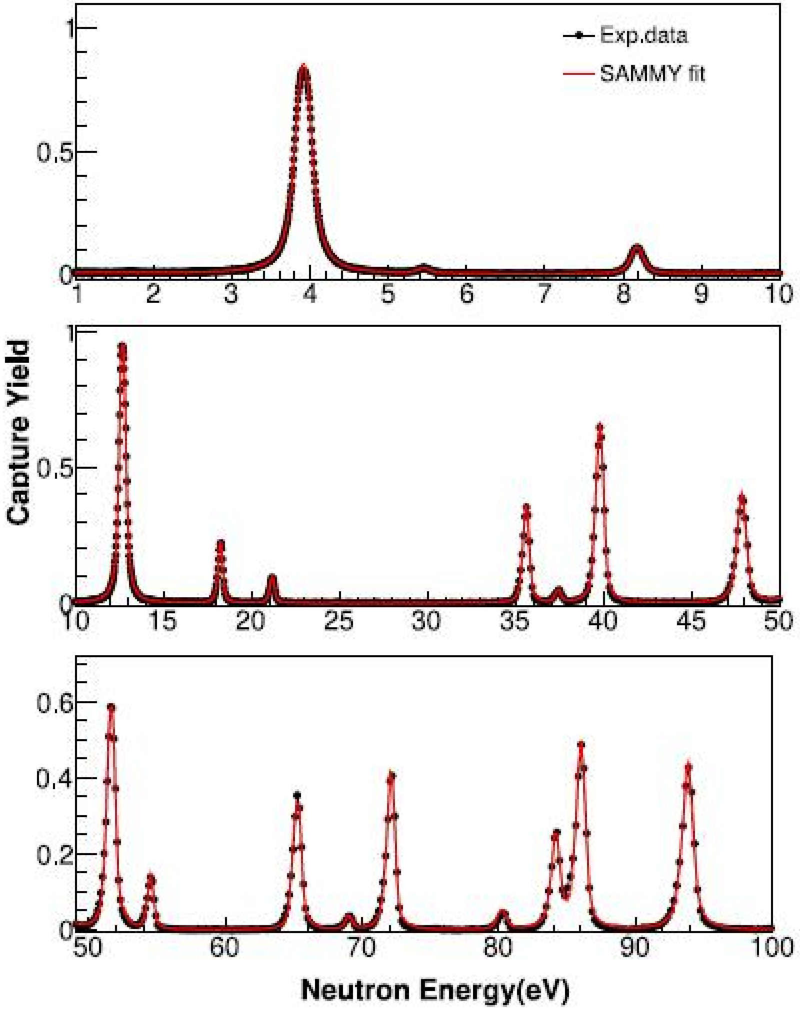


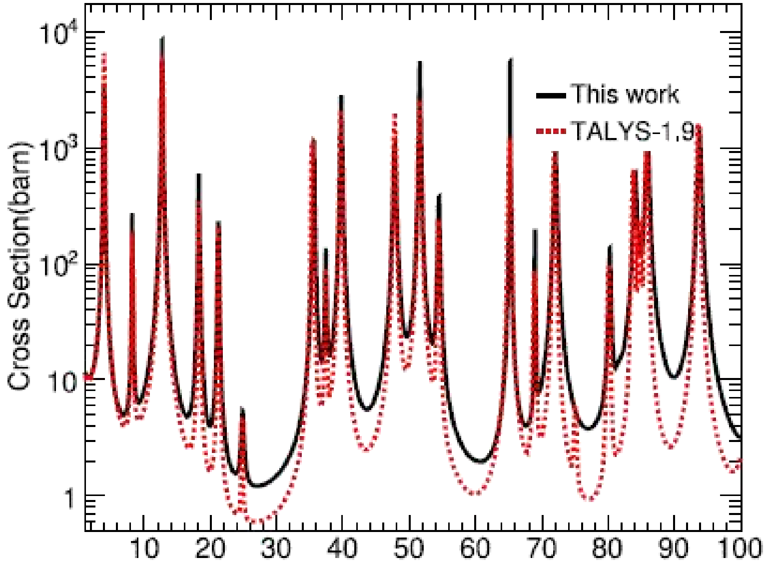


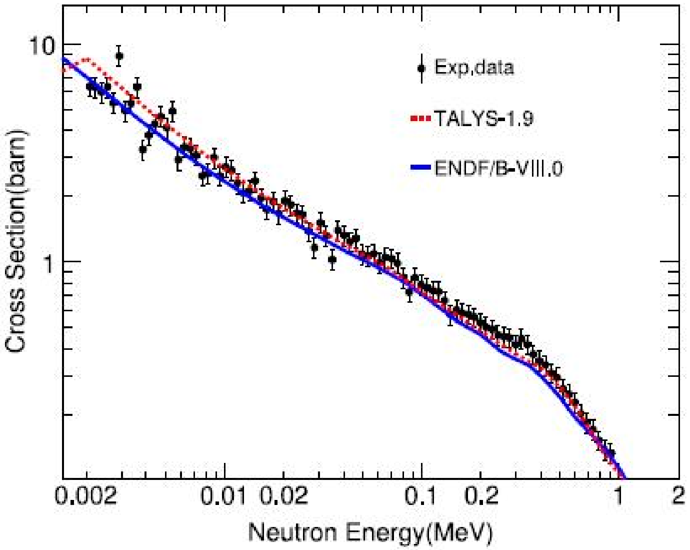
D., Wang, NST36:43 (2025)

中子俘获反应实验研究



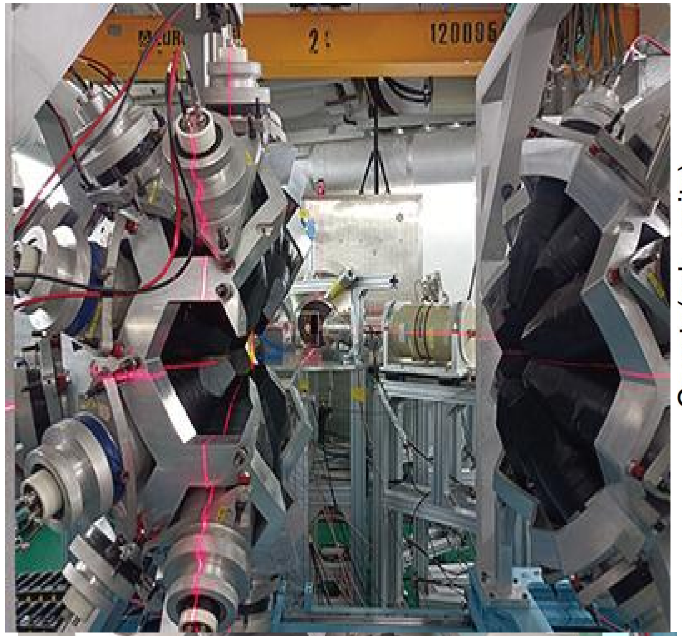


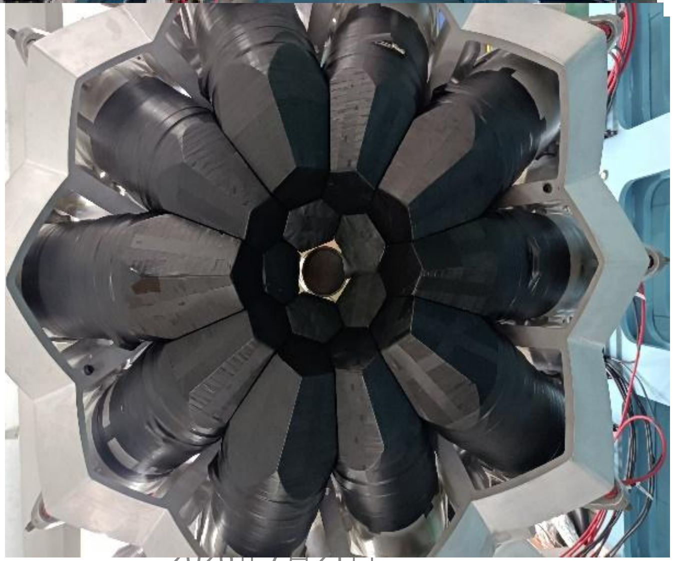


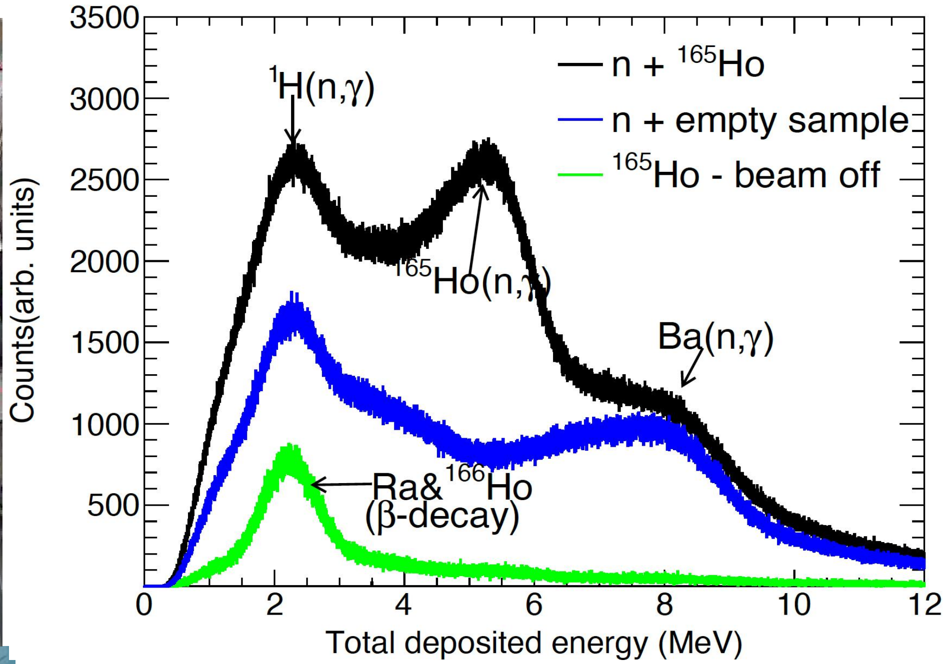


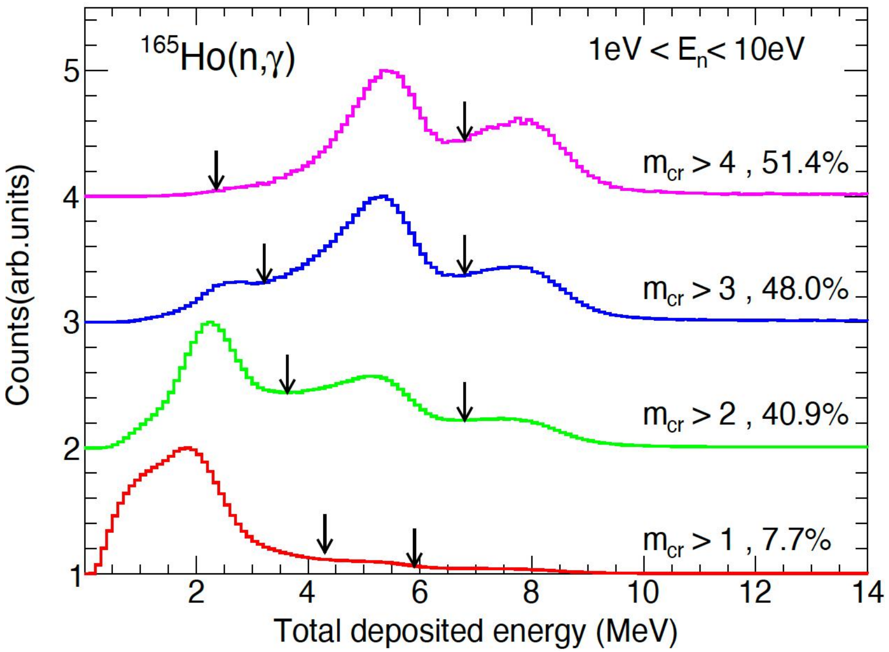
S. Zhang et al., NST36:168 (2025)

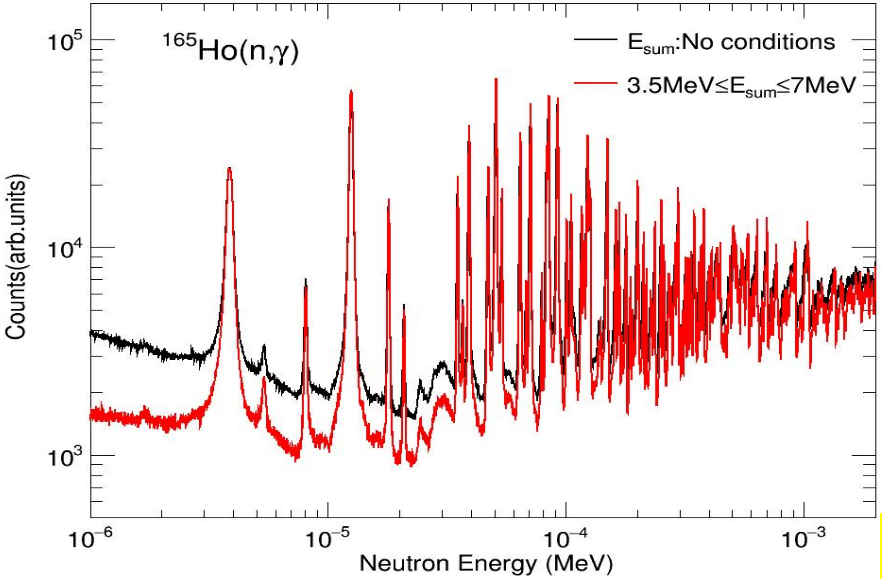
中子俘获反应实验研究

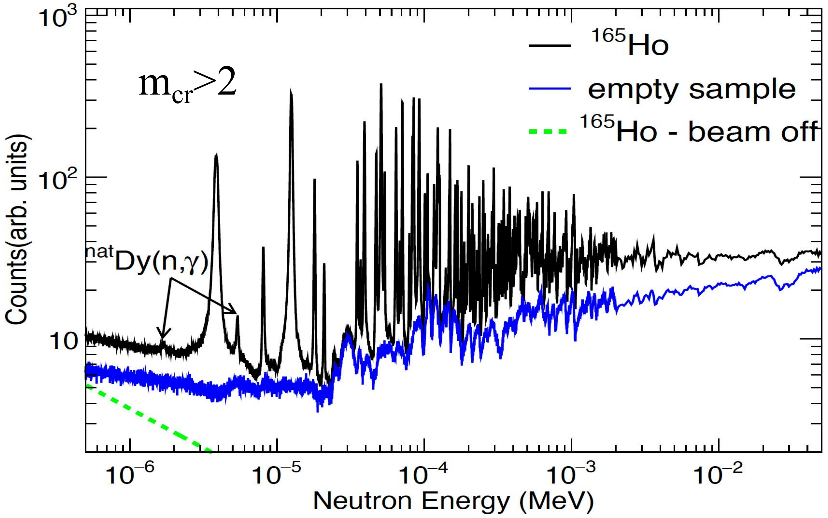






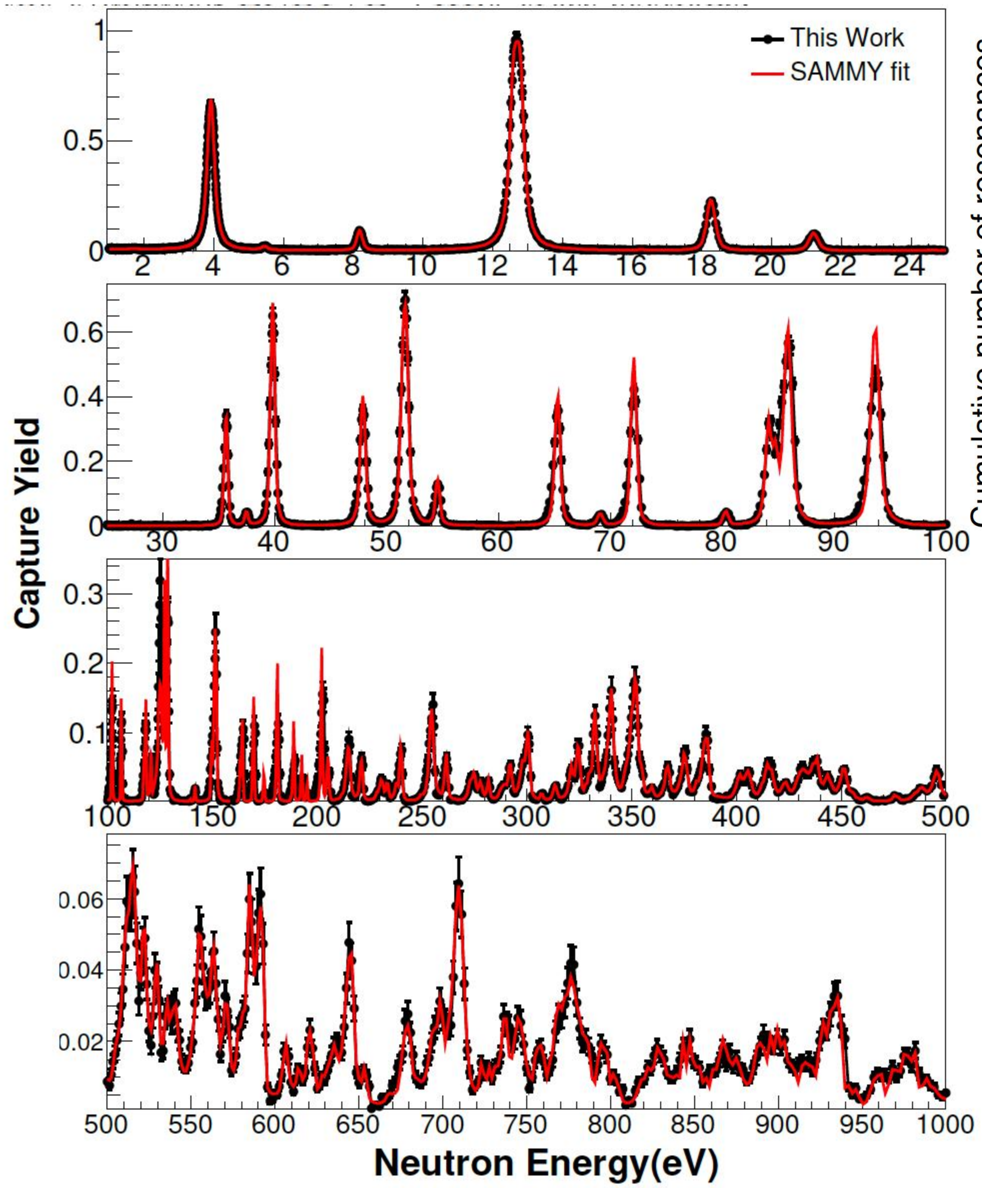


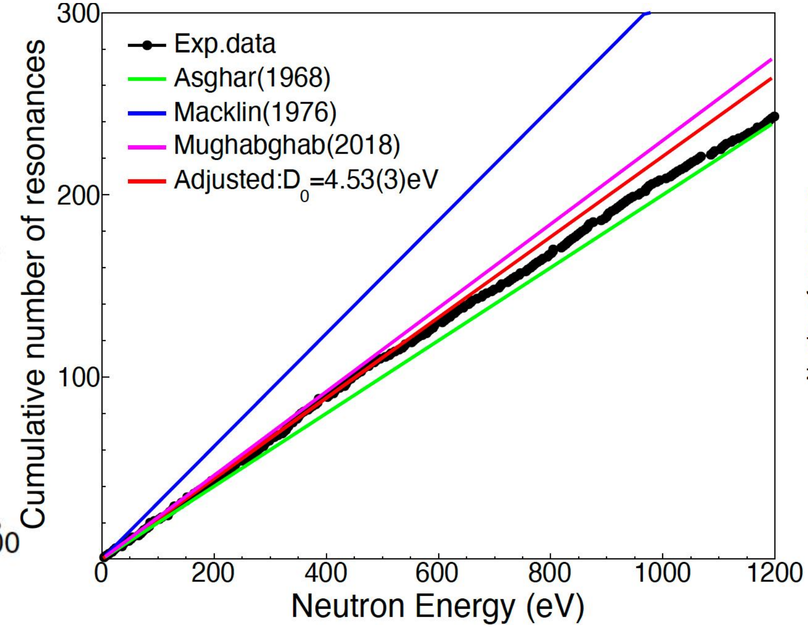


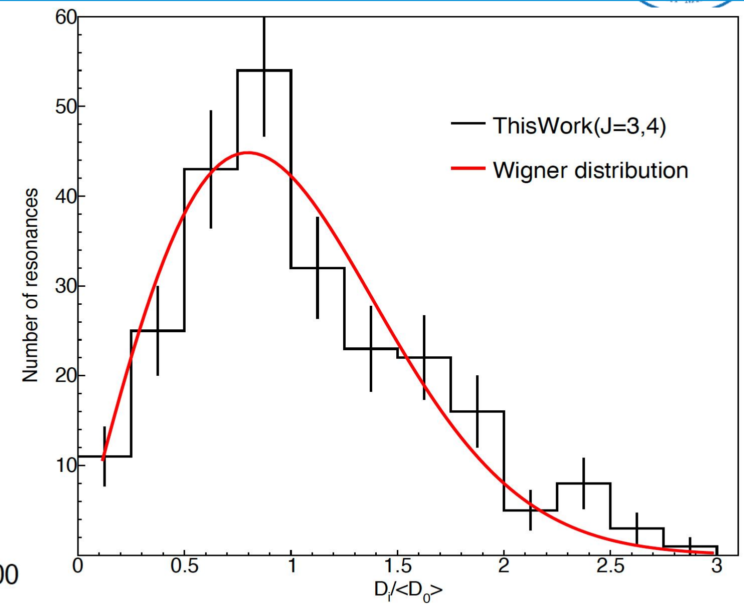


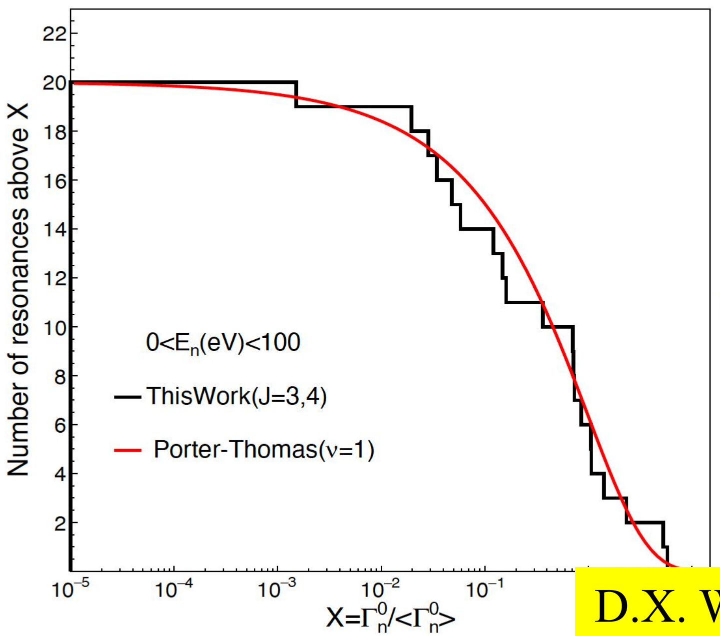
D.X. Wang et al., Eur. Phys. J. A 62, 49 (2026)

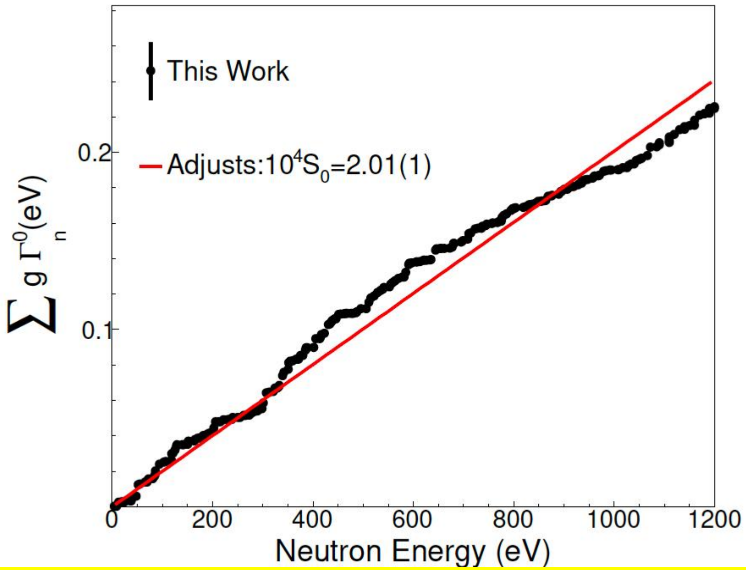
中子俘获反应实验研究





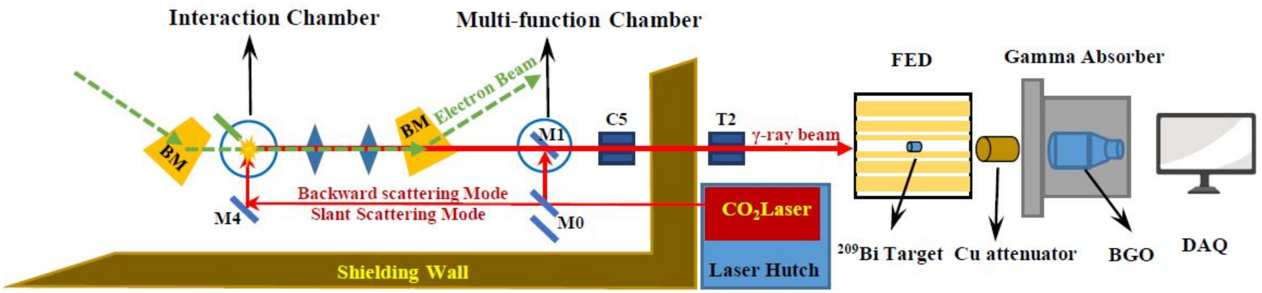


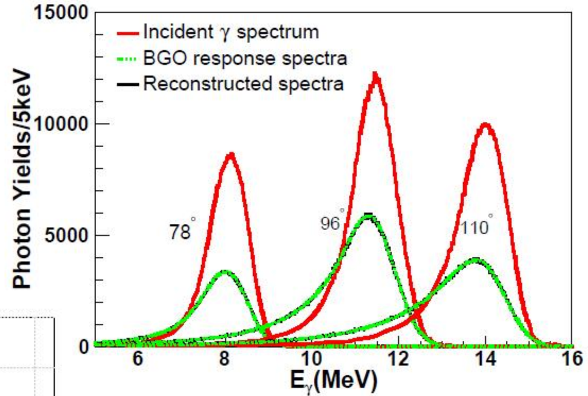


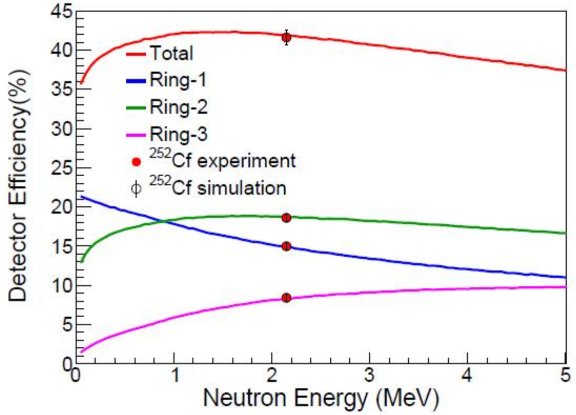


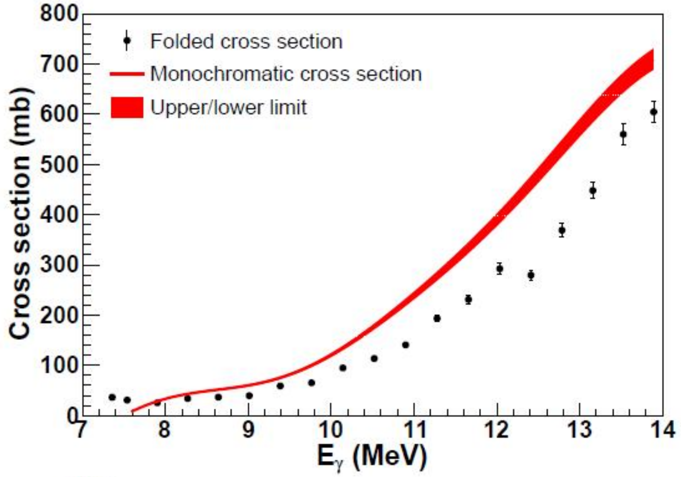
D.X. Wang et al., Eur. Phys. J. A 62, 49 (2026)

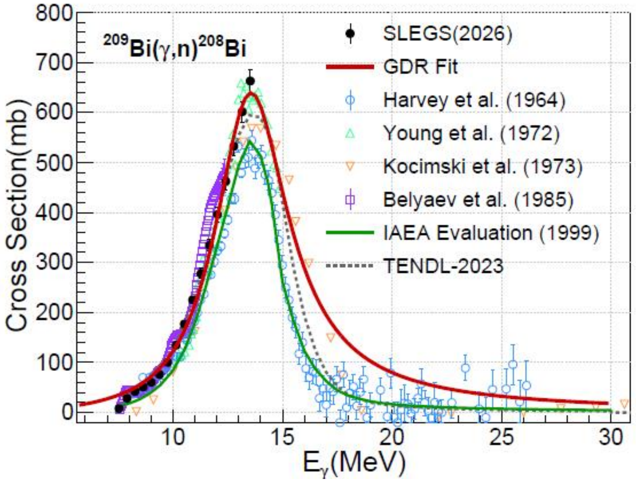
光中子反应实验研究

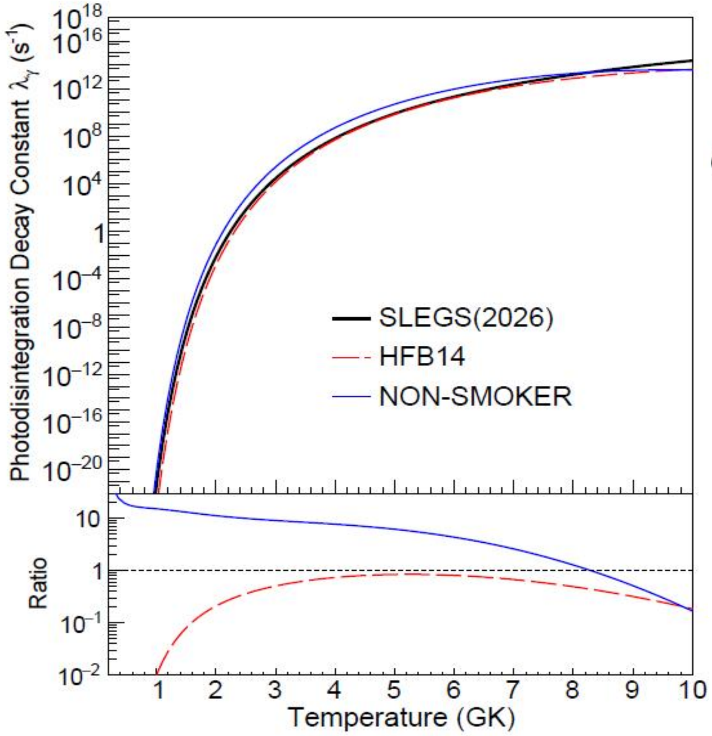








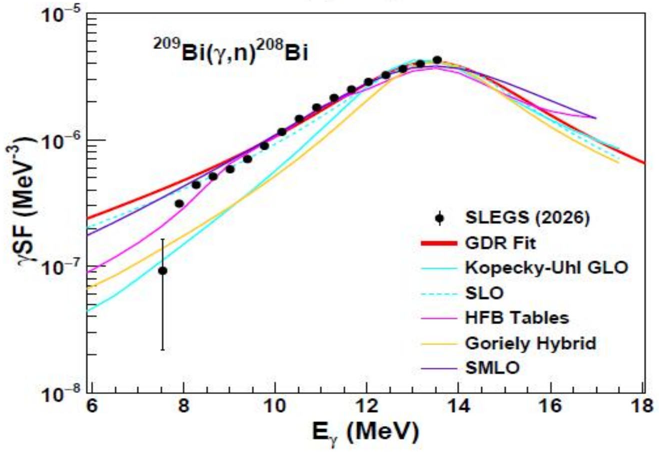


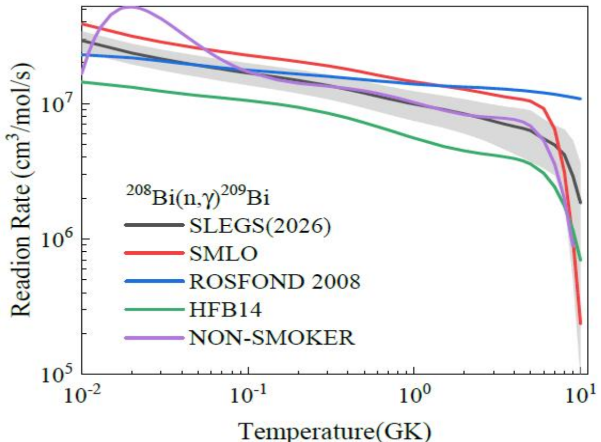


$$\sigma_{E1}(E_\gamma) = \sigma_{GDR} \frac{\Gamma_{GDR}^2 E_\gamma^2}{\left(E_\gamma^2 - E_{GDR}^2\right)^2 + \Gamma_{GDR}^2 E_\gamma^2},$$

$$f_{E1}(E_\gamma) = \frac{1}{3\pi^2 \hbar^2 c^2} \frac{\sigma_{\gamma n}(E_\gamma)}{E_\gamma},$$

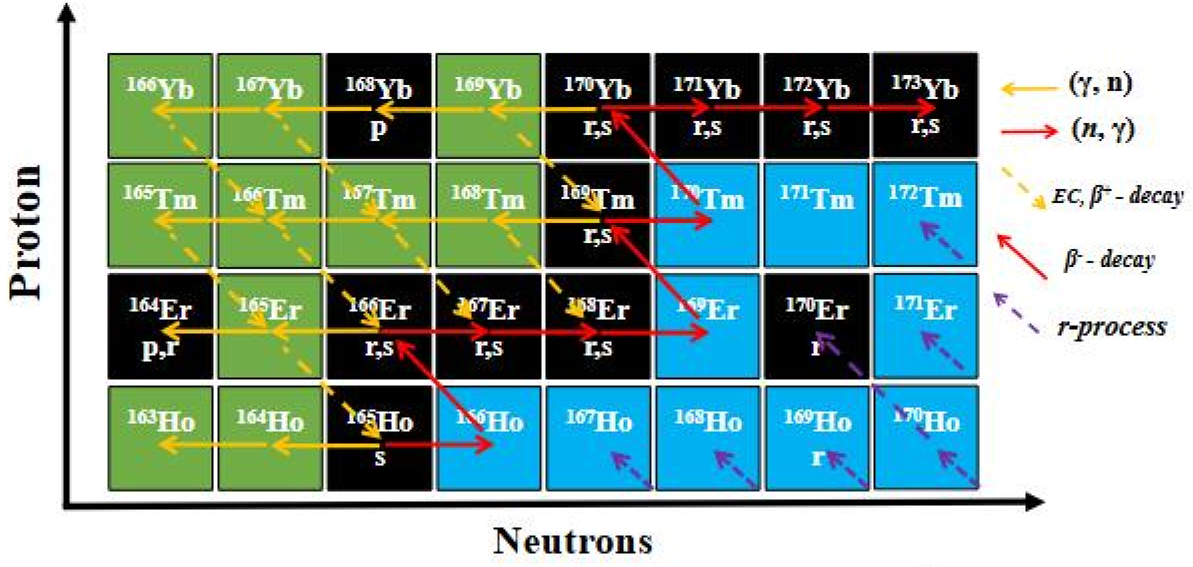
$$\lambda_\gamma(T_9) = \frac{8\pi}{h^3 c^2} \int_{S_n}^{\infty} \frac{E_\gamma^2}{e^{E_\gamma/kT} - 1} \sigma_{\gamma n}(E_\gamma) dE_\gamma.$$

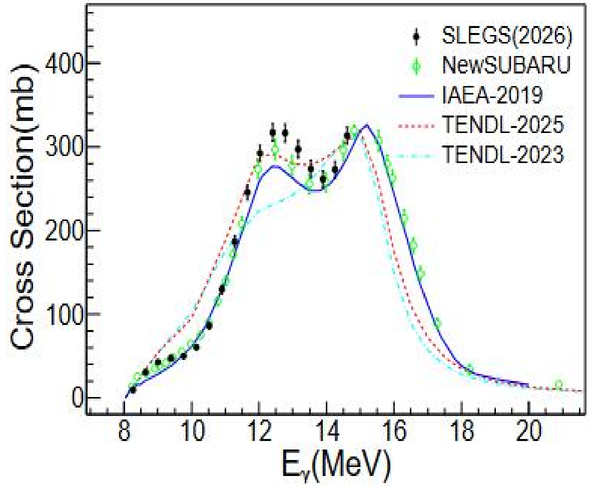


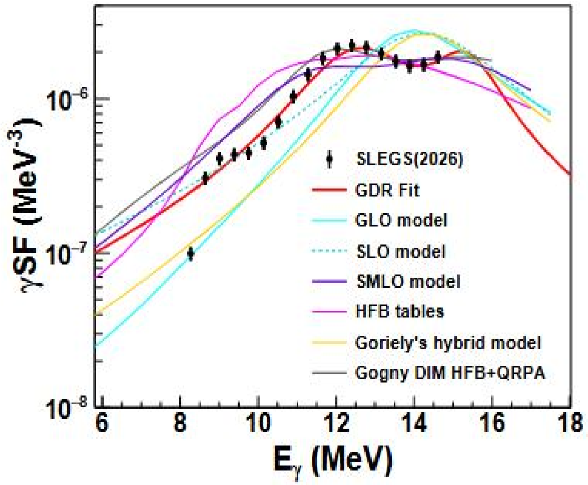


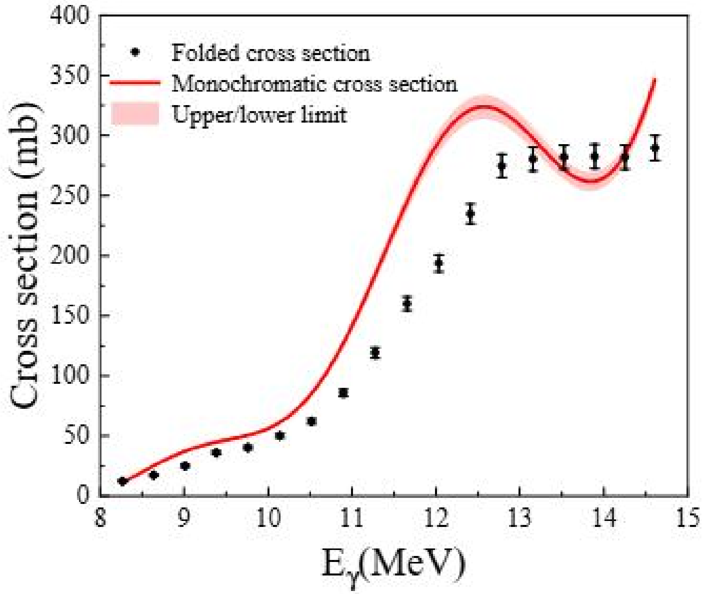
D., Wang, et al.,PRC (2026)under review

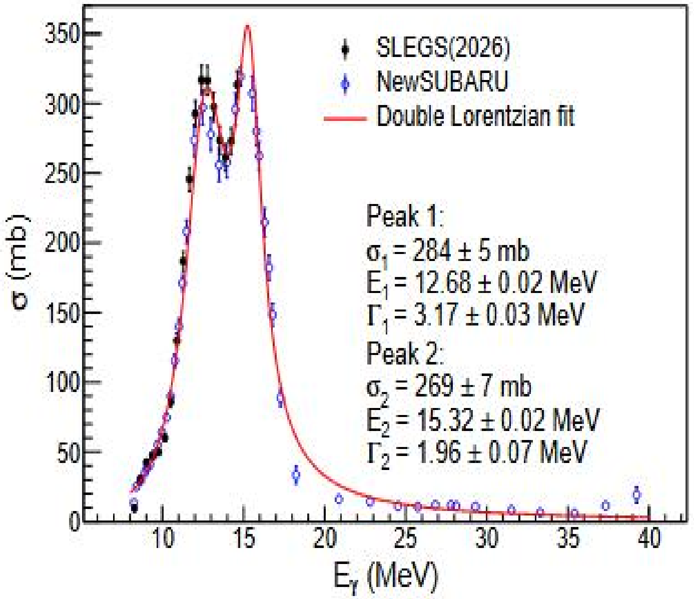
光中子反应实验研究

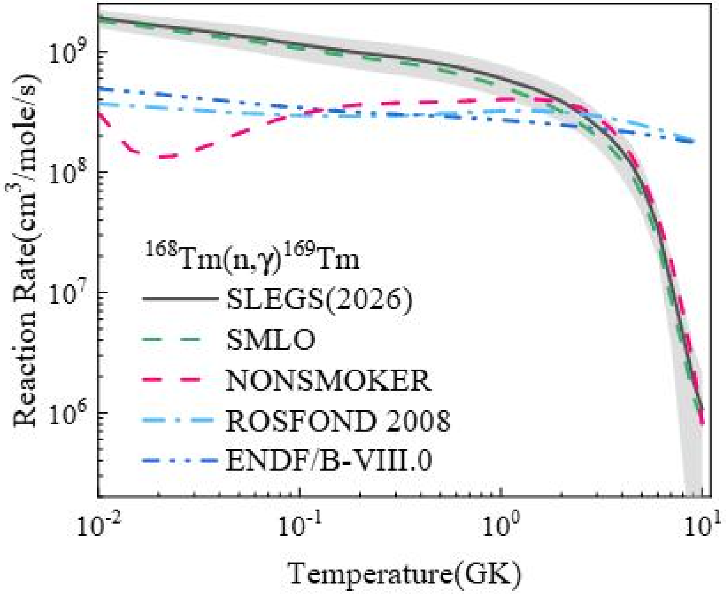






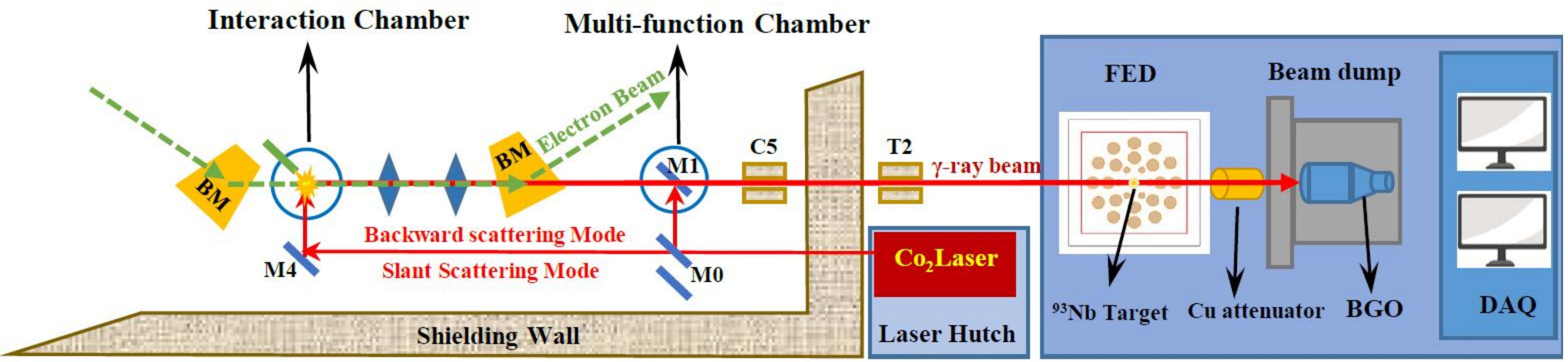


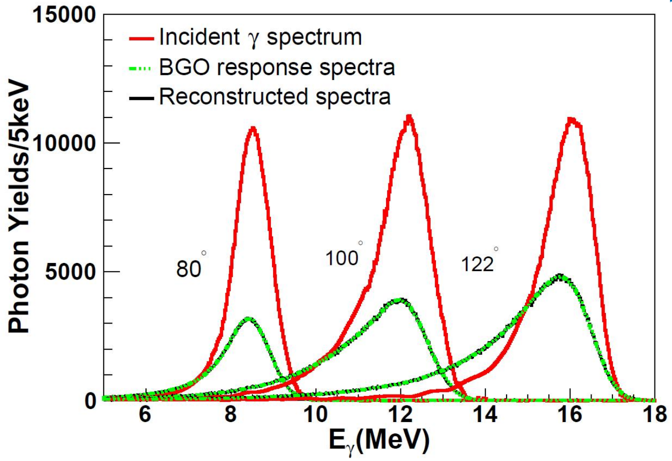


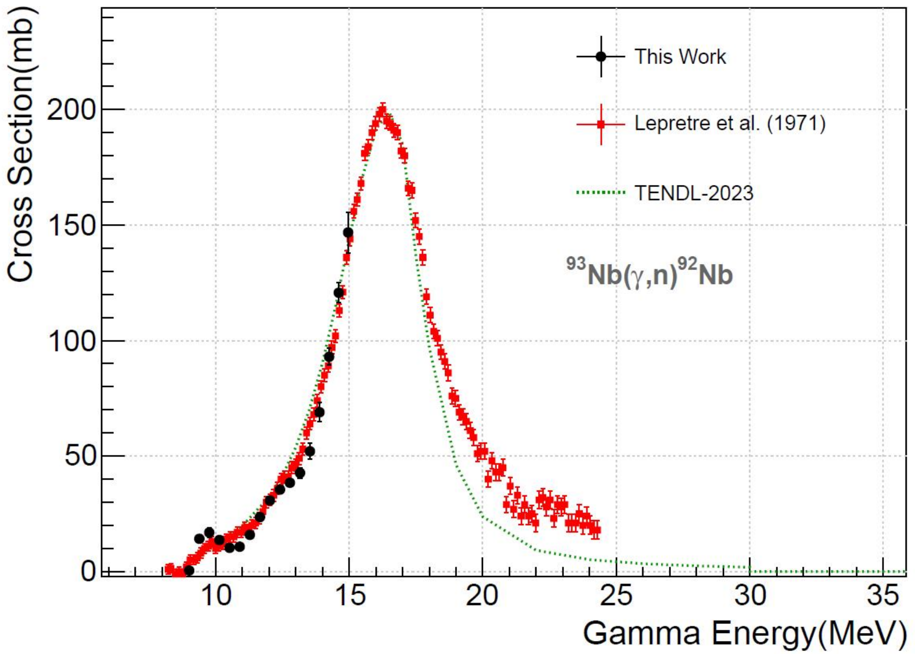


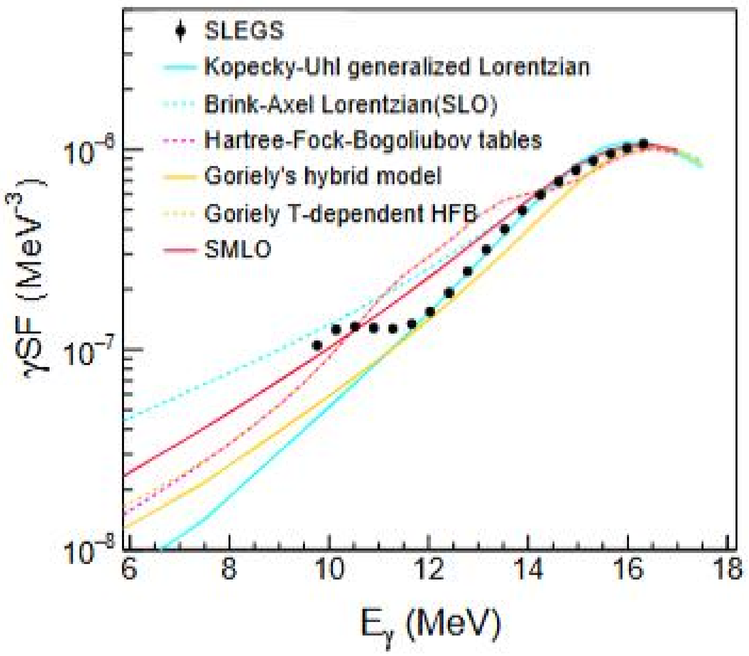
D., Wang, (2026) preparation.

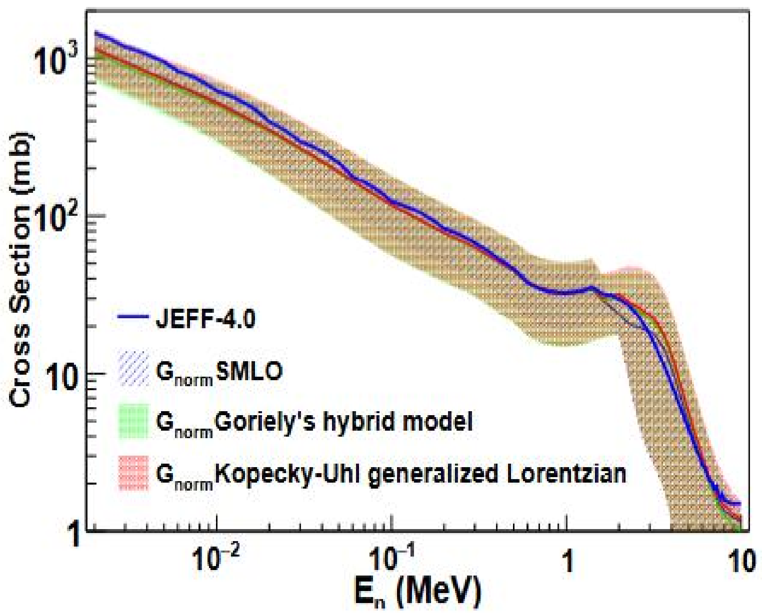
光中子反应实验研究









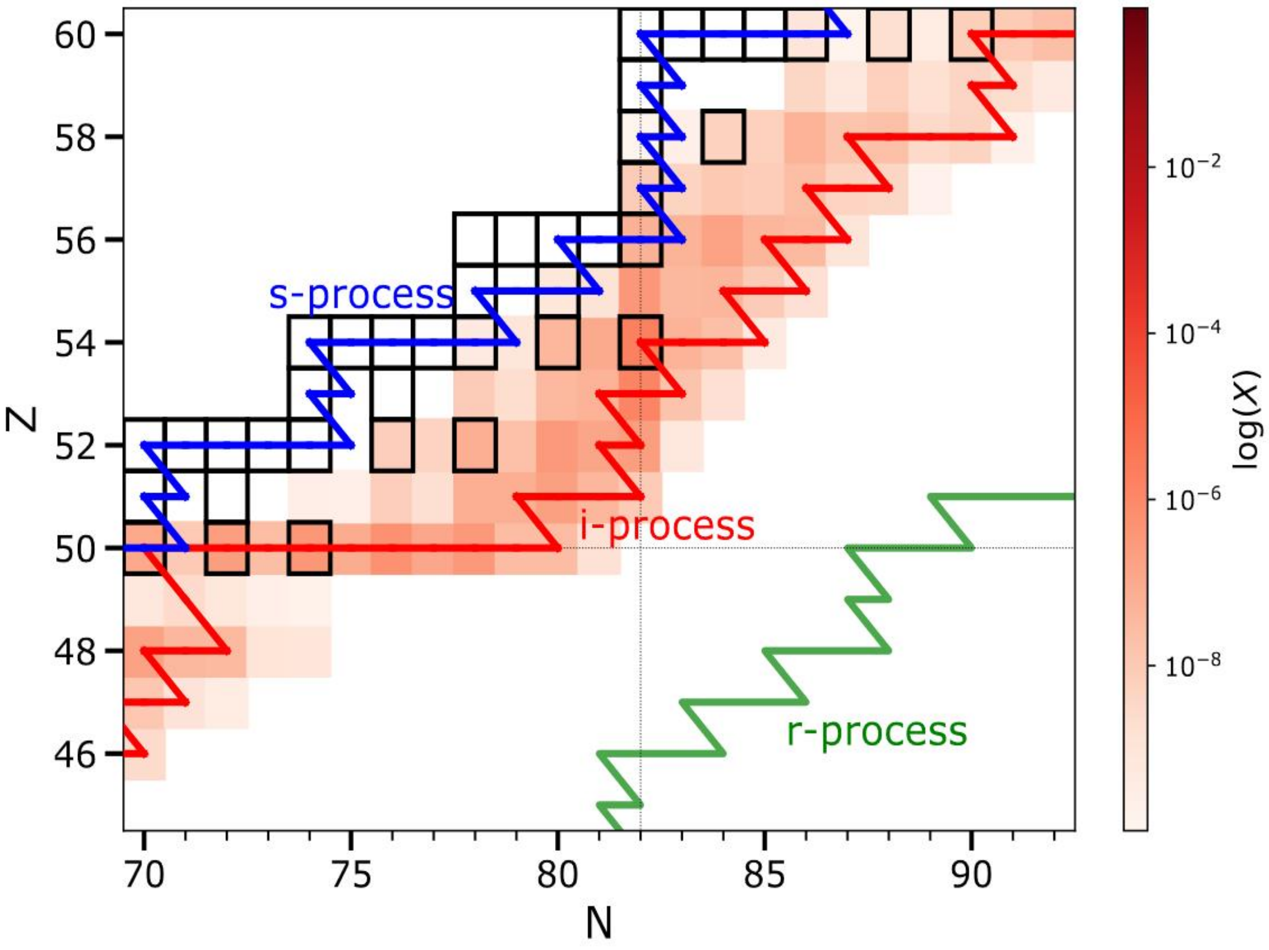


2026年7月21日

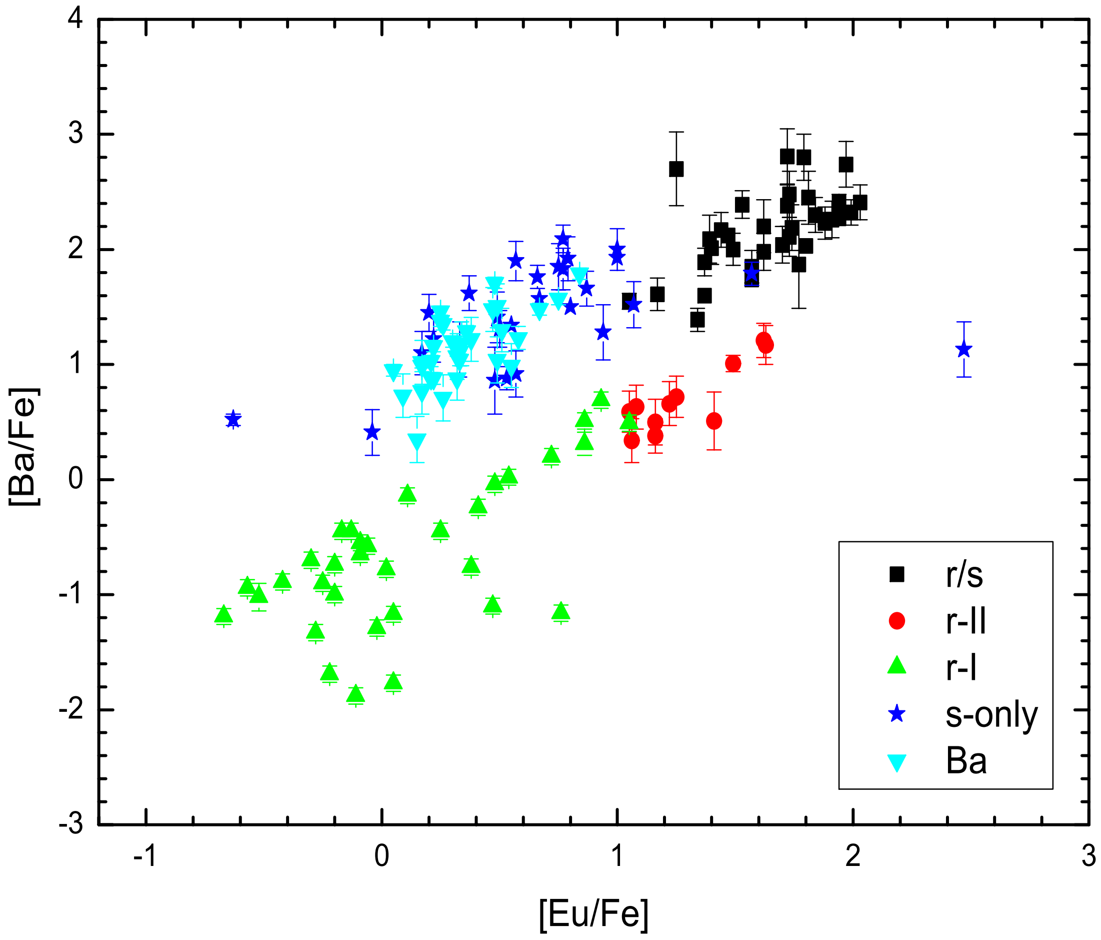
D., Wang, (2026) preparation.

i-process研究

CEMP-s/r: [Fe/H]<−1, [C/Fe]>1, [Ba/Fe]>1, [Eu/Fe]>1, [Ba/Eu]>0



Choplin et al. 2023



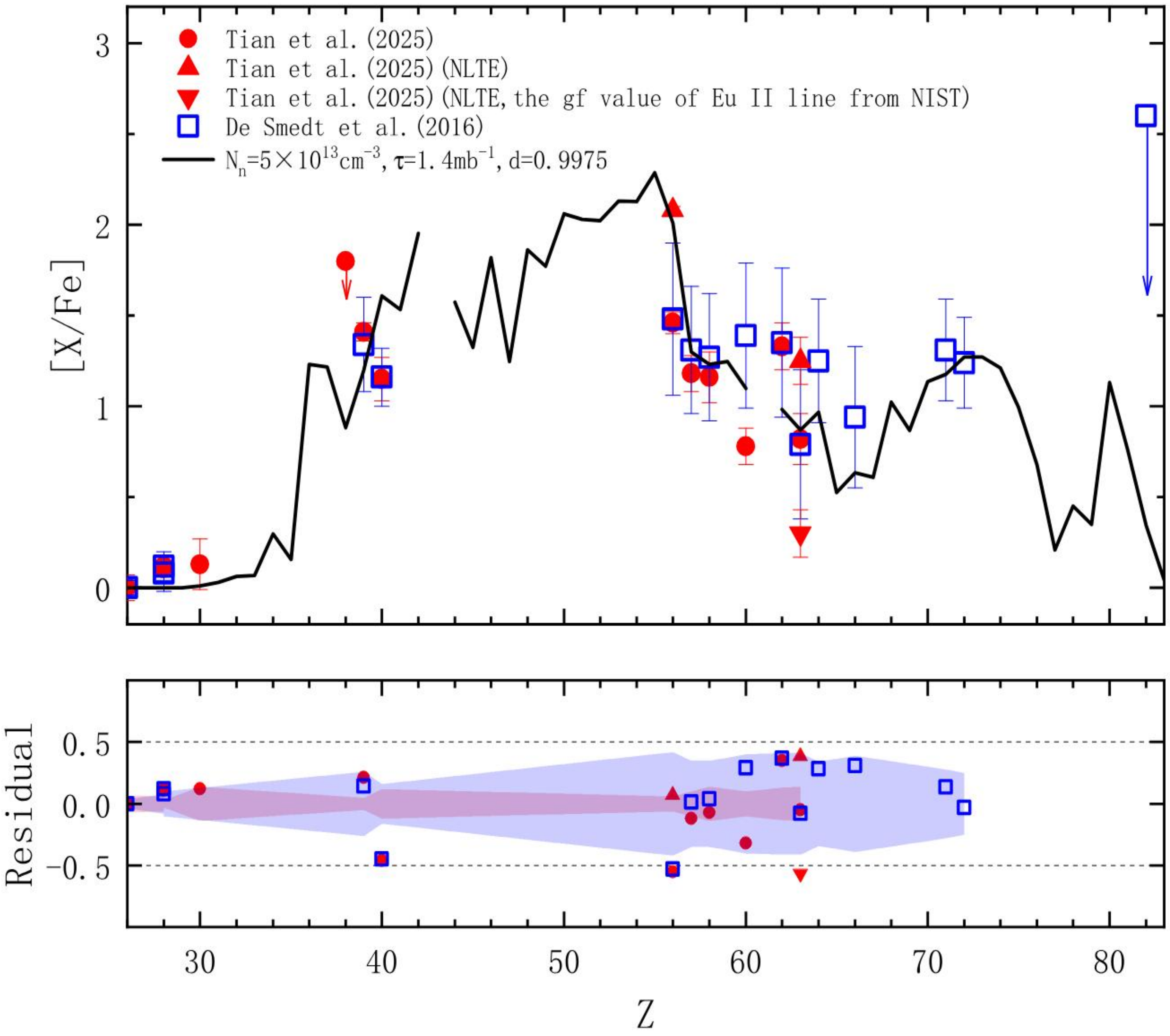
Cui Wen-yuan et al. 2024, in prep.

i-process研究

不同中子俘获过程的对比

Name		T/k	Neutron Source	N_n/cm^{-3}	Time Scale	Astrophysical Sites
s-process	Main	~10^8	$^{13}C(\alpha, n)^{16}O$	10^6-10^{11}	~ 10^4 yr	Low- and intermediate mass AGB stars
	Weak	3×10^8	$^{22}Ne(\alpha, n)^{25}Mg$		~1 yr	He-core/C-shell burning of massive star
i-process		2.5×10^8	$^{13}C(\alpha, n)^{16}O$	10^{12}-10^{16}	~1 day	Protons ingestion events(PIE)
r-process		>10^9	--	>10^{20}	~1 s	Neutron star mergers; Magneto-rotational supernovae; Collapsars

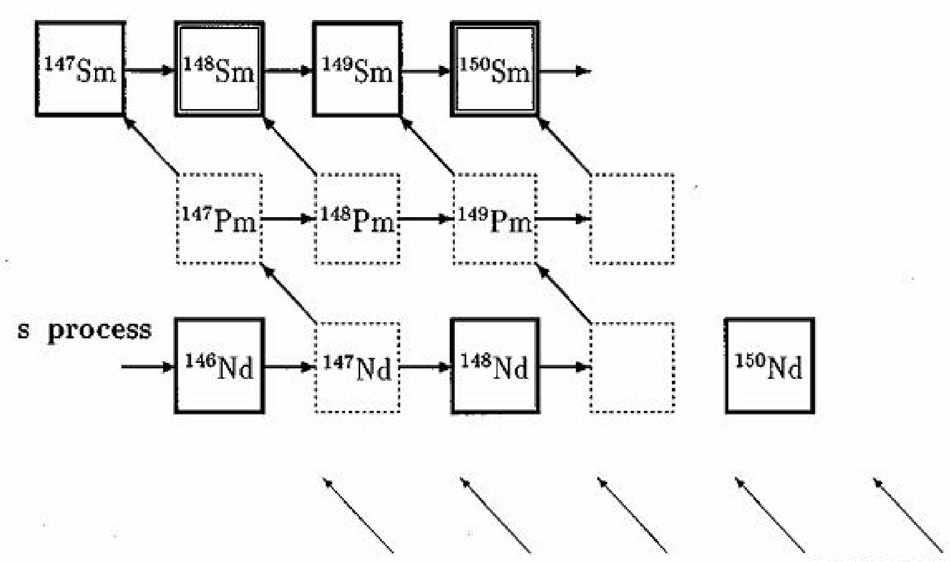
i-process研究

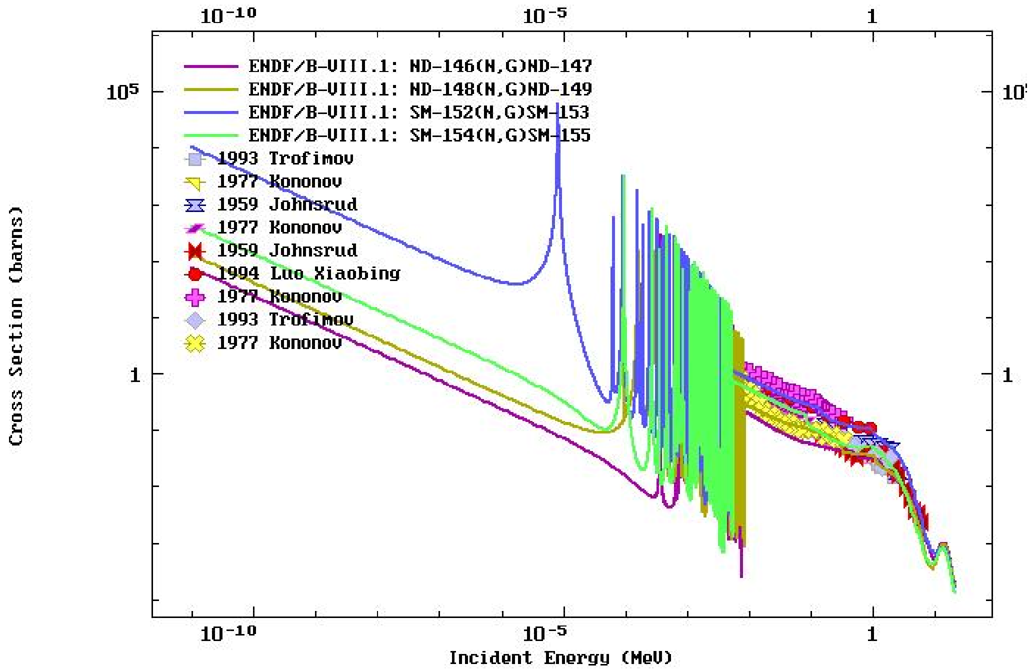


构建了包含7852个核素和51395个反应的核反应网络，计算了重元素的丰度分布，并与一颗Post-AGB星IRAS 14325-6428的观测数据进行对比研究。结果表明，IRAS 14325-6428中的重元素很可能来源于i-过程核合成。

i-process研究

Nd、Sm 同位素链（尤其是^{146}Nd、^{148}Nd 及 ^{152}Sm、^{154}Sm）位于s过程与r过程反应路径附近，其丰度既无法单独用纯s过程也无法单独用纯r过程网络计算准确重现，是判别i过程贡献、约束i过程中子密度和反应网络参数的关键指示核素。





本实验计划利用CSNS反角白光中子源（Back-n）结合GTAF（4π BaF_2 γ总吸收谱仪）宽能区、高效率、近4π立体角探测的优势，精确测量 ^{nat}Nd、^{146}Nd、^{148}Nd、^{nat}Sm、^{152}Sm、^{154}Sm 六个靶从共振区到keV能区的中子俘获截面数据，弥补现有数据空白，为i过程核合成网络计算、恒星演化模型及核天体物理丰度反演提供关键核数据支撑。

核物理学科介绍：人才队伍

4人中科院毕业，3人海外经历，1人省杰青.

核物理学科介绍："十年"建设经历

2015

1. 聚变中子积分实验

2016

2. 原子核团簇结构
3. 核天体网络计算

2019

4. 激光诱导质谱仪
5. 天体中子俘获反应

2021

6. 环境与食品辐射测量
7. 月球土壤放射性分析

2023

8. 辐射蒙药材诱变育种机理
9. 辐射探测新材料及其应用
10. 激光击穿光谱技术及应用

2024

11. 光中子反应测量
12. 机器学习分析方法

2025

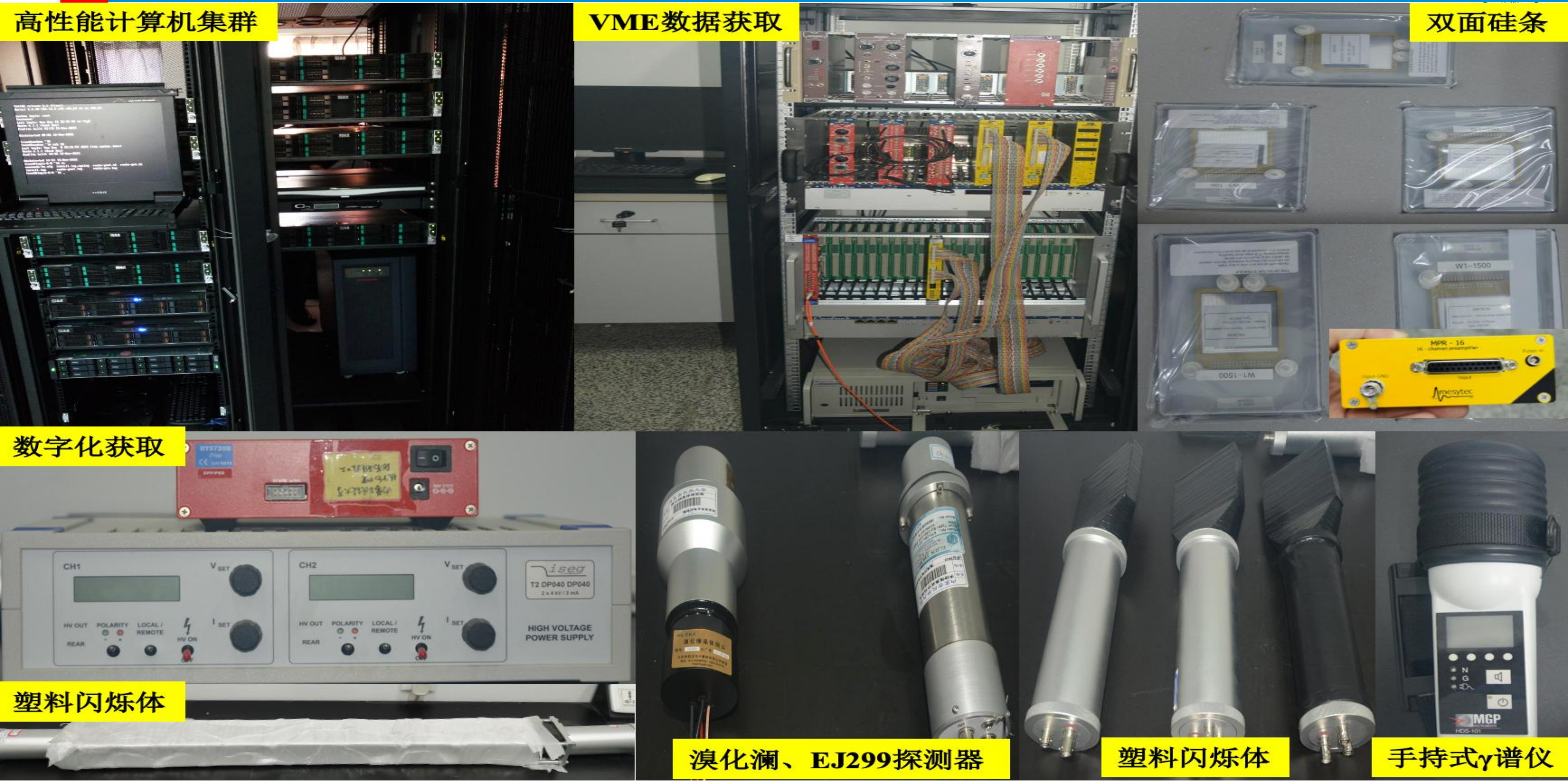
13. 单光子成像系统研制
14. 中子伽马土壤测量仪
15. 相对论重离子核物理

十五五

内蒙古自治区重点实验室

核物理与核技术应用重点实验室

核物理学科介绍：科研平台



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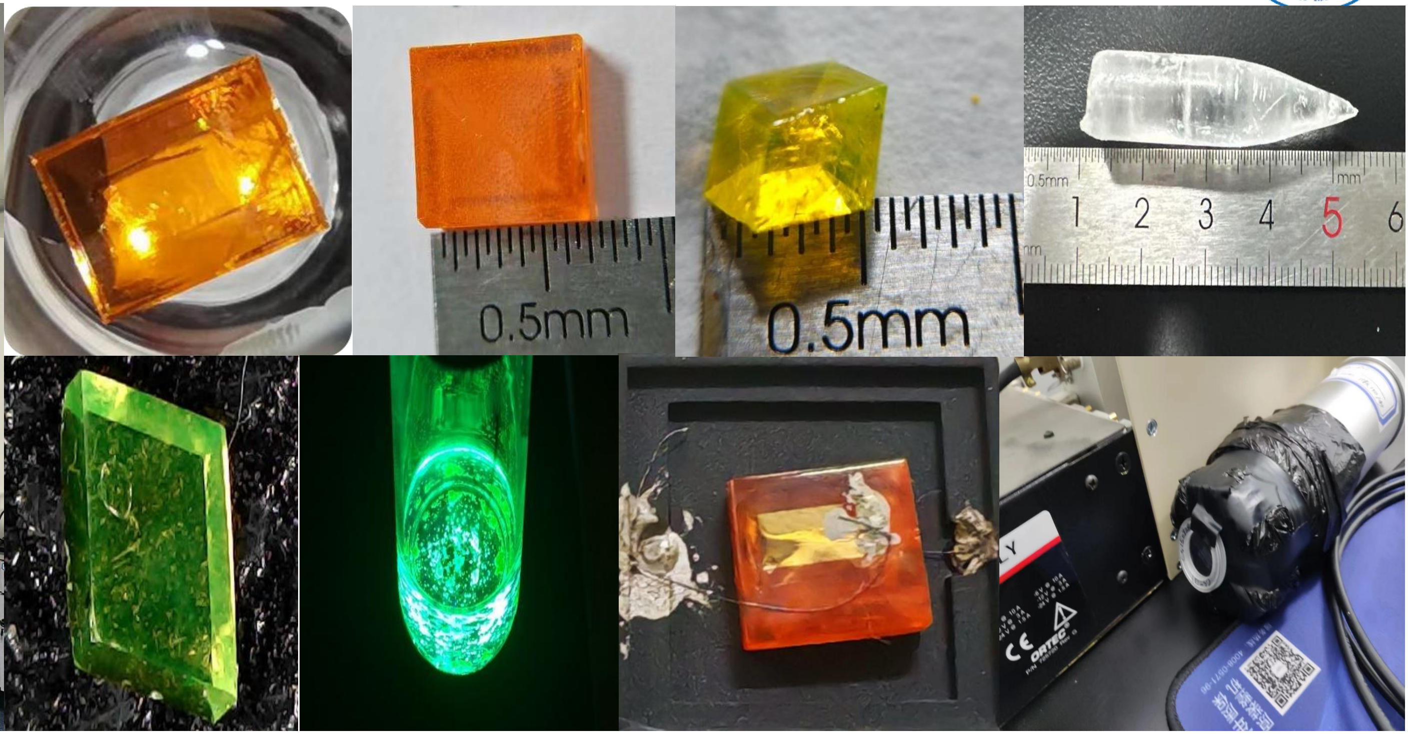

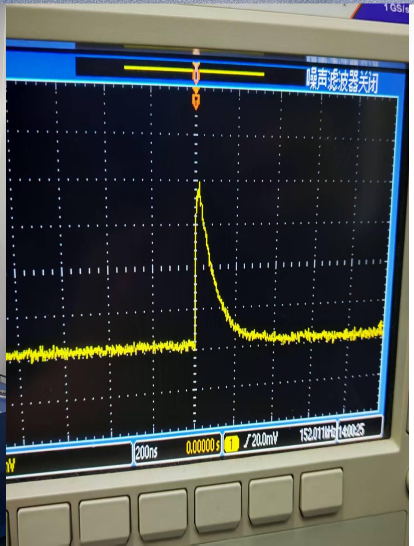

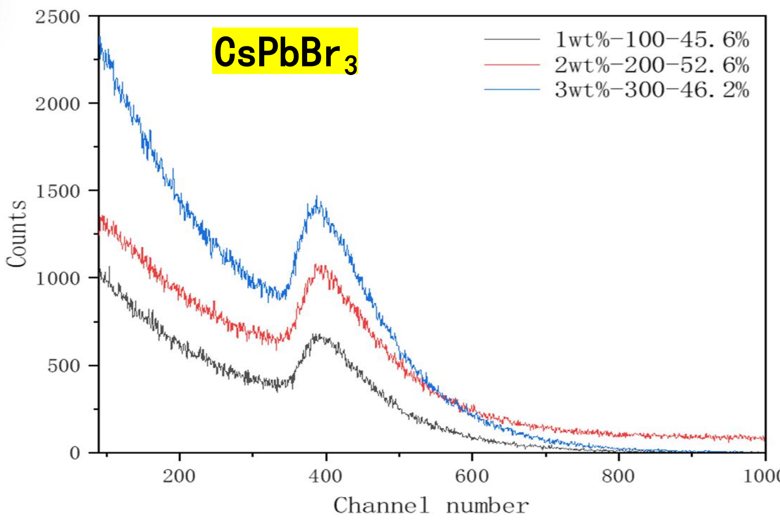

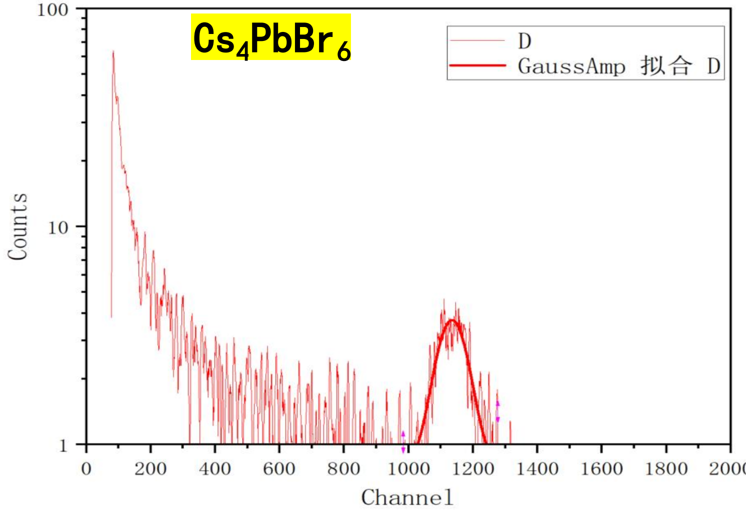

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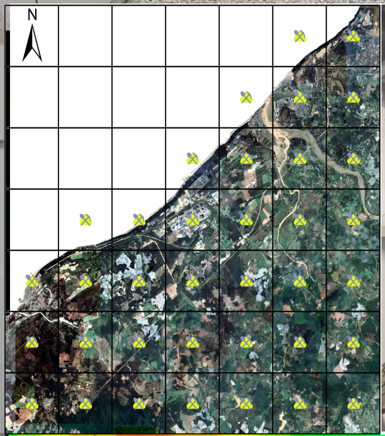

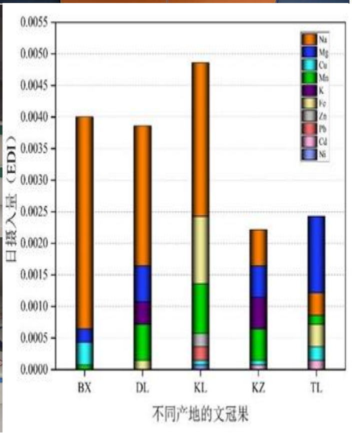

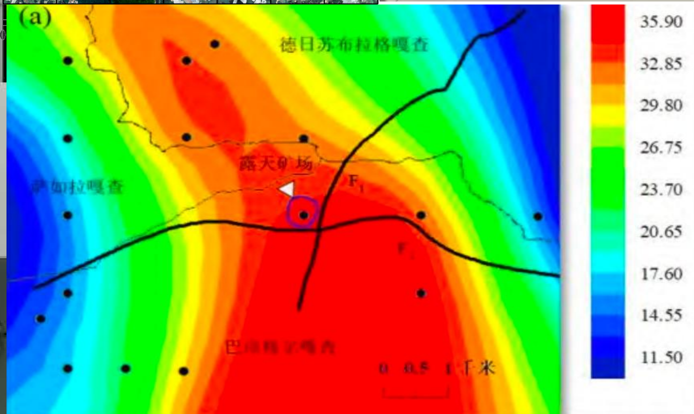

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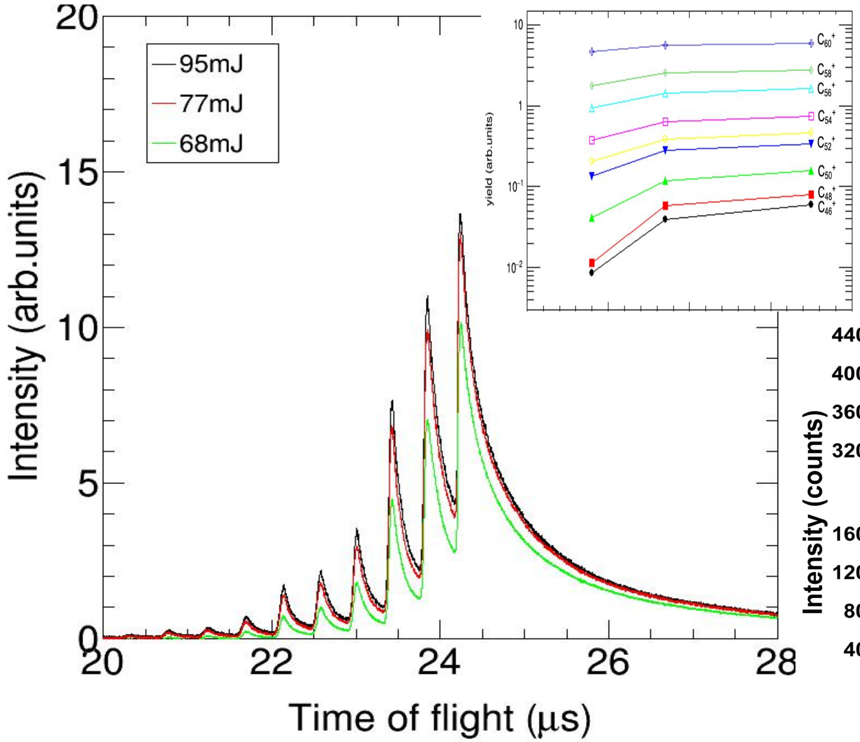
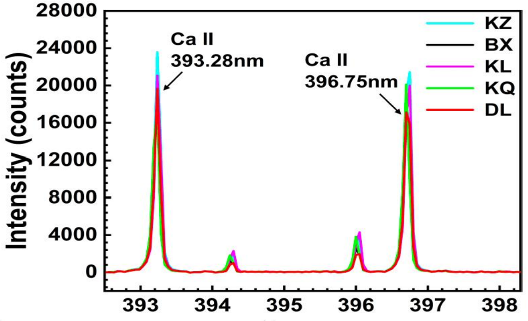
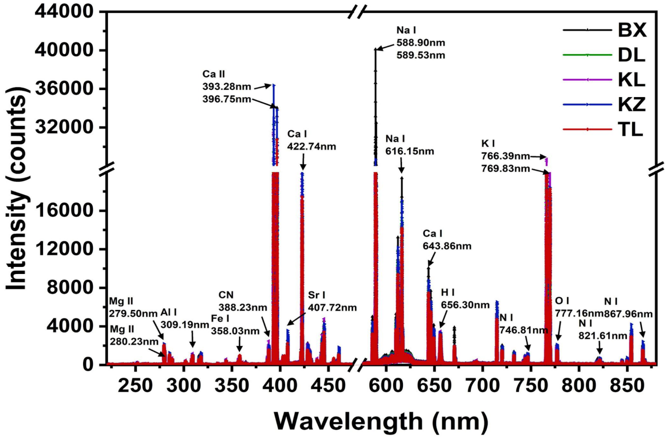
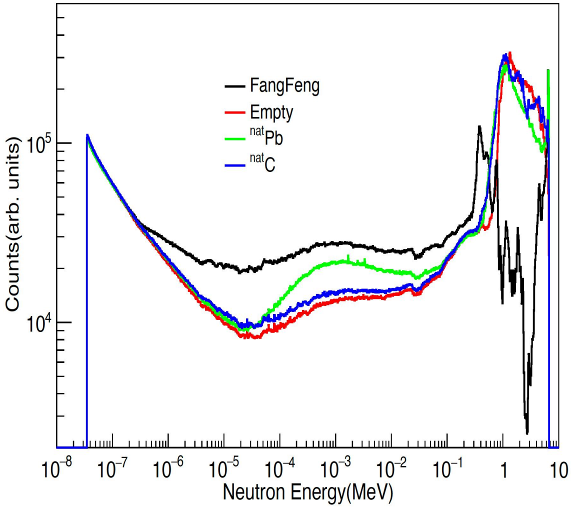






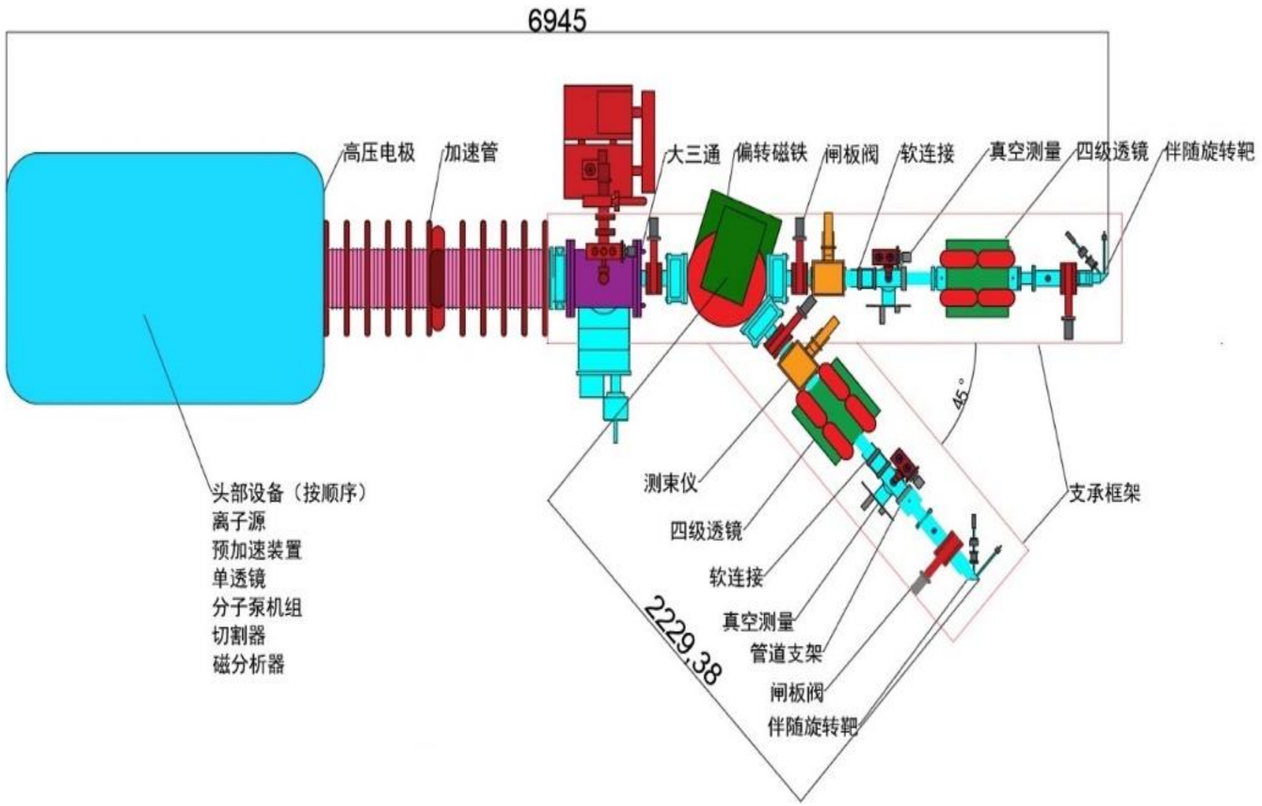


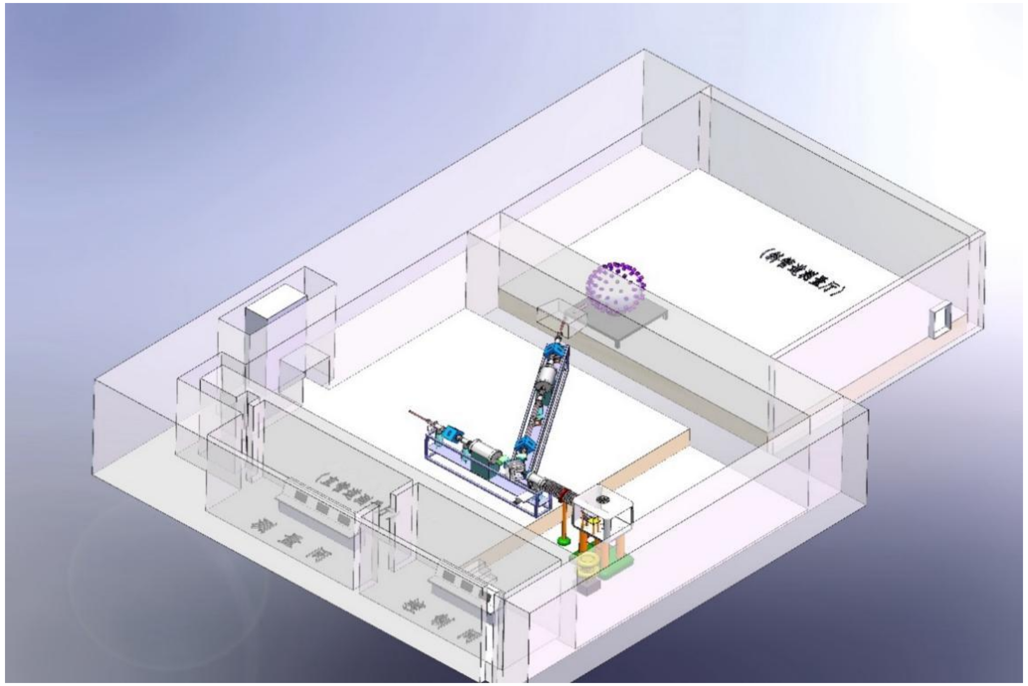
核物理学科介绍：科研平台（申请采购）

多用途氘氚聚变反应中子源：401陈洪涛研究员

设计指标：

- D+离子能量300keV，流强1mA；
- 2.5MeV中子产额1×10⁹/s，14.8MeV中子产额1×10¹¹/s；
- 脉冲束频率1.5MHz，脉冲宽度小于2ns；
- 离靶1cm处约0.5Gy $S^{-1}cm^{-2}$的14.8MeV中子辐照剂量。





应用领域：

- 特色作物辐照育种
- 中子活化分析
- 低能核物理实验
- 中子辐照材料
- 中子核数据测量
- 中子照相技术

期待“核”你相聚草原——“第23次RIBLL合作组会议”

Thanks Very Much !