清华大学
Tsinghua University

太阳中微子研讨会
2024年1月19-21，中山大学

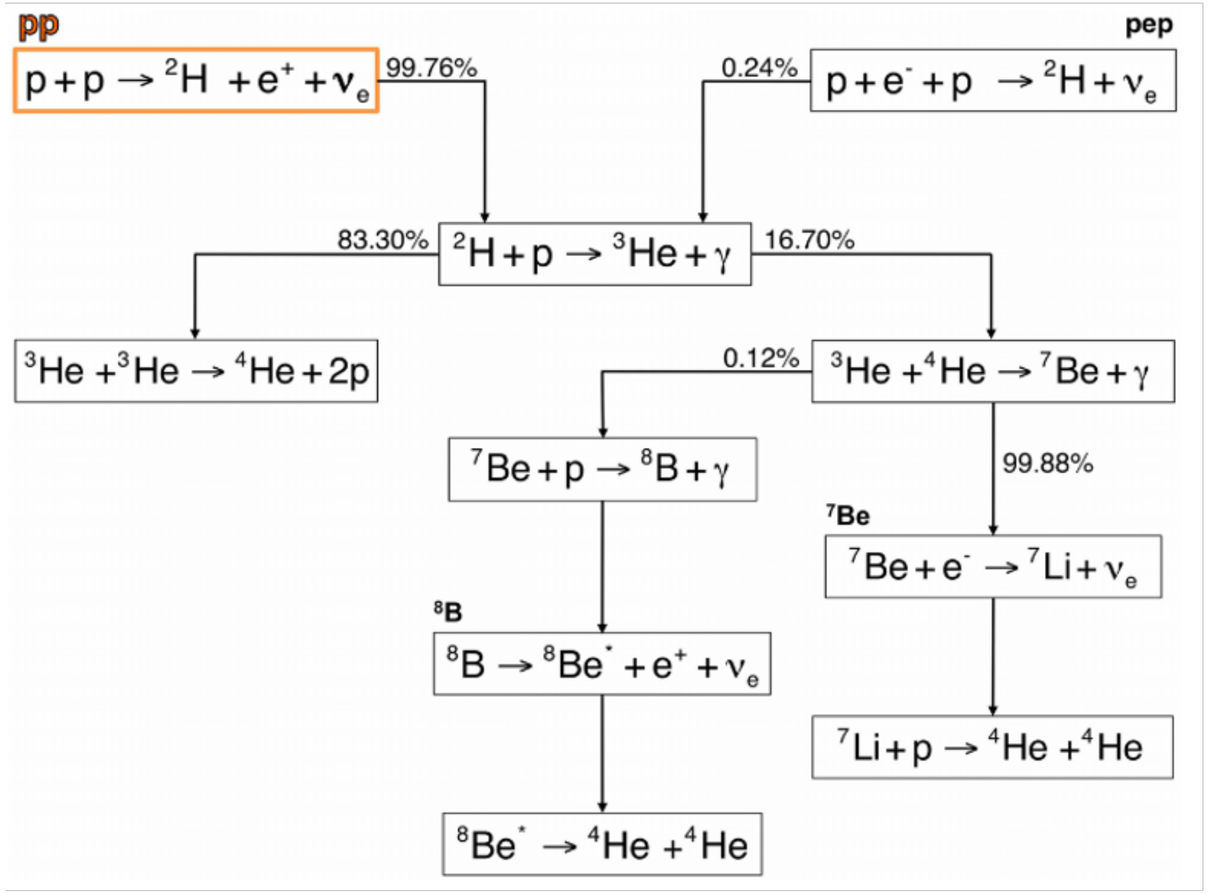
会议讨论议题举例

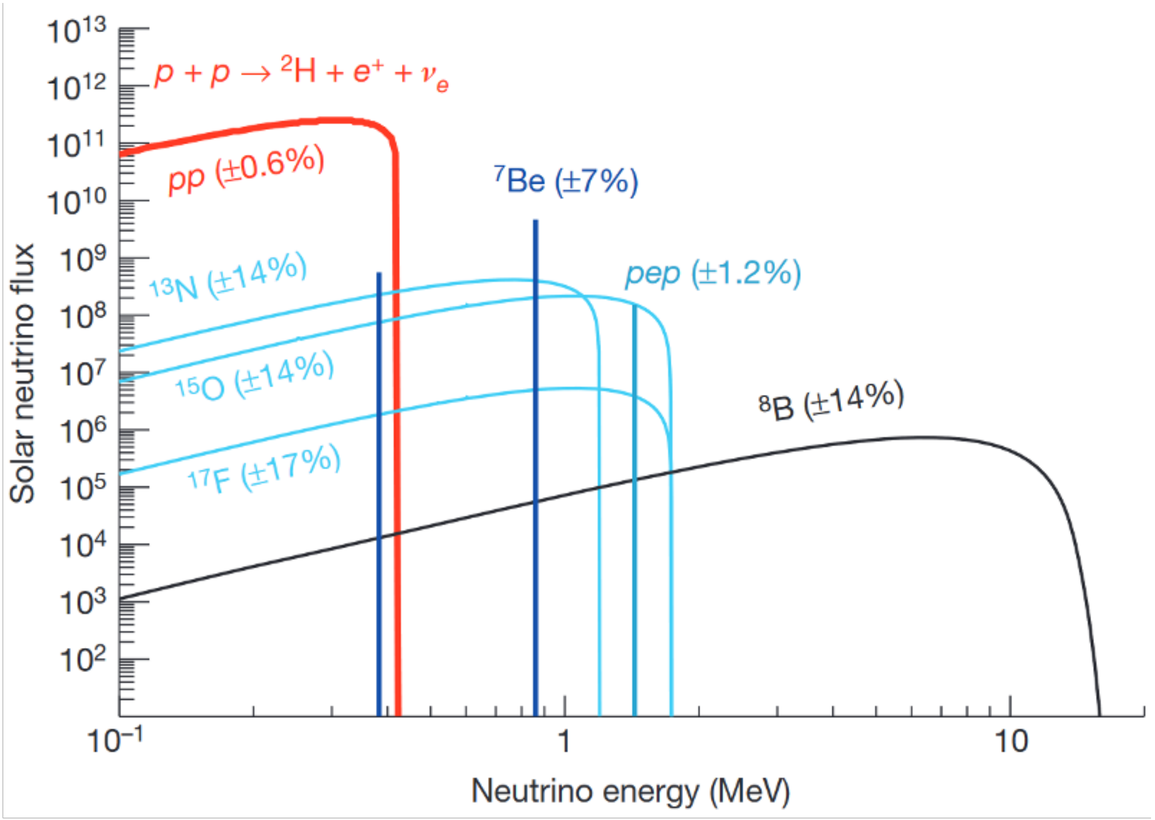
不同中微子探测实验的互补性

高飞 feigao@tsinghua.edu.cn
清华大学 物理系

基于本次研讨会公开材料准备，感谢各位的精彩报告！

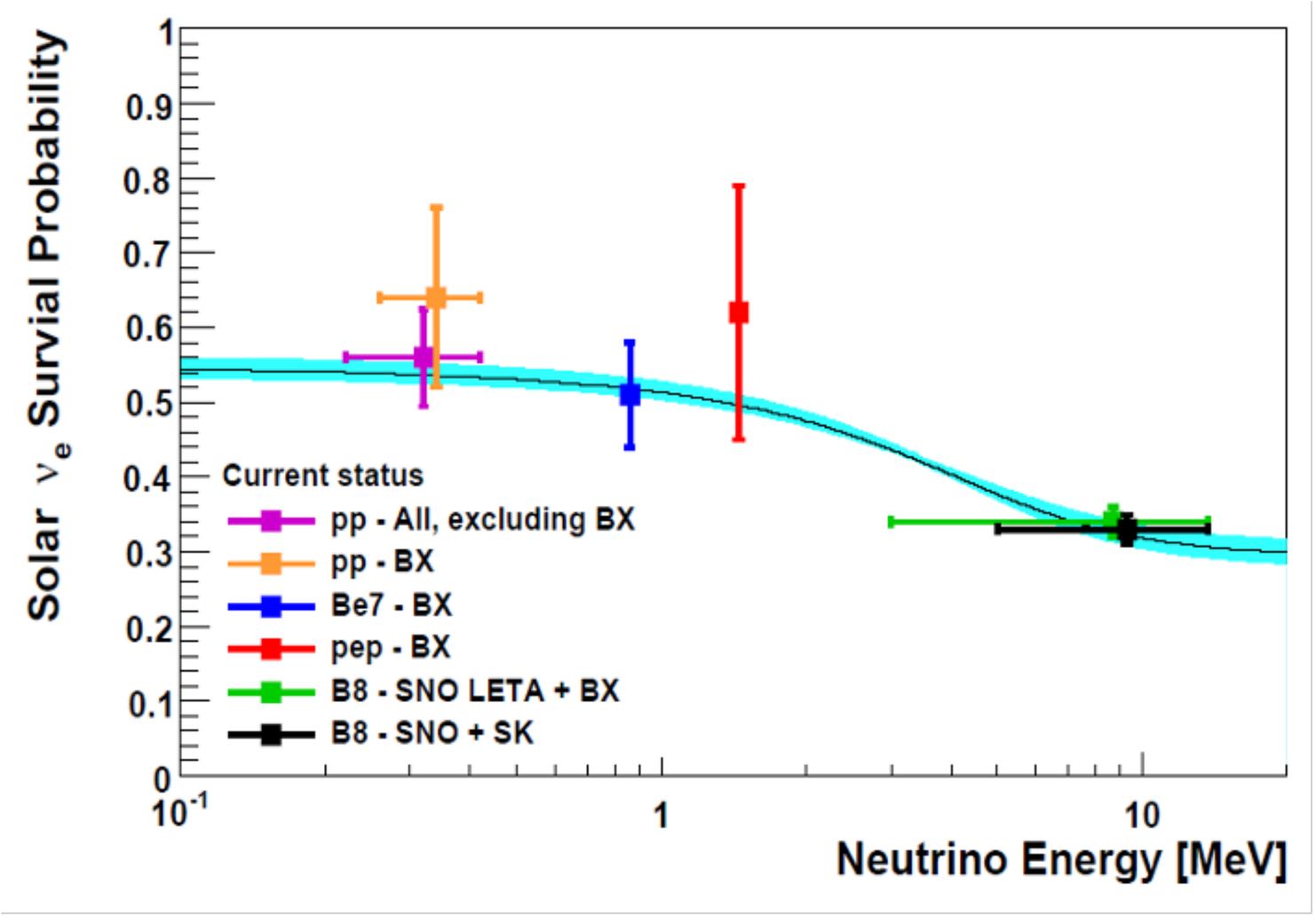
太阳中微子—pp 链





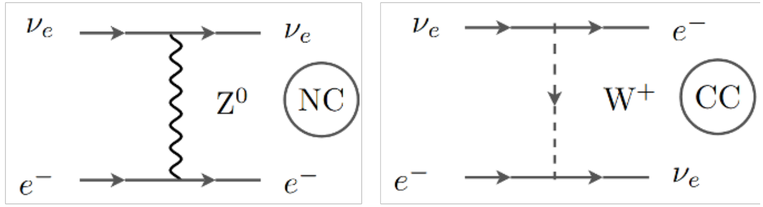
[Nature volume 512, pages 383–386(2014)]

中微子振荡的物质效应

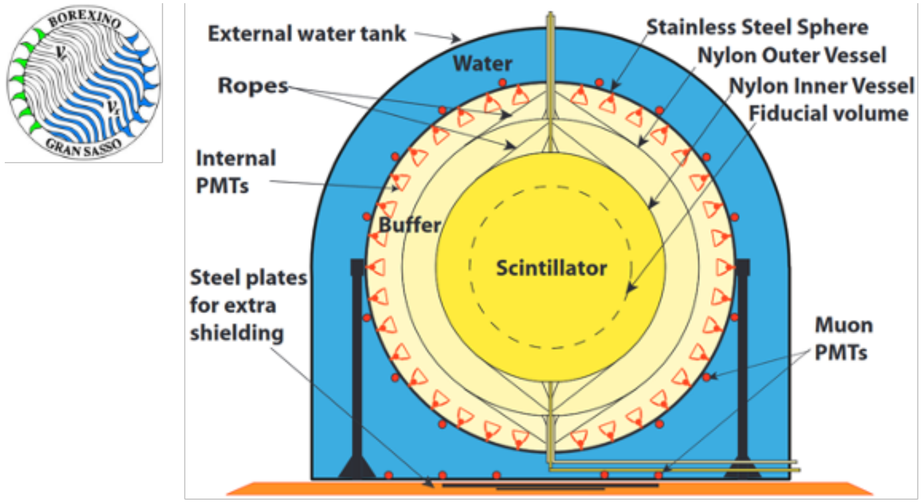

Solar ν_e Survial Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10^{-1}
1
10
Neutrino Energy [MeV]
Current status
pp - All, excluding BX
pp - BX
Be7 - BX
pep - BX
B8 - SNO LETA + BX
B8 - SNO + SK

pp中微子的探测-液体闪烁体Borexino

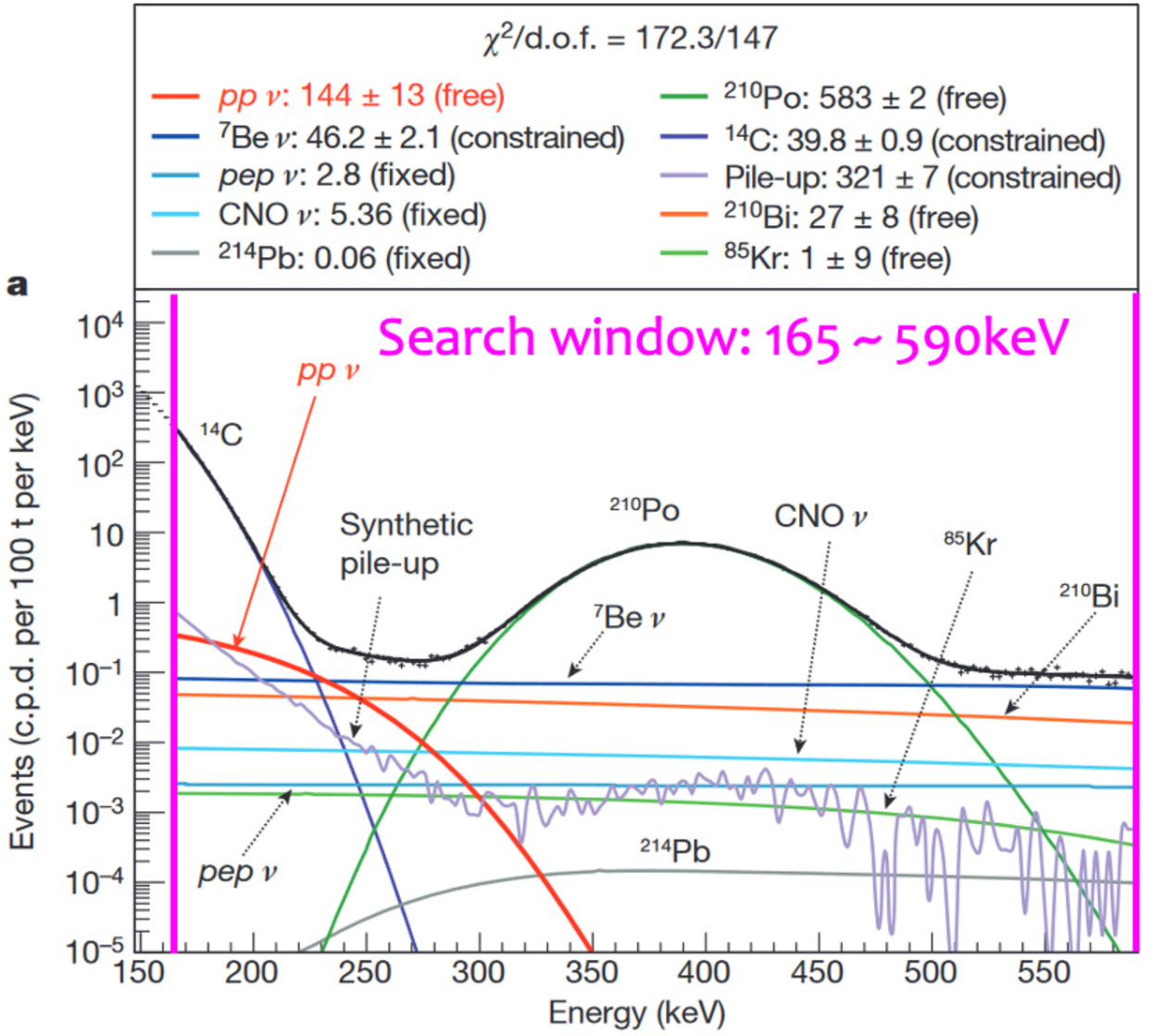
$$\nu_x + e^- \longrightarrow \nu_x + e^-$$



neutral current　　charged current

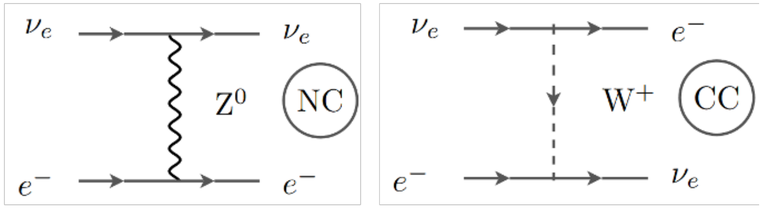


实验的最大不确定度在哪?



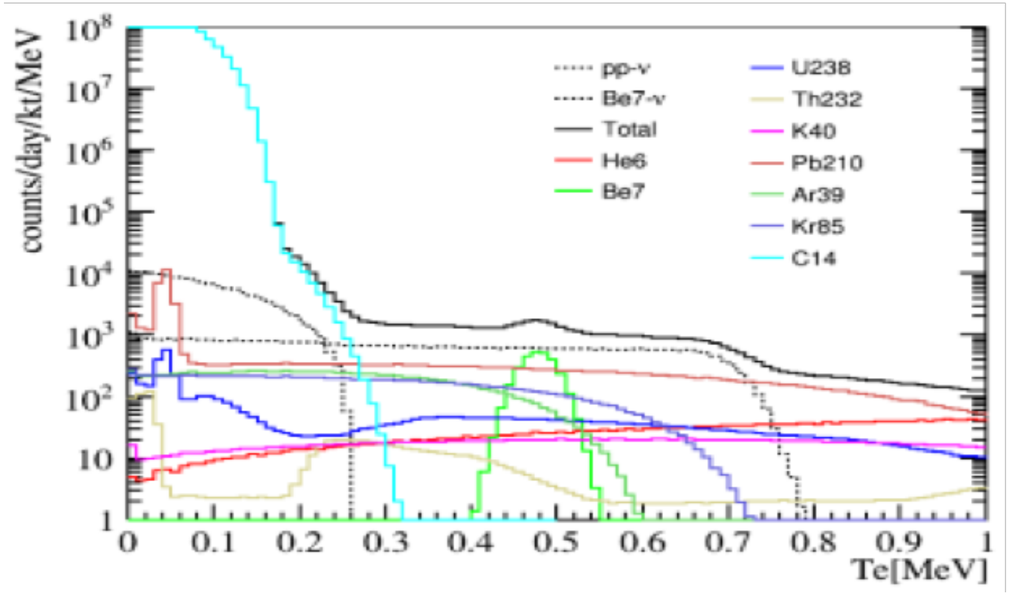
pp中微子的探测-JUNO

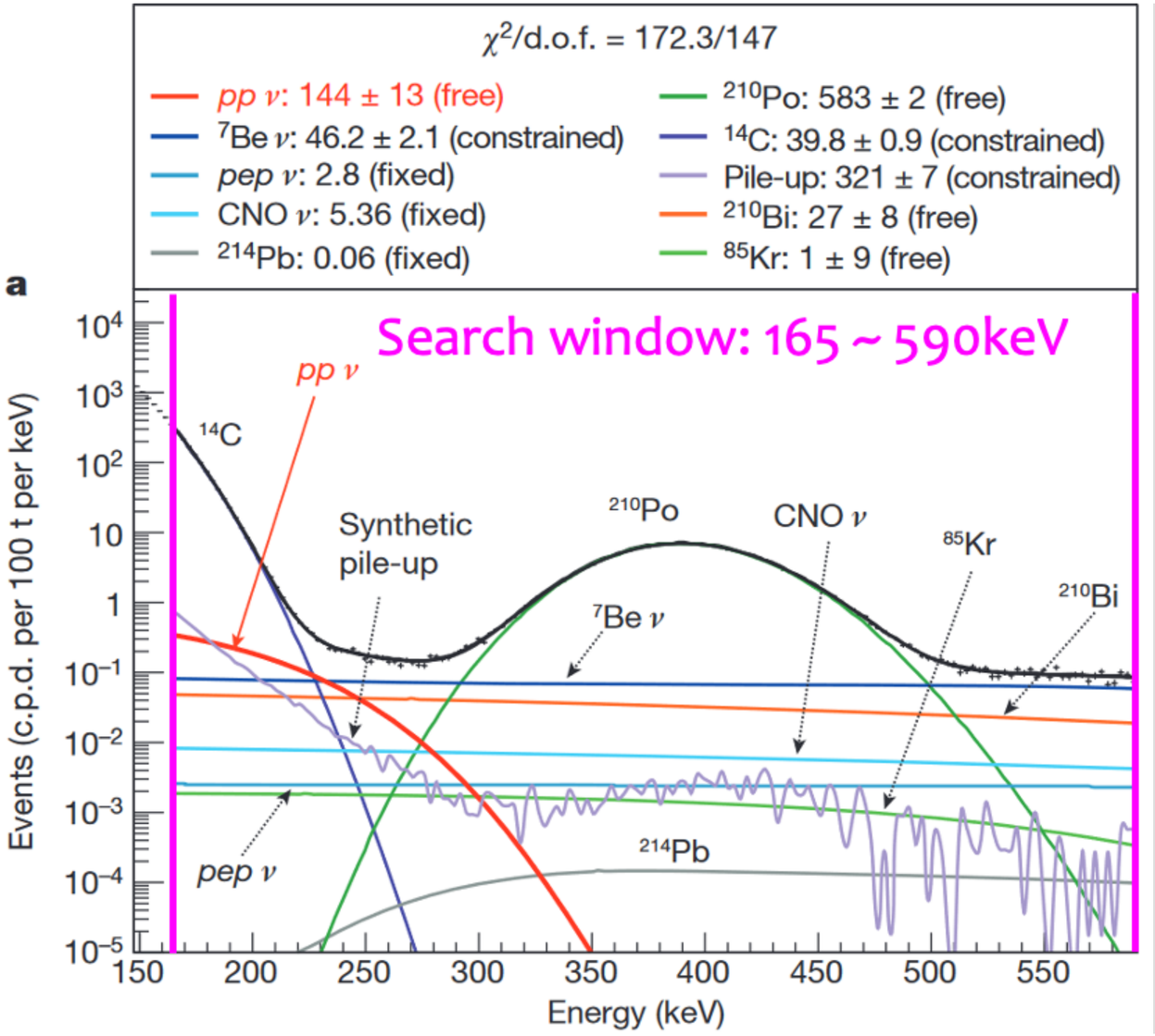
$$\nu_x + e^- \longrightarrow \nu_x + e^-$$



neutral current charged current

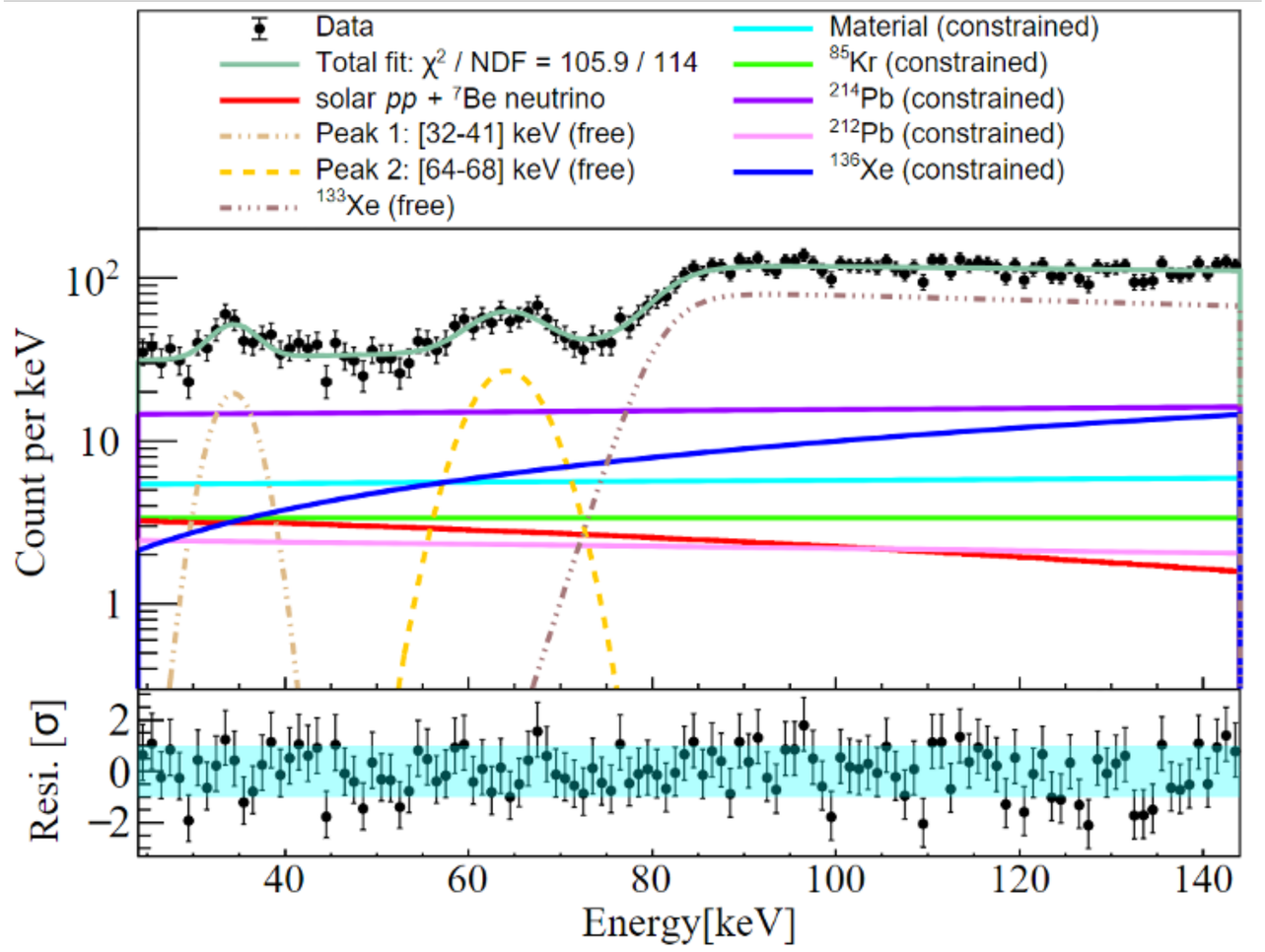
JUNO at ^{14}C 10^{-18}

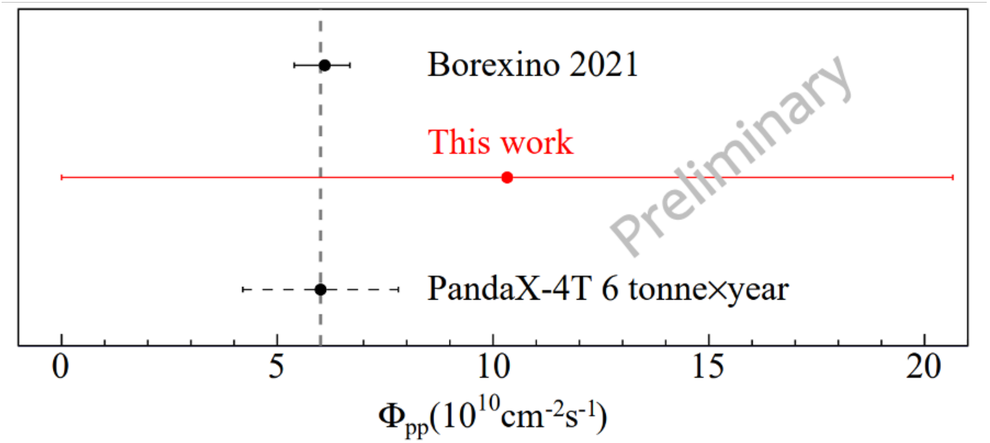


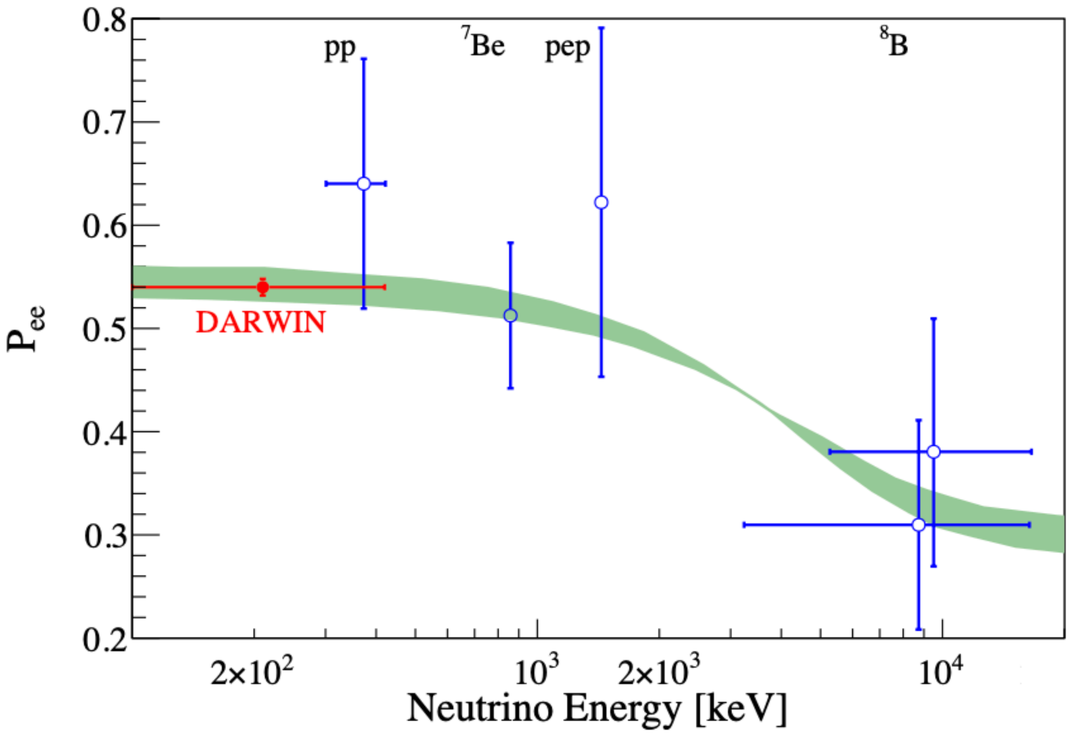


JUNO是否有能力突破?

pp中微子的探测-PandaX

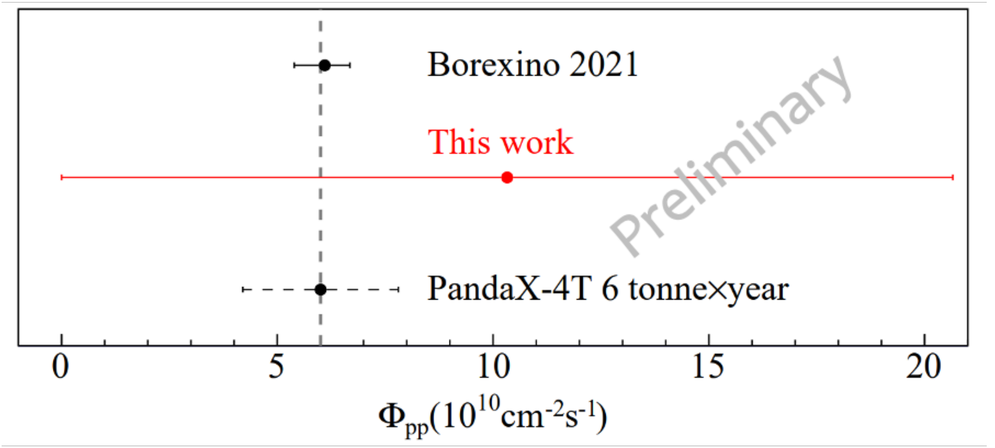


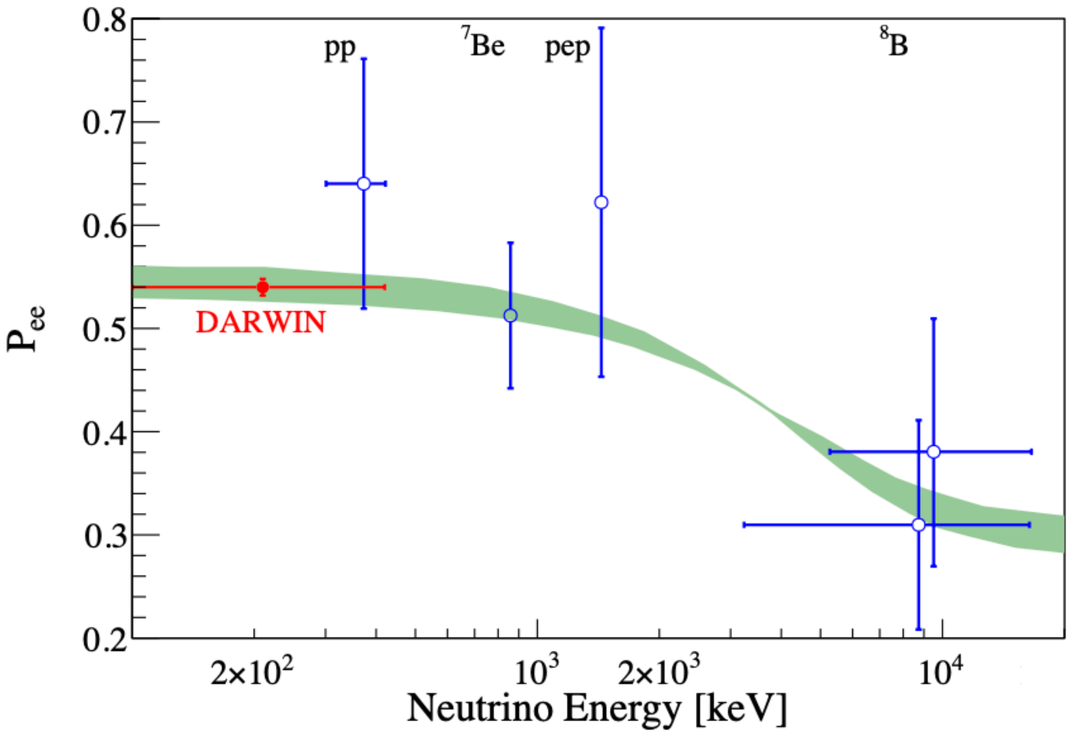




pp中微子的探测-PandaX

	Components	Counts
$\sigma_{\text{constraint}}$	^{85}Kr	203
	^{214}Pb	87
	^{212}Pb	69
	Material	21
	^{136}Xe	19
	Peak 1 width	37
	Peak 2 width	33
	Data selection	30
	Subtotal	**237**
σ_{manual}	Energy scale	111
	Energy resolution	19
	Fit range	32
	^{214}Pb spectrum	82
	^{212}Pb spectrum	17
	^{85}Kr spectrum	6
	Subtotal	**144**
	Total	**277**

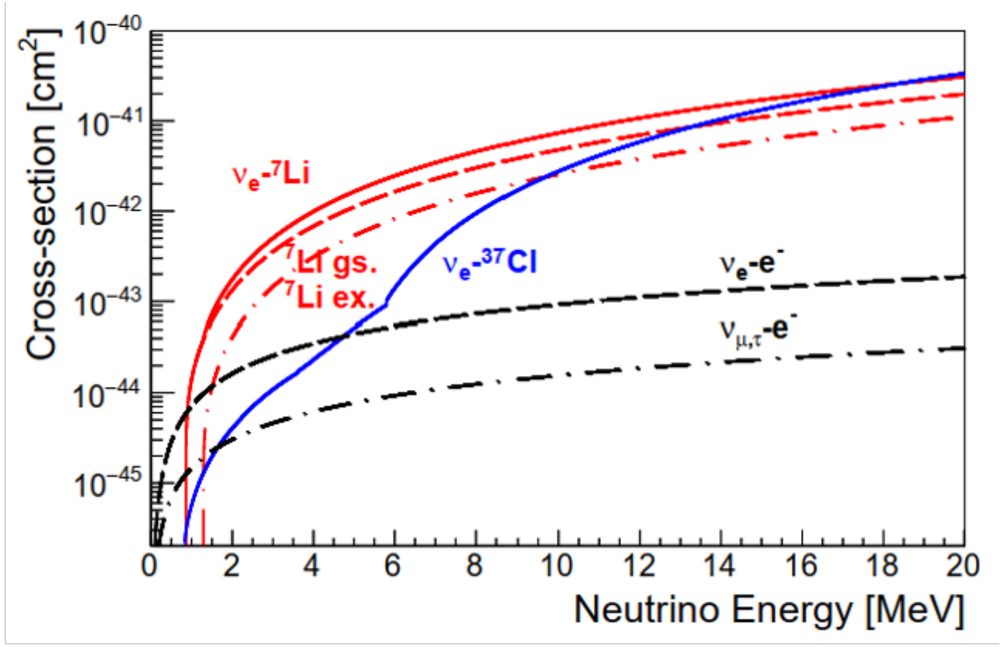


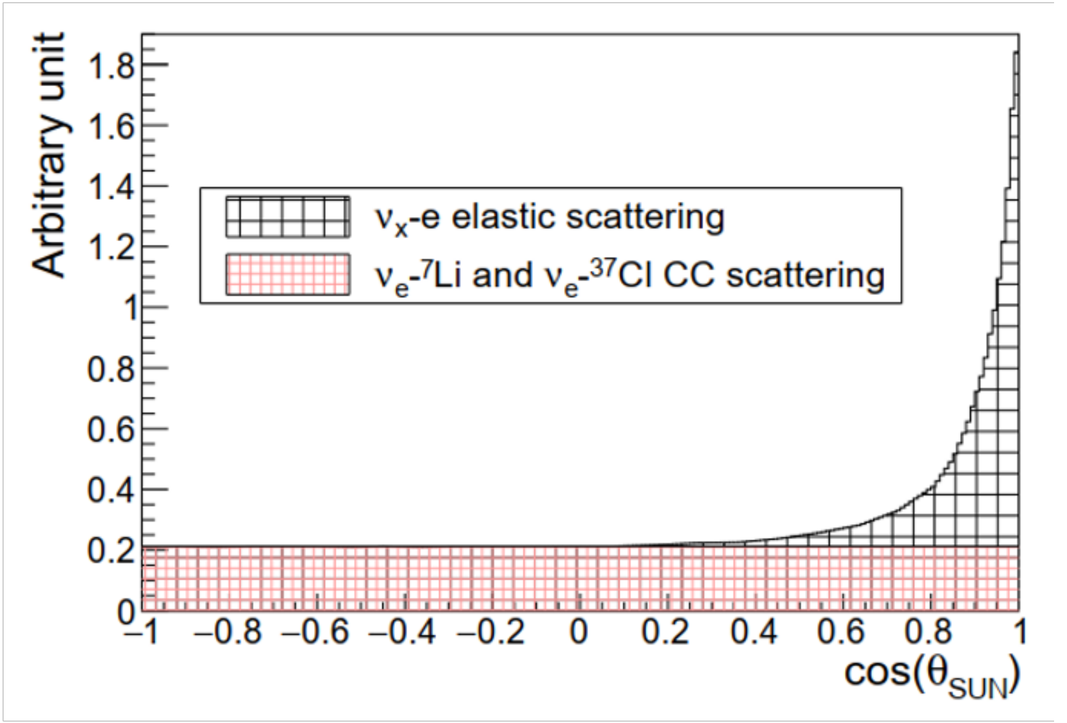


未来最大的不确定度在哪?

我们如何达到这个水平?

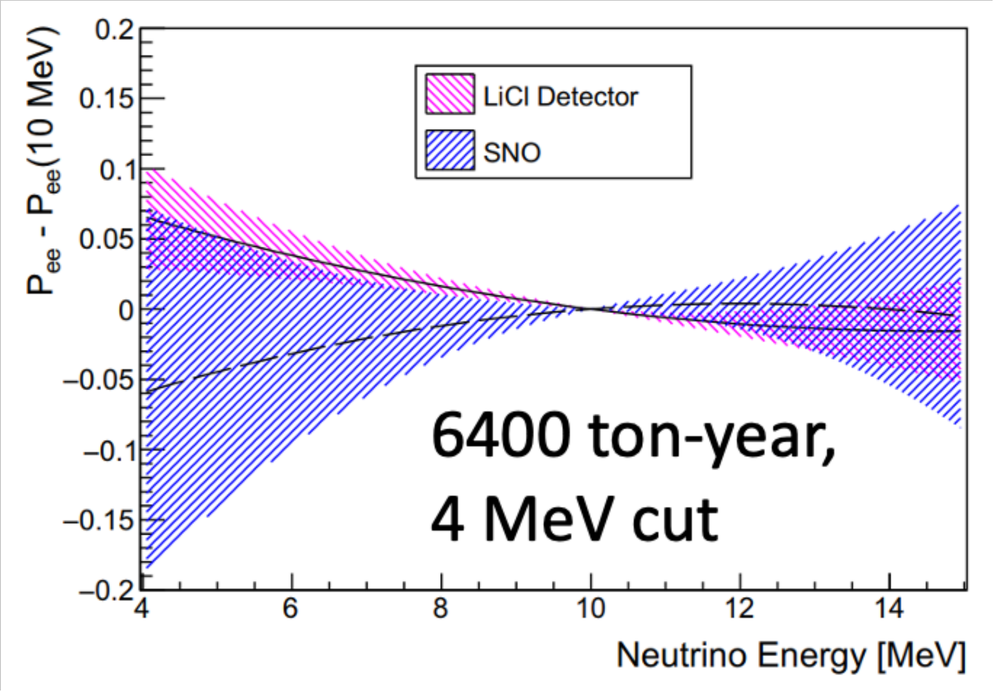
B8太阳中微子的探测-JNE

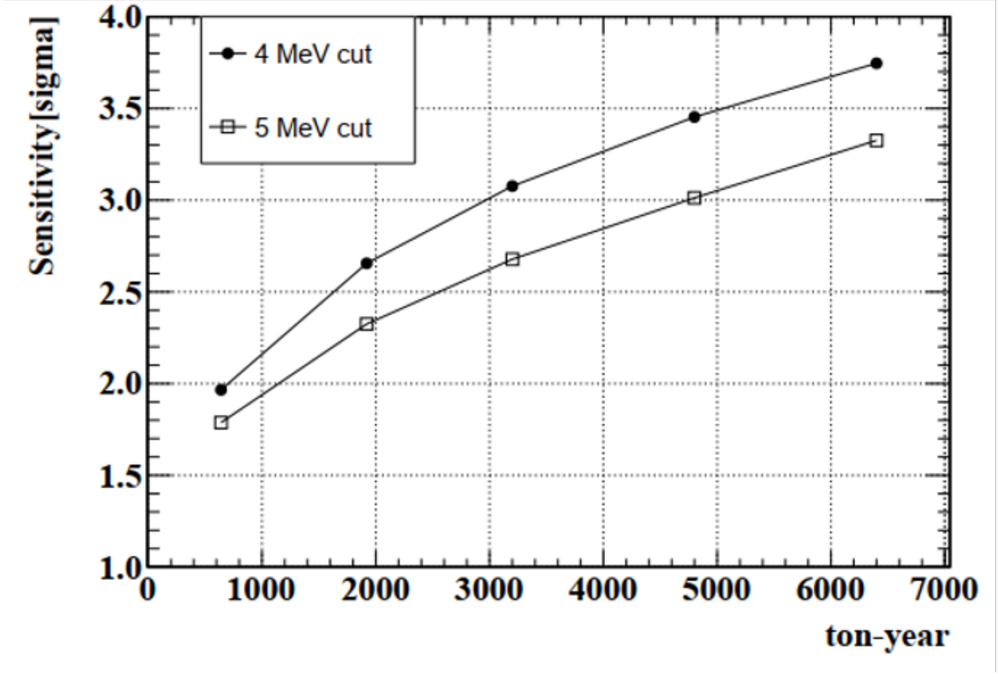


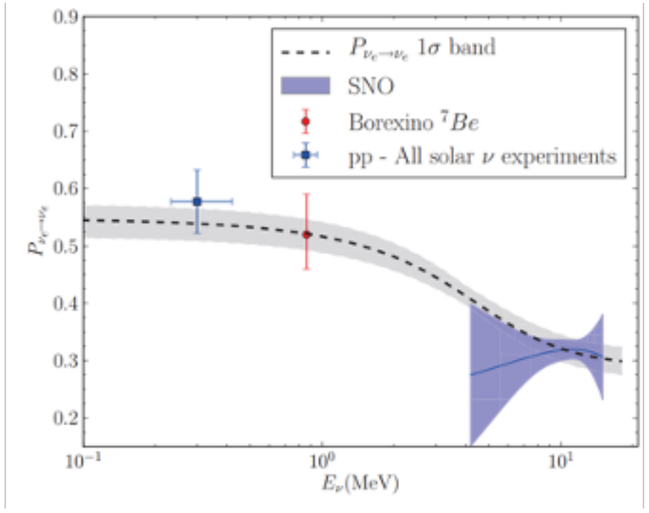


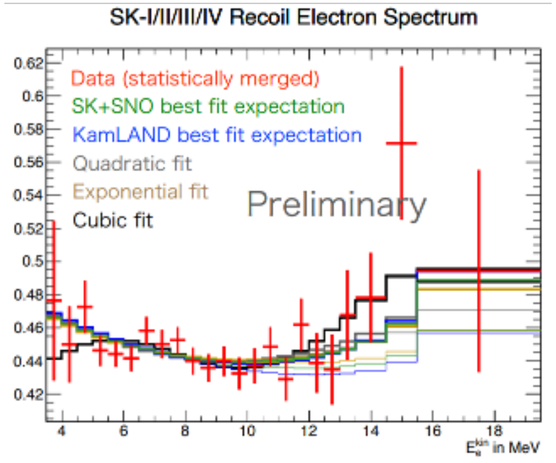
	^{7}Li	^{37}Cl	All CC	e^-
Molarity (mol/L)	11	2.9	NA	610
Event rate (No Osci)	305	22.7	328	271
Event rate (Osci)	101	7.28	108	124
Event rate (Osci & >4 MeV)	94.5	7.24	102	48.0
Event rate (Osci & >5 MeV)	87.3	7.17	94.4	34.5

B8太阳中微子的探测-JNE



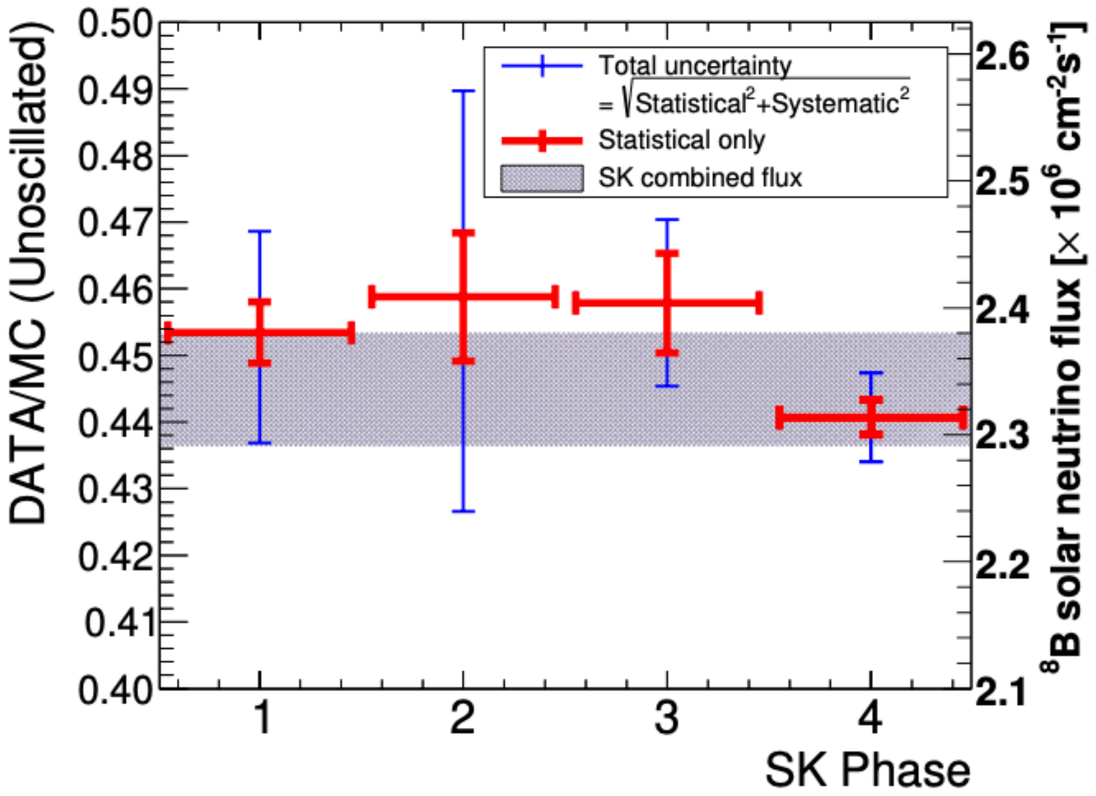


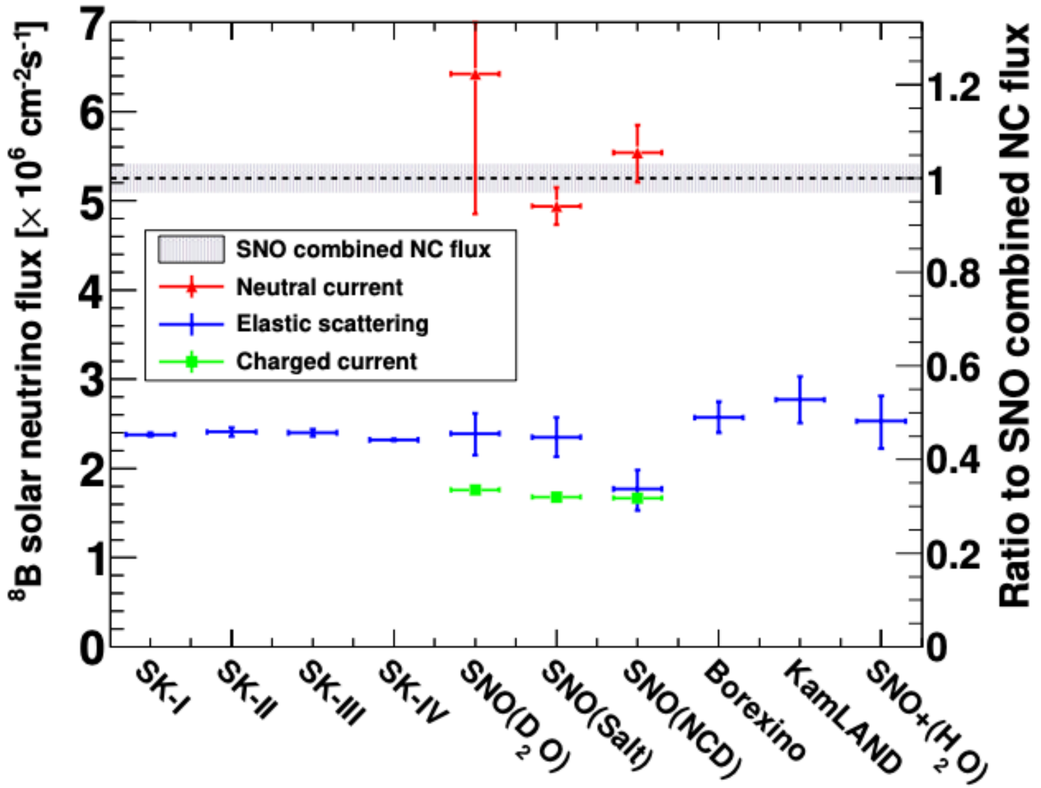




Slightly favors up-turn,
though need more data

B8太阳中微子的探测-Super-K

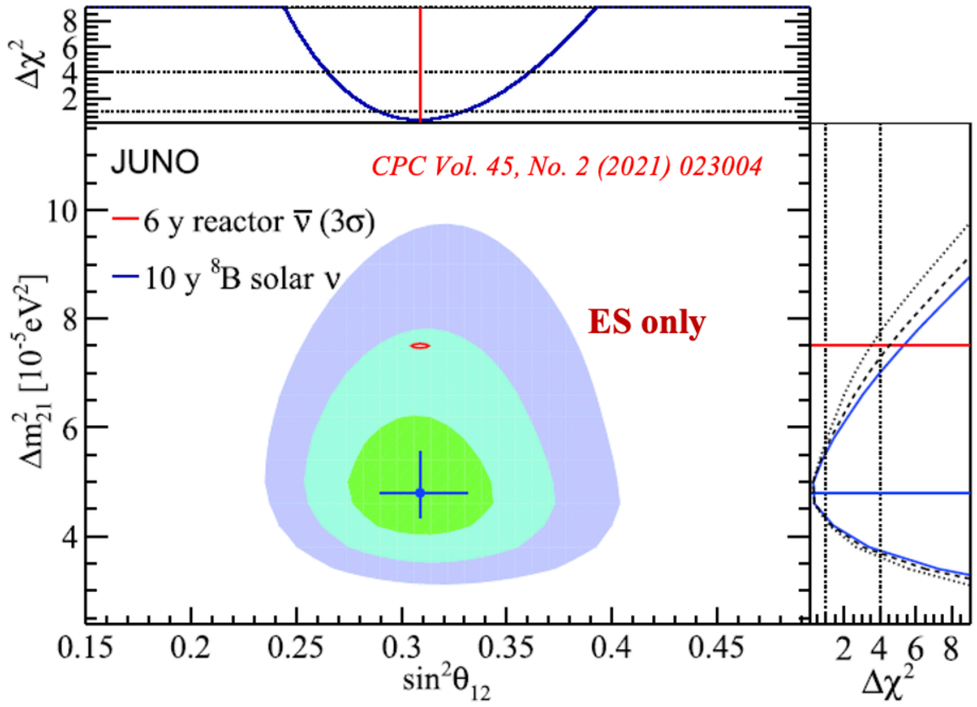


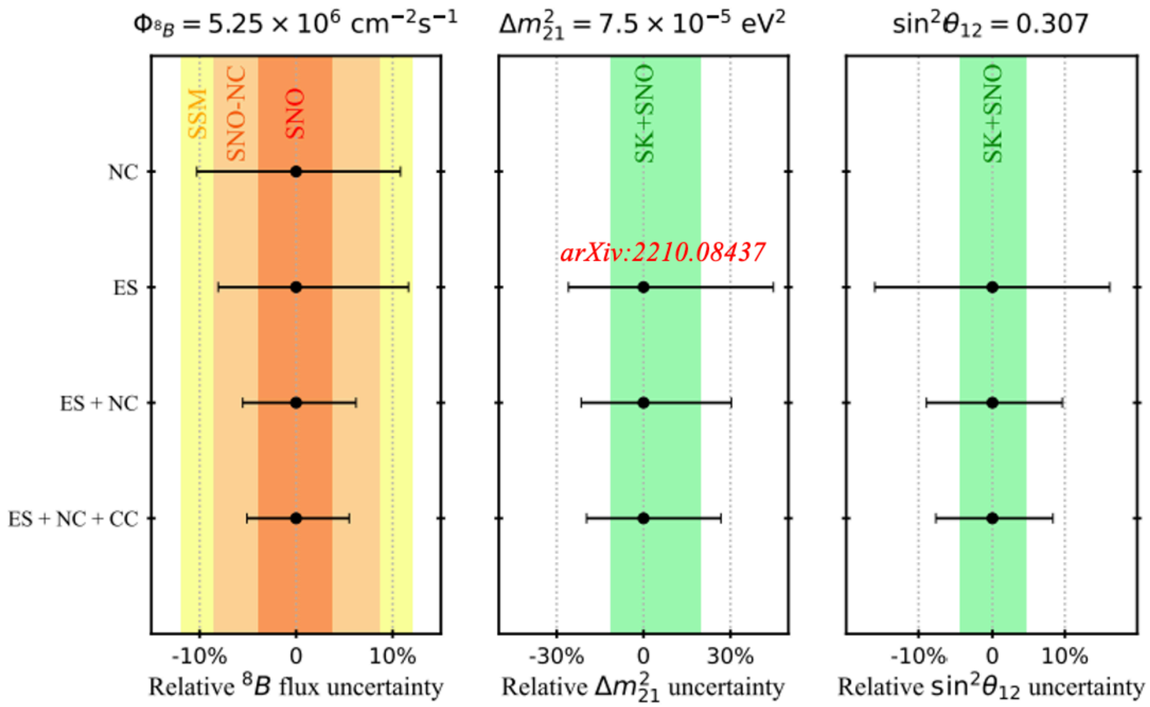


^{8}B 测量到了新的精度

B8太阳中微子的探测-JUNO

- 利用ES, NC, CC三个反应道
  - ✓可模型无关的测量^{8}B太阳中微子流强（5%），两个振荡参数$\sin^2\theta_{12}$（8%）和Δm^2_{21}（20%）
  - ✓如果联合SNO-NC结果，可获得世界上最高的^{8}B中微子流强精度3%

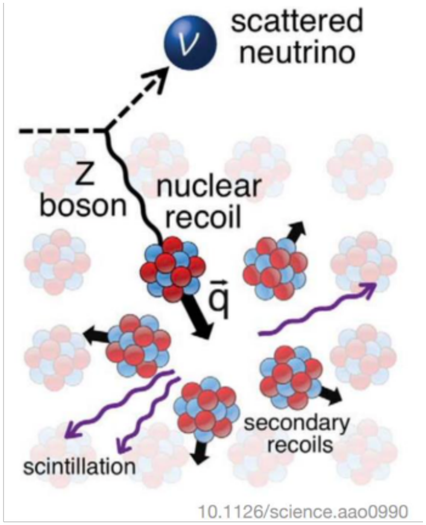




^{210}Po reach Phase I of Borexino (10^4 cpd/kt), dashed line in the right panel

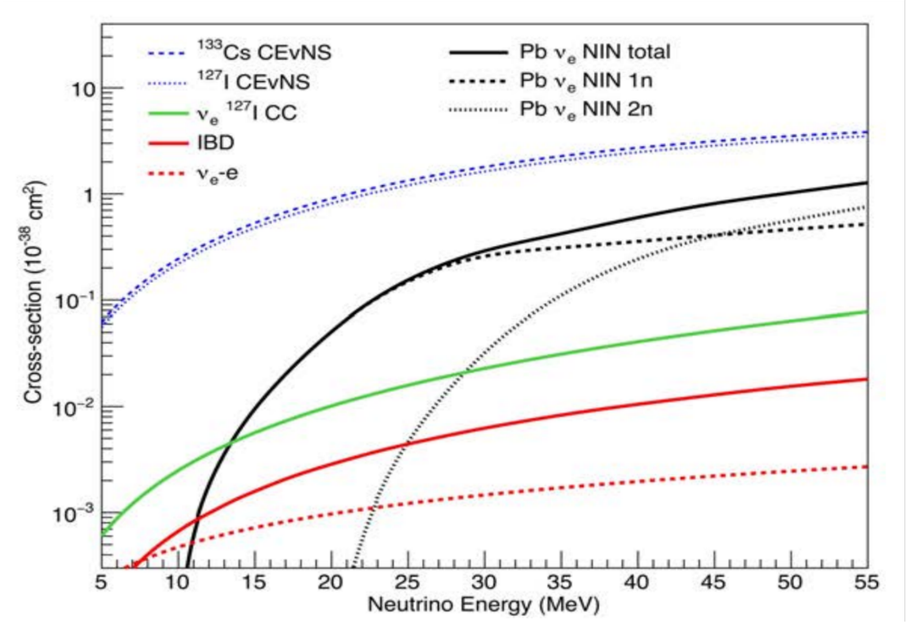
^{238}U/^{232}Th ~ 10^{-15} g/g, E_{vis} > 5 MeV, dotted line in the right panel

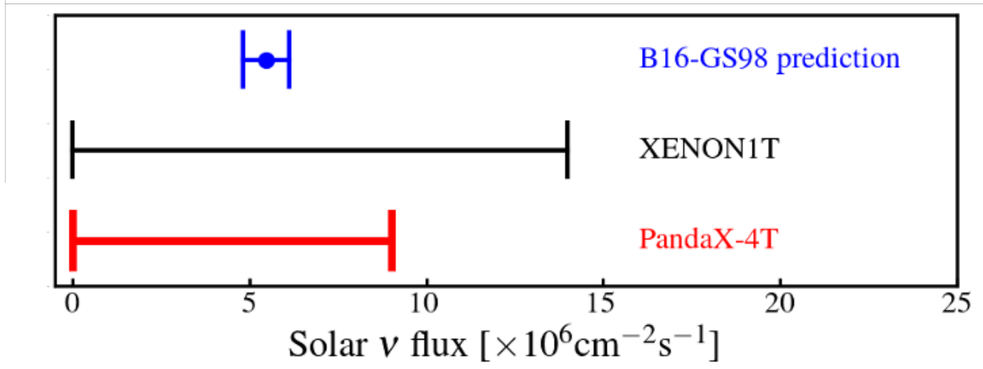
B8太阳中微子的探测-PandaX

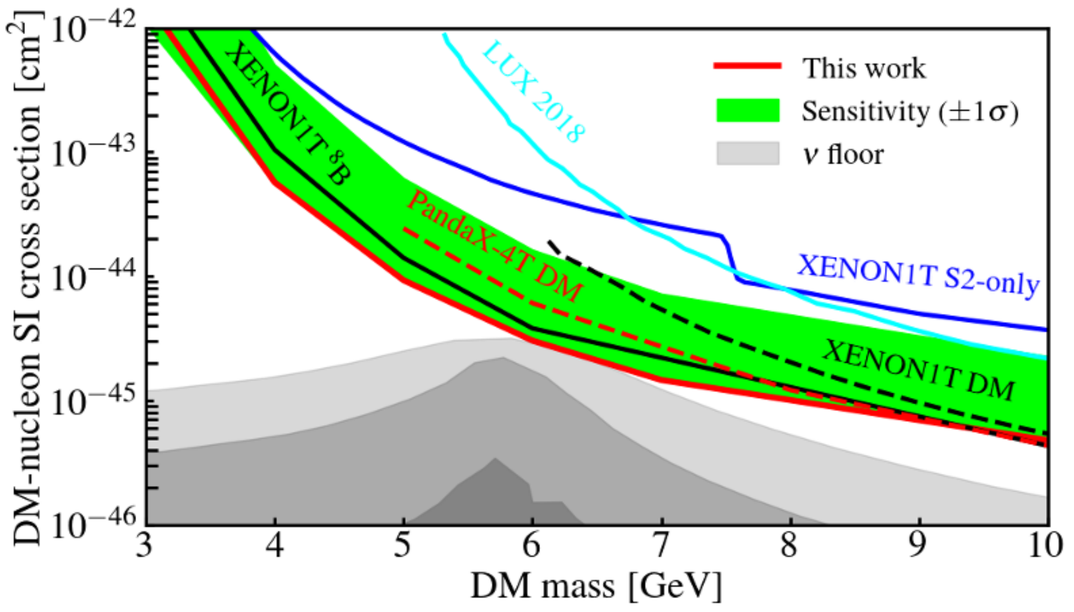


Apply-BDT result

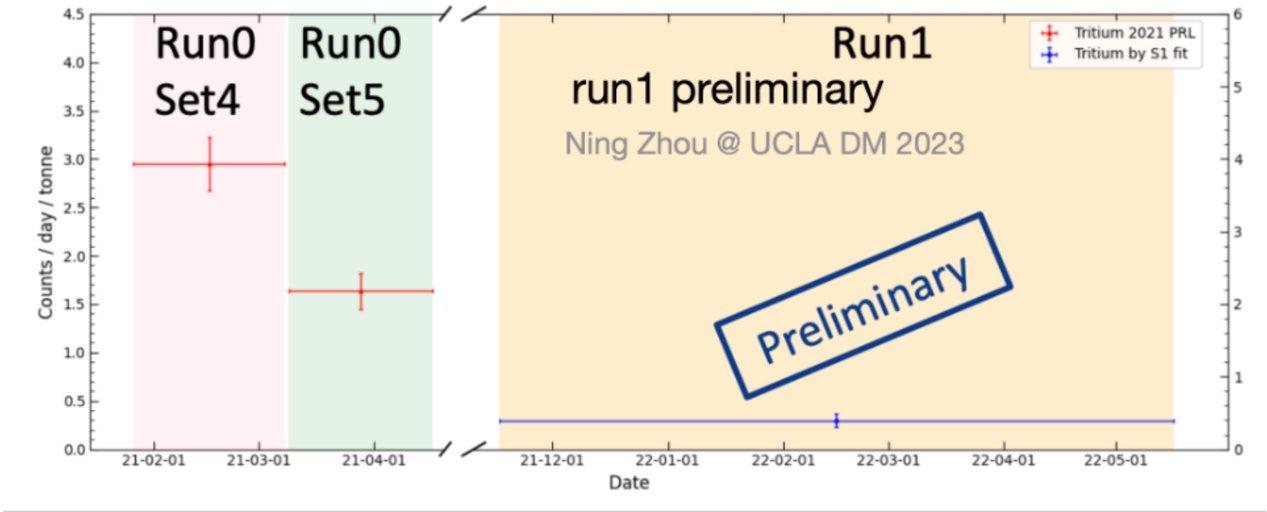
N-hit	Total bkg	B8	Data
2	1.50	1.42	1
3	0.07	0.29	0

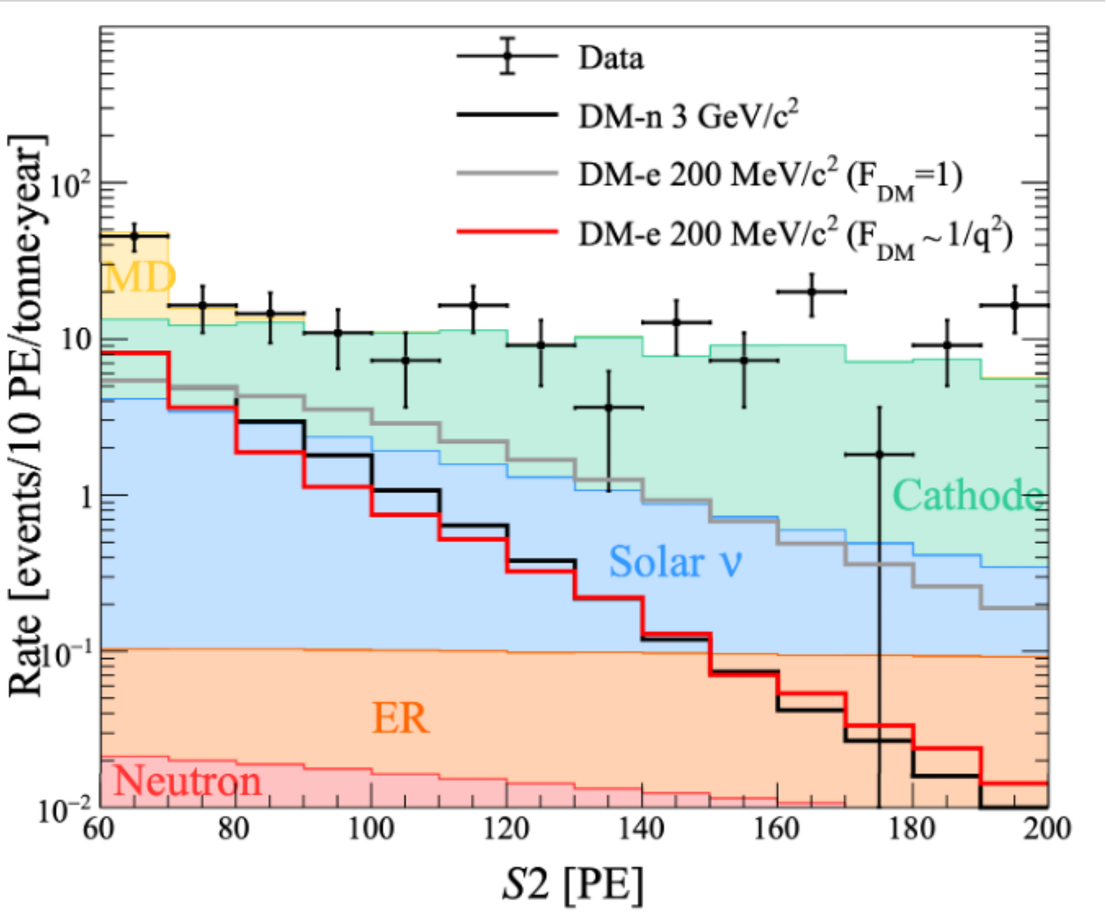






B8太阳中微子的探测-PandaX



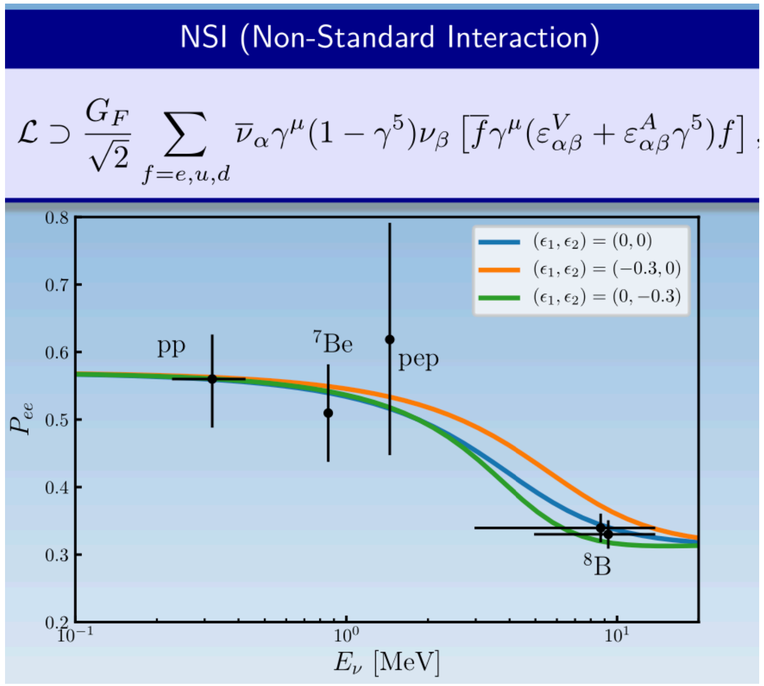


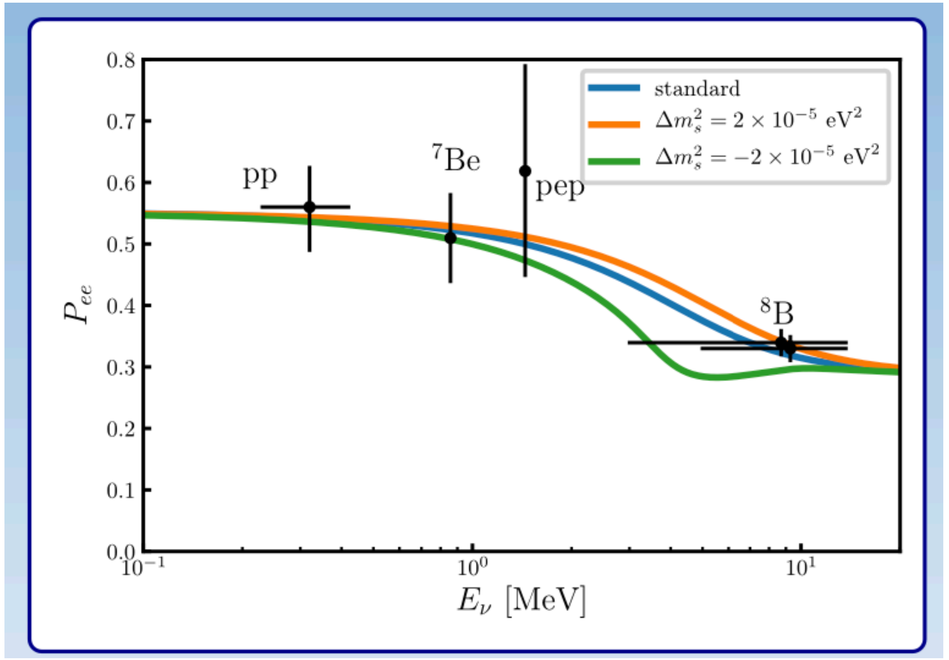
CEvNS是否具有不可替代作用，对于限制中微子物理有什么独特意义?

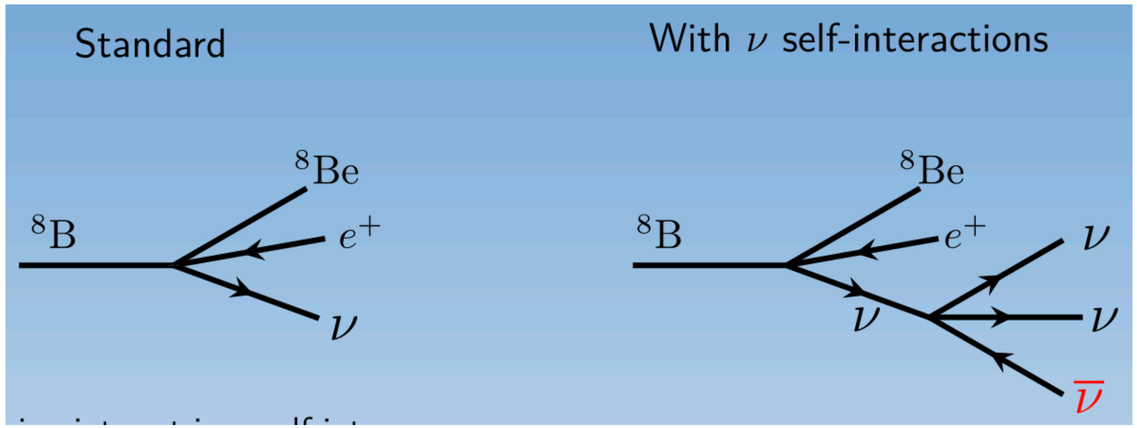
为了实现这一目标，我们需要什么样的统计精度?

实验室如何实现这样的测量精度？我们如何减少实验的系统误差?

多种探测器协同测量，对哪些（新）物理灵敏度有显著提升?







哪一个探测通道对这些（新）物理的灵敏度最高?

是否存在对下一代实验全局灵敏度分析

其他的讨论课题

CNO?

pep

…

实验测量精度 — 对太阳模型有合适的反馈

…