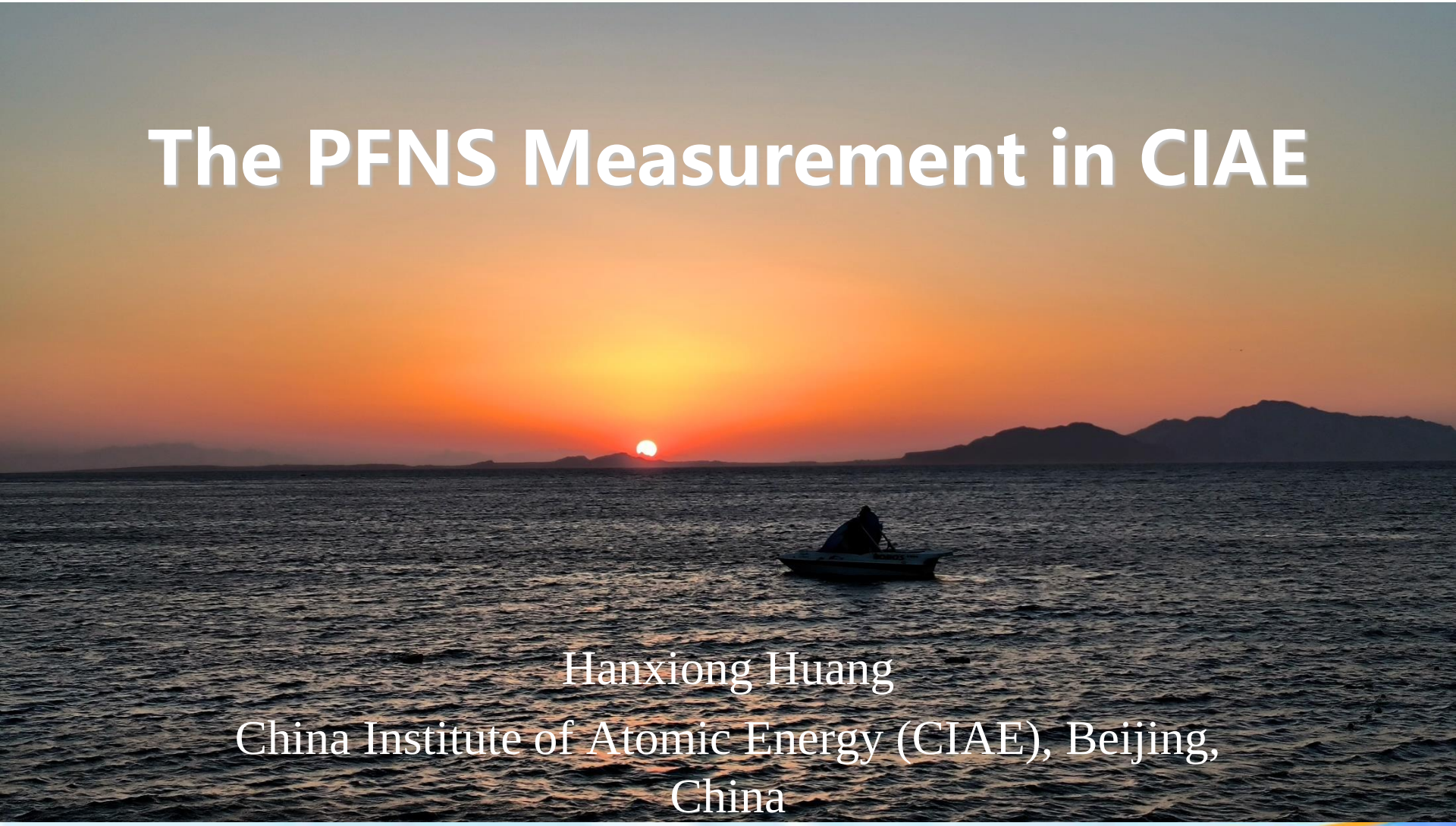
中国原子能科学研究院
CHINA INSTITUTE OF ATOMIC ENERGY

The PFNS Measurement in CIAE



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2. The status of PFNS
3. The technique of PFNS measurement
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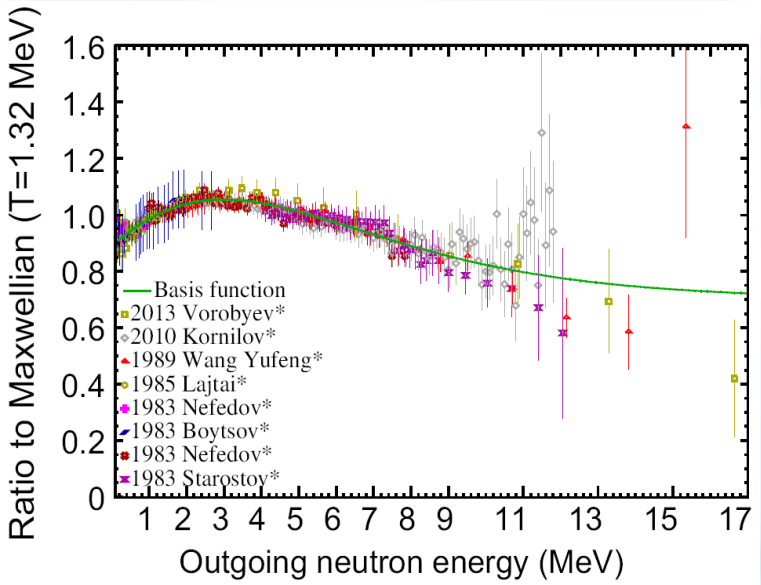
1. Overview of the PFNS

a) PFNS-Prompt Fission Neutron Spectra,
Before the β decay, within 10^{-14} s, >98%.

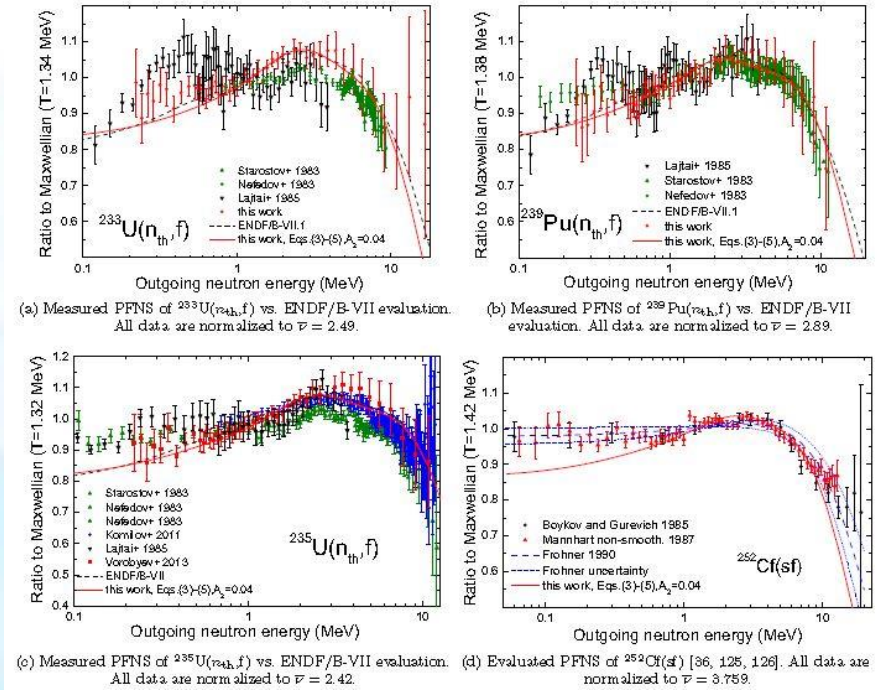
b) It is very useful for nuclear device design, radiation shielding calculation and nuclear reaction research.

c) Data in both ends of the spectra is divergent from each other

d)Why the divarication exist?



The PFNS of ^{235}U induced by hot neutrons



(a) Measured PFNS of ^{233}U(n_{th},f) vs. ENDF/B-VII evaluation. All data are normalized to $\bar{\nu}$ = 2.49.

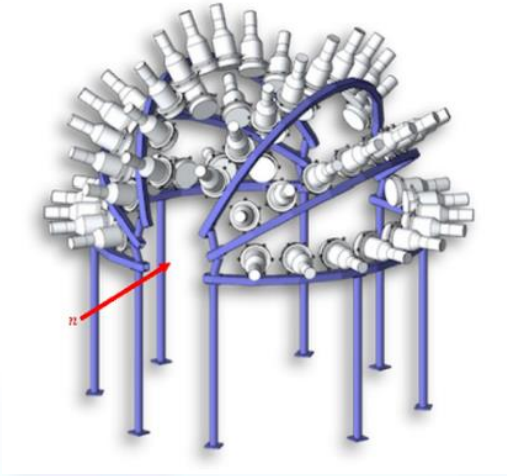
(b) Measured PFNS of ^{239}Pu(n_{th},f) vs. ENDF/B-VII evaluation. All data are normalized to $\bar{\nu}$ = 2.89.

(c) Measured PFNS of ^{235}U(n_{th},f) vs. ENDF/B-VII evaluation. All data are normalized to $\bar{\nu}$ = 2.42.

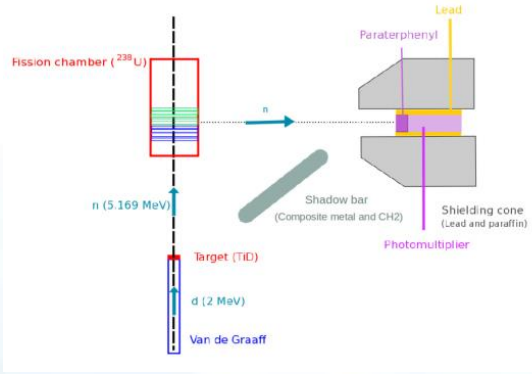
(d) Evaluated PFNS of ^{252}Cf(sf) [36, 125, 126]. All data are normalized to $\bar{\nu}$ = 3.759.

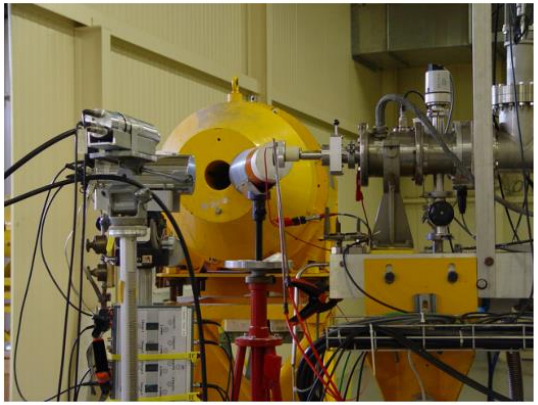
The PFNS of different nuclides

2. The status of PFNS

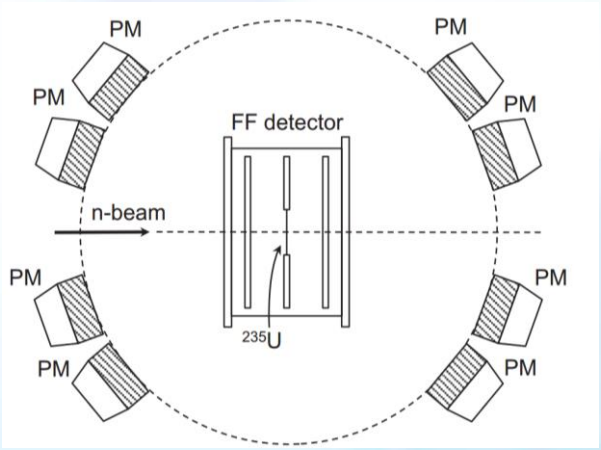


USA, CHI-NU array

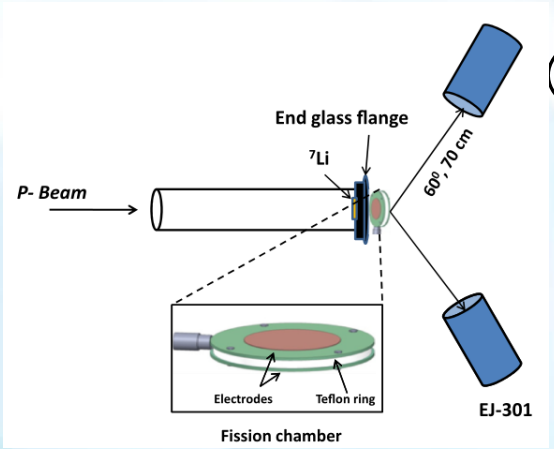




France, A. Sardeta,∗ , T. Graniera , B. Laurent et. al

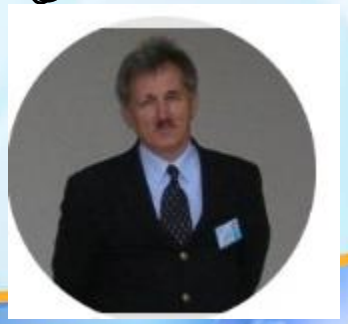


Belgium, Alf Göök et al.



India, V. V. Desai, B. K. Naya et. al

Colleagues,
PFNS is still a tricky business.
Sincerely,
Vladimir Maslov

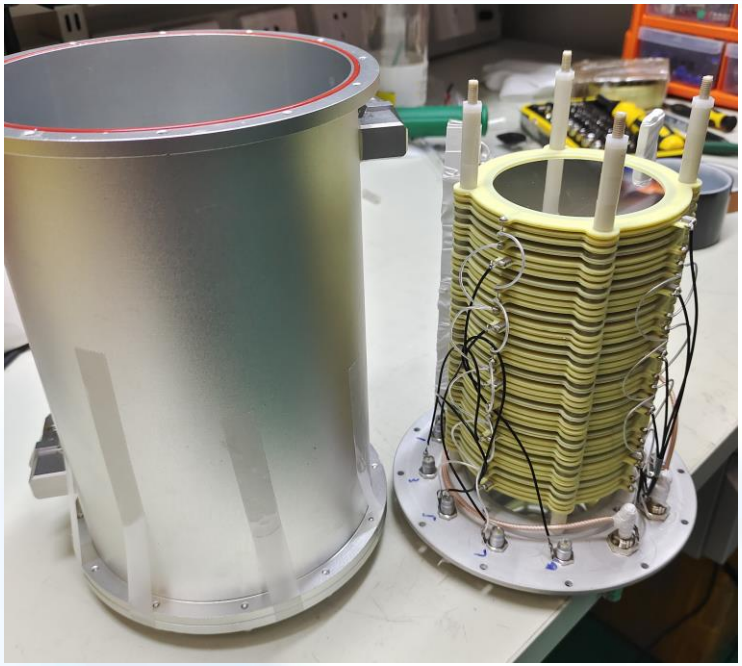


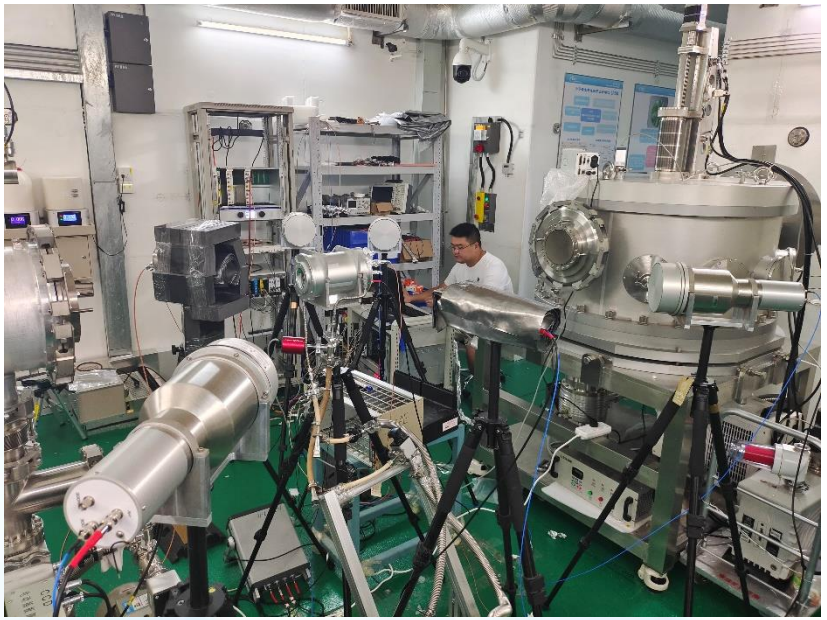
List of the parameters for different PFNS facilities

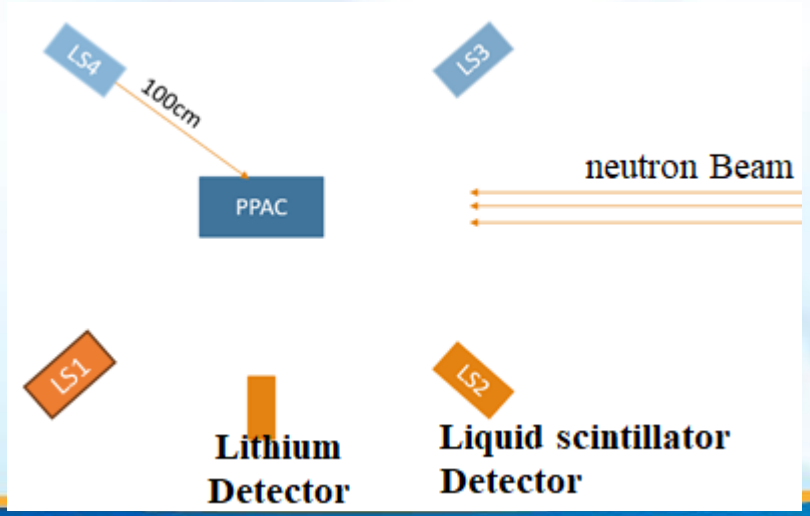
Laboratory/ First author	No. of Detectors	No. of cell in PPAC	Distance of NTOF	Sample	Mass of the sample	Year
CIAE/Li Anli	2	103	2.5	238U	~5g	1996
France/A. Sardet	1	10	N/A	^{235}U,^{238}U,^{237}Np	N/A	2013
Japan/Miura	1	24 for ^{233}U	2	^{233}U, ^{238}U, ^{232}Th	2.28g for ^{233}U, ϕ20mm*50mm for the others	2002
Los Alamos/CHI-NU	60	10	1	^{235}U,^{239}Pu,…	100mg	~2019
India/Desai	2	1	0.7	^{238}U	2.1mg/cm^2	2015
FINDA/Hanxiong	48	10	1	^{235}U	100mg	2023

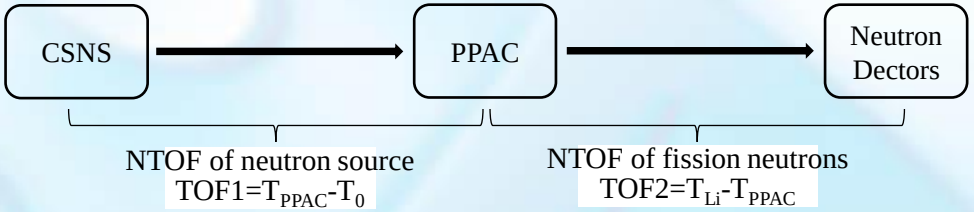
The experimental data of PFNS induced by white neutron source is more valuable.

3. The technique of PFNS measurement



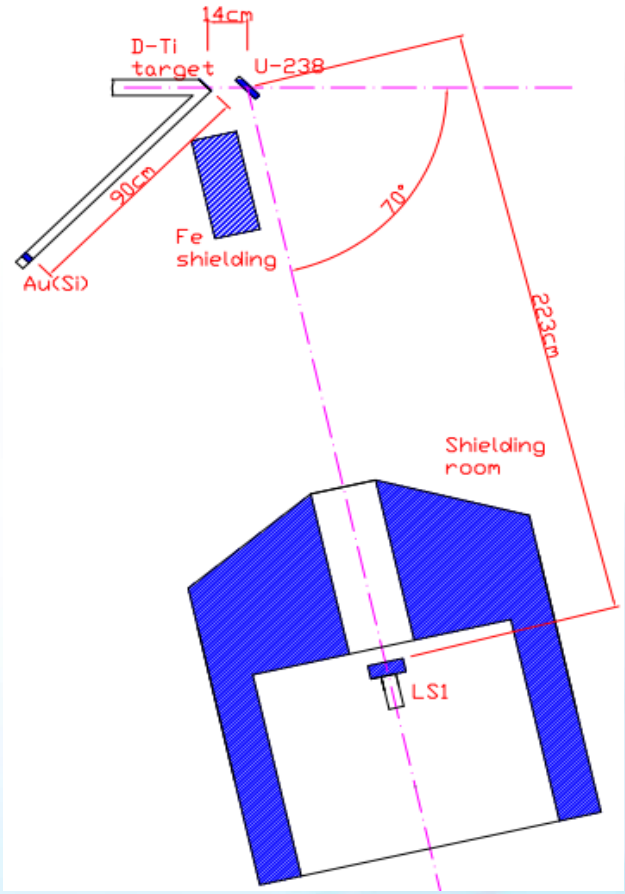




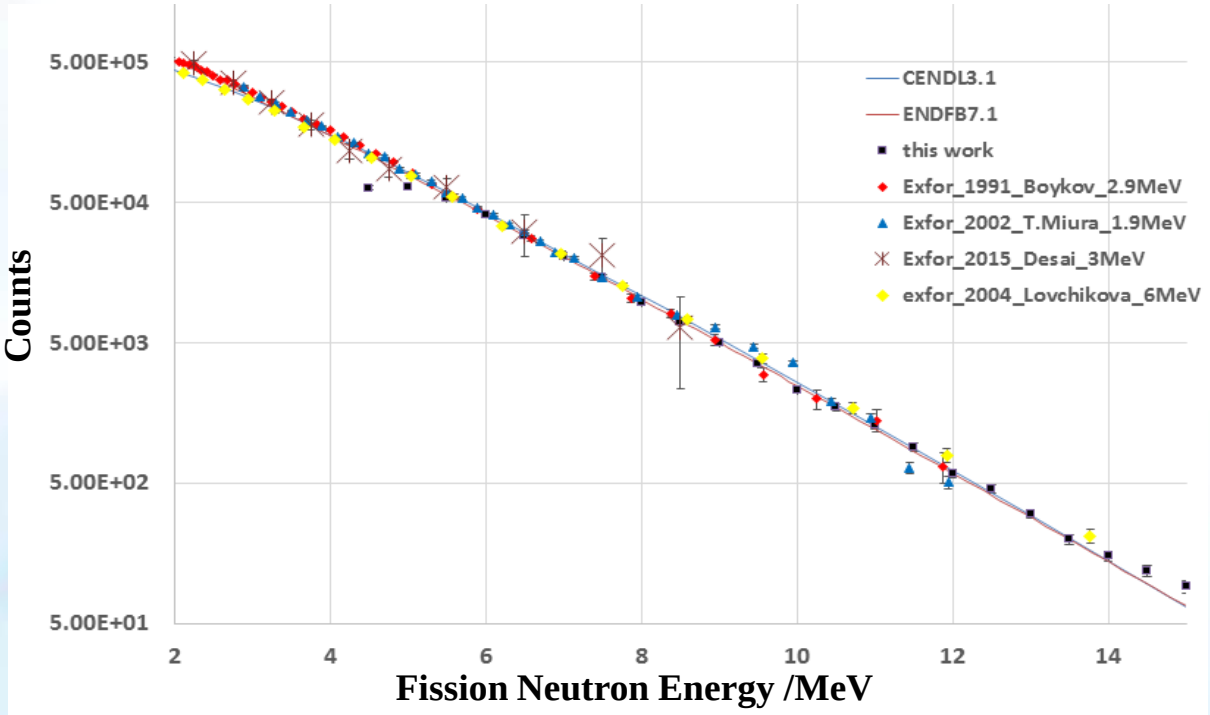


4. The measurement progress in CIAE

① The PFNS of 238U induced by 2.8 MeV neutron



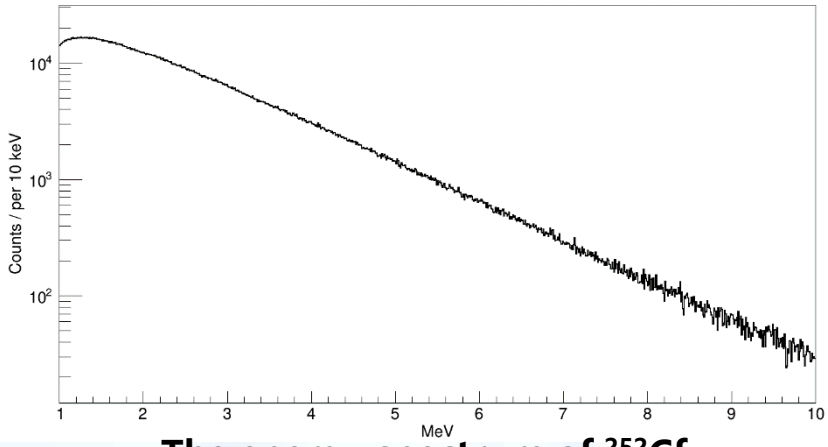
The layout of PFNS measurement for big mass sample



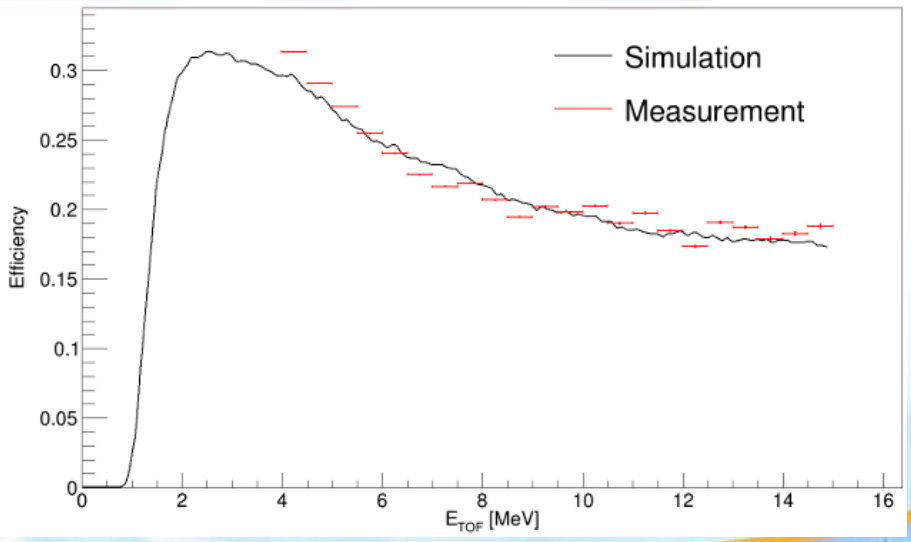
The PFNS of ^{238}U induced by 2.8 MeV neutrons

② The efficiency calibration for neutron detectors with a ^{252}Cf sourcce

The layout of efficiency calibration

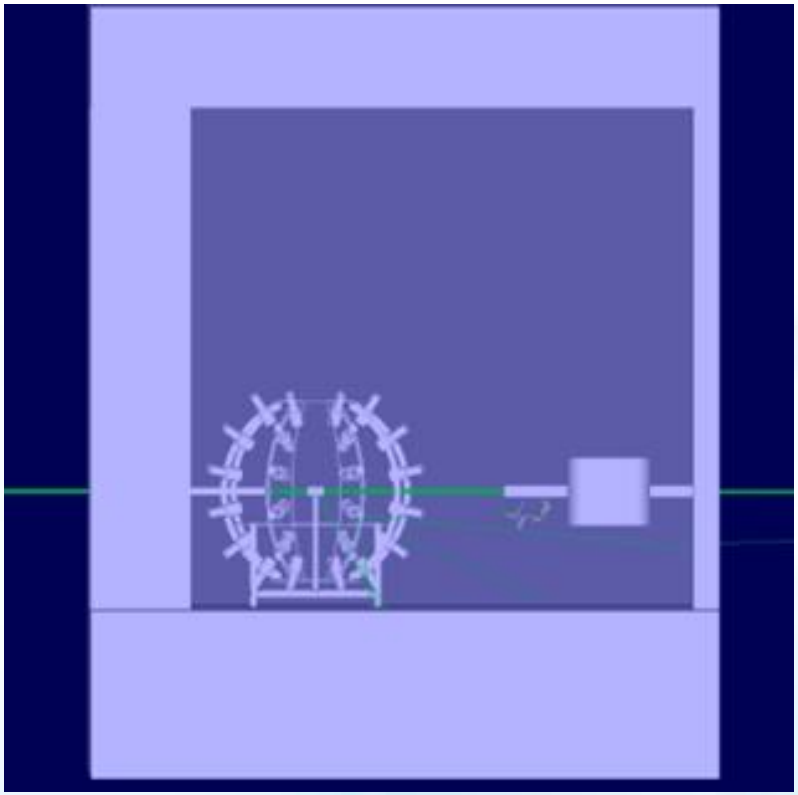


The energy spectrum of ^{252}Cf



The efficiency for single detector

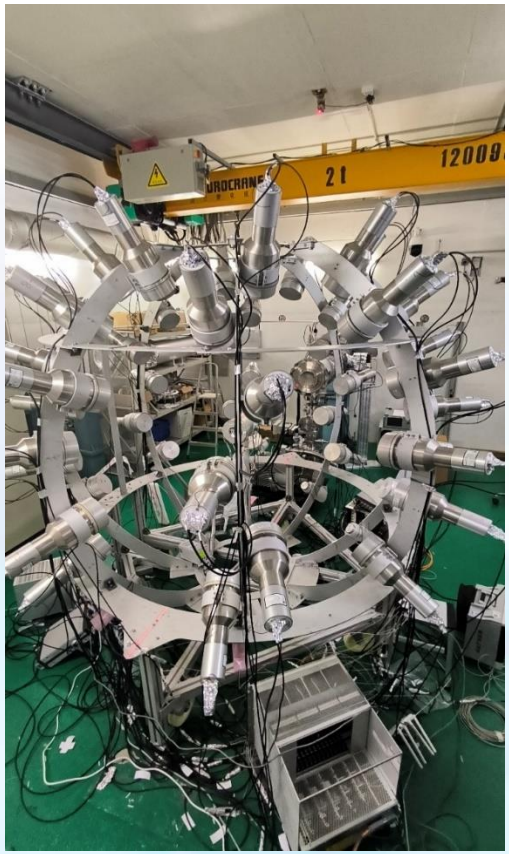
③ The PFNS measurement at CSNS back-n



Back ground simulation with Geant4

Where the neutrons came from	Counts	Percentage
Air	166477	5.4804%
Other LS det.	195285	6.4288%
Detector support	51771	1.7043%
Fission	120786	3.9763%
Fission plate liner(100um SSL)	1461428	48.1103%
Fragment stop plate(10um)	828341	27.2690%
PPAC散射	31691	1.0433%
Left wall	39379	1.2964%
Right wall	63140	2.0786%
Back wall	12180	0.4010%
Front wall	12283	0.4044%
Roof	5741	0.1890%
floor	44057	1.4504%
Chamber	5105	0.1681%
Total	3037664	100.0000%

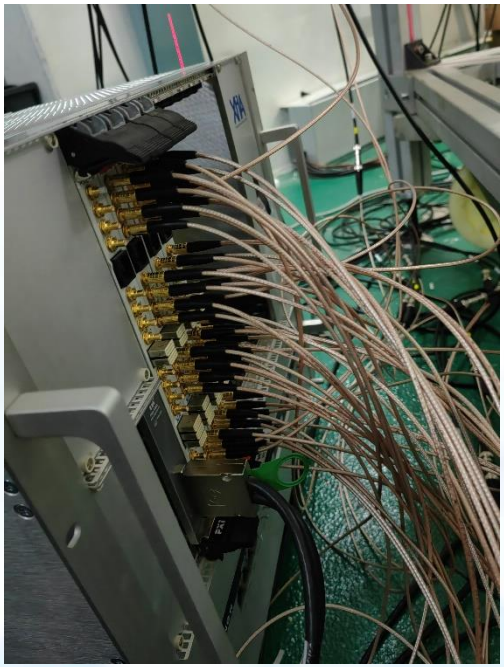
Some parameters for PFNS experiment at back-n



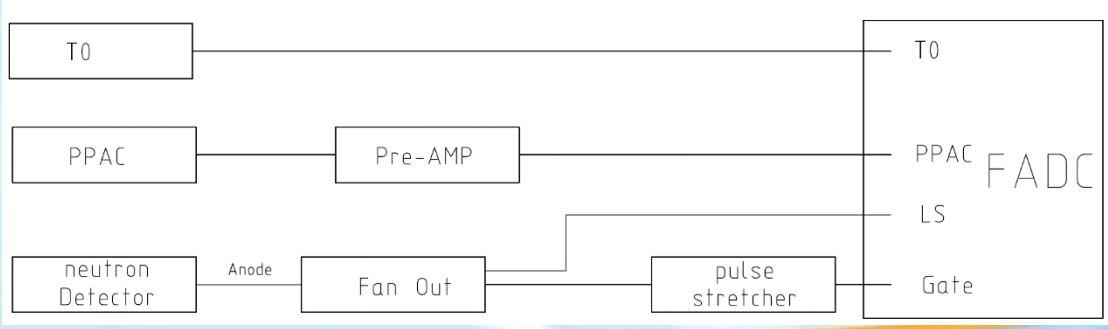
FIssion Neutron spectrum Detector Array-FINDA

Parameter	content
Detector number	48
Detector type	Liquid scintillator (LS)
Sample	^{235}U
Sample mass	~40 mg
Time resolution between PPAC and LS	1 ns
DAQ time	~300 hours
Distance for source neutron	55 m
Distance for fission neutron	1 m
LS type	EJ301

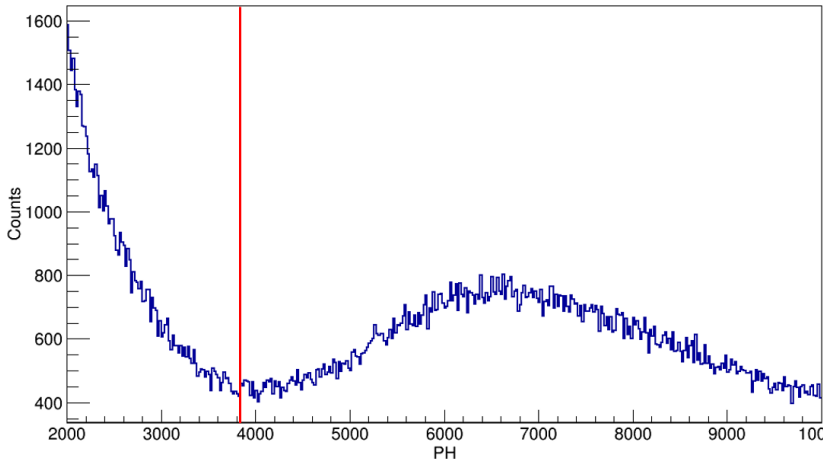
Four XIA 16-channel Pixie16 500M SPS 12bits modules



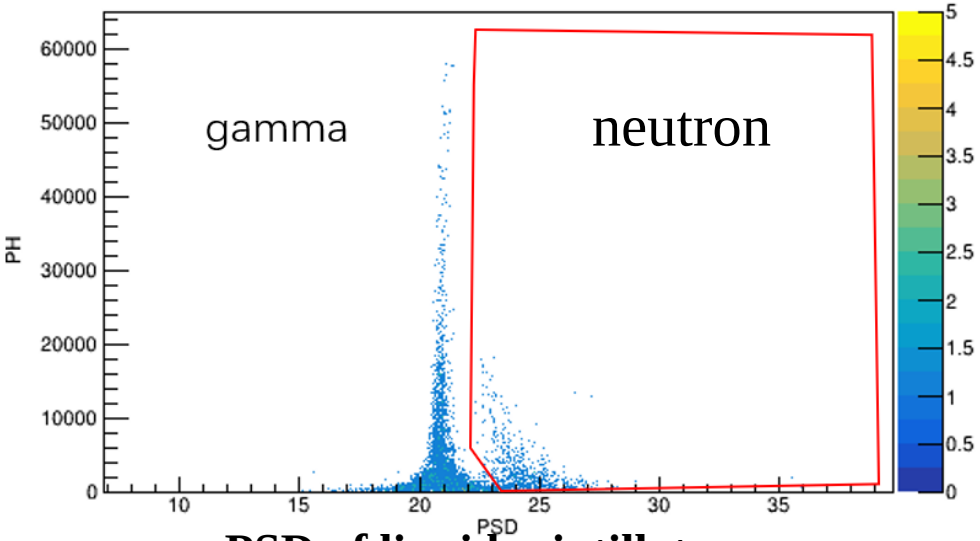
DAQ for PFNS measurement: amplitude, QDC, time stamp



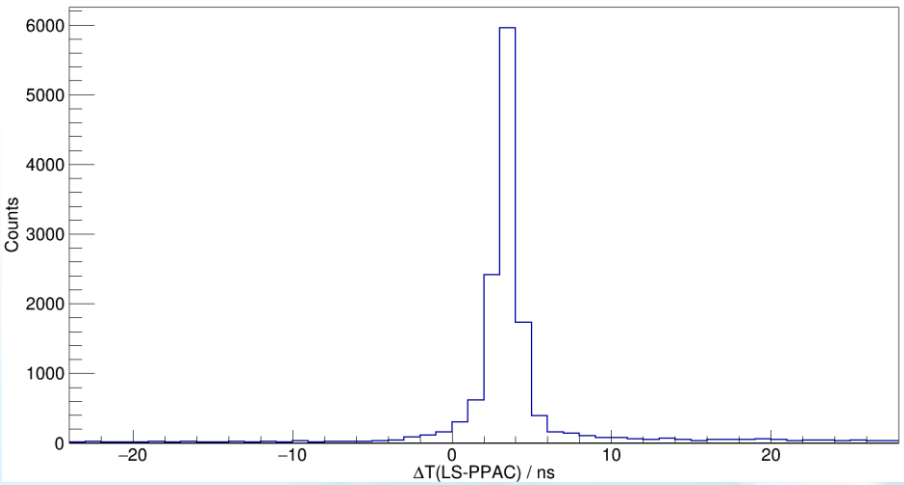
Some Preliminary results I



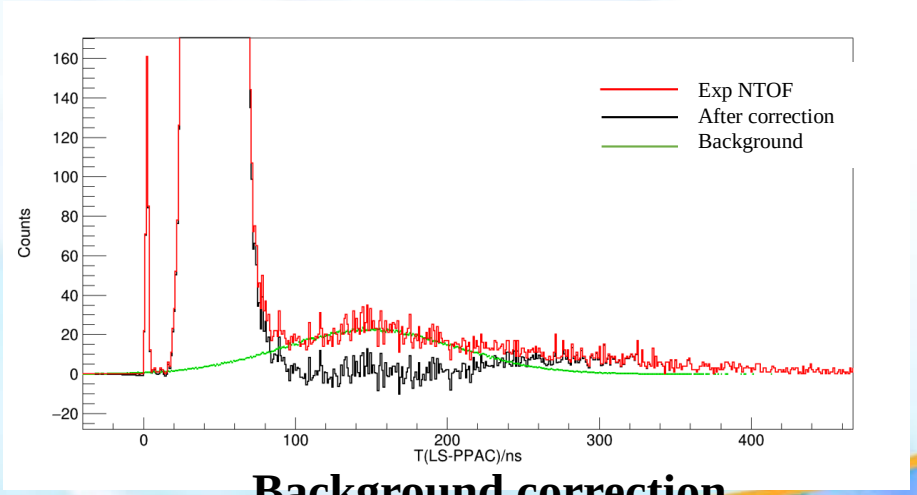
The threshold of PPAC energy spectrum



PSD of liquid scintillator

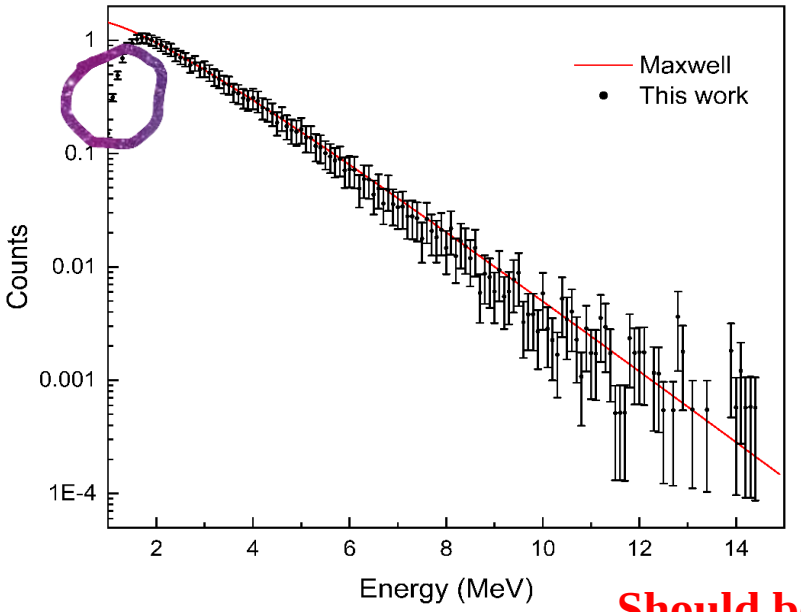


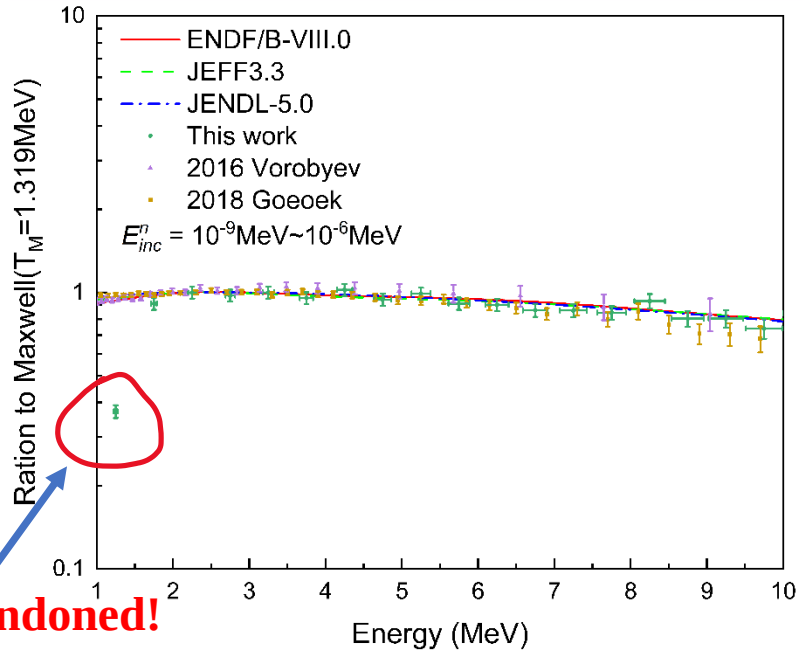
Zero time correction



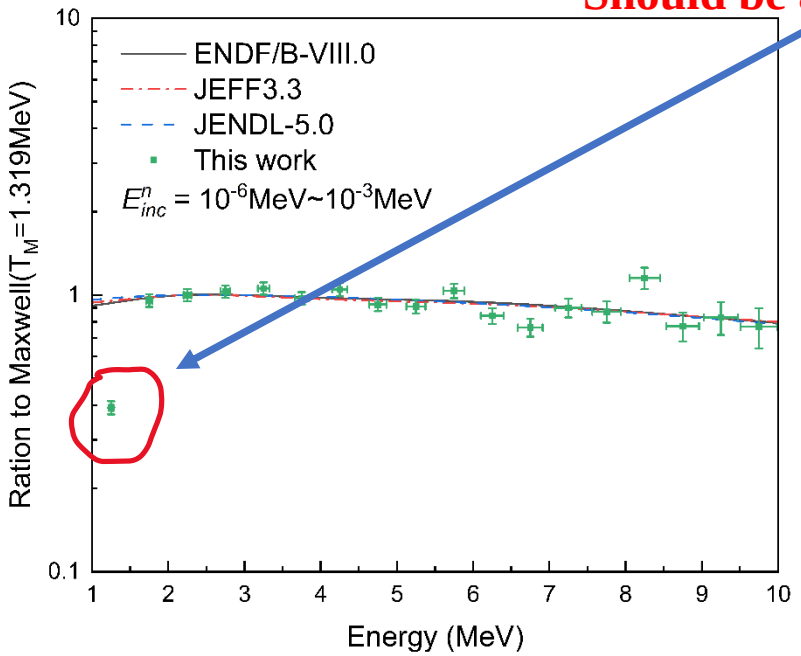
Background correction

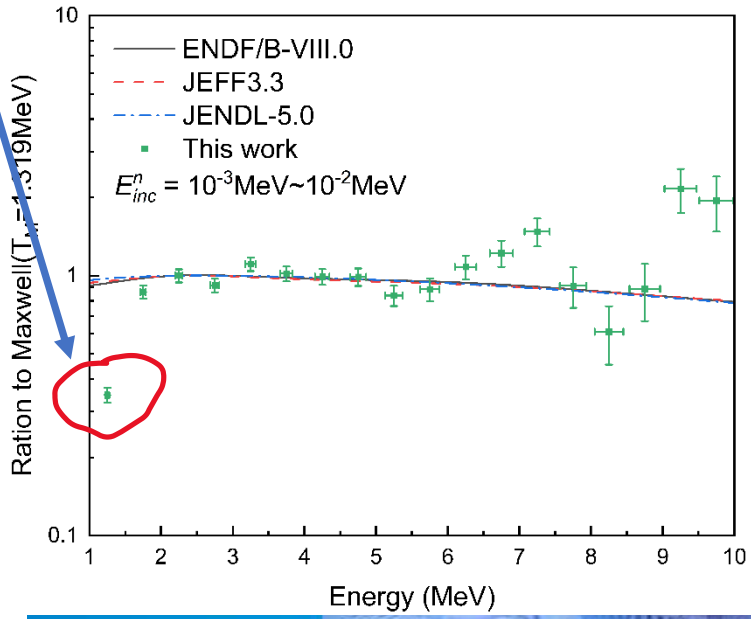
Some Preliminary results II





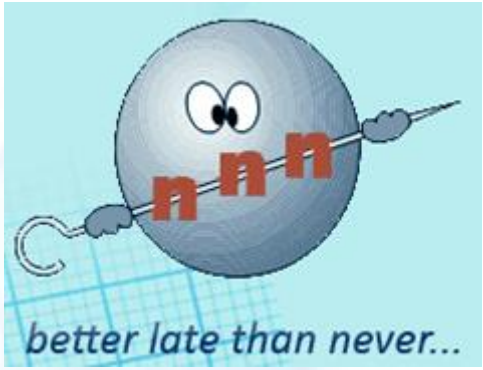
Should be abandoned!





5. Summary & future plan

- **PFNS research with white neutron source has been started in China, there are still a lot of work to be done.**



- **Future plan**

  ① **Improve the data quality**

  ② **Measure the PFNS of some other elements**

  ③ **Try to measure the angular distribution of fission neutrons**

  ④ **Seeking some cooperations with FINDA**

Advices, questions and comments are welcome.

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