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

CNDC
CHINA NUCLEAR DATA CENTER

Progress on Nuclear data Measurements in China

Xichao Ruan

China Nuclear Data Center
China Institute of Atomic Energy

WPEC-2020, May 11-15, 2020, Paris, France

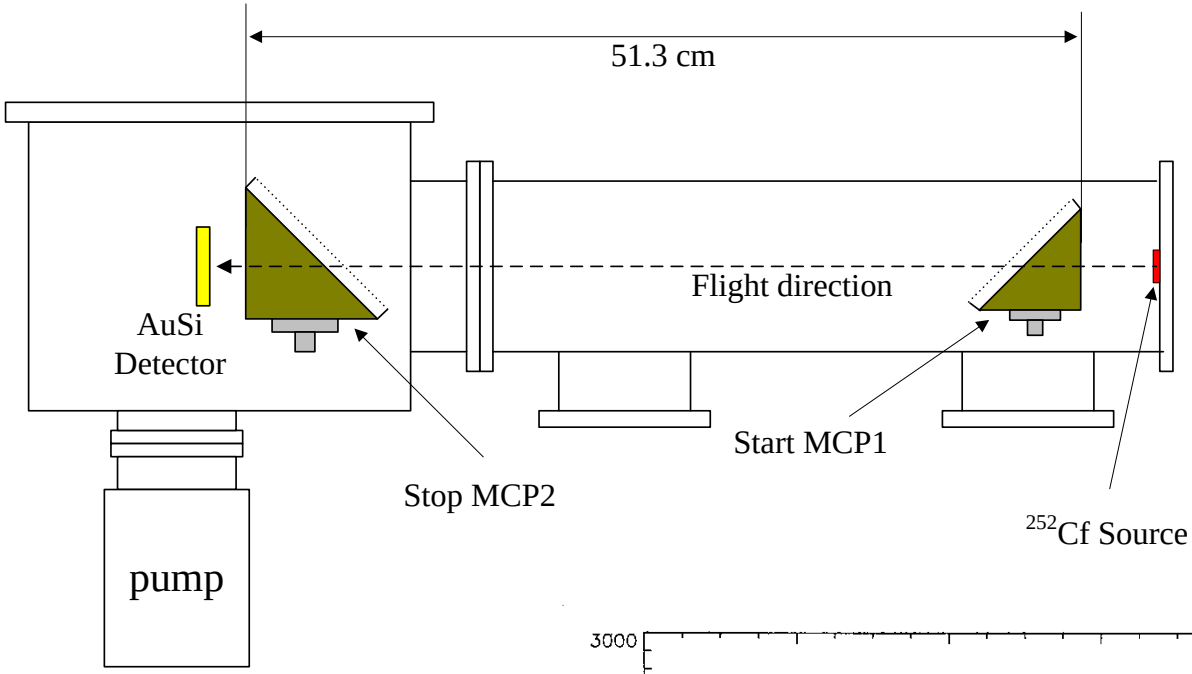
Progress of ND measurements in the following institutes are collected

China Institute of Atomic Energy

Highlights in 2019

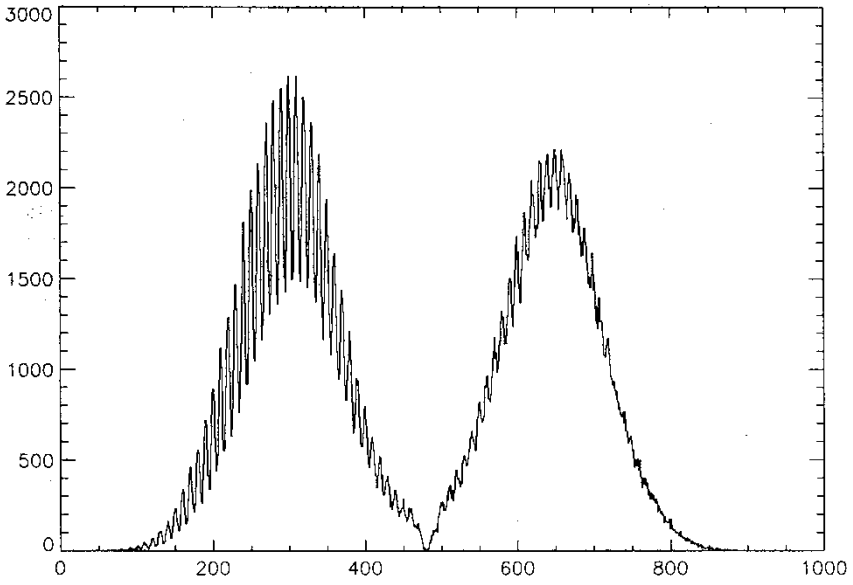
1. R&D of fission mass distribution measurement technique
2. Neutron and gamma leakage spectrum measurement
3. Construction of white neutron beamlines at CIAE 100 MeV Cyclotron facility
4. Progress at CSNS

1. R&D of fission mass distribution measurement technique with TOF-E method

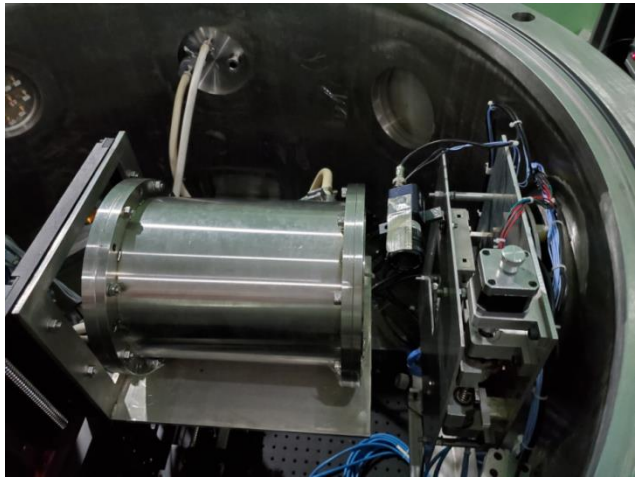


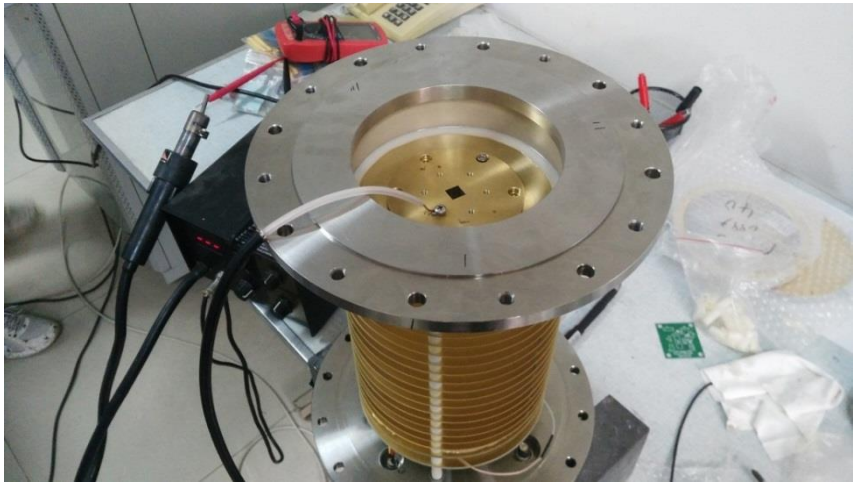
$$M = 2E\,t^2/l^2$$

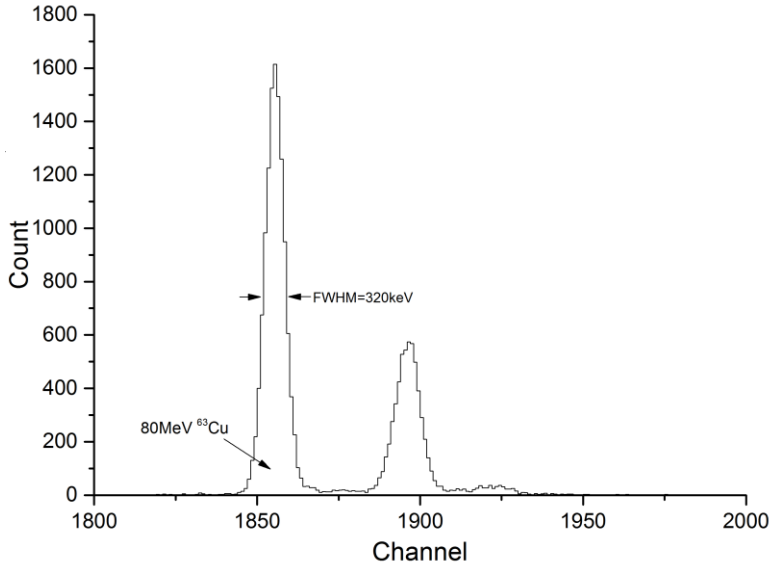
$$\frac{\delta M}{M} = \sqrt{\left(\frac{\delta E}{E}\right)^2 + \left(2\frac{\delta t}{t}\right)^2 + \left(2\frac{\delta l}{l}\right)^2}$$

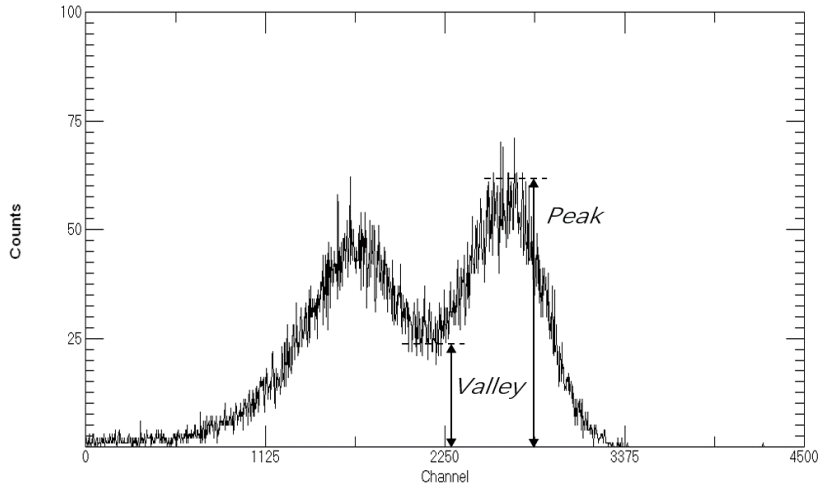


Development of high resolution IC





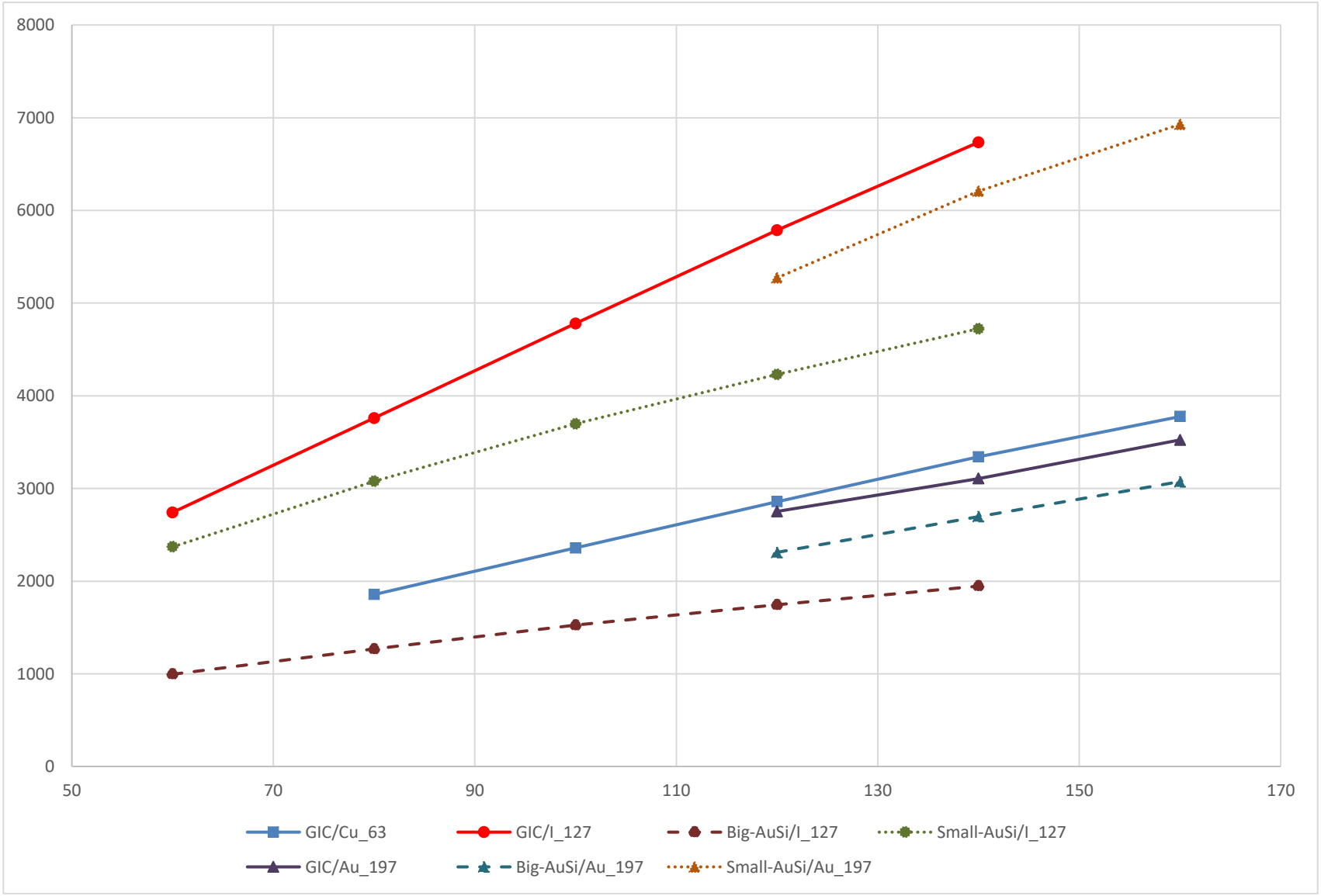




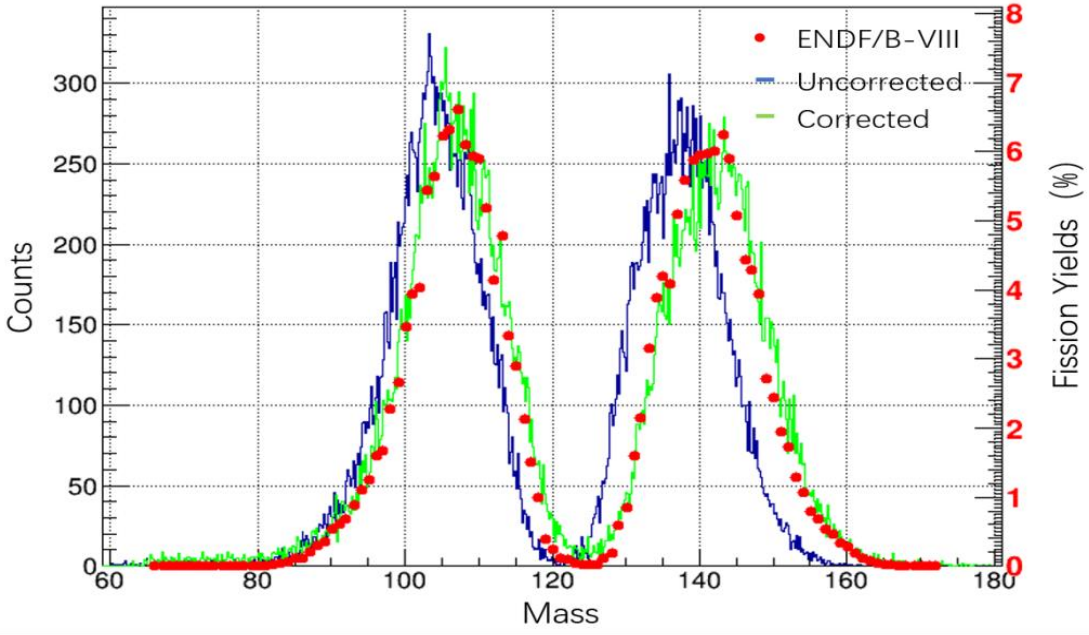
Energy resolution about 0.4% (with 80 MeV Cu+ beam) achieved

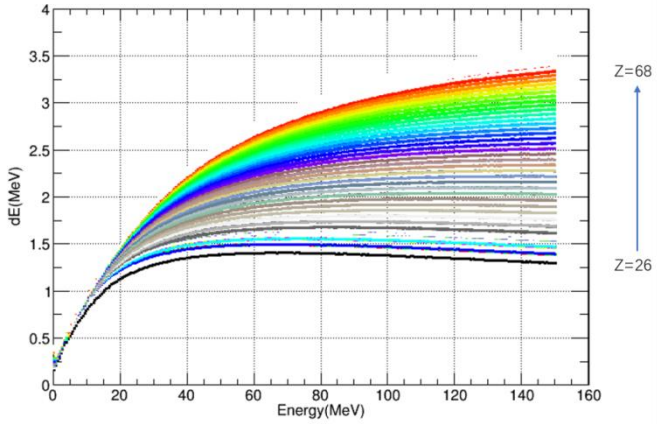
Energy spectrum of Cf sf fragments，Peak to valley ratio: 2.76

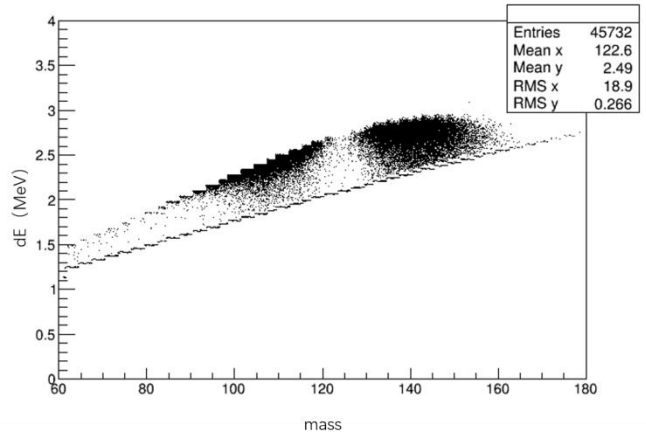
Energy calibration at the HI-13 tandem accelerator



Preliminary result or cf-252 measurement





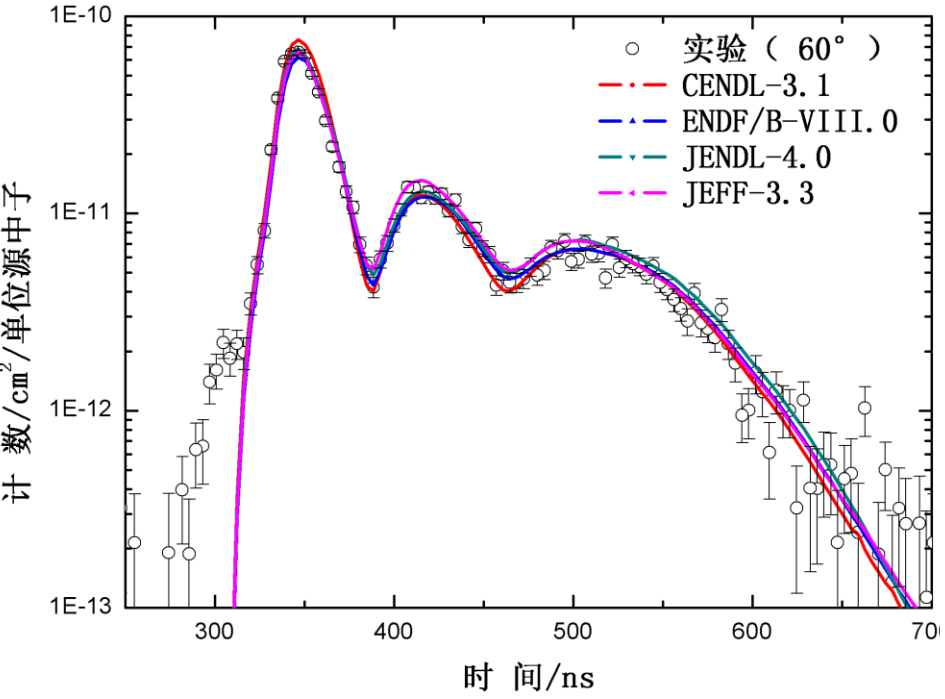


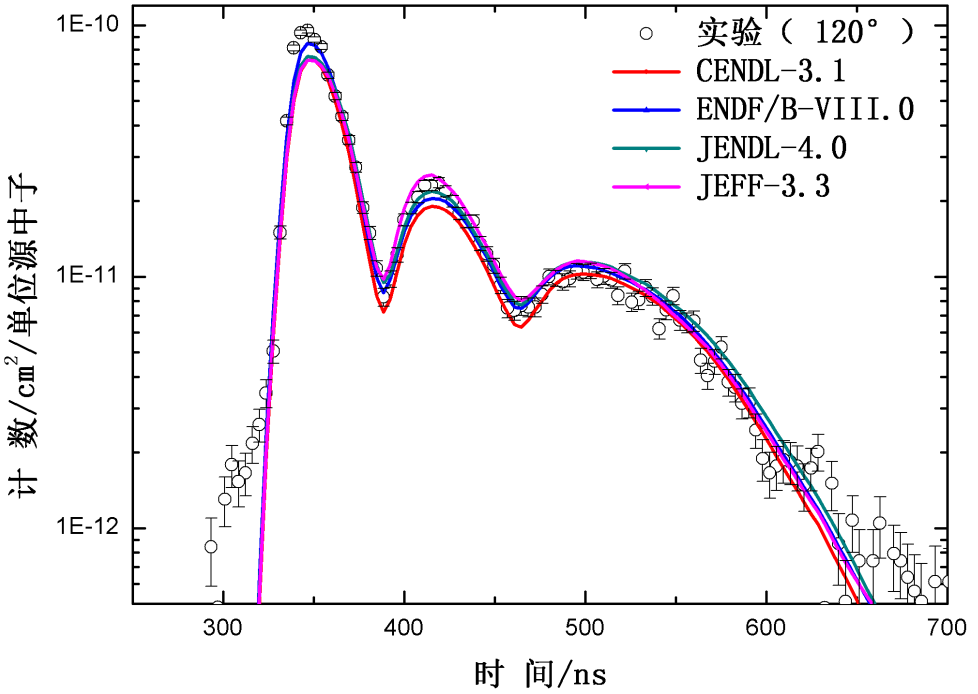
N	A	E	Zp	dE
1	60	120	26	1.62
2	60	120.5	26	1.6
3				
.				
.				
.				
.				
36000	180	0	68	0

- Energy loss correction for the windows is critical

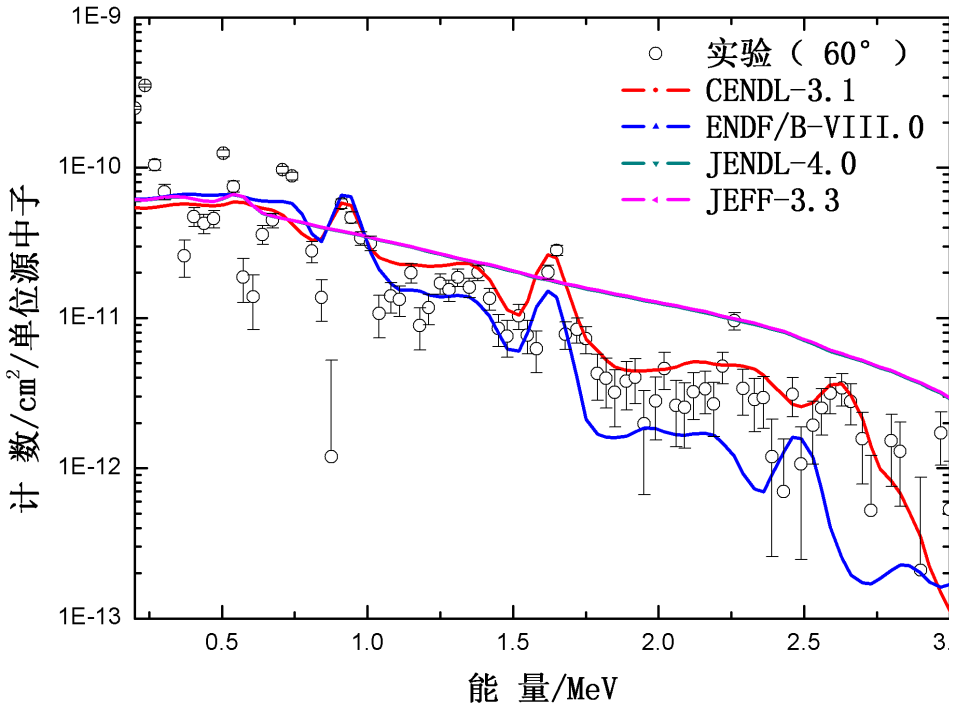
2. Neutron leakage spectrum measurement for d-D and d-T neutron sources

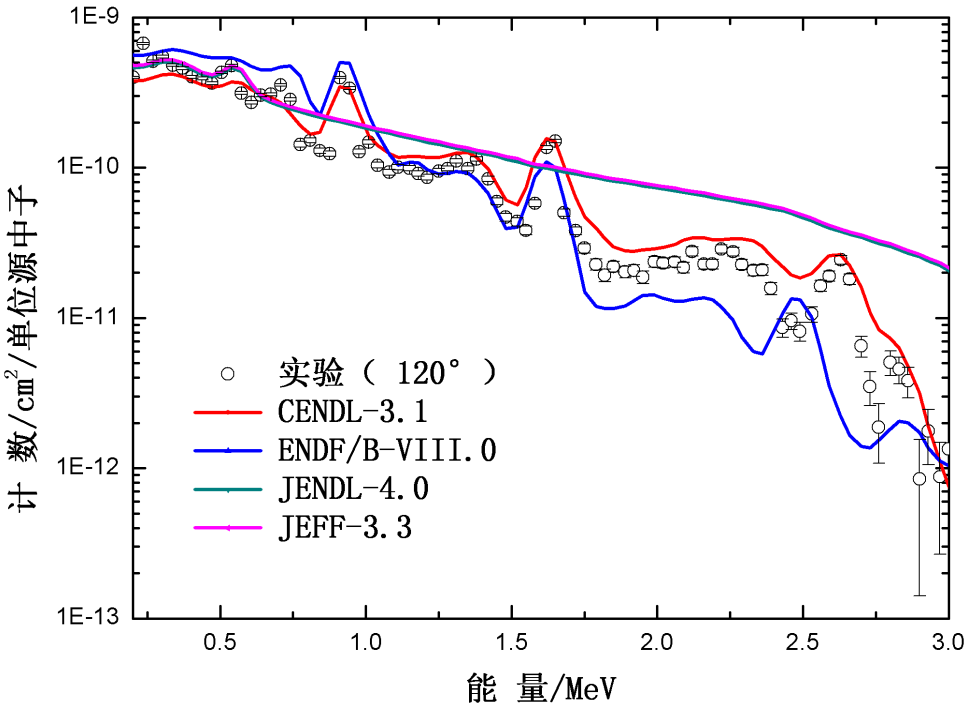
D-D source, Bi sample with 5×10×10 cm



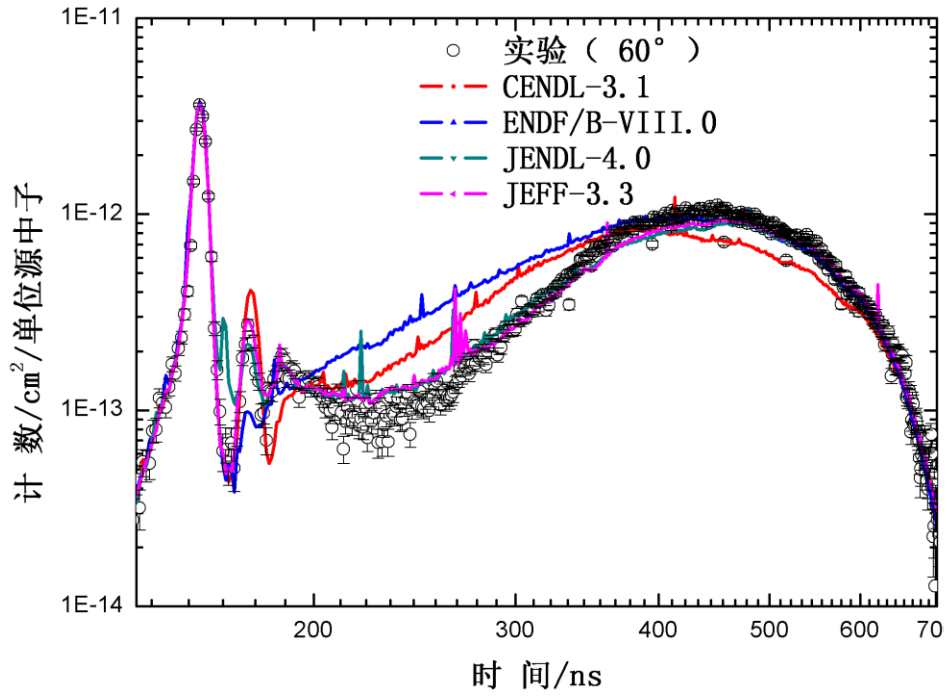


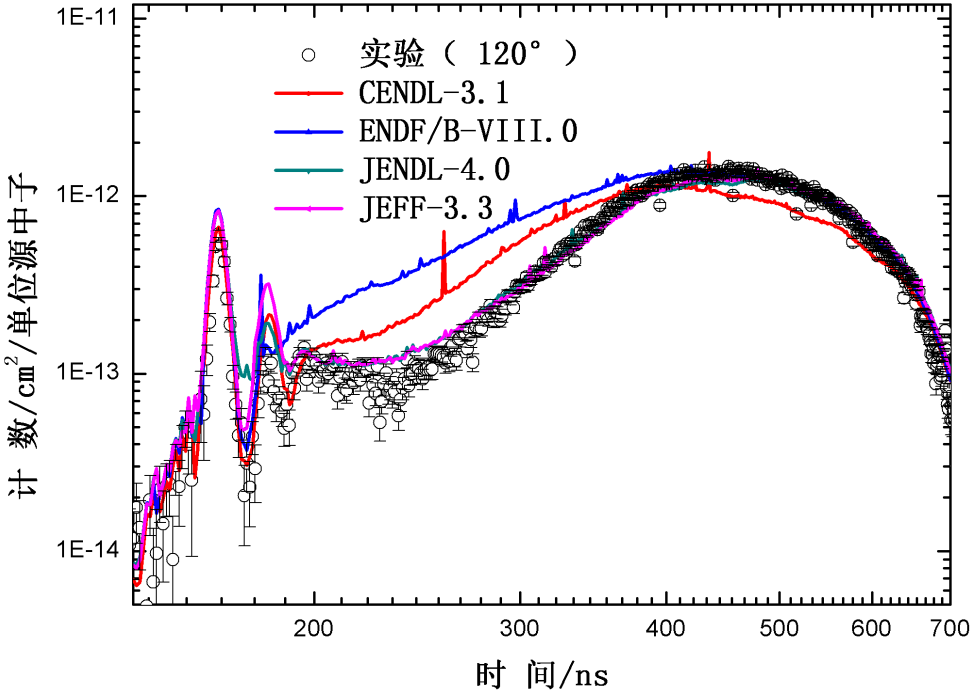
D-D source, Bi sample, γ spectrum



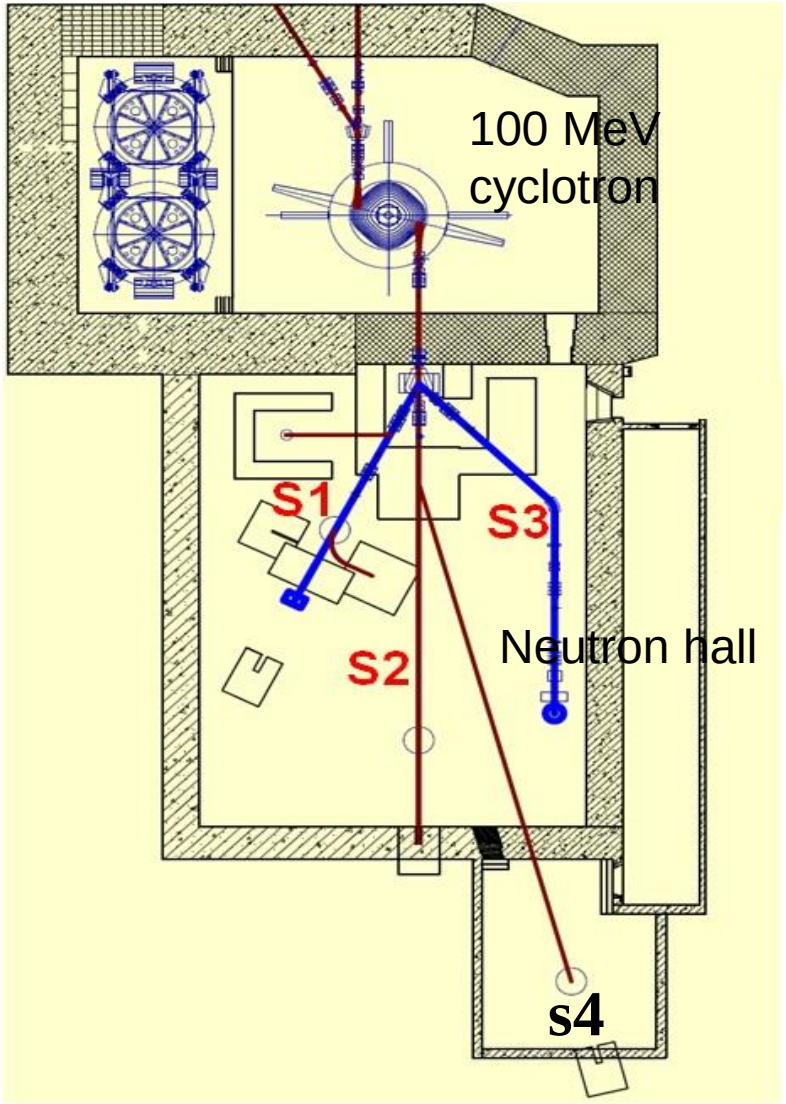


D-T source, Bi sample





3. Construction of white neutron beamlines at CIAE 100 MeV Cyclotron facility



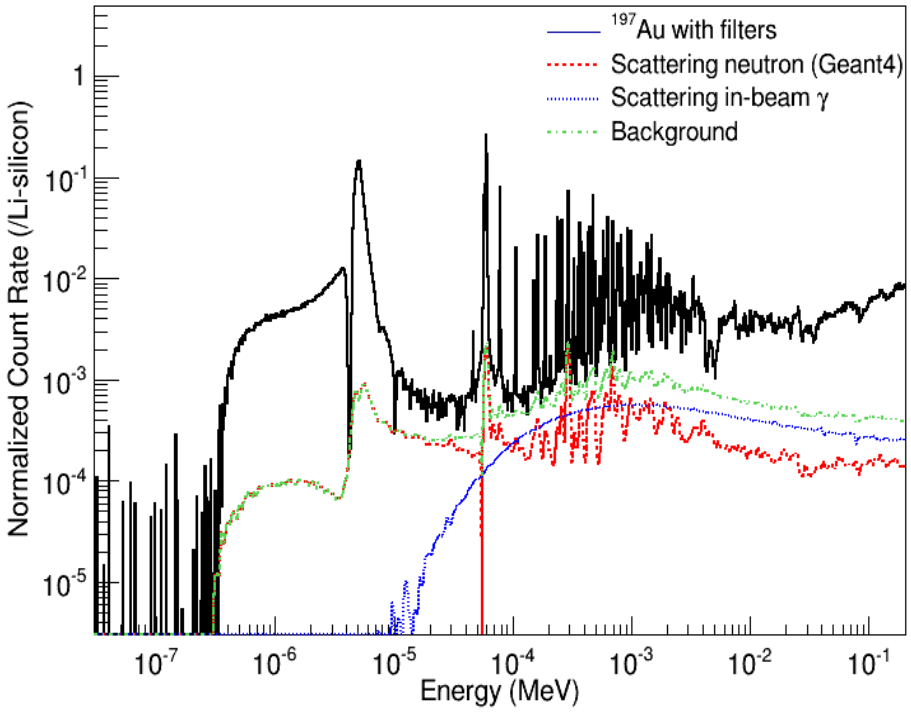
- **S1: quasi-monoenergetic neutron beam**
- **S2: white neutron beam, 15 m**
- **S3: proton beam**
- **S4: white neutron beam, 30 m**

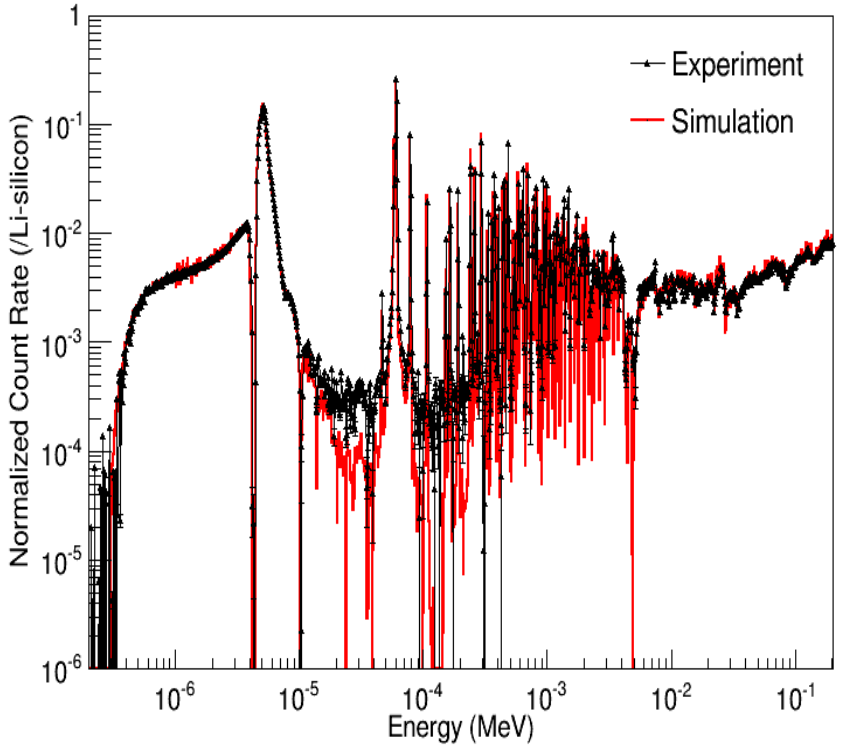
- **Neutron dosimetry**
- **Nuclear data measurement**
- **SEE study**

4. Progress at CSNS

1. Background study for capture XS measurement
2. Installation and commissioning of GTAF-II

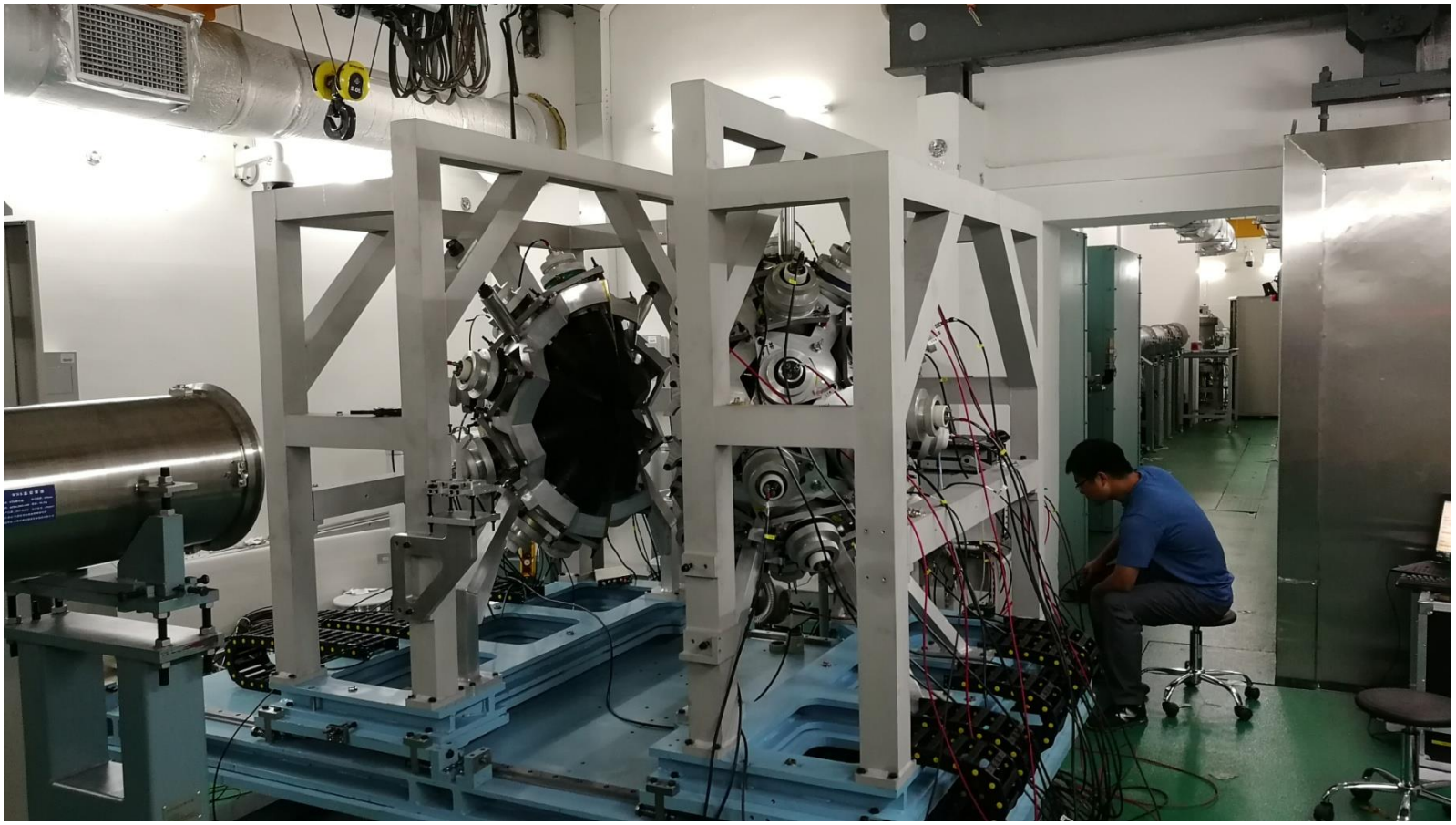
1. Background study for capture XS measurement





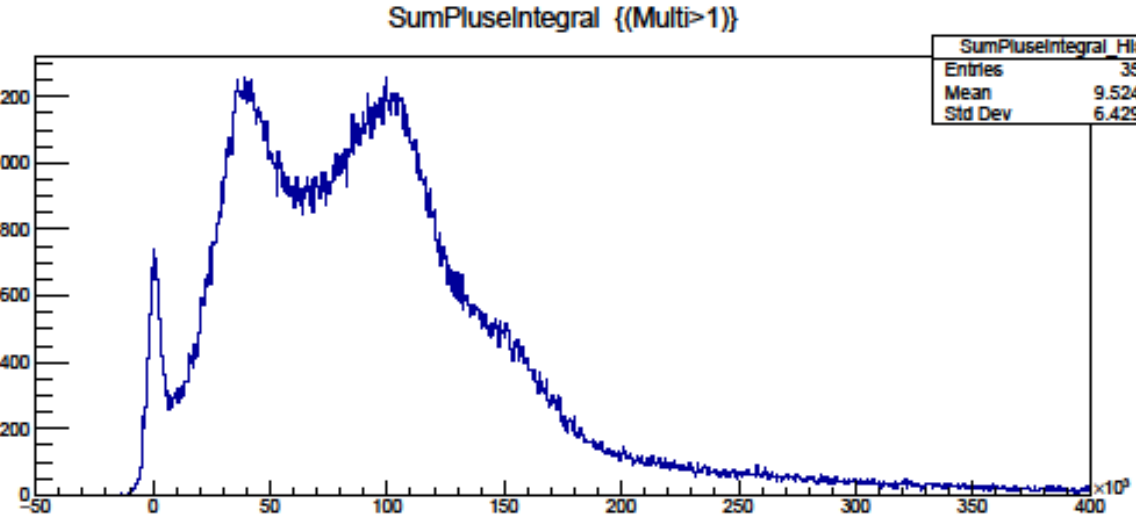
Backgrounds due to neutron scattering, in beam gamma are studied carefully

1. Installation and commissioning of GTAF-II

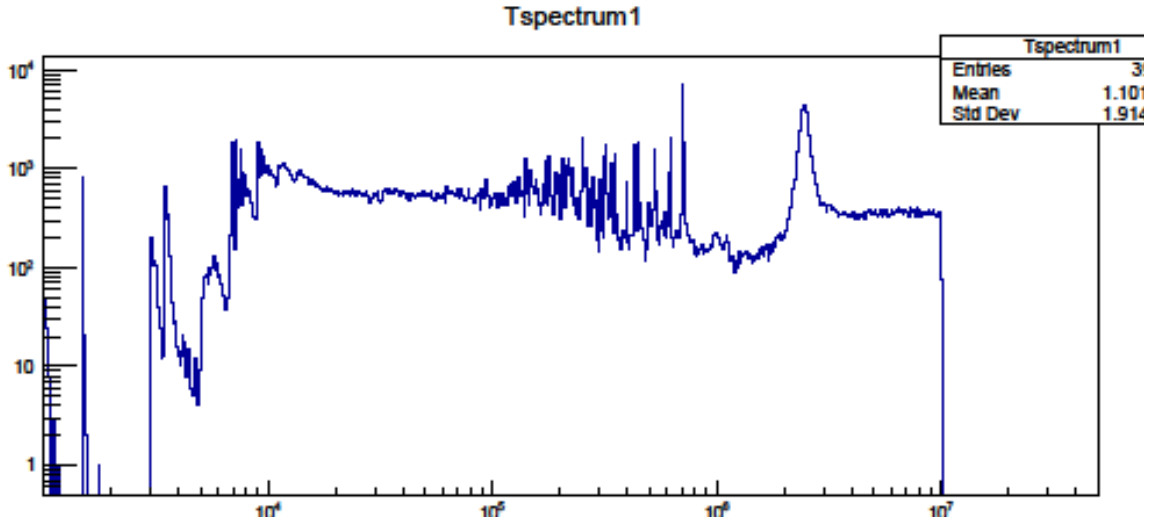


GTAF-II now was installed at the CSNS

Test measurement with Au sample



Esum



TOF

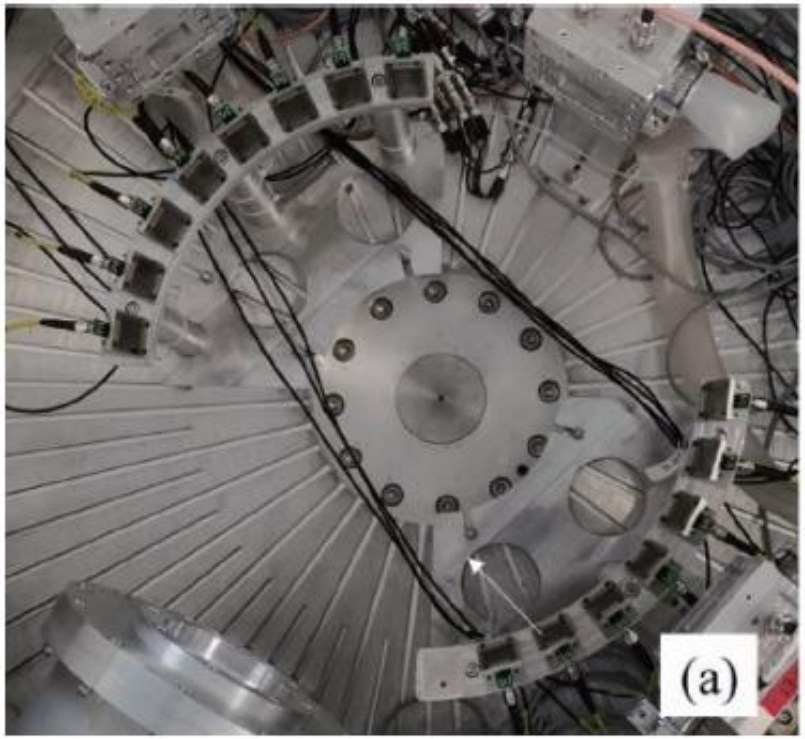
Peking University

Prof. Guohui Zhang

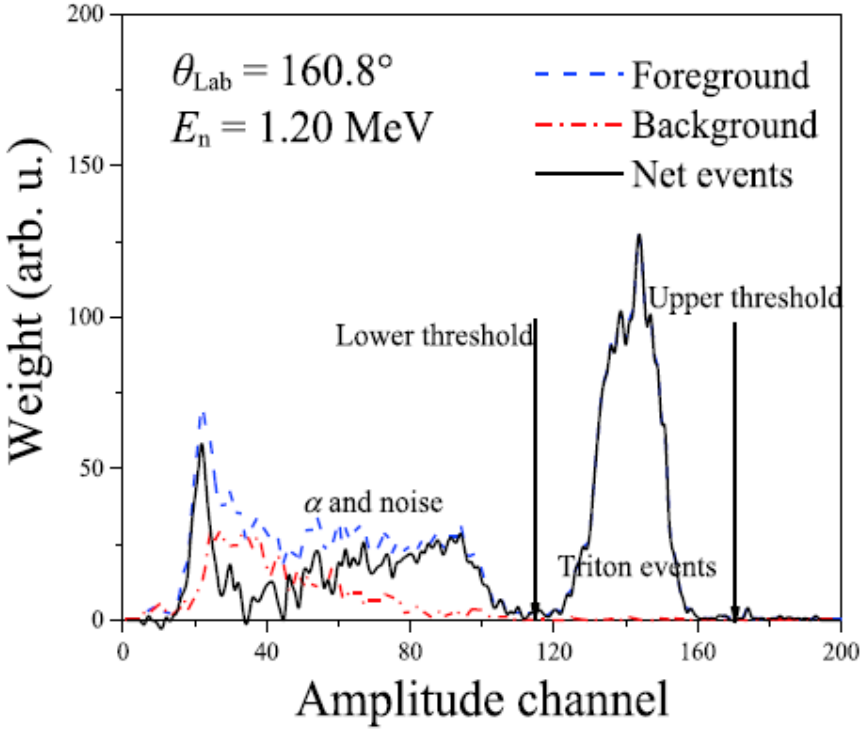
ghzhang@pku.edu.cn

6Li(n, t)4He reaction from 1.0 eV to 3.0 MeV

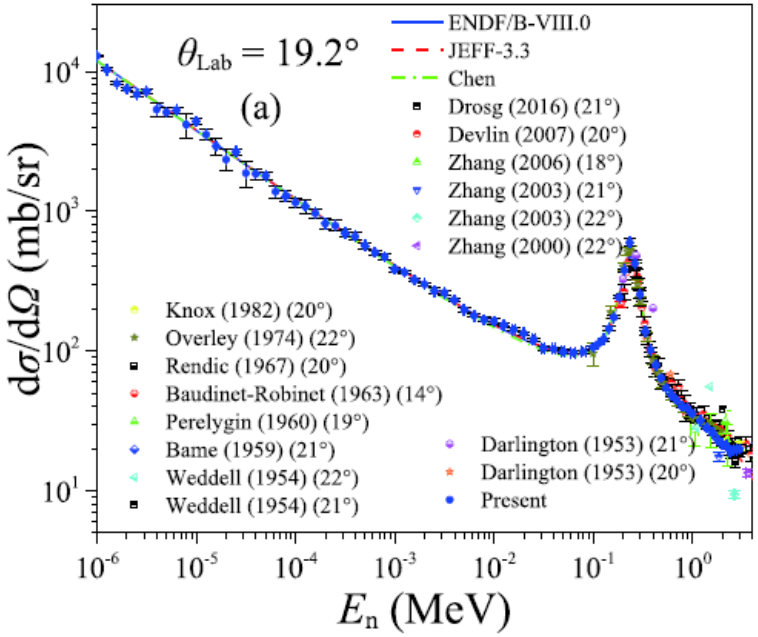
Chinese Phys. C **44** 014003

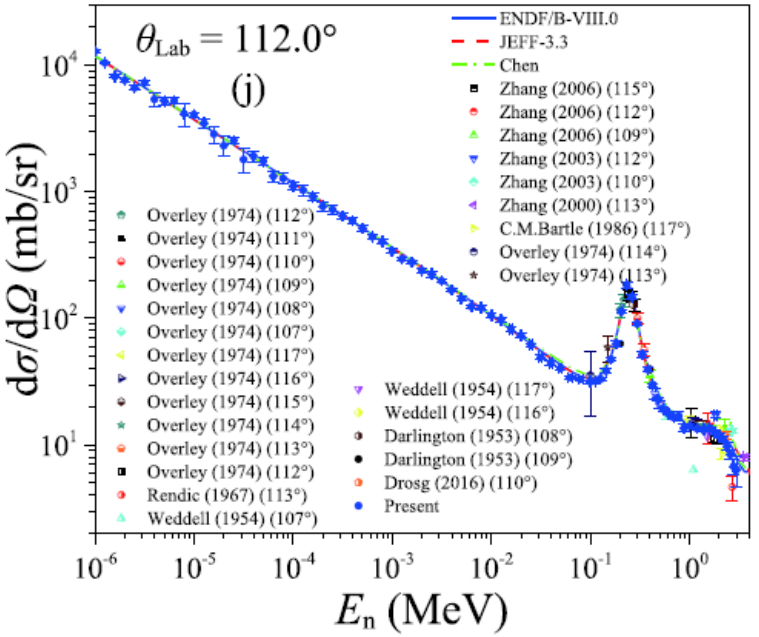


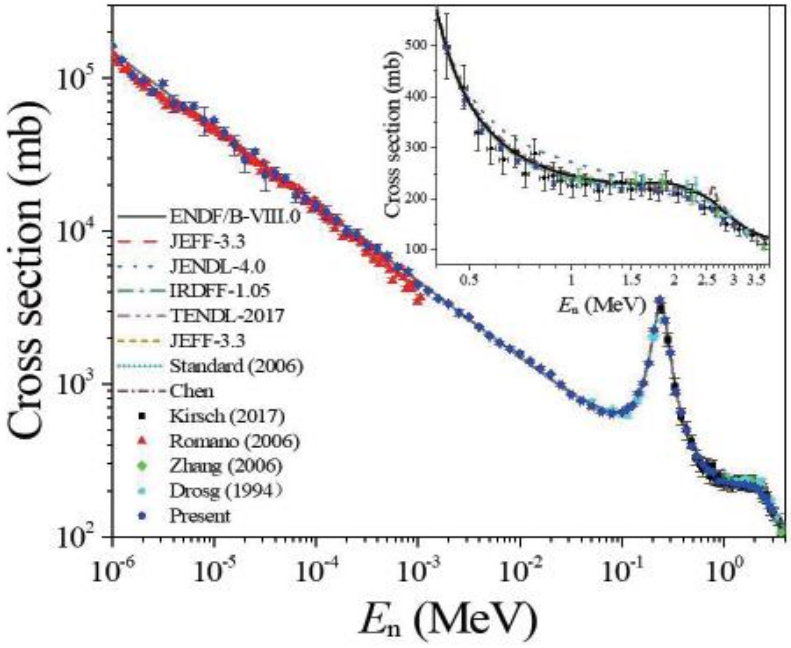
Si detector array (15 detectors covered from 20 to 160 degrees)

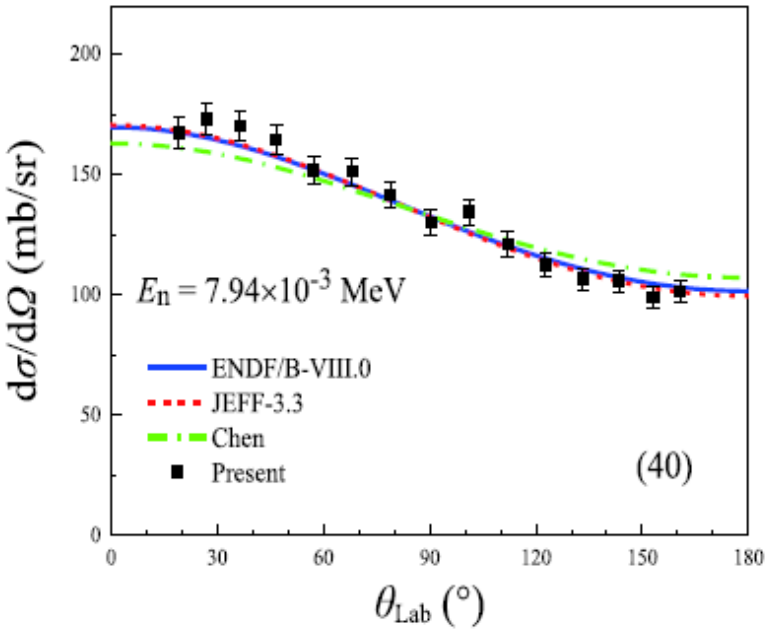


Measured spectrum


θ_{Lab} = 19.2°
(a)
ENDF/B-VIII.0
JEFF-3.3
Chen
Drosg (2016) (21°)
Devlin (2007) (20°)
Zhang (2006) (18°)
Zhang (2003) (21°)
Zhang (2003) (22°)
Zhang (2000) (22°)
Knox (1982) (20°)
Overley (1974) (22°)
Rendic (1967) (20°)
Baudinet-Robinet (1963) (14°)
Perelygin (1960) (19°)
Bame (1959) (21°)
Weddell (1954) (22°)
Weddell (1954) (21°)
Darlington (1953) (21°)
Darlington (1953) (20°)
Present
dσ/dΩ (mb/sr)
E_n (MeV)

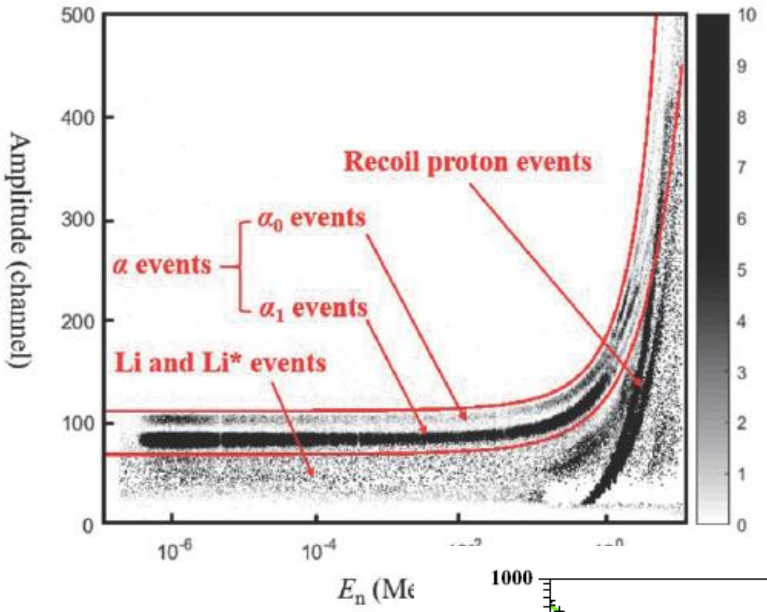

θ_{Lab} = 112.0°
(j)
ENDF/B-VIII.0
JEFF-3.3
Chen
Zhang (2006) (115°)
Zhang (2006) (112°)
Zhang (2006) (109°)
Zhang (2003) (112°)
Zhang (2003) (110°)
Zhang (2000) (113°)
C.M.Bartle (1986) (117°)
Overley (1974) (114°)
Overley (1974) (113°)
Overley (1974) (112°)
Overley (1974) (111°)
Overley (1974) (110°)
Overley (1974) (109°)
Overley (1974) (108°)
Overley (1974) (107°)
Overley (1974) (117°)
Overley (1974) (116°)
Overley (1974) (115°)
Overley (1974) (114°)
Overley (1974) (113°)
Overley (1974) (112°)
Rendic (1967) (113°)
Weddell (1954) (107°)
Weddell (1954) (117°)
Weddell (1954) (116°)
Darlington (1953) (108°)
Darlington (1953) (109°)
Drosg (2016) (110°)
Present
dσ/dΩ (mb/sr)
E_n (MeV)

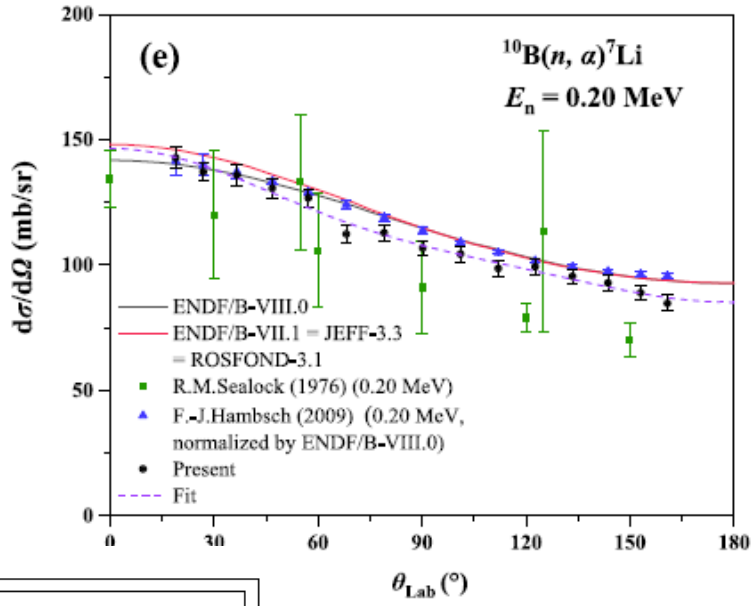

ENDF/B-VIII.0
JEFF-3.3
JENDL-4.0
IRDFF-1.05
TENDL-2017
JEFF-3.3
Standard (2006)
Chen
Kirsch (2017)
Romano (2006)
Zhang (2006)
Drosg (1994)
Present
Cross section (mb)
E_n (MeV)
Cross section (mb)
E_n (MeV)

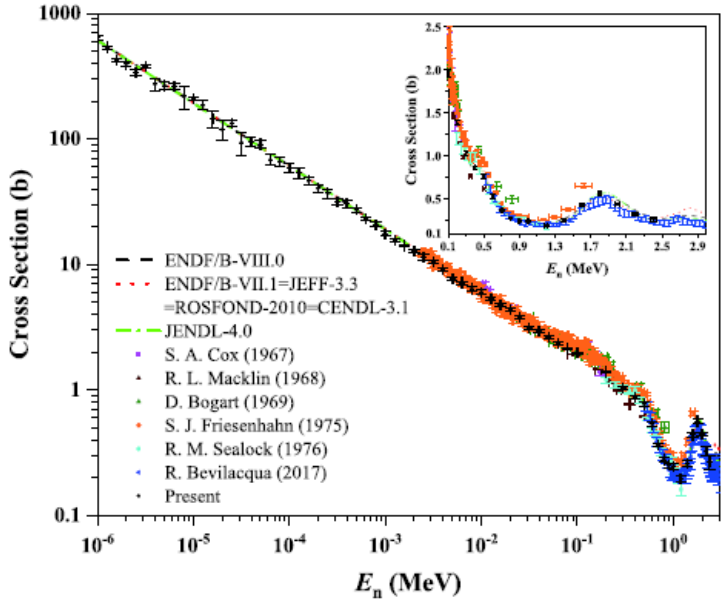

E_n = 7.94×10^{-3} MeV
ENDF/B-VIII.0
JEFF-3.3
Chen
Present
(40)
dσ/dΩ (mb/sr)
θ_{Lab} (°)

10B(n, α)7Li reaction in the neutron energy range from 1.0 eV to 2.5 MeV

Chinese Physics C Vol. 43, No. 12 (2019) 124002







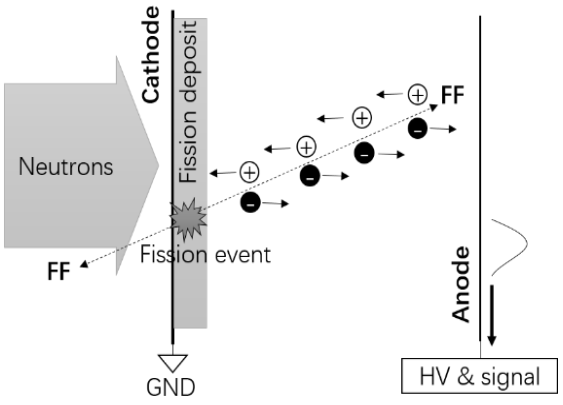
Fission cross section measurement at CSNS by China Academy of Engineering Physics

Dr. Yiwei Yang

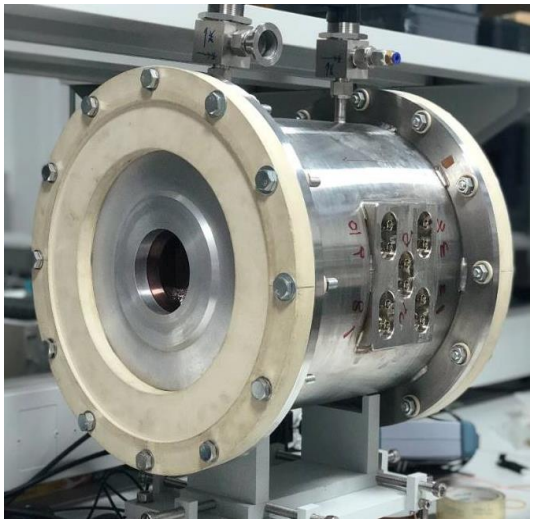
winfield1920@126.com

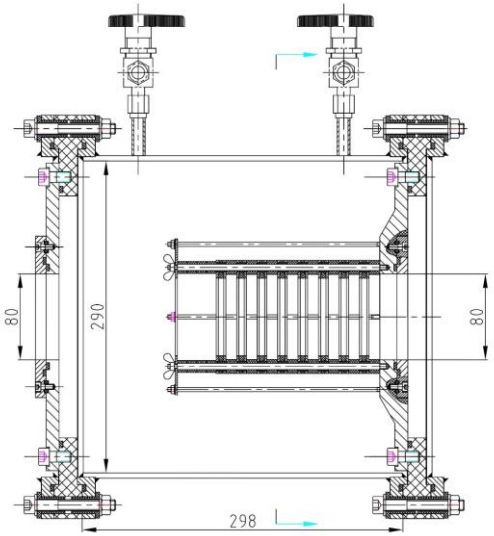
Fast Ionization Chamber for Fission Cross Section Measurement (FIXM)

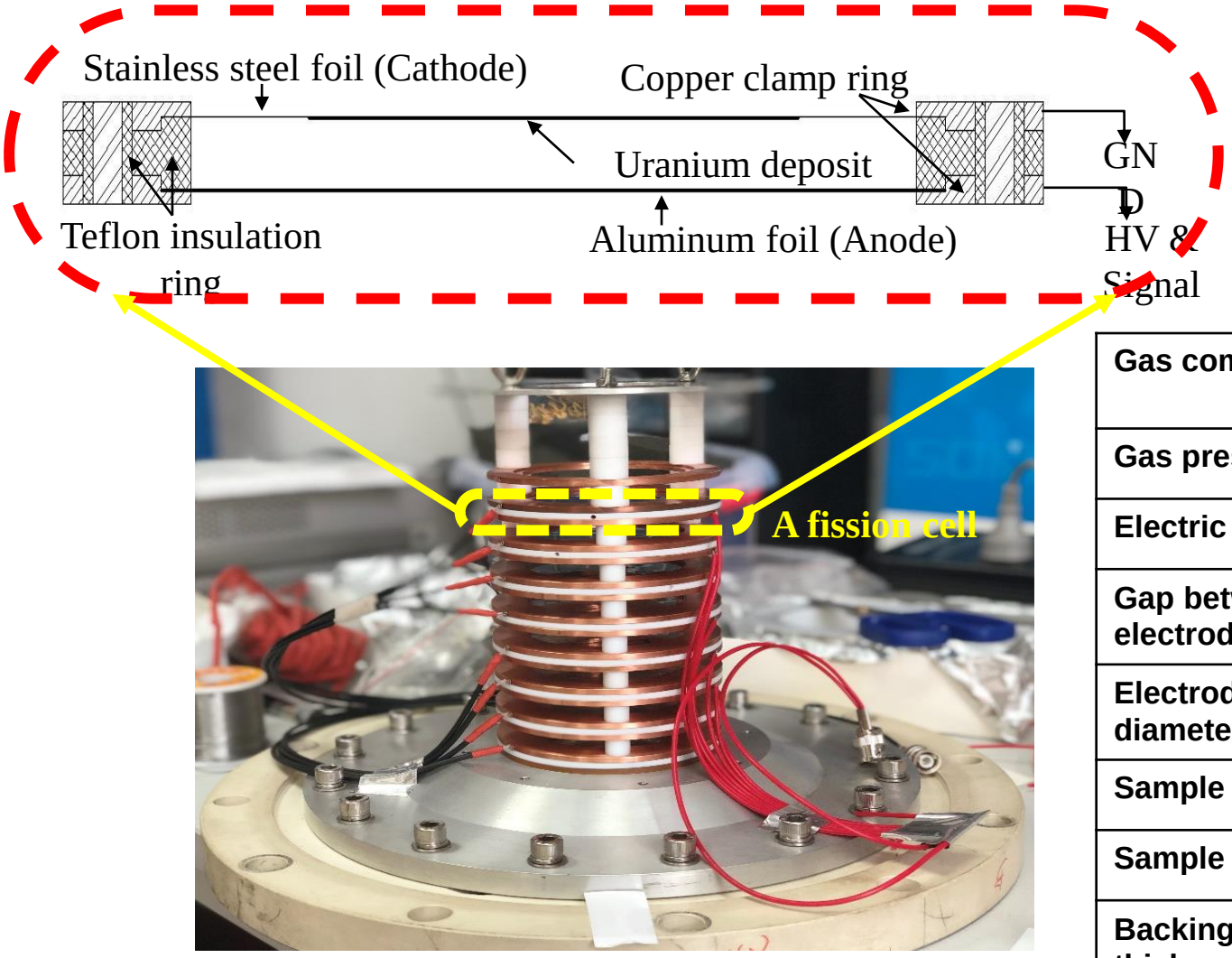
- Ionization chamber**: simple** and **fast enough** for current operation mode of CSNS.
- Signal rise time about 40 ns.



Basic principle diagram



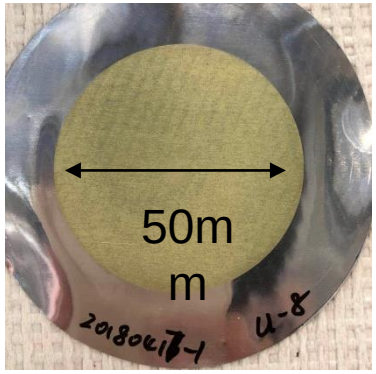


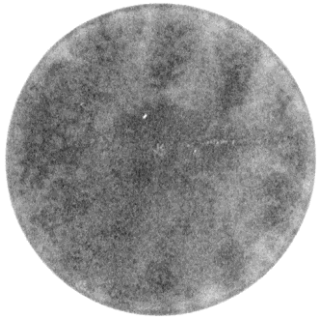


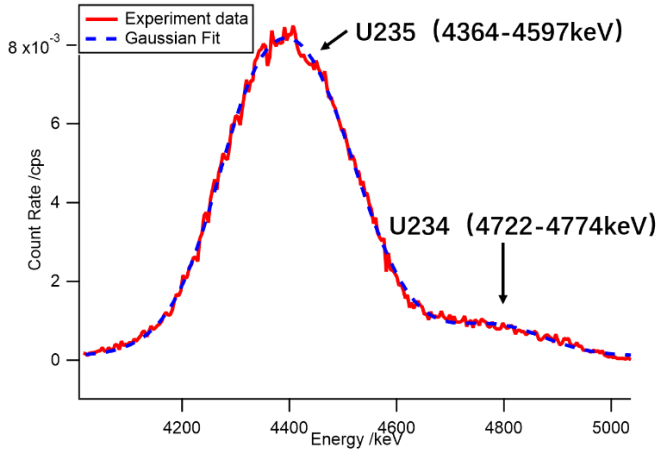
Gas composition	**Ar (90%)+CF_4(10%)**
Gas pressure	**800 mbar**
Electric field	**400 V/cm**
Gap between electrodes	**5 mm**
Electrode diameter	**100 mm**
Sample diameter	**50 mm**
Sample thickness	**150-300 μg/cm^2**
Backing thickness	**100 μm(Al) or 20 μm(Fe)**
Sample uniformity	**~5%**

Fission Samples

- Fissile material was electroplated on metal backing (Al or Stainless steel)
- Abundance: ^{235}U >99.98%), ^{238}U (>99.99%), ^{236}U (>99.9%), ^{232}Th (>99.9%)







- Characterization:
  - Mass: small solid angle α-particle counting;
  - Uniformity: α-particle imaging plate;
  - Diameter: edge recognition of the α-particle image;

Measurement of the U-238/U-235 fission cross section ratio at CSNS – Back-n WNS

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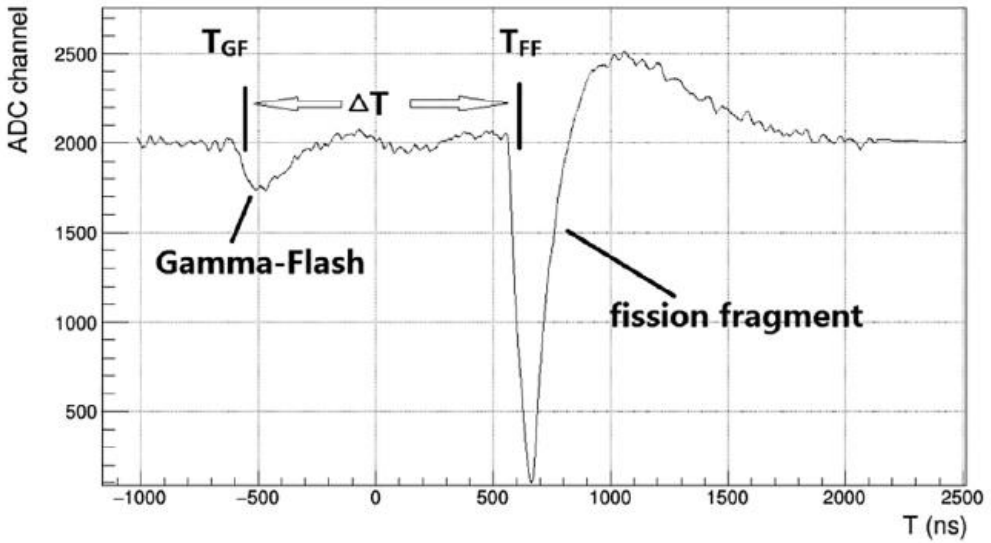
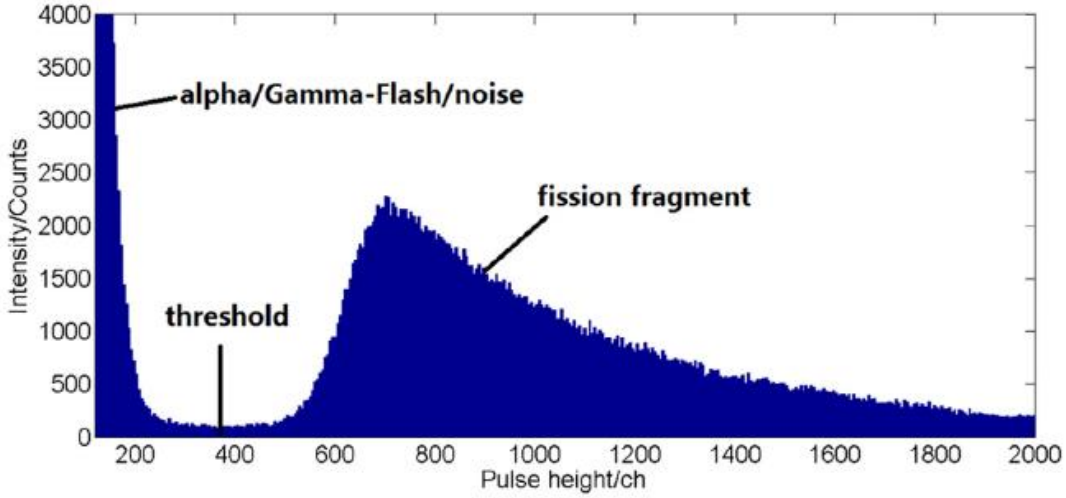


Fission signal



PH spectrum

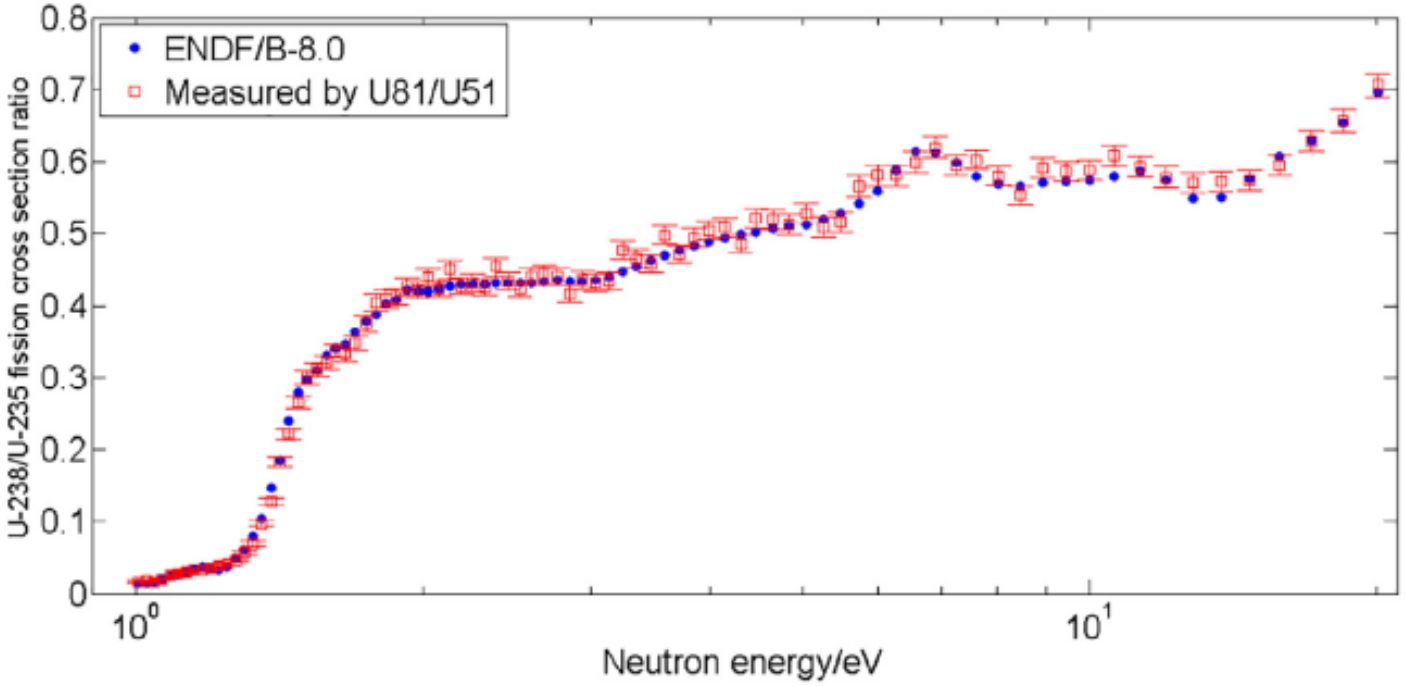
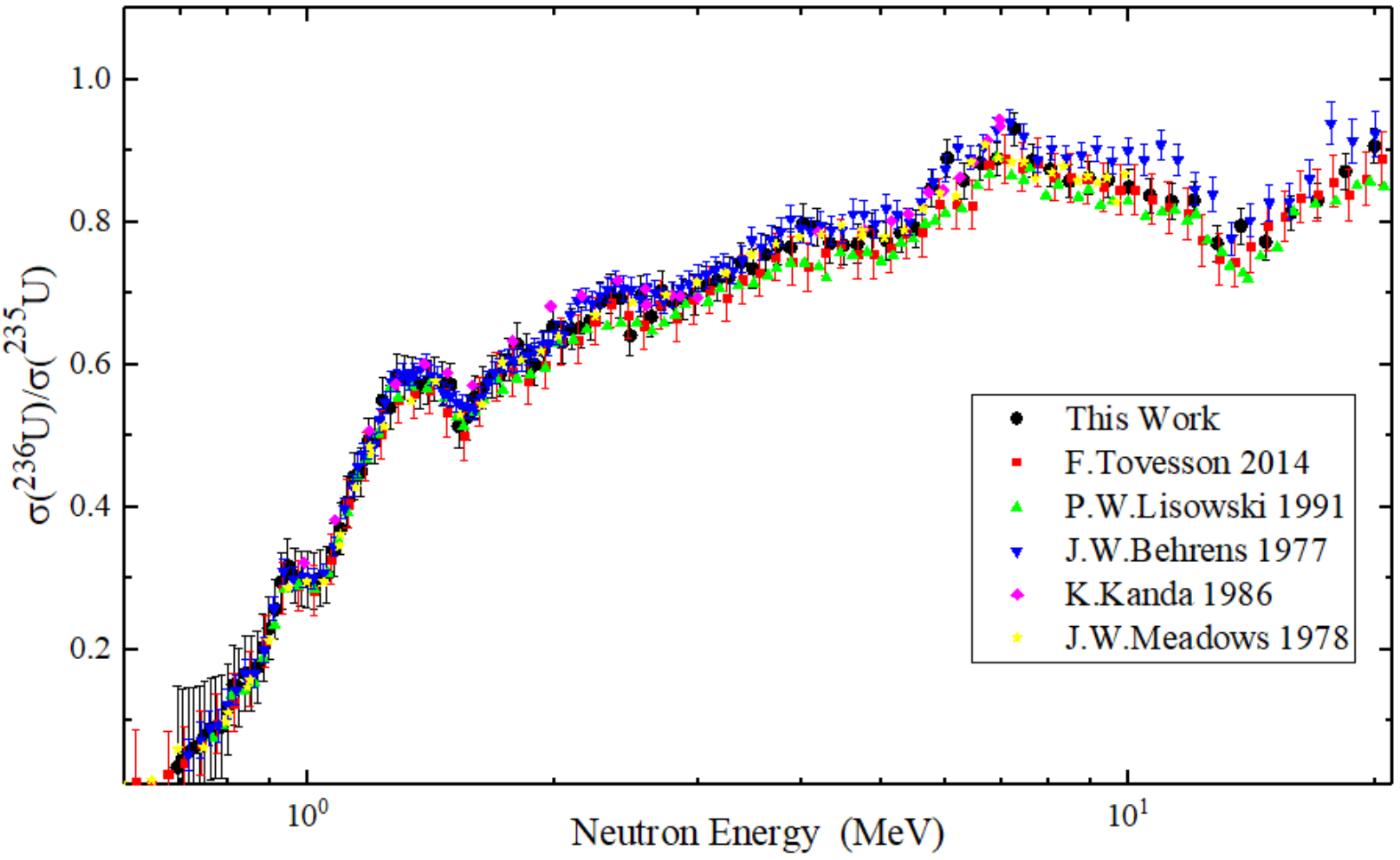


Fig. 13. The measured U-238/U-235 fission cross section ratios in 1–20 MeV region.

Measured U-238/U-235 ratio



236U fission cross section result

Thank you for your attention !