Nuclear data measurement activities in China

Xichao Ruan

CHINA NUCLEAR DATA CENTER

Institutes involve in nuclear data measurement in China

中国科学院近代物理研究所 Institute of Modern Physics, Chinese Academy of Sciences

ADS related (proton induced)

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

Excitation function, FY, gamma production yields, DX and DDX, benchmark experiments, etc

北京大学 PEKING UNIVERSITY

(n,LCP) reaction

兰州大学 LANZHOU UNIVERSITY

Excitation function around 14 MeV

中国工程物理研究院 CHINA ACADEMY OF ENGINEERING PHYSICS

Integral experiments

SNS 中国散裂中子源 CHINA SPALLATION NEUTRON SOURCE

SINAP 中国科学院上海应用物理研究所 Shanghai Institute of Applied Physics, Chinese Academy of Sciences

Th-U cycle related

China Institute of Atomic Energy

1. (n,2n) cross section measurement
2. Fission yield measurement
3. (n,n'g) and (n,2ng) measurement
4. Nuclear data benchmark experiments

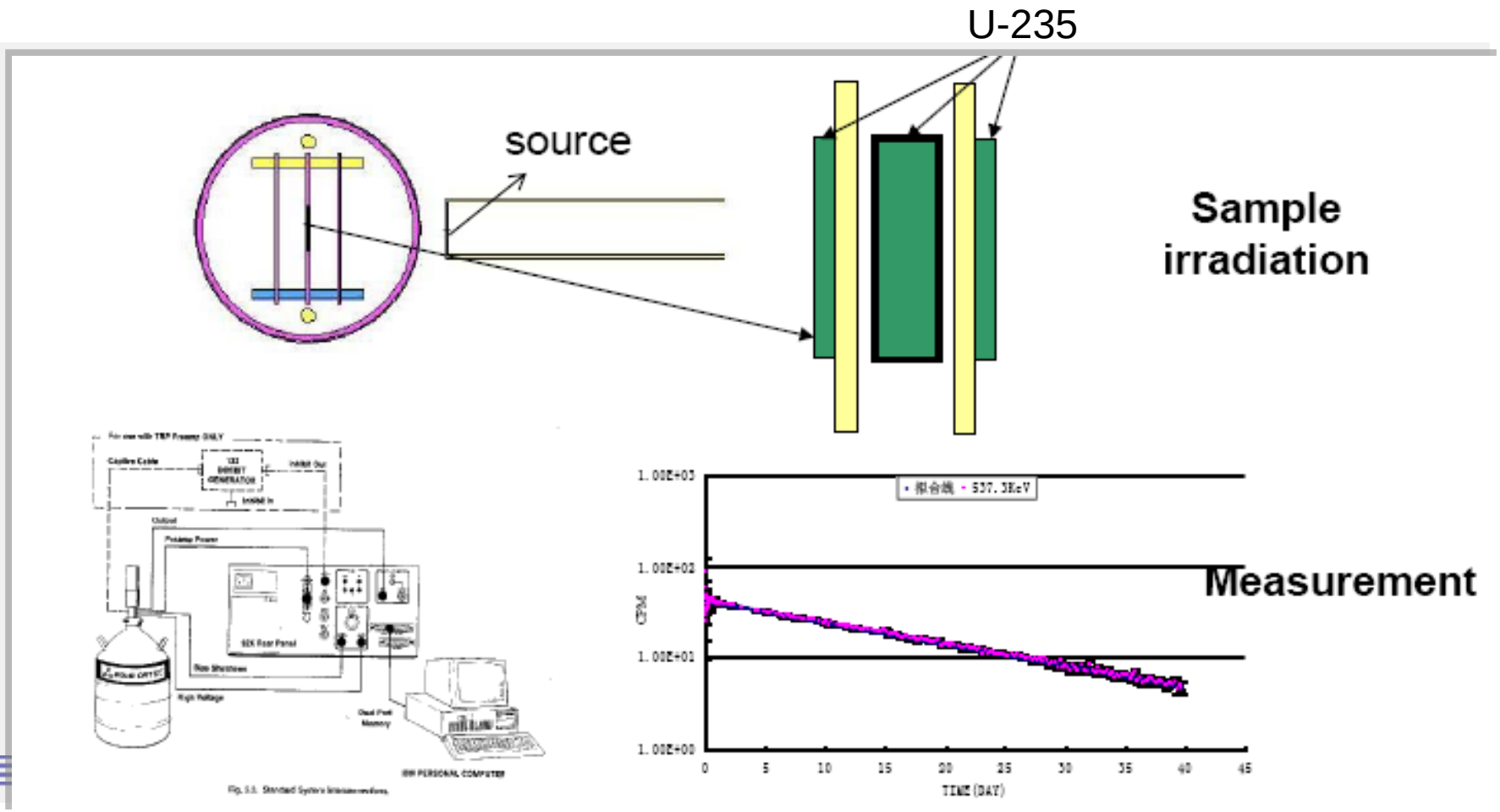
(n,2n) cross section measurement

A He-3 detector array composed of 80 He-3 counters was constructed for measuring (n,2n) cross sections

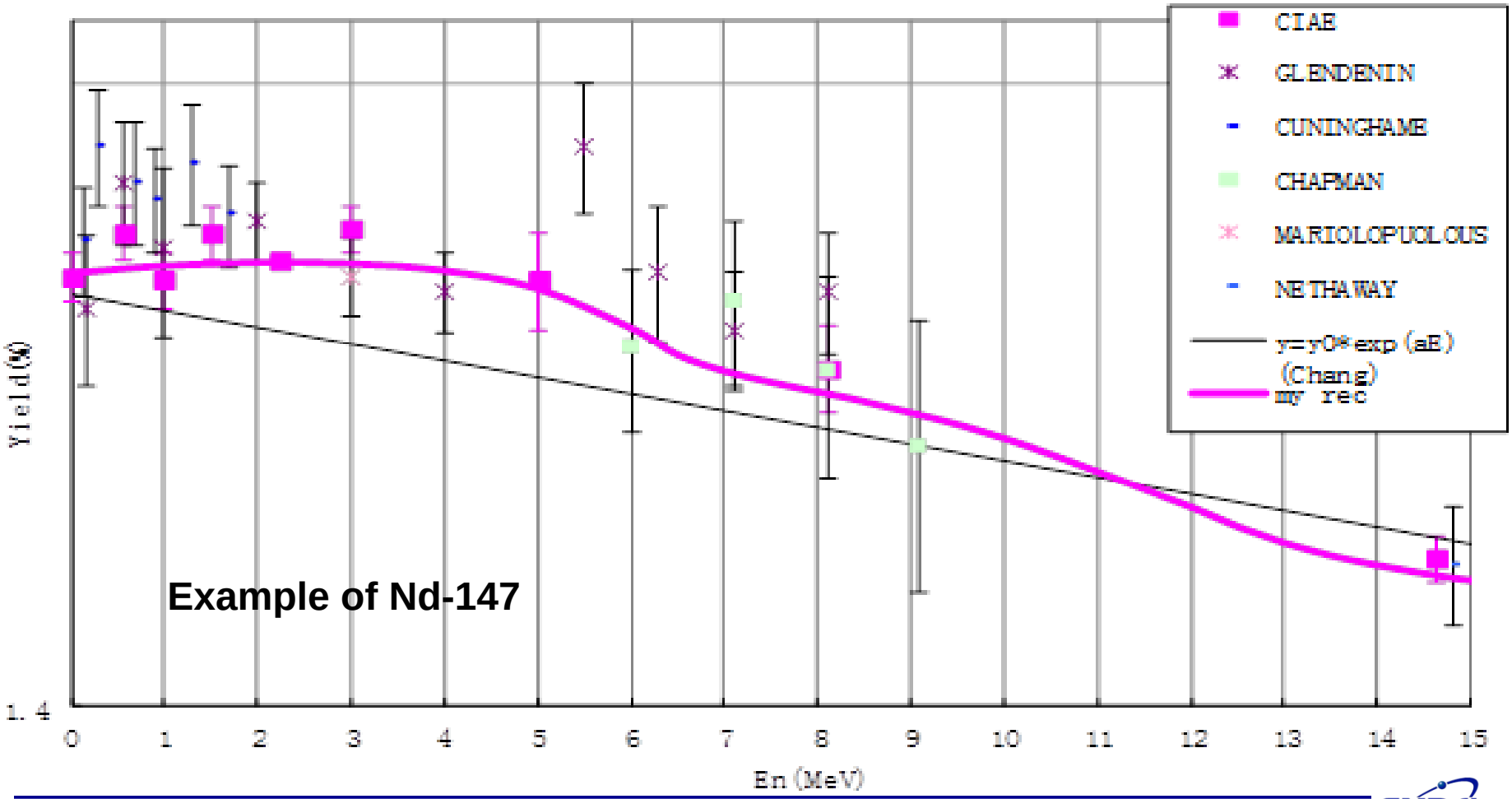
- The detector is ready!
- Efficiency calibration for Cf-252 source finished!
- Waiting for in-beam test.

Fission yield measurement

The fission yields of Zr-95, Zr-97, Mo-99, Ru-103, I-133, Ba-140 and Nd-147 for U-235 induced by Cf-252 fission neutrons were measured.

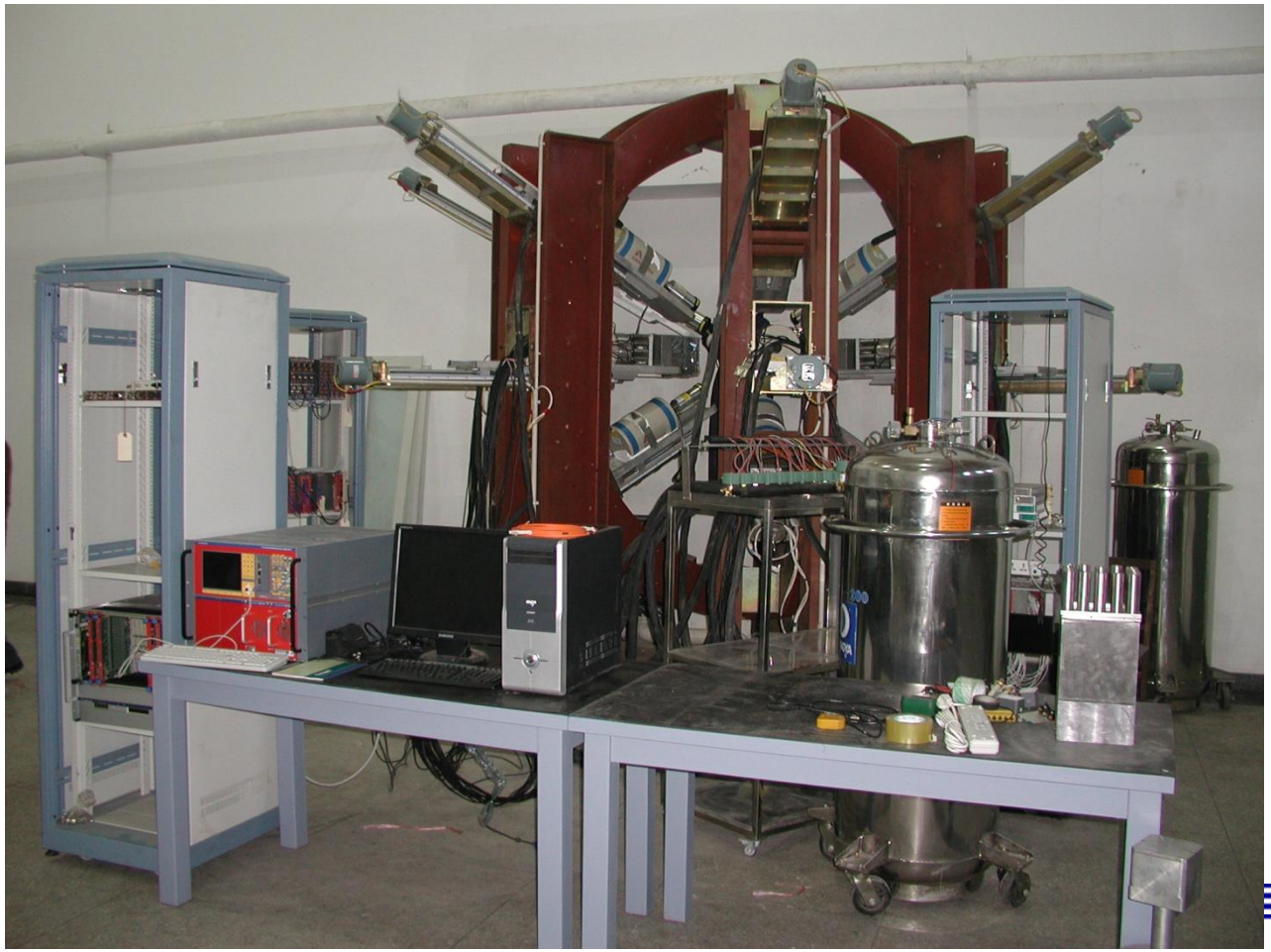


Combined with our previous measurements, the energy dependent fission yields were obtained.



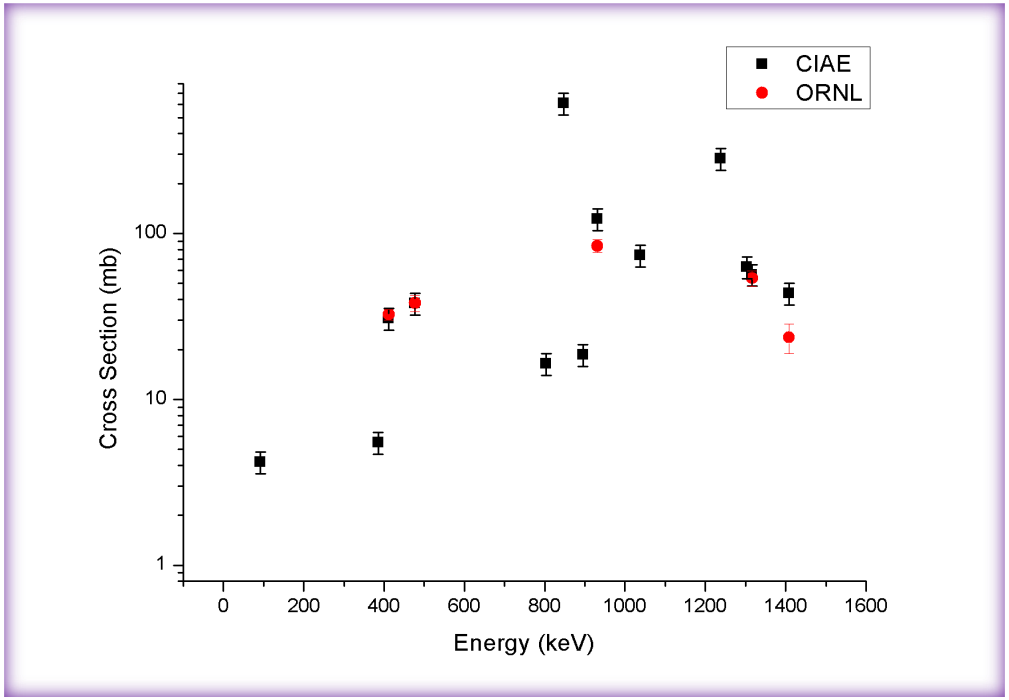
(n,n'g) and (n,2ng)measurement

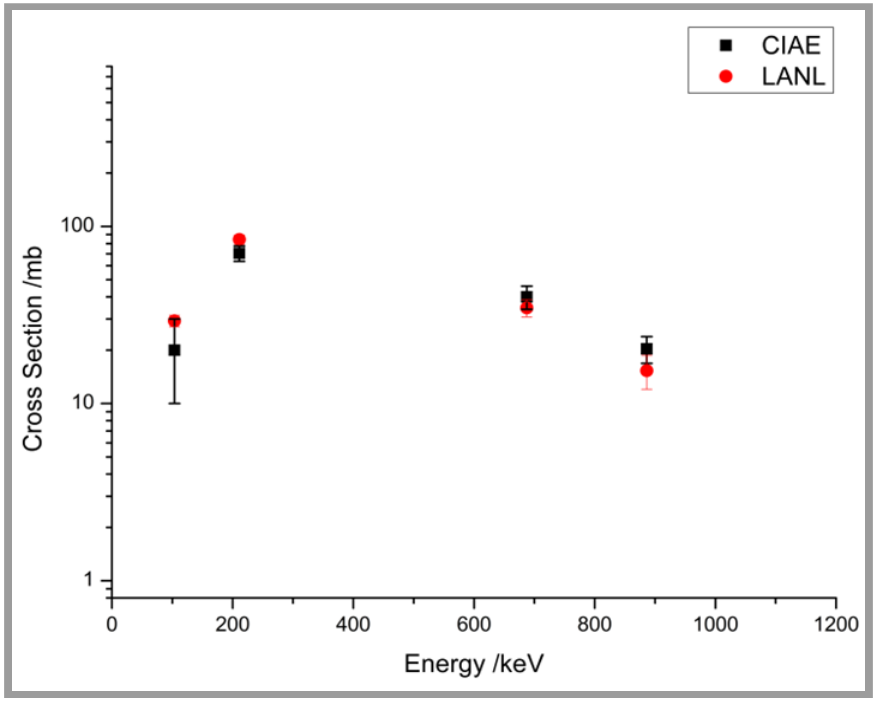
(n,n'g) and (n,2ng) for iron at 14 MeV, (n,n'g) for U-238 at 14 MeV have been obtained.



HPGe detector array at CIAE

- **6 CLOVER detectors**
- **6 planer HPGe detectors**



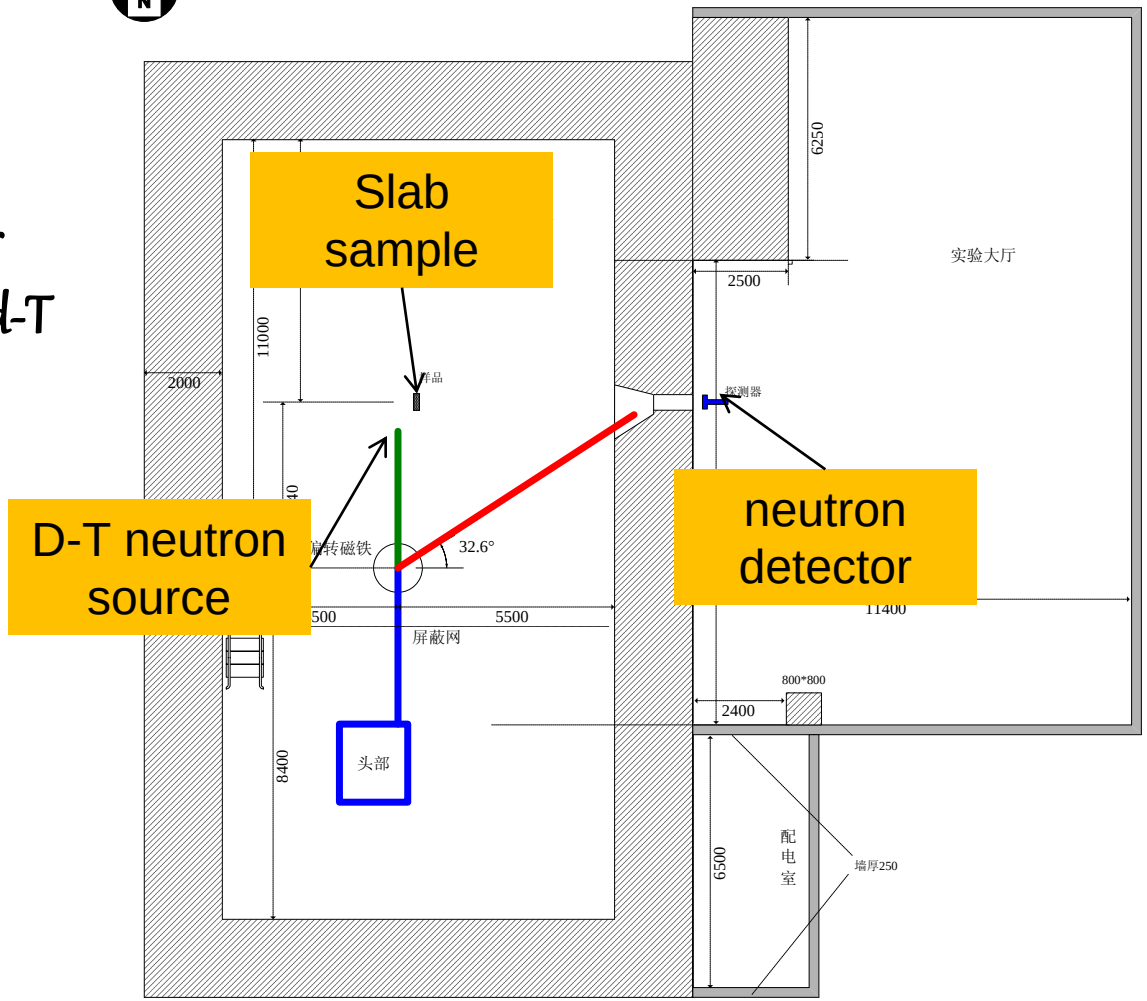


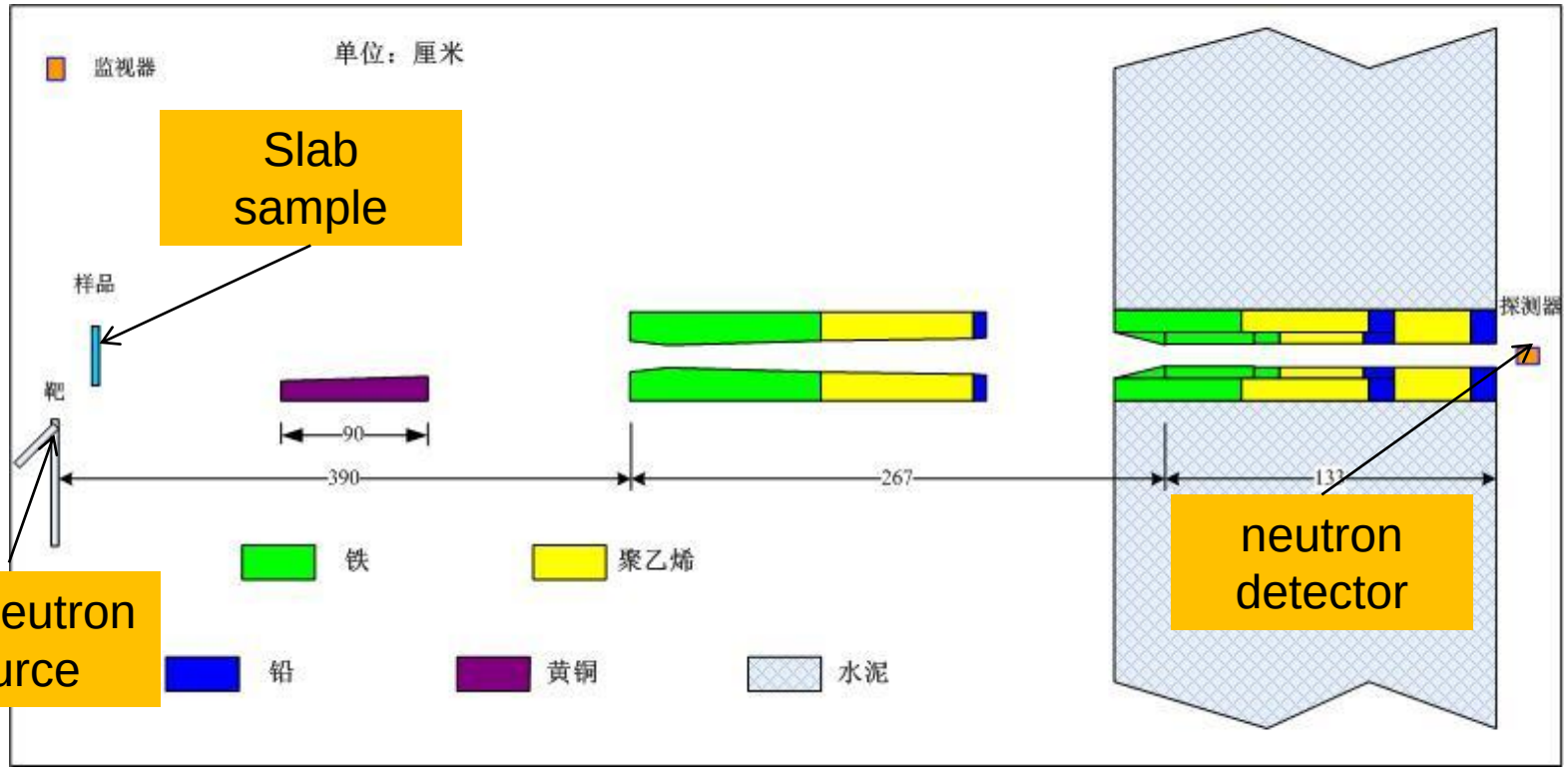
Fe-56(n,2ng)

U-238(n,2ng)

Nuclear data benchmark experiment

Measure the neutron leakage spectrum from slab samples for different angles with a 14 MeV d-T neutron source

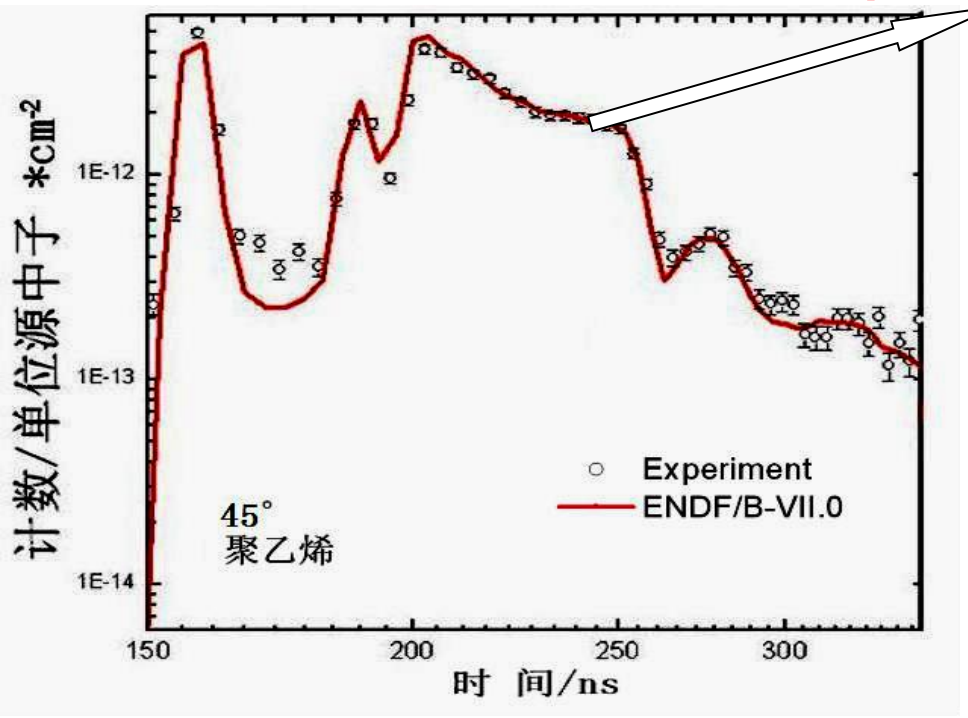


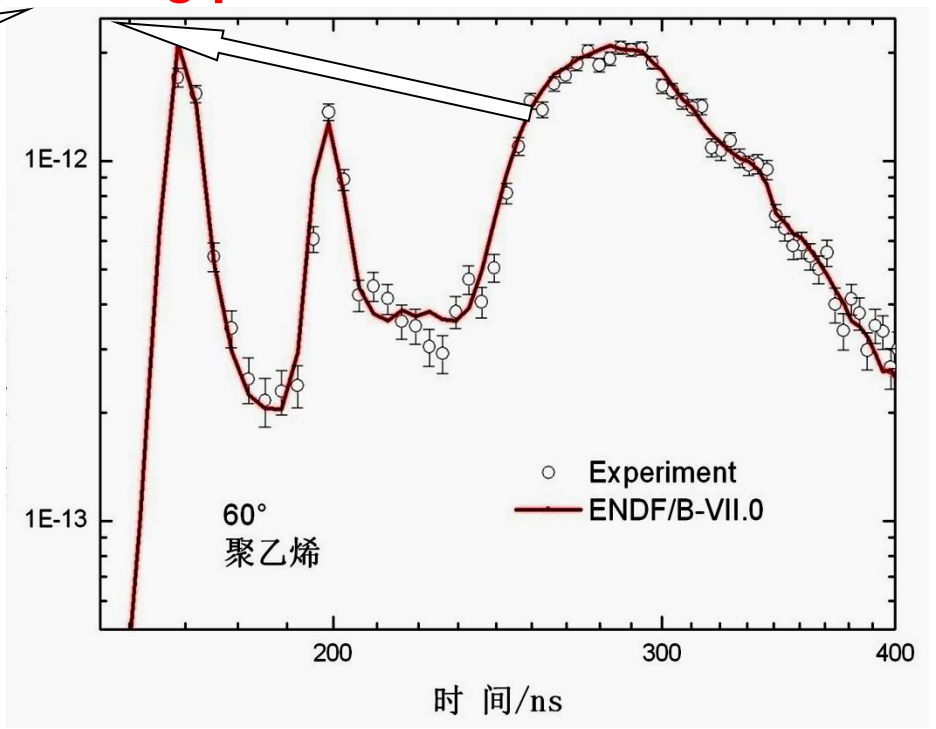


The collimator system

System verification with a PE slab sample

n-p scattering peak



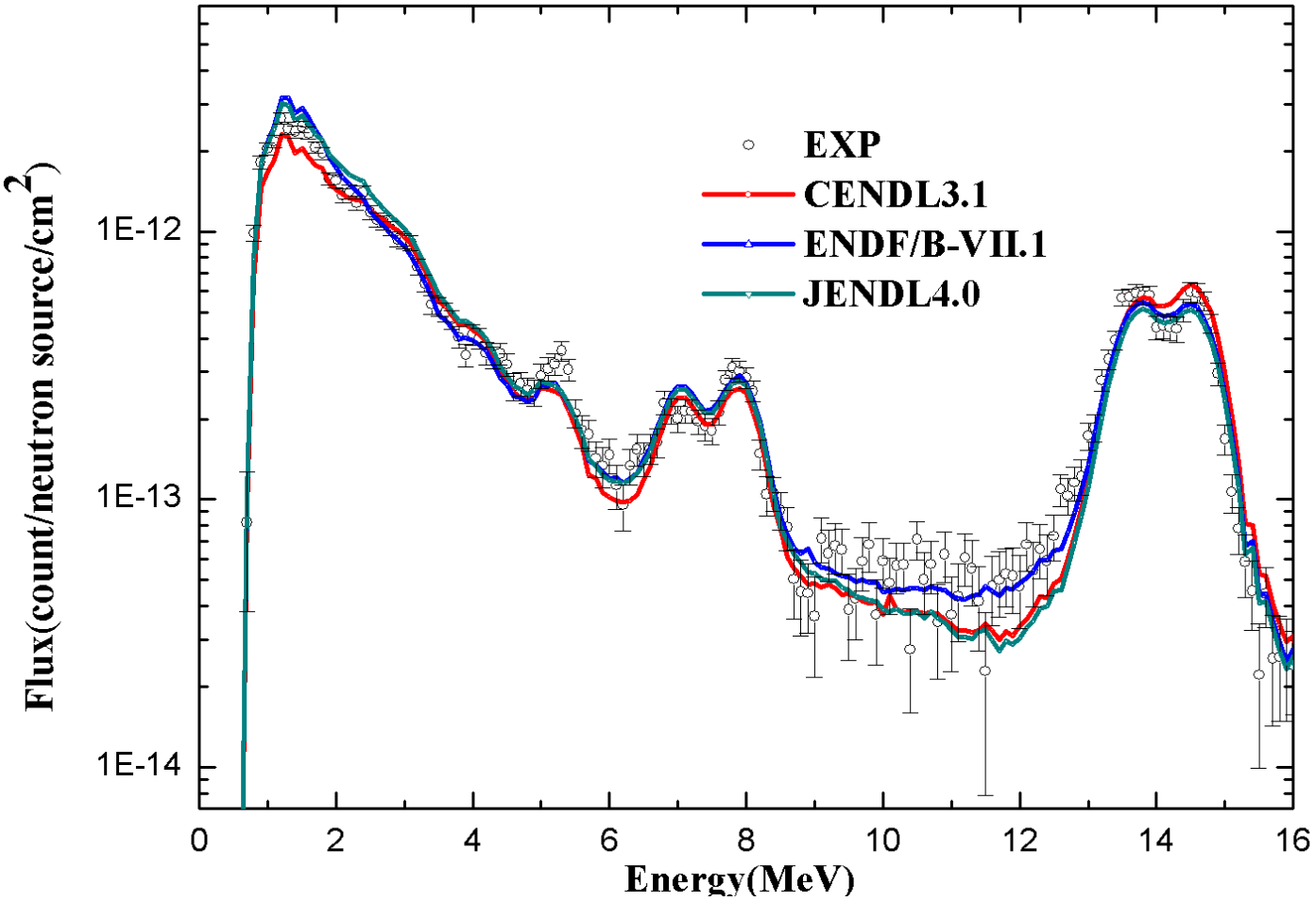


Neutron leakage spectra from a slab PE sample

List of measured samples

Sample	Sample size/cm	Sample thickness/cm	Angle/°
^{238}U	10×10	5	45、135
Be	10×10	5、11	60、120
^{n}Ga	Φ13	3.2、6.4	60、120
^{n}W	10×10	3.5、7	60、120
Granular W	10×10	5	60
C	Φ13	20	60、120
SiC	Φ13	20	60、120
Pb	Φ13	5	60
Pb-Bi	Φ13	5	60
ThO_2	Φ13	5.4、10.8	60、120
H_2O	Φ13	5.2	60
PE	Φ13 10×10	6 5	60 45

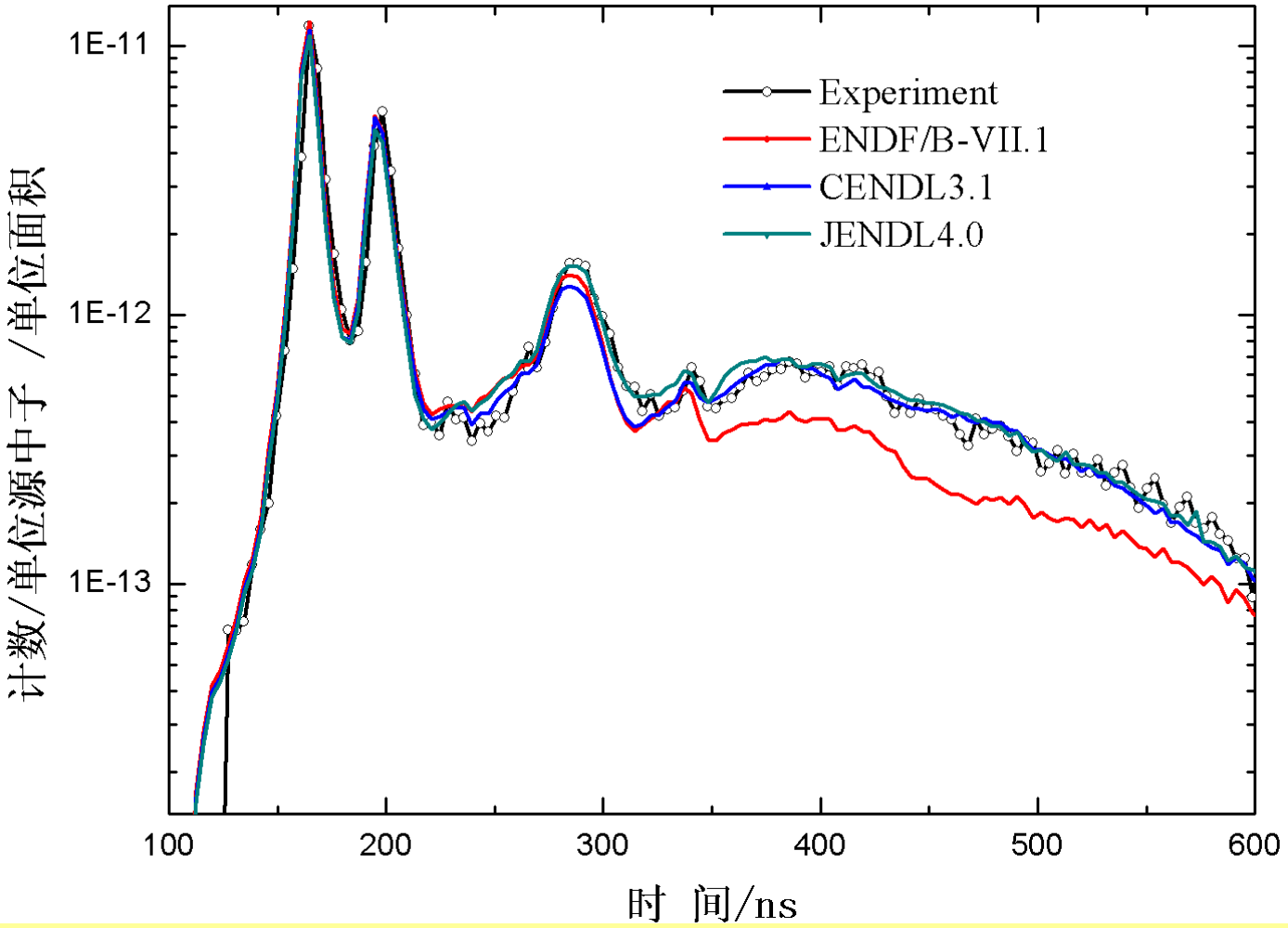
Result of ThO_2



✓**ENDF/B-VII.1 best fit the experimental data**

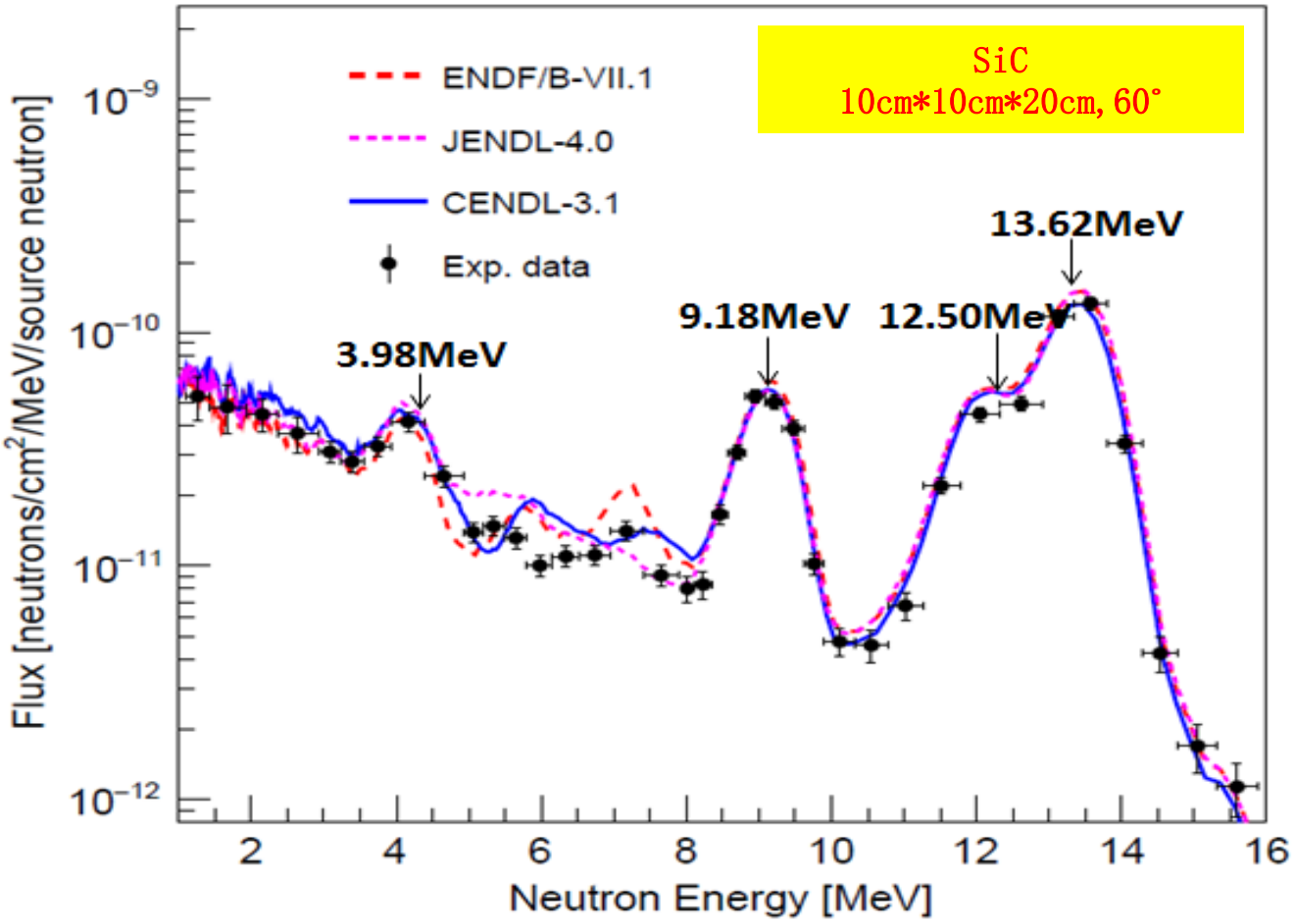
完成情况介绍

Result of Carbon



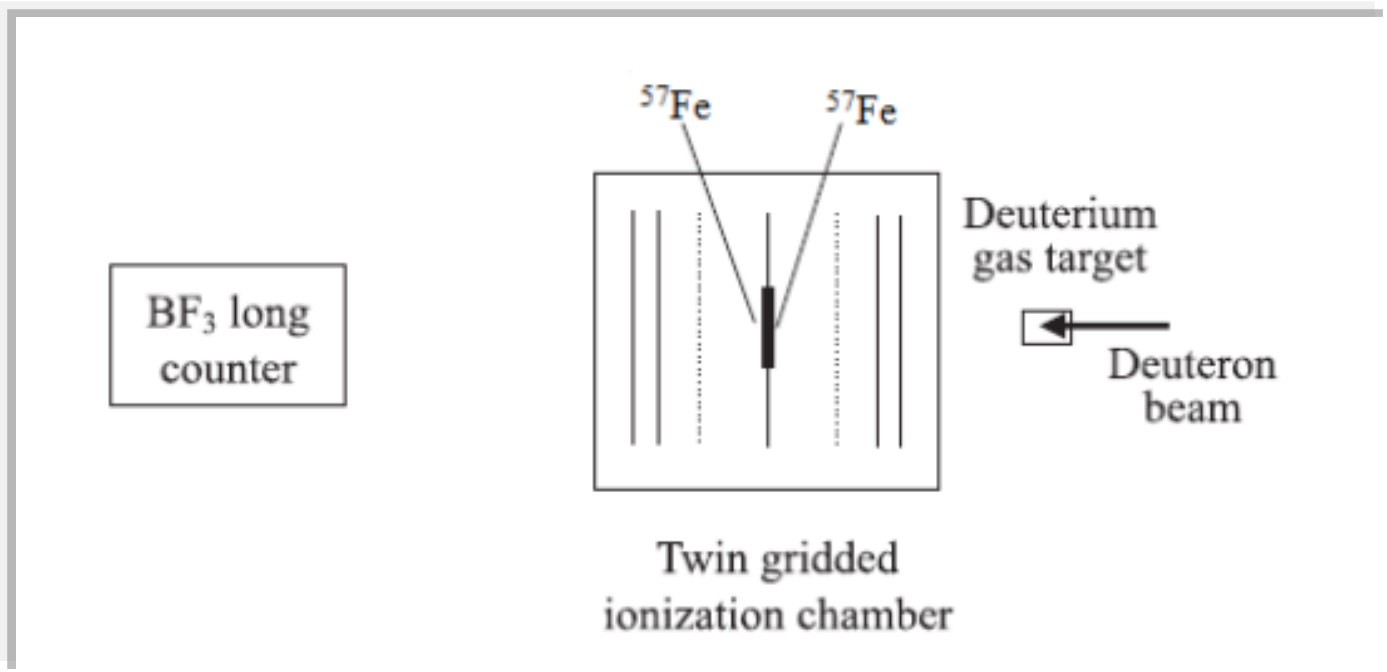
✓ENDF/B-VII.1 is much lower than the experiment

Result of SiC

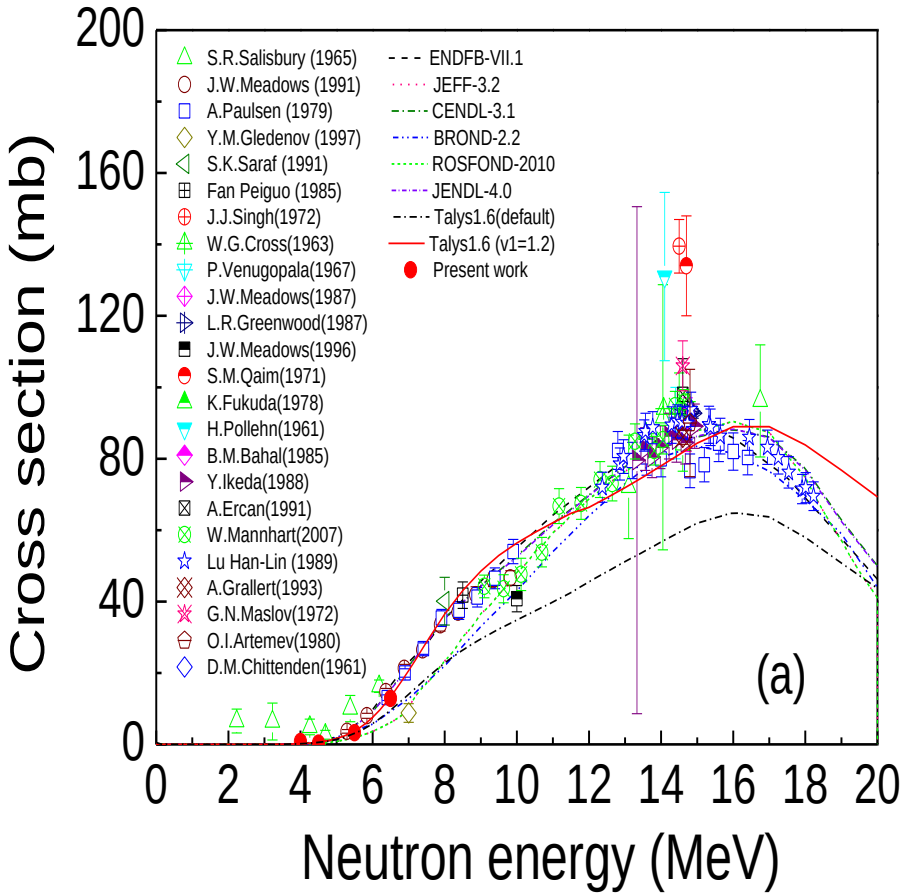


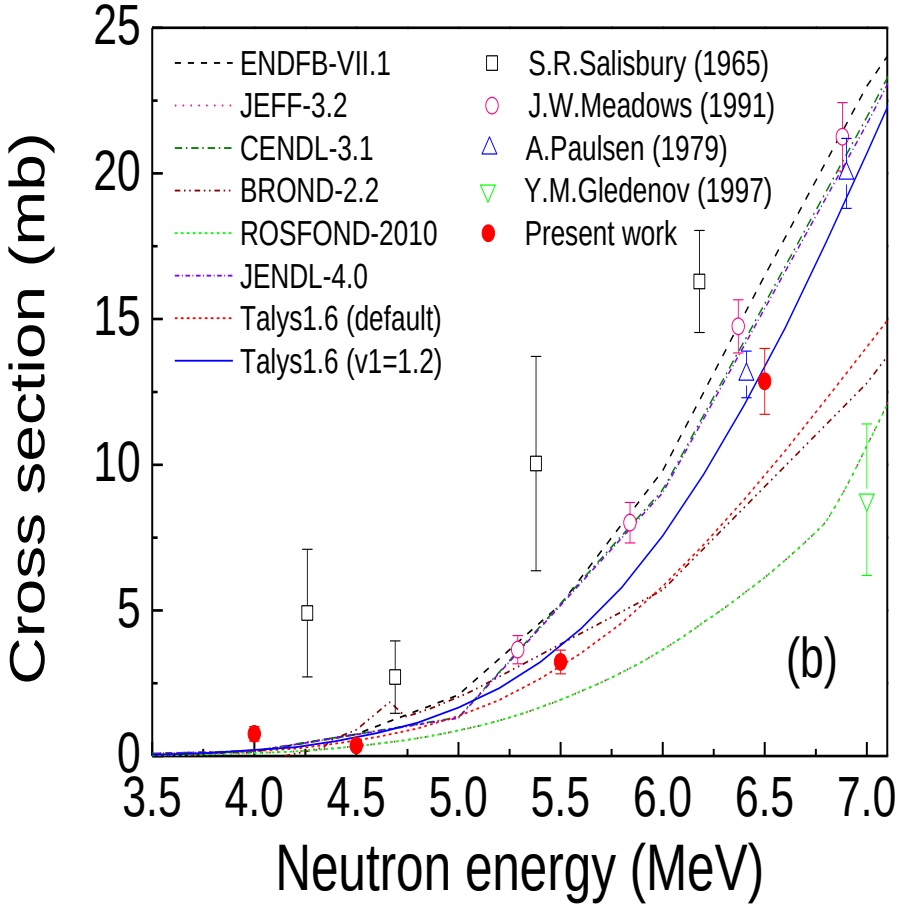
Peking University

- **(n,α) reaction cross section measurement in the 4.0-7.0 MeV region**
- **Recent works: 54Fe and 56Fe**



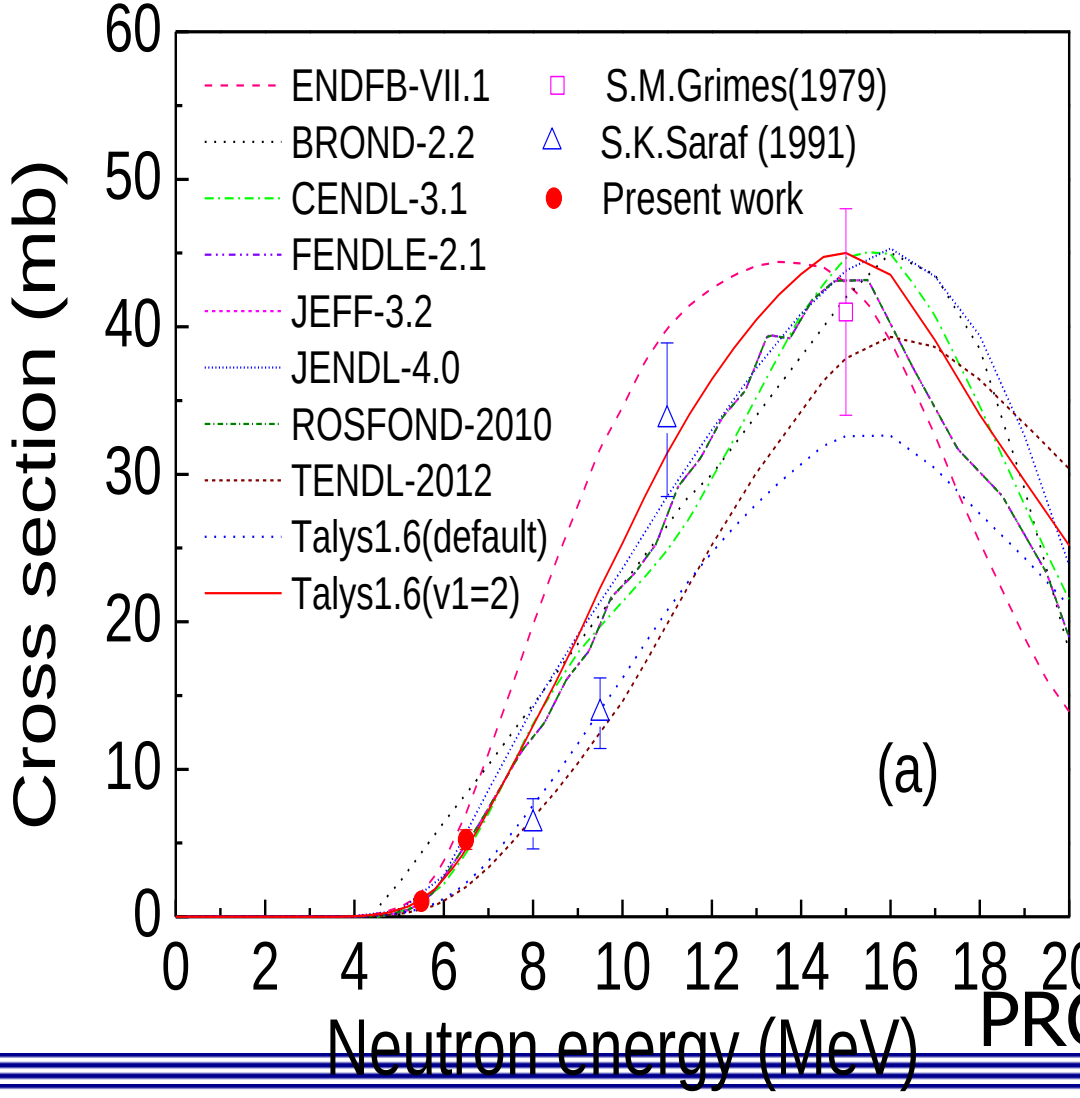
$^{54}Fe(n,\alpha)^{51}Cr$





PRC 92(2015)044601

$^{56}Fe(n,\alpha)^{53}Cr$



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ADS related nuclear data measurements at IMP,CAS (2015)

Zhiqiang Chen

ADS Nuclear Data Laboratory

Institute of Modern Physics,

Chinese Academy of sciences (IMP,CAS)

HIRFL-CSR Complex in Lanzhou

SSC(K=450)
100 AMeV (H.I.), 110 MeV (p)

SFC (K=69)
10 AMeV (H.I.), 17~35 MeV (p)

RIBLL2
RIBs at hundreds of AMeV

CSRe

RIBLL1
RIBs at tens of AMeV

PISA

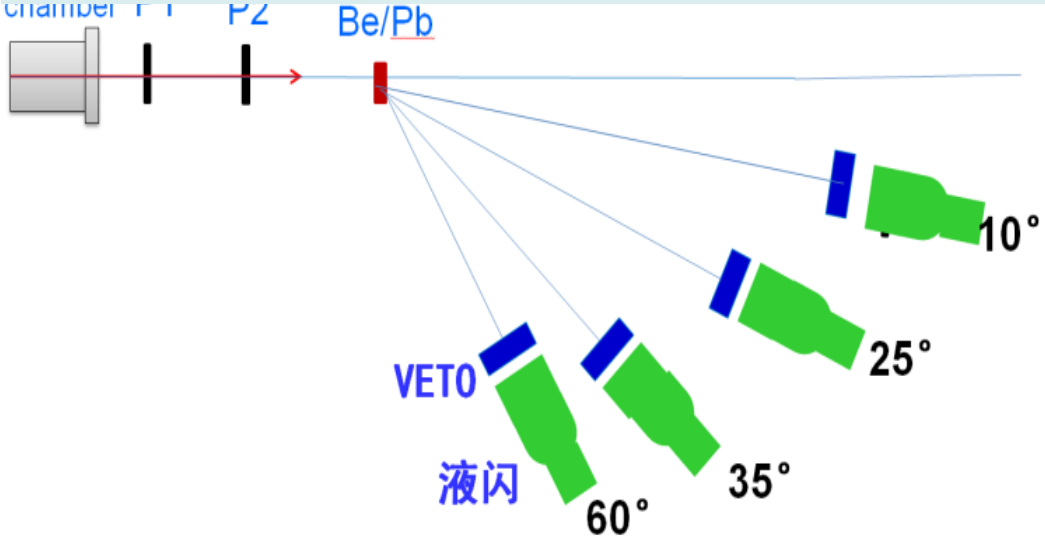
Proton:2.5GeV

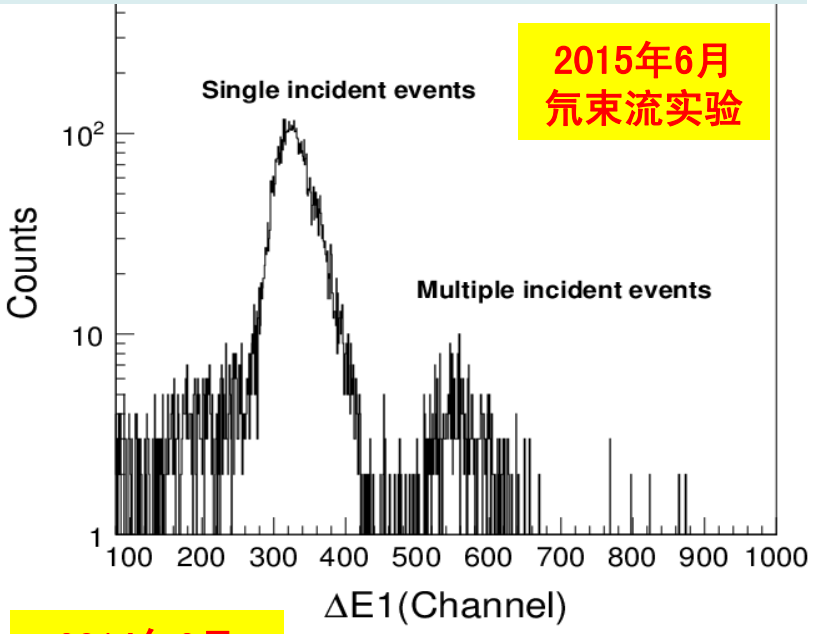
Cancer Therapy

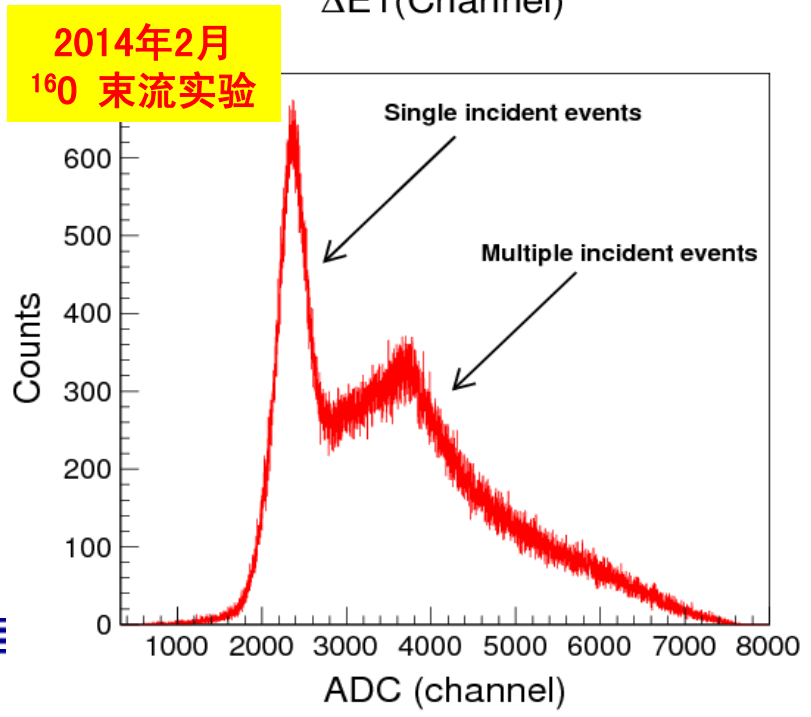
CSRm
1000 AMeV (H.I.), ≤ 2.8 GeV (p)

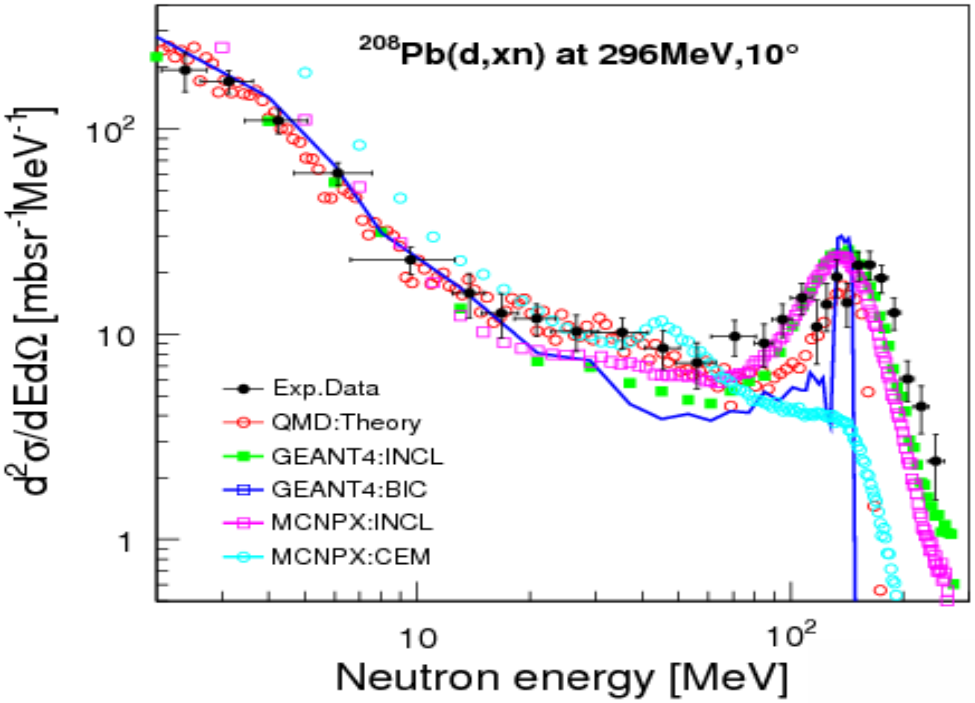
PISA terminal is used for ADS Nuclear data measurements.

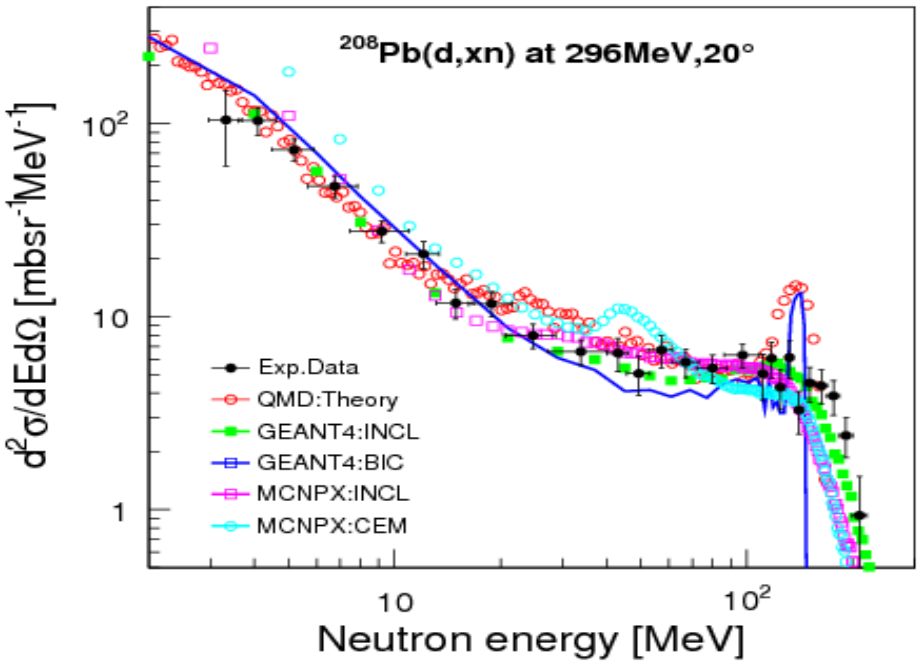
Neutron emission spectra induced by deuteron

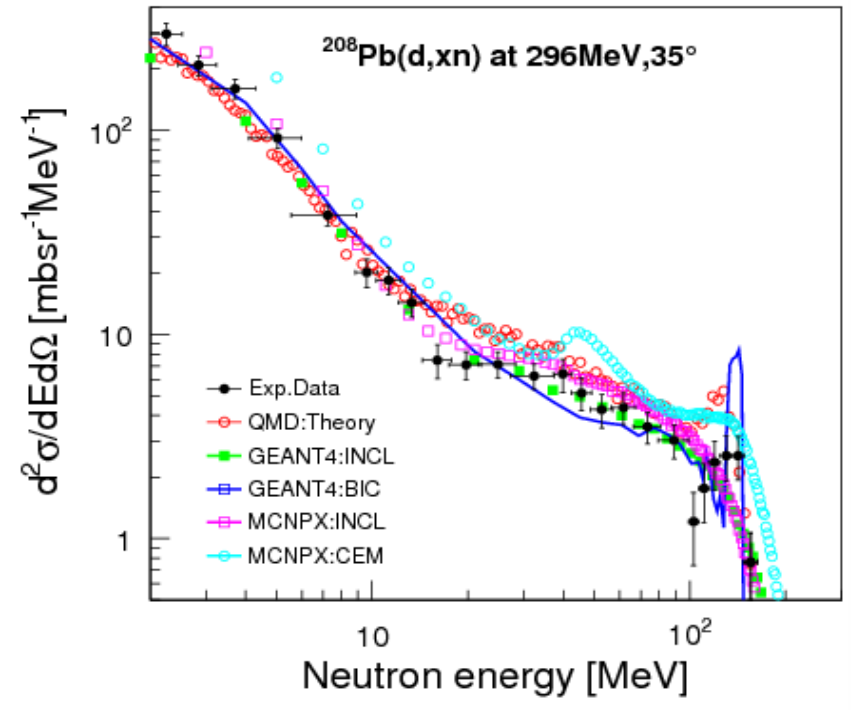


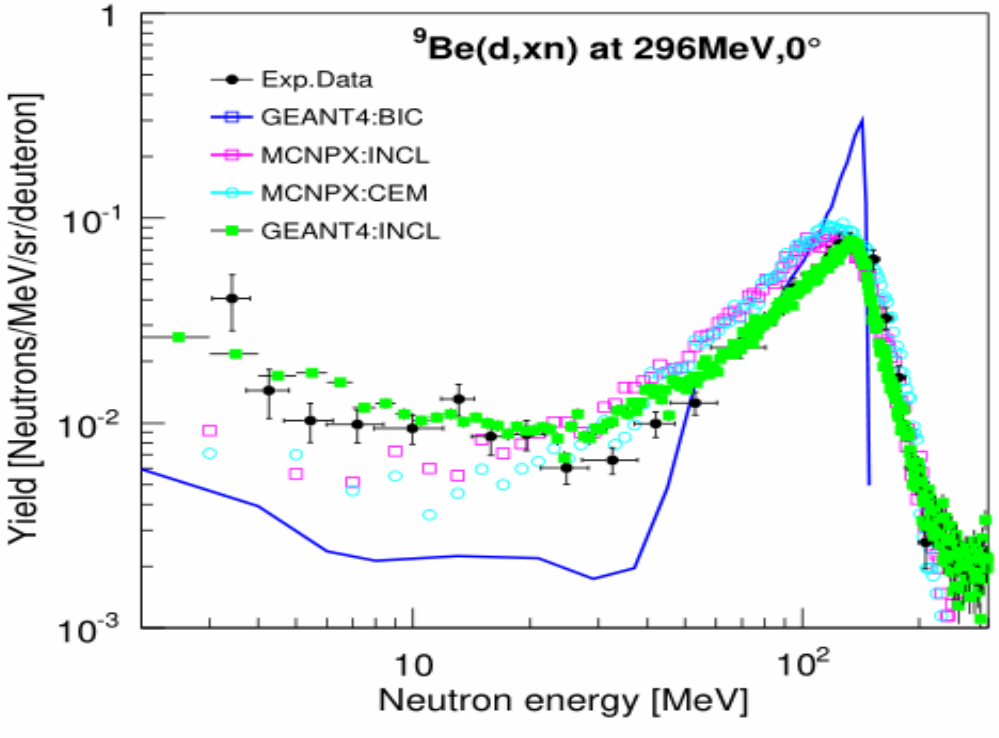





^{208}Pb(d,xn) at 296MeV,10°
$d^2\sigma/dEd\Omega$ [mbsr^{-1}MeV^{-1}]
Neutron energy [MeV]
Exp.Data
QMD:Theory
GEANT4:INCL
GEANT4:BIC
MCNPX:INCL
MCNPX:CEM


^{208}Pb(d,xn) at 296MeV,20°
$d^2\sigma/dEd\Omega$ [mbsr^{-1}MeV^{-1}]
Neutron energy [MeV]
Exp.Data
QMD:Theory
GEANT4:INCL
GEANT4:BIC
MCNPX:INCL
MCNPX:CEM


^{208}Pb(d,xn) at 296MeV,35°
$d^2\sigma/dEd\Omega$ [mbsr^{-1}MeV^{-1}]
Neutron energy [MeV]
Exp.Data
QMD:Theory
GEANT4:INCL
GEANT4:BIC
MCNPX:INCL
MCNPX:CEM

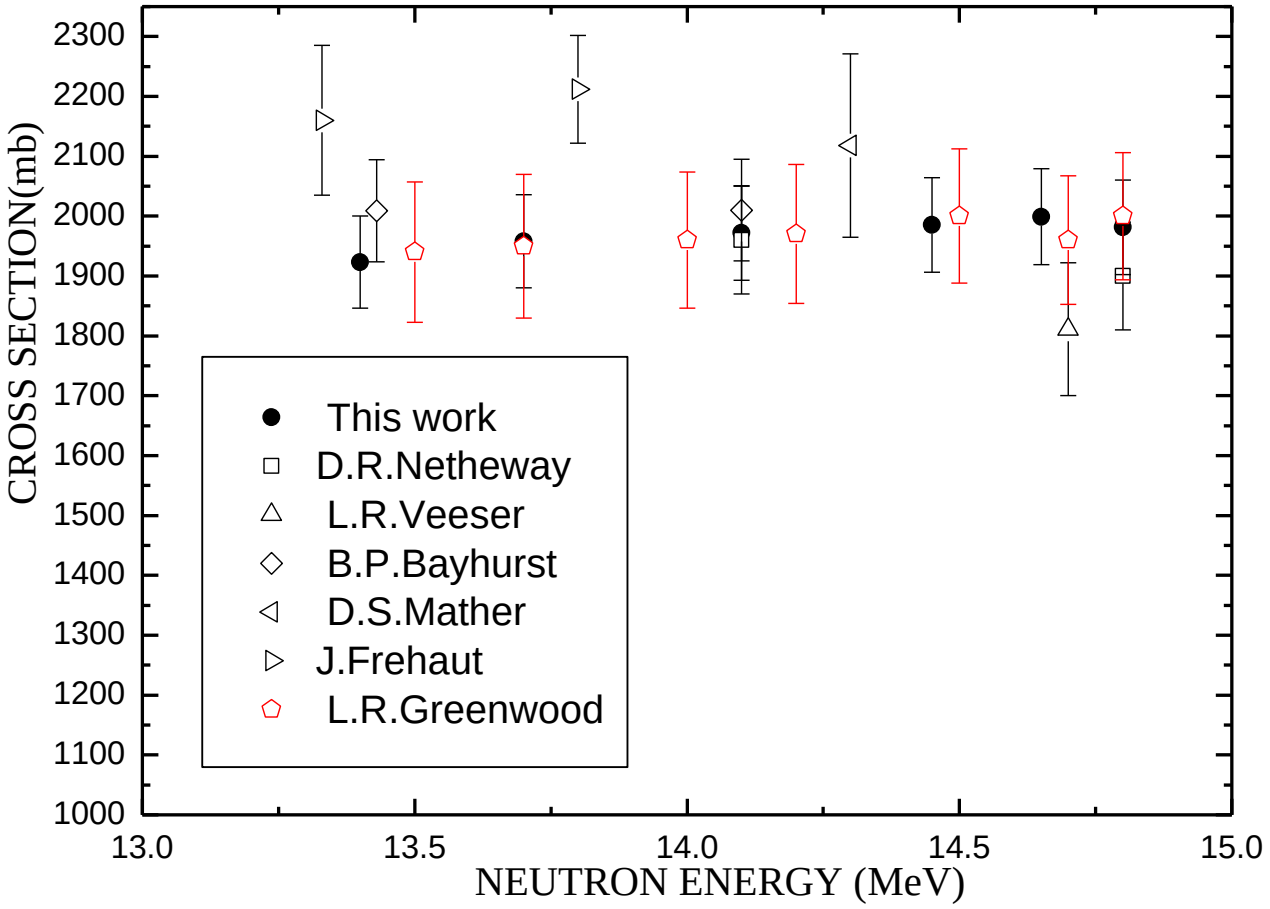

^{9}Be(d,xn) at 296MeV,0°
Yield [Neutrons/MeV/sr/deuteron]
Neutron energy [MeV]
Exp.Data
GEANT4:BIC
MCNPX:INCL
MCNPX:CEM
GEANT4:INCL

China Academy of Engineering Physics (CAEP)

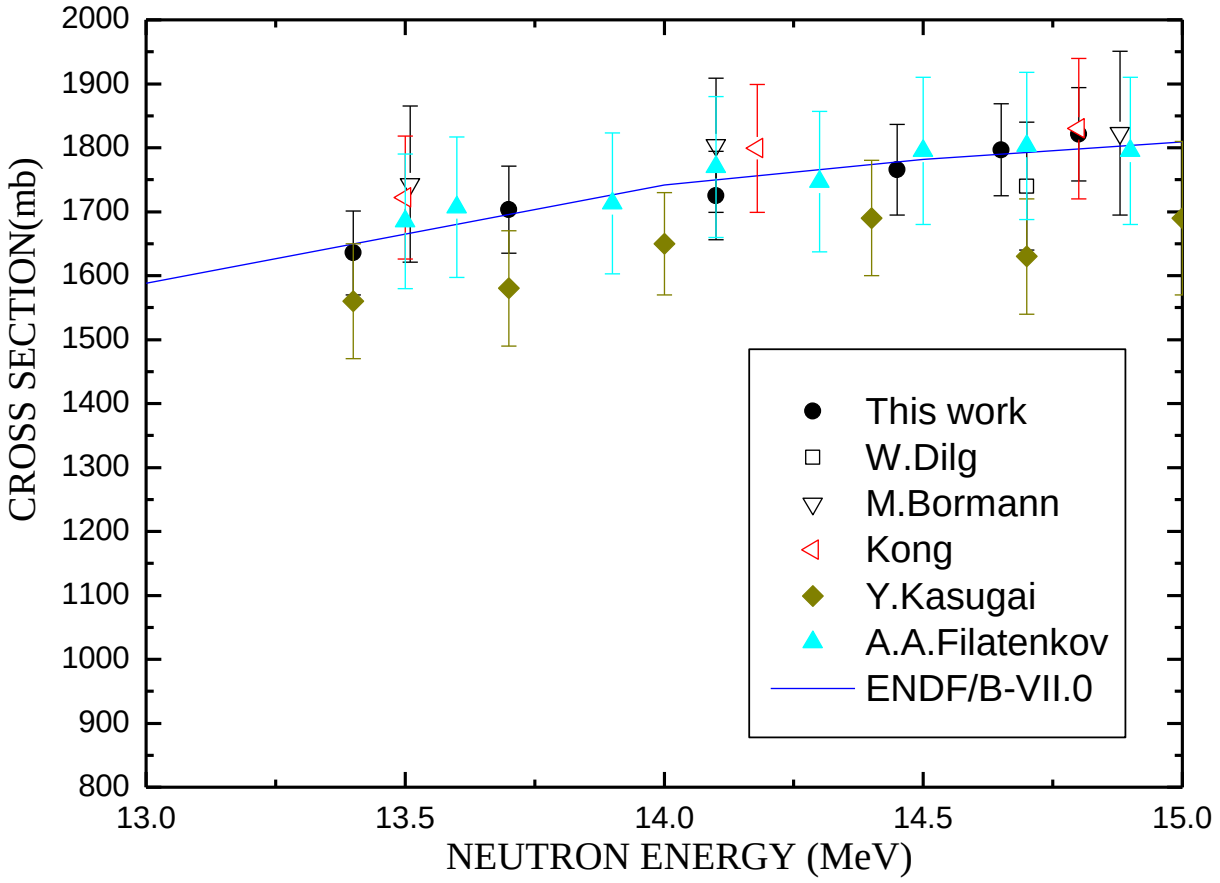
(n,2n) reaction cross section measurement for

^{169}Tm、^{85}Rb、^{87}Rb、^{140}Ce 、^{142}Ce 、^{197}Au 、^{238}U、^{175}Lu、^{89}Y、^{185}Re

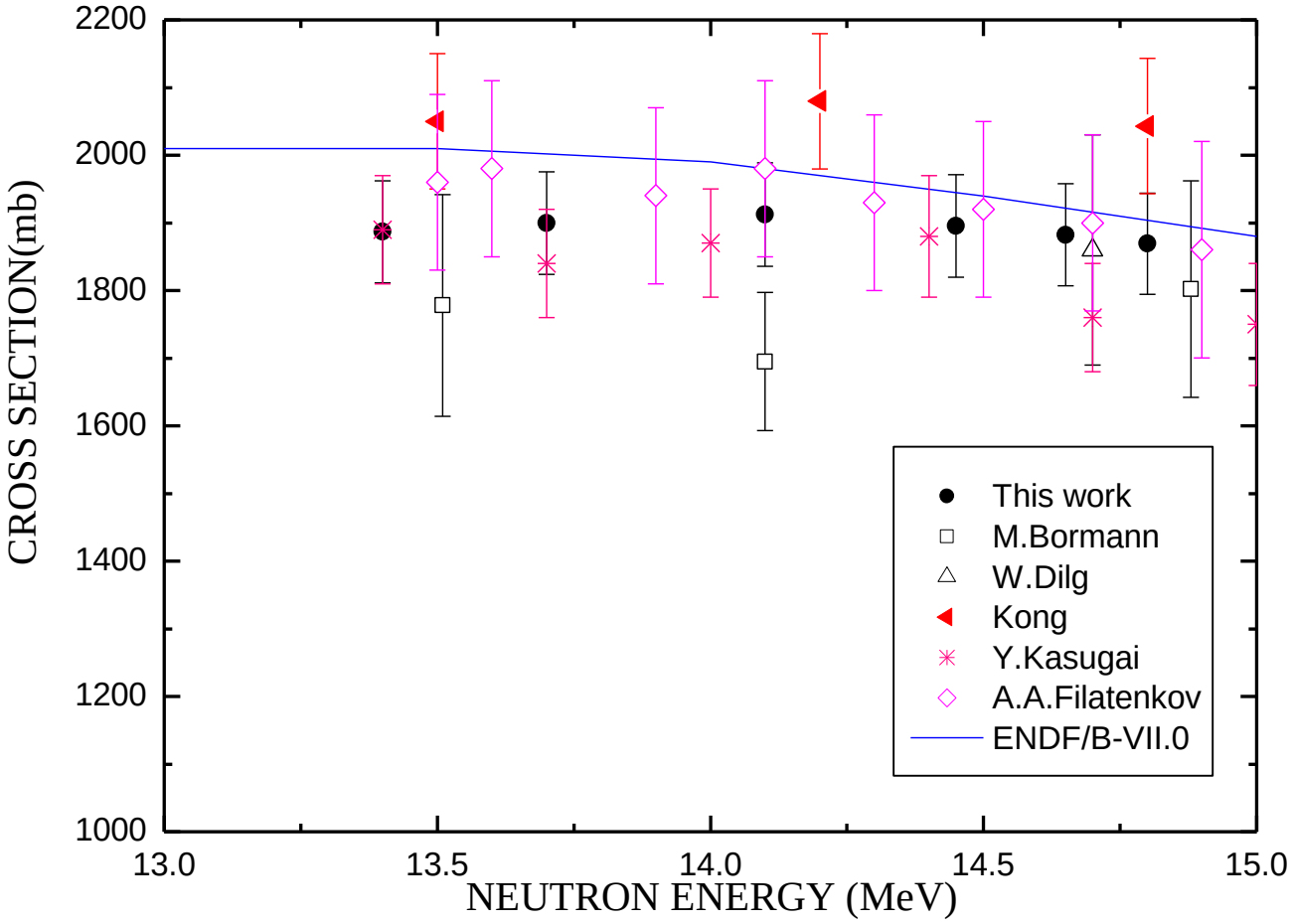
with activation method.



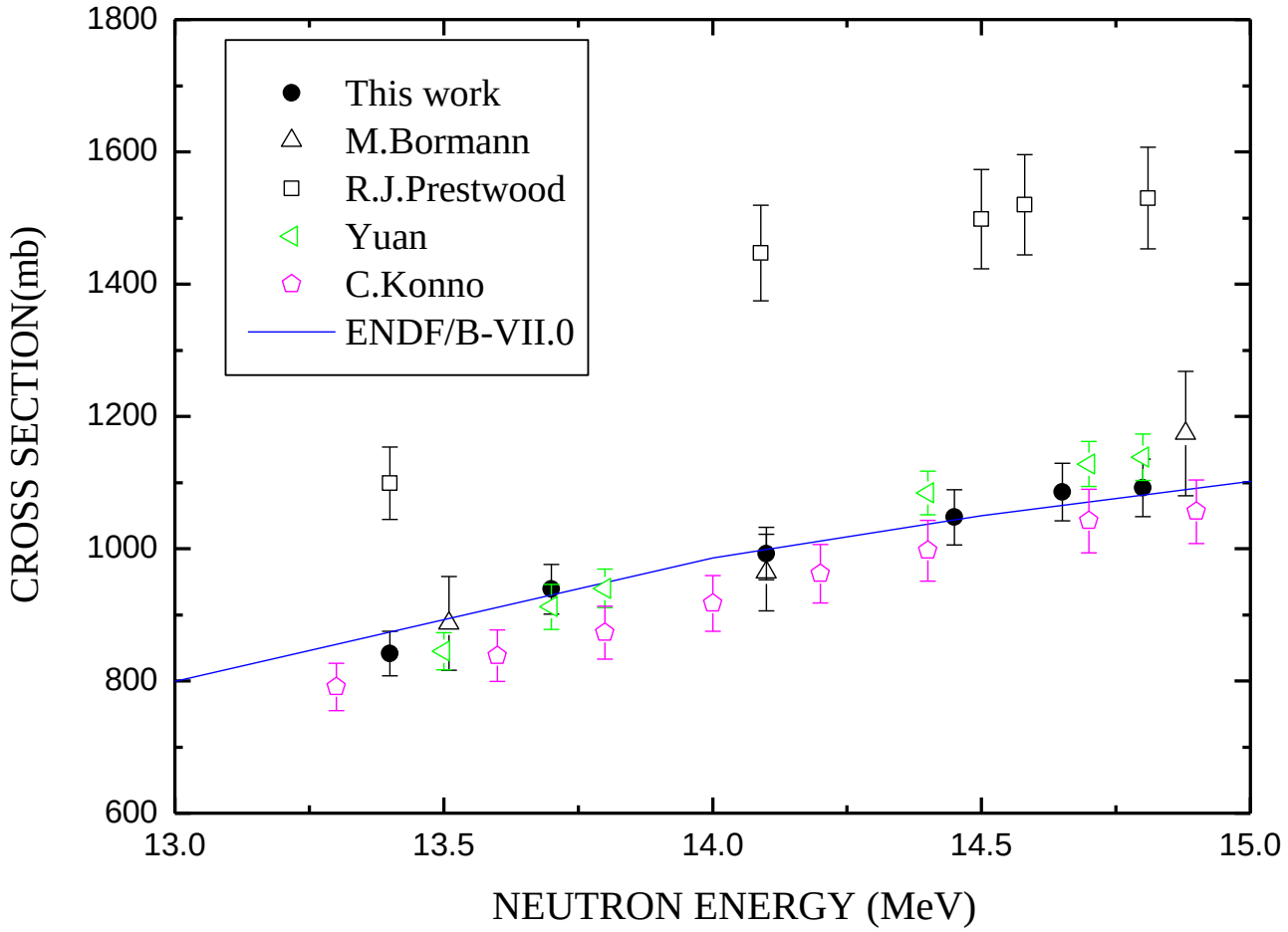
Cross section for the $^{169}Tm(n,2n)^{168}Tm$ reaction.



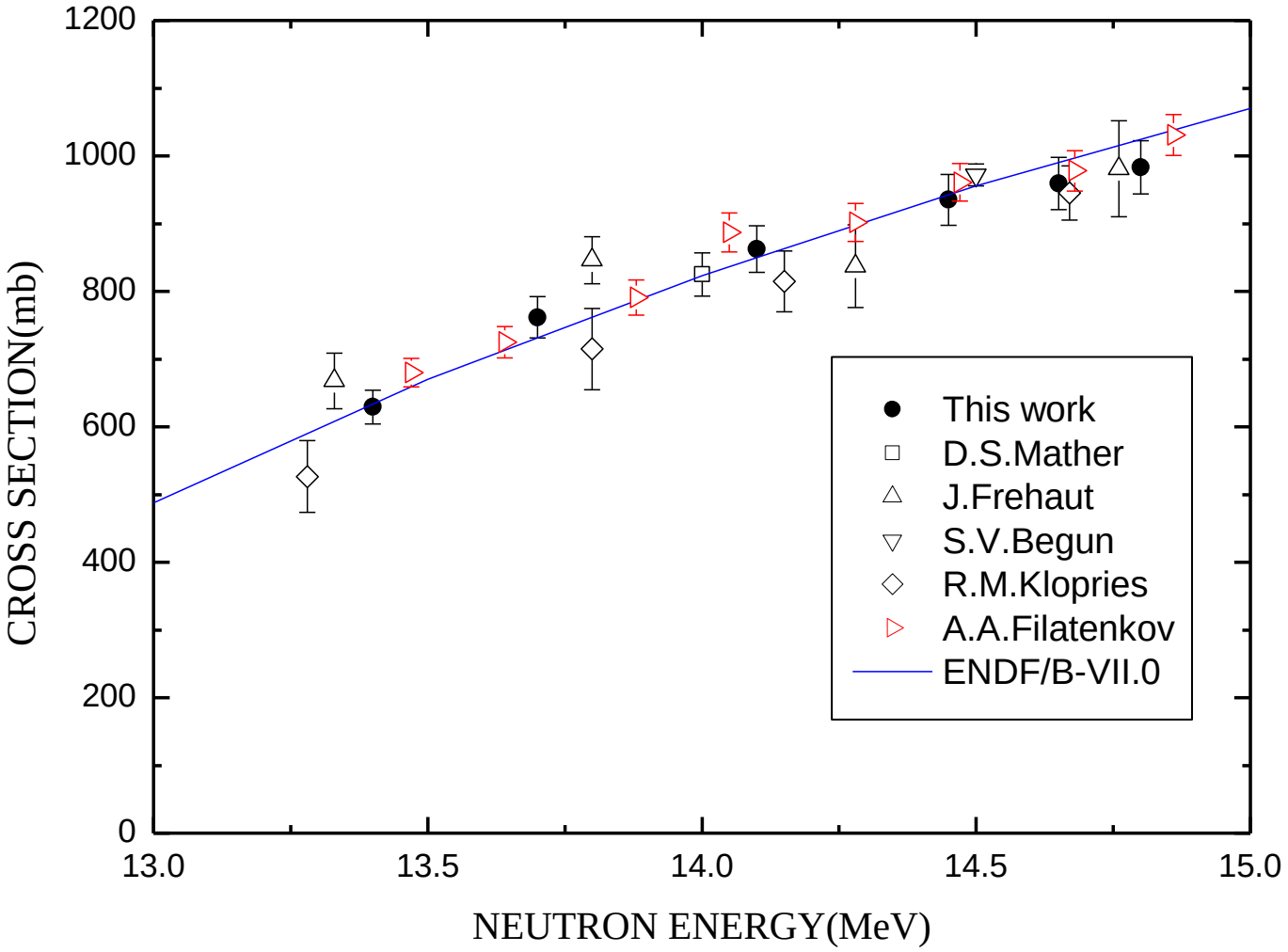
Cross section for the $^{140}Ce(n,2n)^{139}Ce$ reaction.



Cross section for the $^{142}Ce(n,2n)^{141}Ce$ reaction.



Cross section for the $^{85}Rb(n,2n)^{84}Rb$ reaction.



Cross section for the $^{89}Y(n,2n)^{88}Y$ reaction.

Status of CSNS back-streaming neutron beam line

1. The tunnel civil construction finished.
2. The beam line construction will be finished in the mid of 2017.
3. Proton on target in the fall of 2017.
4. Phase I experiments:
   1) beam test
   2)total cross section measurement
   3)capture cross section measurement with C6D6 detector
   4)fission cross section measurement with a parallal ionization chamber.

Thank you for your attention !