Neutron Nuclear Data Evaluation of Actinoid Nuclei for CENDL-3.1

the 2^{nd} Asian Nuclear Reaction Database Development Workshop (Beijing)

CHEN Guochang
cgc@ciae.ac.cn

China Nuclear Data Center (CNDC)
China Institute of Atomic Energy (CIAE)

September 7, 2011

Contents

Contents

Introduction

Introduction of CENDL-3.1

1. CENDL-3.1: new generation evaluated nuclear data library, Dec.-24-2009

2. Contains 240 nuclei, up to 20 MeV

Introduction

Introduction of CENDL-3.1

1. CENDL-3.1: new generation evaluated nuclear data library, Dec.-24-2009
2. Contains 240 nuclei, up to 20 MeV
3. 206 nuclides are newly evaluated
4. 24 nuclides are taken from CENDL-2.1
5. 31 actinoid nuclides in CENDL-3.1
6. Period: 2000 $\sim$ 2006

Introduction

Introduction of CENDL-3.1

1. CENDL-3.1: new generation evaluated nuclear data library, Dec.-24-2009
2. Contains 240 nuclei, up to 20 MeV
3. 206 nuclides are newly evaluated
4. 24 nuclides are taken from CENDL-2.1
5. 31 actinoid nuclides in CENDL-3.1
6. Period: 2000 $\sim$ 2006

Introduction

Introduction of CENDL-3.1

1. CENDL-3.1: new generation evaluated nuclear data library, Dec.-24-2009
2. Contains 240 nuclei, up to 20 MeV
3. 206 nuclides are newly evaluated
4. 24 nuclides are taken from CENDL-2.1
5. 31 actinoid nuclides in CENDL-3.1
6. Period: 2000 $\sim$ 2006

Introduction

Introduction of CENDL-3.1

1. CENDL-3.1: new generation evaluated nuclear data library, Dec.-24-2009
2. Contains 240 nuclei, up to 20 MeV
3. 206 nuclides are newly evaluated
4. 24 nuclides are taken from CENDL-2.1
5. 31 actinoid nuclides in CENDL-3.1
6. Period: 2000 $\sim$ 2006

Introduction

Introduction of CENDL-3.1

1. CENDL-3.1: new generation evaluated nuclear data library, Dec.-24-2009
2. Contains 240 nuclei, up to 20 MeV
3. 206 nuclides are newly evaluated
4. 24 nuclides are taken from CENDL-2.1
5. 31 actinoid nuclides in CENDL-3.1
6. Period: 2000 $\sim$ 2006

Introduction

- Actinoid nuclides in CENDL-3.1 database

Iso.	C-2.1	C-3.1	New
U	235,238	232-241	232-234,236,237,239-241
Np	237	236-239	236,238,239
Pu	239,240	236-246	236-238,241-246
Am	241	240-244	240,242,242m,243,244

Introduction

- Actinoid nuclides in CENDL-3.1 database

Iso.	C-2.1	C-3.1	New
U	235,238	232-241	232-234,236,237,239-241(8)
Np	237	236-239	236,238,239(3)
Pu	239,240	236-246	236-238,241-246(9)
Am	241	240-244	240,242,242m,243,244(5)

Introduction

Major aspects of present evaluation

1. Systematic accumulation, correction and evaluation of all relevant experimental information
2. Re-normalize to standard reaction XS
3. Assessment of the applicability of OMP before 2000 year
4. Theoretical calculation to interpret the evaluated experimental data
5. Assembly of the experimental and theoretical results into ENDF format file

Introduction

Major aspects of present evaluation

1. Systematic accumulation, correction and evaluation of all relevant experimental information
2. Re-normalize to standard reaction XS
3. Assessment of the applicability of OMP before 2000 year
4. Theoretical calculation to interpret the evaluated experimental data
5. Assembly of the experimental and theoretical results into ENDF format file

Introduction

Major aspects of present evaluation

1. Systematic accumulation, correction and evaluation of all relevant experimental information
2. Re-normalize to standard reaction XS
3. Assessment of the applicability of OMP before 2000 year
4. Theoretical calculation to interpret the evaluated experimental data
5. Assembly of the experimental and theoretical results into ENDF format file

Introduction

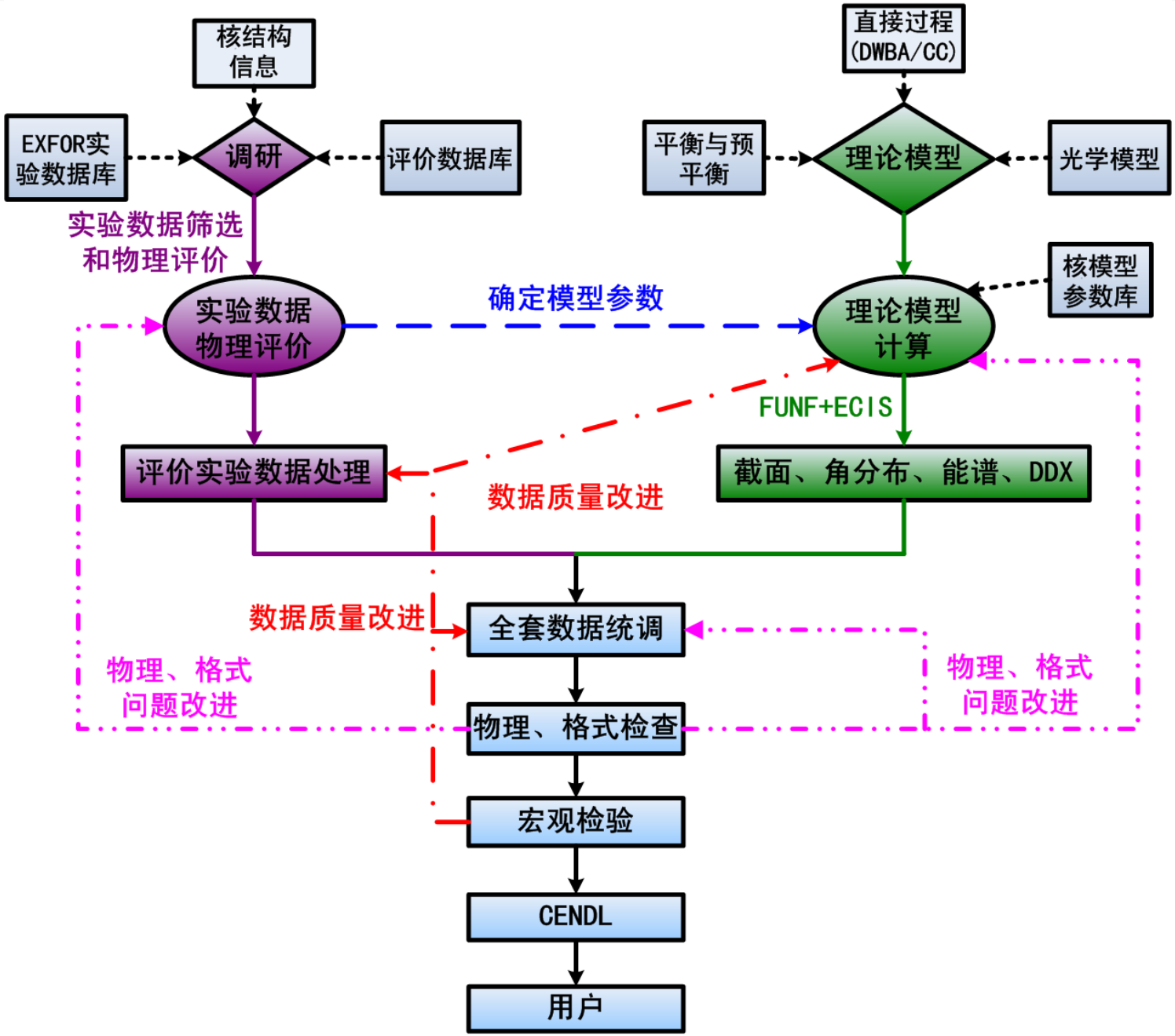
Major aspects of present evaluation

1. Systematic accumulation, correction and evaluation of all relevant experimental information
2. Re-normalize to standard reaction XS
3. Assessment of the applicability of OMP before 2000 year
4. Theoretical calculation to interpret the evaluated experimental data
5. Assembly of the experimental and theoretical results into ENDF format file

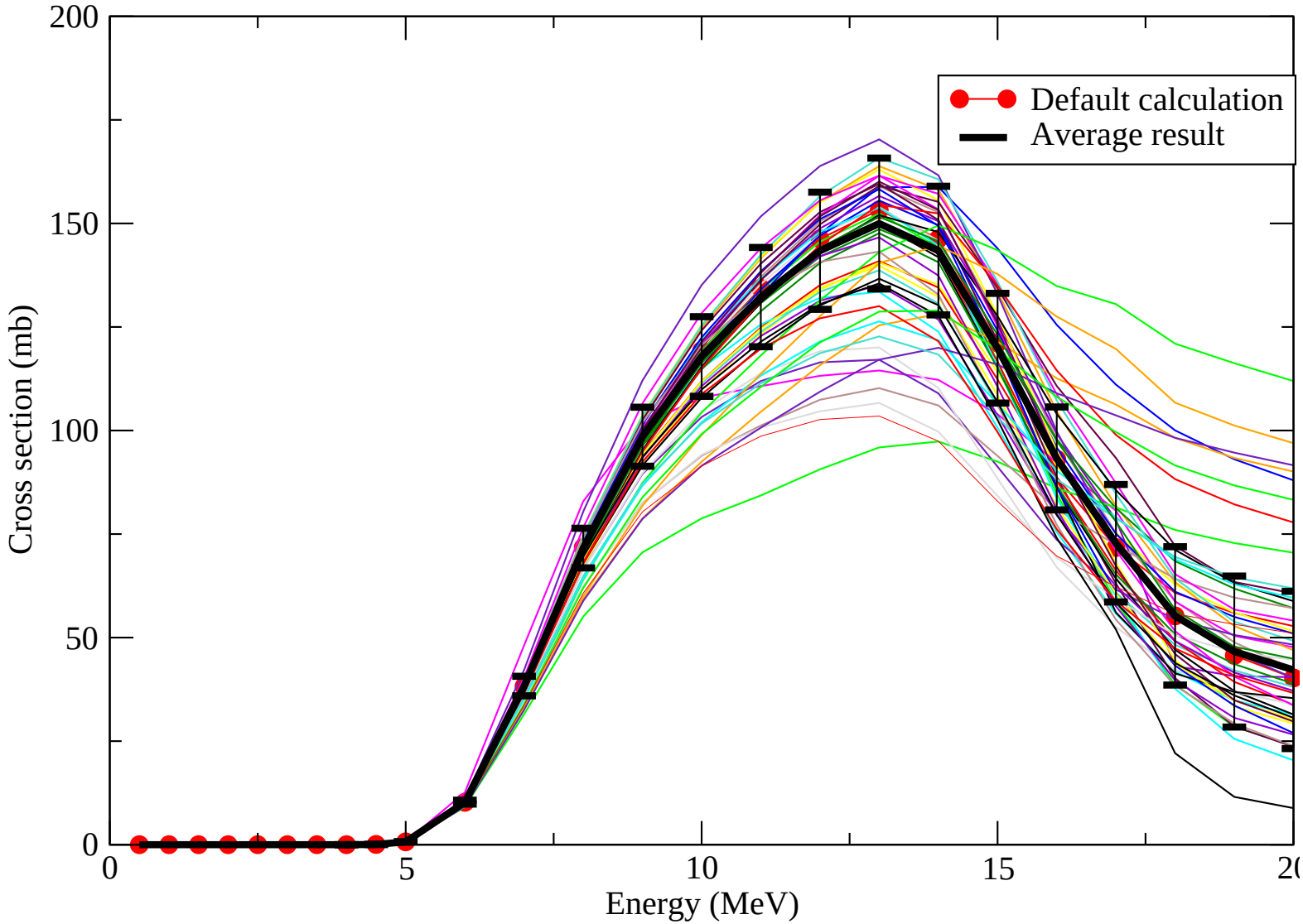
Introduction

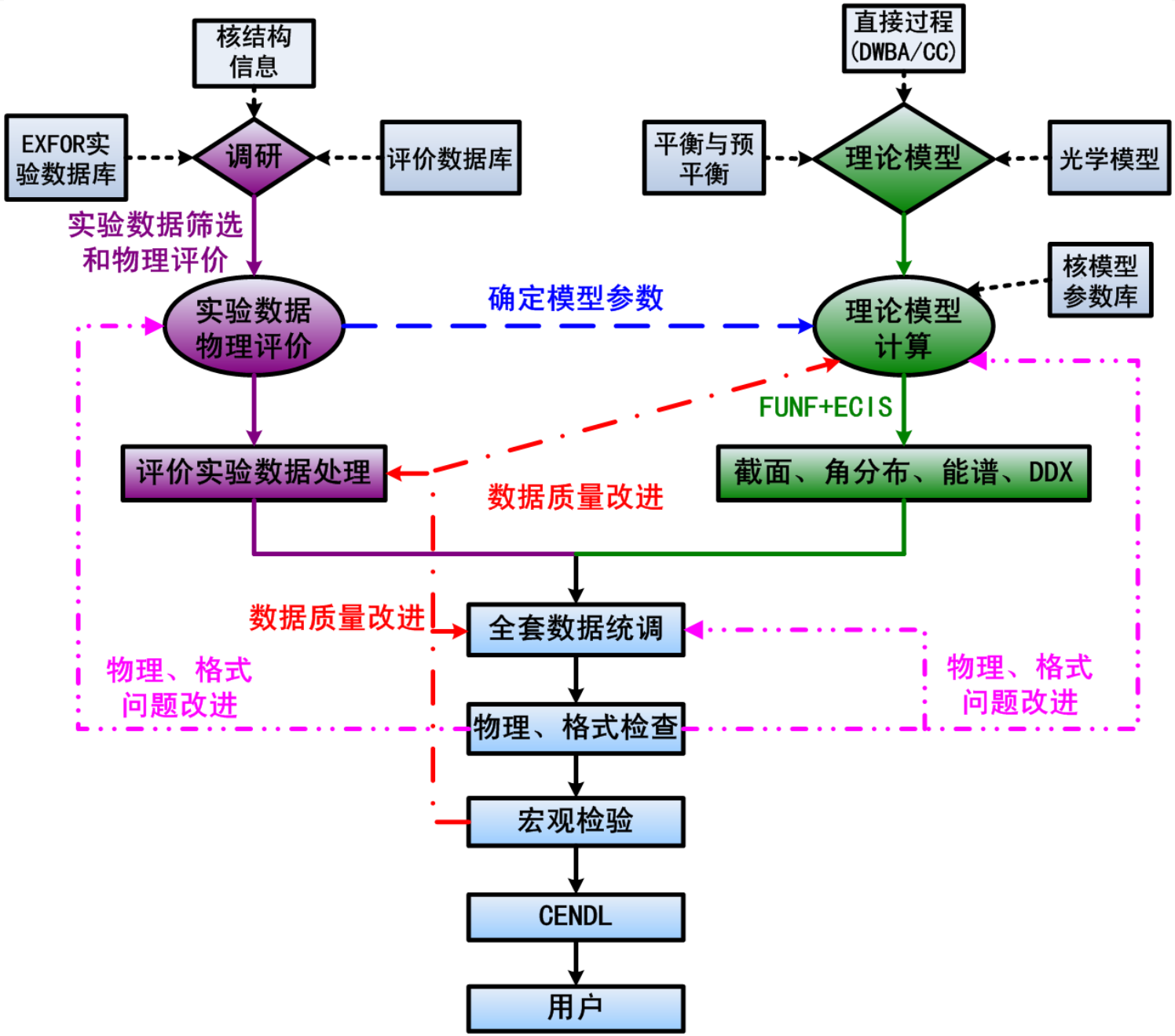
Major aspects of present evaluation

1. Systematic accumulation, correction and evaluation of all relevant experimental information
2. Re-normalize to standard reaction XS
3. Assessment of the applicability of OMP before 2000 year
4. Theoretical calculation to interpret the evaluated experimental data
5. Assembly of the experimental and theoretical results into ENDF format file


核结构信息
直接过程(DWBA/CC)
EXFOR实验数据库
调研
评价数据库
平衡与预平衡
理论模型
光学模型
实验数据筛选和物理评价
核模型参数库
实验数据物理评价
确定模型参数
理论模型计算
FUNF+ECIS
评价实验数据处理
数据质量改进
截面、角分布、能谱、DDX
数据质量改进
全套数据统调
物理、格式问题改进
物理、格式问题改进
物理、格式检查
宏观检验
CENDL
用户

- ^{56}Fe(n, p) XS random calculation

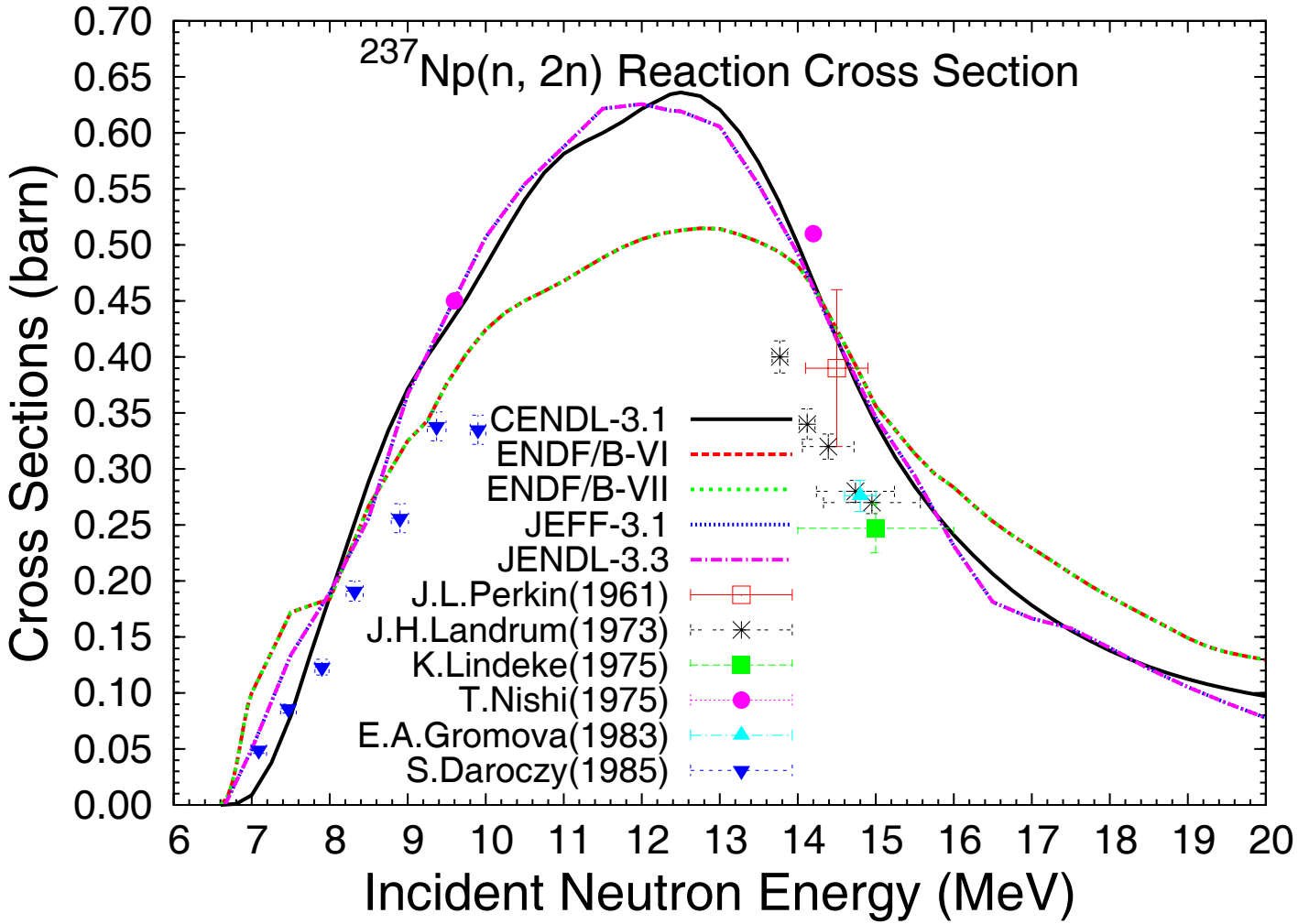



核结构信息
直接过程(DWBA/CC)
EXFOR实验数据库
调研
评价数据库
平衡与预平衡
理论模型
光学模型
实验数据筛选和物理评价
核模型参数库
实验数据物理评价
确定模型参数
理论模型计算
FUNF+ECIS
评价实验数据处理
数据质量改进
截面、角分布、能谱、DDX
数据质量改进
全套数据统调
物理、格式问题改进
物理、格式问题改进
物理、格式检查
宏观检验
CENDL
用户

Contents

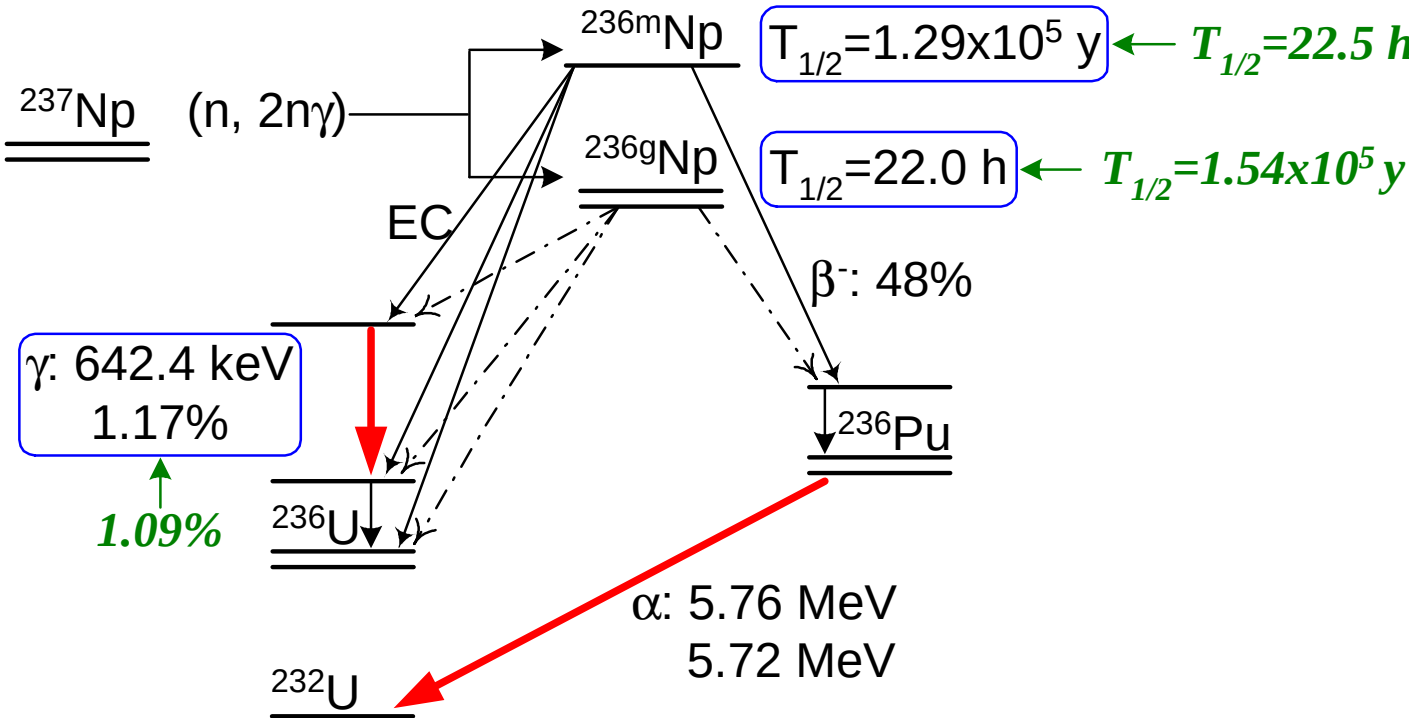
Experimental Data Evaluation

- ^{237}Np(n, 2n) reaction XS evaluation



Experimental Data Evaluation

- ^{237}Np(n, 2n) reaction XS evaluation

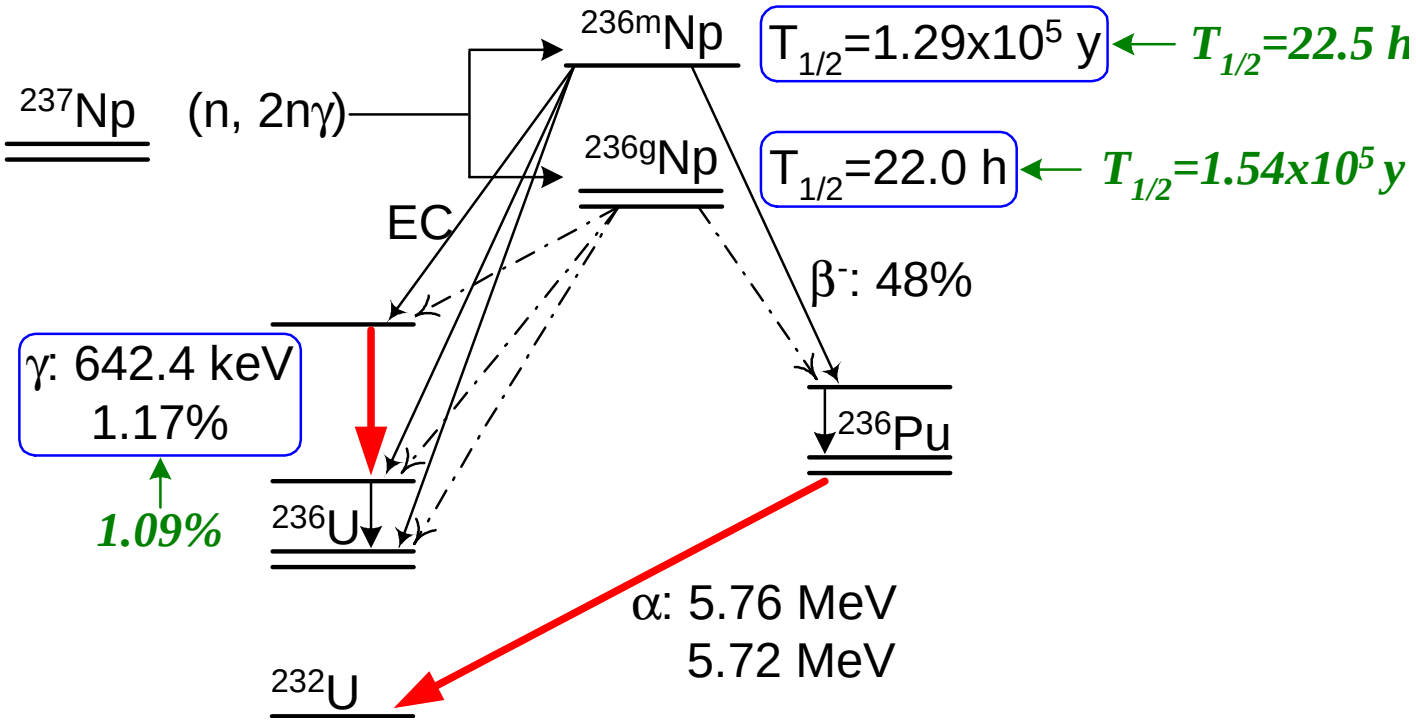


Exp. results: ^{237}Np(n, 2n)^{236m}Np reaction XS

$\sigma(^{236m}\mathrm{Np})/\sigma_{2n}$: ~ 73%

Experimental Data Evaluation

- ^{237}Np(n, 2n) reaction XS evaluation

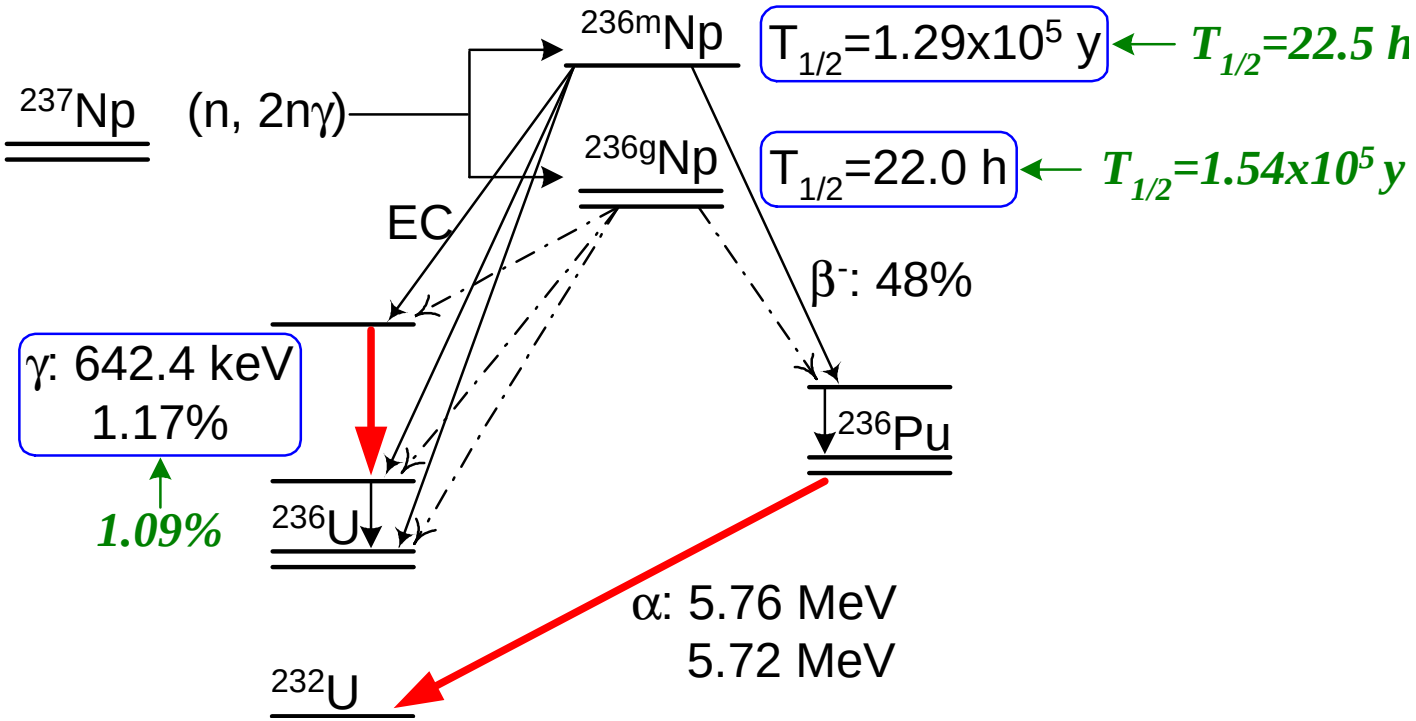


☞ Exp. results: ^{237}Np(n, 2n)^{236m}Np reaction XS

☞ $\sigma(^{236m}\mathrm{Np})/\sigma_{2n}$: $\sim$ 73%

Experimental Data Evaluation

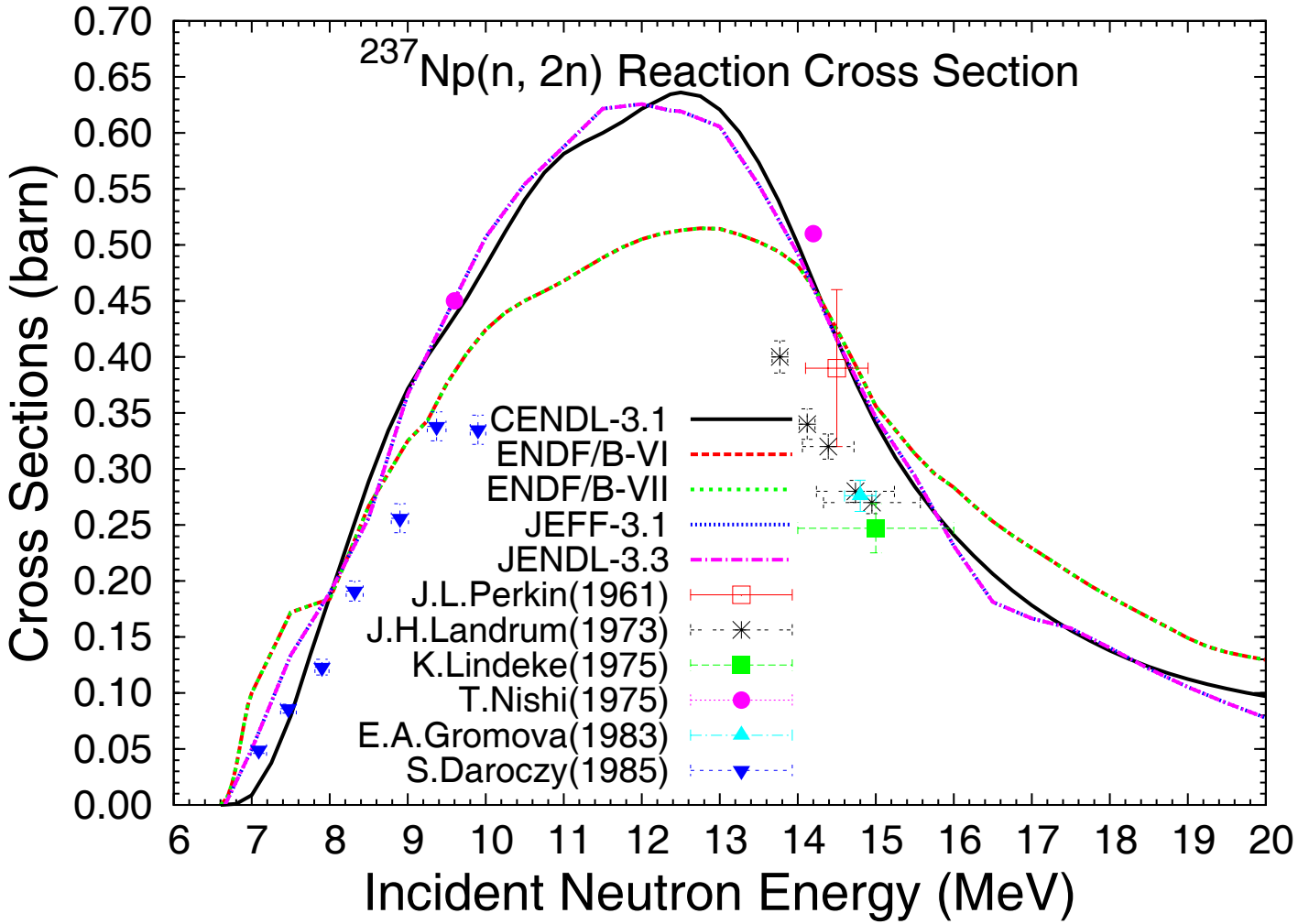
- ^{237}Np(n, 2n) reaction XS evaluation



- Exp. results: ^{237}Np(n, 2n)^{236m}Np reaction XS
- $\sigma(^{236m}\mathrm{Np})/\sigma_{2n}$: $\sim$ 73%

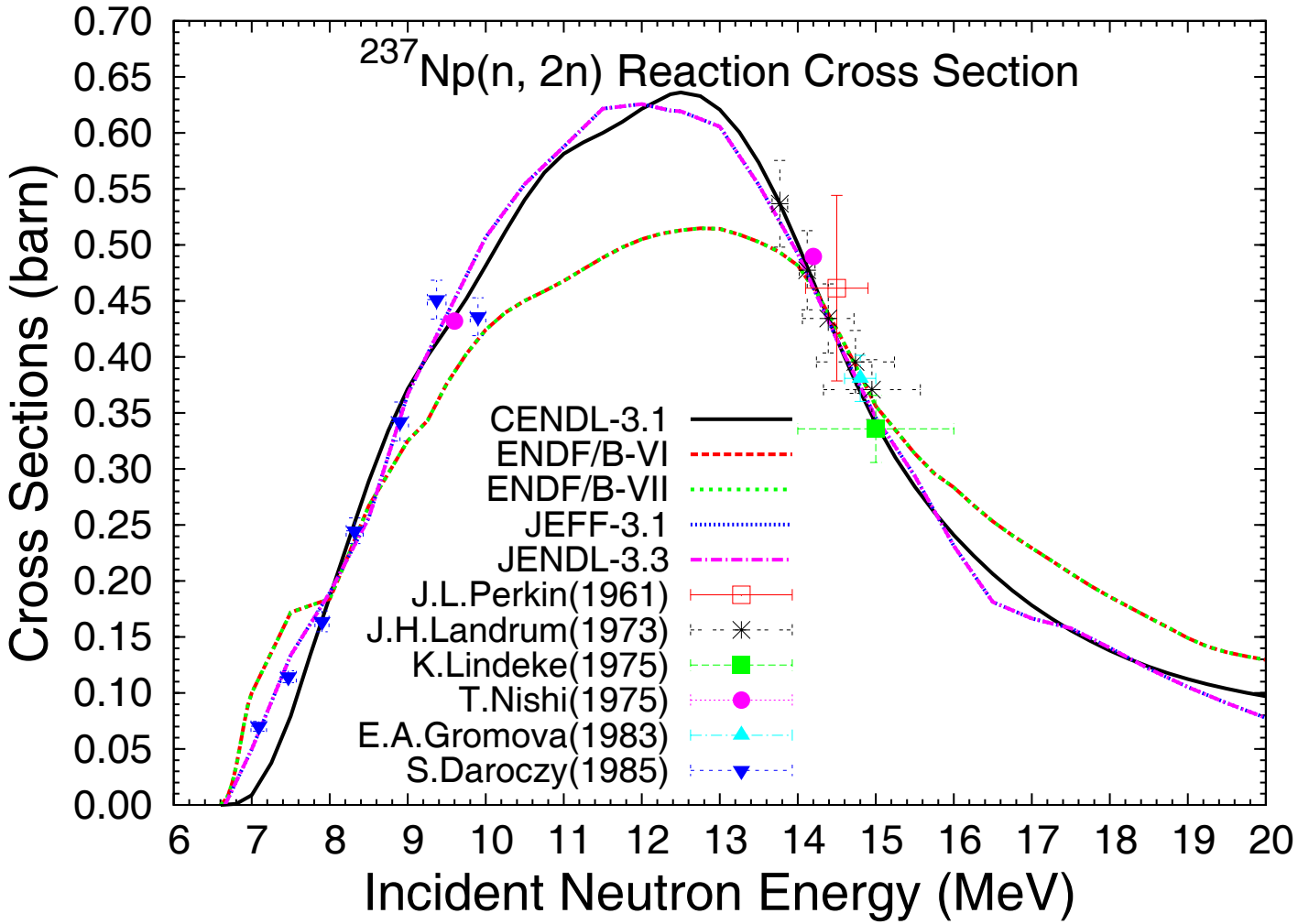
Experimental Data Evaluation

- ^{237}Np(n, 2n) reaction XS evaluation



Experimental Data Evaluation

- ^{237}Np(n, 2n) reaction XS evaluation



Experimental Data Evaluation

(n, f) reaction XS evaluation

- Method: TOF+FISCH+Threshold XS method
- Measured Contains: XS or Ratio

- XS results: normalize to standard XS
- Ratio: need to analyse the measurements more detailed, and correct and evaluate
- XS and Ratio exp. data were taken into account together

Experimental Data Evaluation

(n, f) reaction XS evaluation

- Method: TOF+FISCH+Threshold XS method
- Measured Contains: XS or Ratio

- XS results: normalize to standard XS
- Ratio: need to analyse the measurements more detailed, and correct and evaluate
- XS and Ratio exp. data were taken into account together

Experimental Data Evaluation

(n, f) reaction XS evaluation

- Method: TOF+FISCH+Threshold XS method
- Measured Contains: XS or Ratio

- XS results: normalize to standard XS
- Ratio: need to analyse the measurements more detailed, and correct and evaluate
- XS and Ratio exp. data were taken into account together

Experimental Data Evaluation

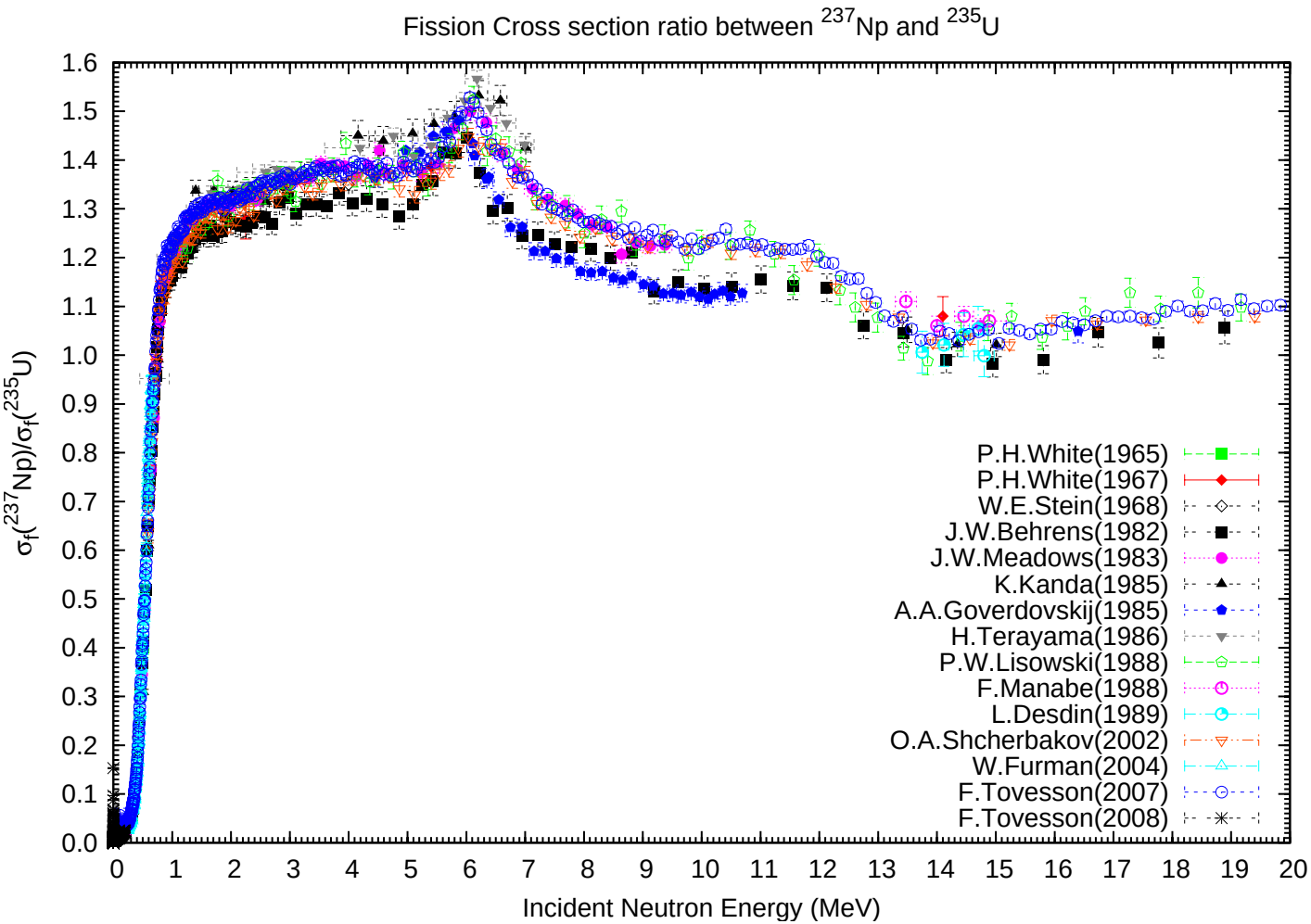
(n, f) reaction XS evaluation

- Method: TOF+FISCH+Threshold XS method
- Measured Contains: XS or Ratio

- XS results: normalize to standard XS
- Ratio: need to analyse the measurements more detailed, and correct and evaluate
- XS and Ratio exp. data were taken into account together

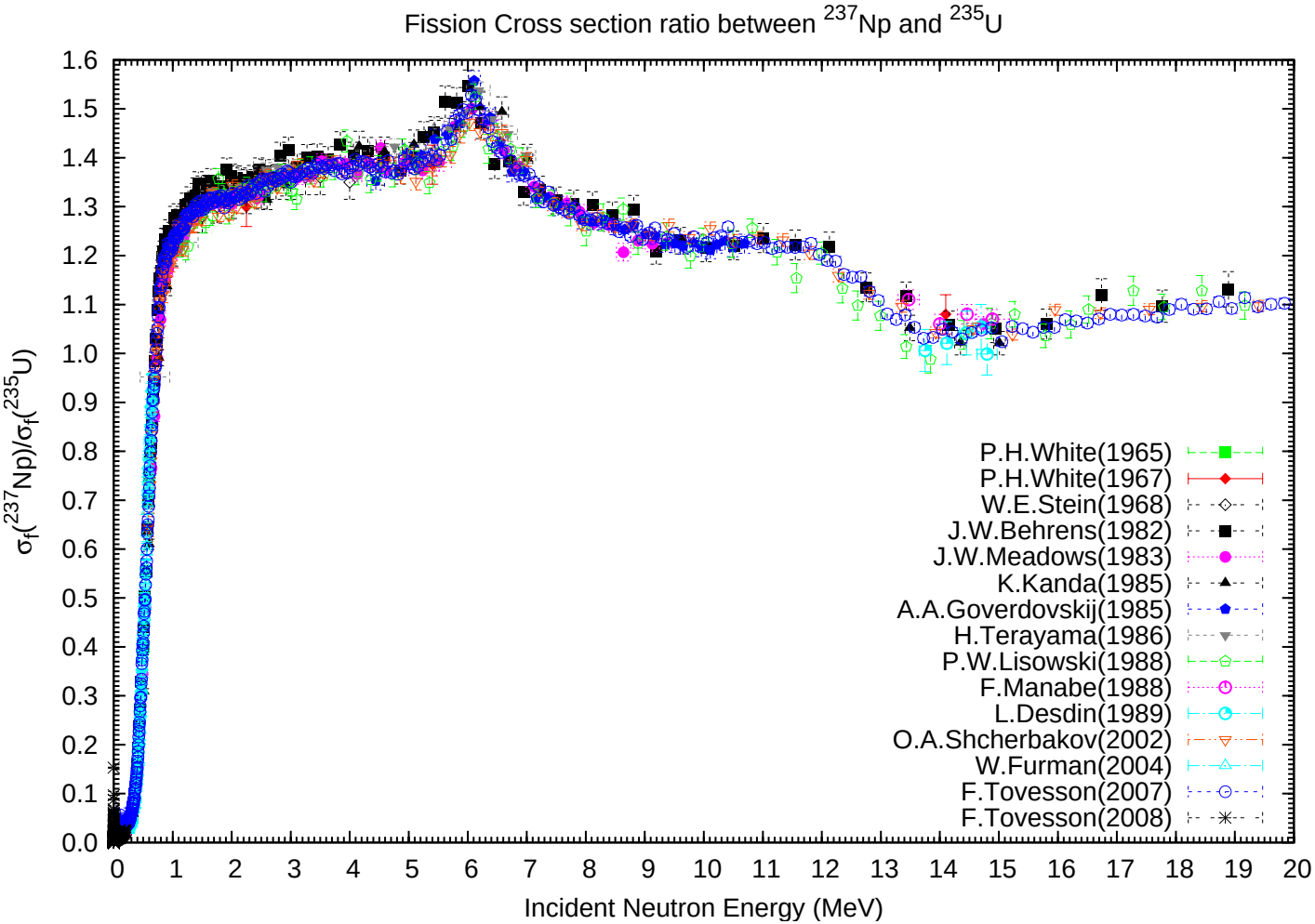
Experimental Data Evaluation

- ^{237}Np(n, f) reaction XS evaluation



Experimental Data Evaluation

- ^{237}Np(n, f) reaction XS evaluation



Contents

Evaluation Results

Evaluation Results

CENDL-3.1

- U Isotope: $^{232-241}$U(10)
- Np Isotope: $^{236-239}$Np(4)
- Pu Isotope: $^{236-246}$Pu(11)
- Am Isotope: $^{240-244,242m}$Am(6)

ENDF/B-VII

- U Isotope: $^{232-241}$U(10)
- Np Isotope: $^{235-239}$Np(5)
- Pu Isotope: $^{236-244,246}$Pu(10)
- Am Isotope: $^{241-244m,242m}$Am(6)

Evaluation Results

CENDL-3.1

- U Isotope:
  $^{232-241}$U(10)
- Np Isotope:
  $^{236-239}$Np(4)
- Pu Isotope:
  $^{236-246}$Pu(11)
- Am Isotope:
  $^{240-244,242m}$Am(6)

ENDF/B-VII

- U Isotope:
  $^{232-241}$U(10)
- Np Isotope:
  $^{235-239}$Np(5)
- Pu Isotope:
  $^{236-244,246}$Pu(10)
- Am Isotope:
  $^{241-244m,242m}$Am(6)

Evaluation Results

CENDL-3.1

- U Isotope:
  $^{232-241}$U(10)
- Np Isotope:
  $^{236-239}$Np(4)
- Pu Isotope:
  $^{236-246}$Pu(11)
- Am Isotope:
  $^{240-244,242m}$Am(6)

ENDF/B-VII

- U Isotope:
  $^{232-241}$U(10)
- Np Isotope:
  $^{235-239}$Np(5)
- Pu Isotope:
  $^{236-244,246}$Pu(10)
- Am Isotope:
  $^{241-244m,242m}$Am(6)

Evaluation Results

CENDL-3.1

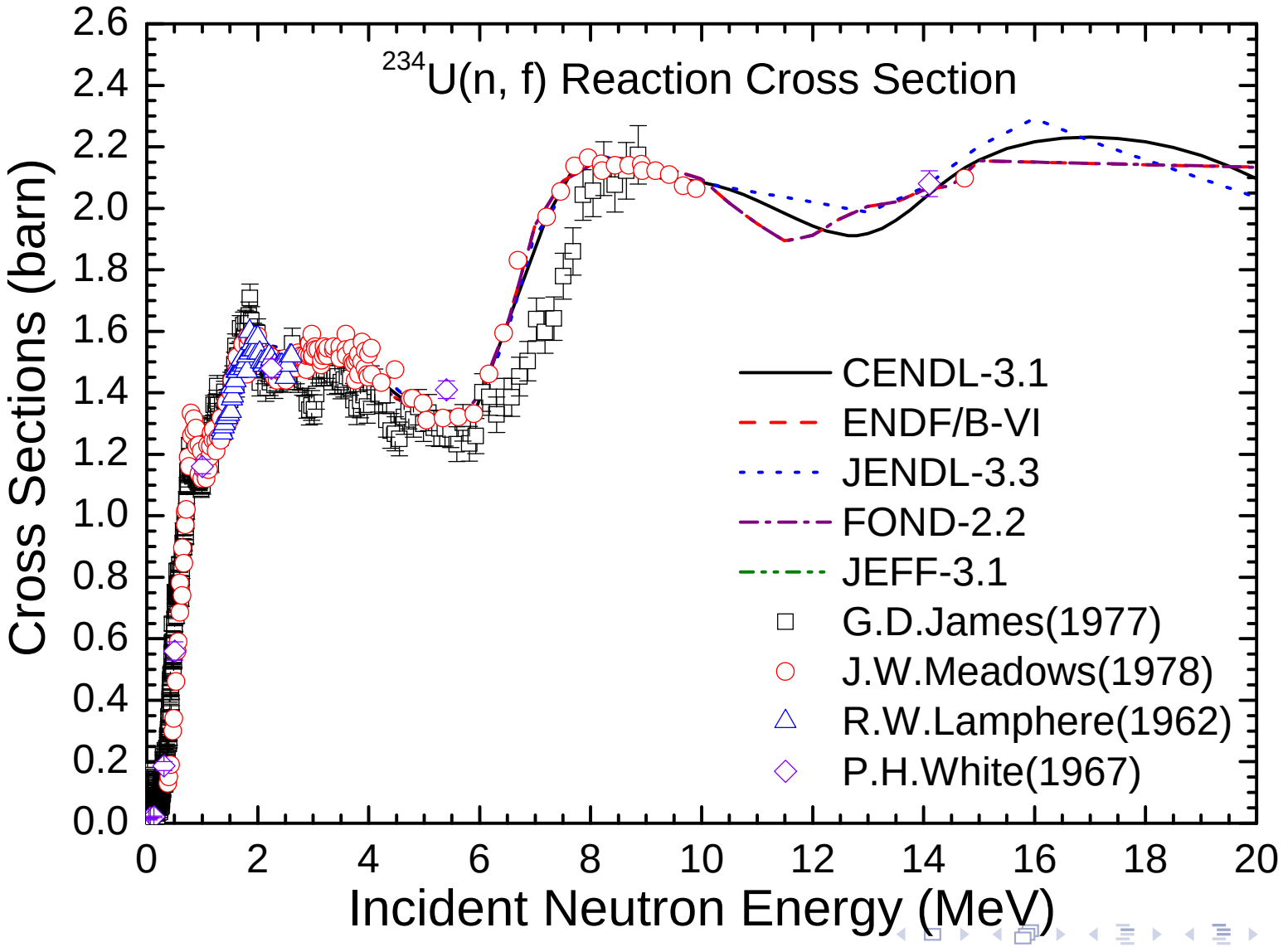
- U Isotope:
  $^{232-241}$U(10)
- Np Isotope:
  $^{236-239}$Np(4)
- Pu Isotope:
  $^{236-246}$Pu(11)
- Am Isotope:
  $^{240-244,242m}$Am(6)

ENDF/B-VII

- U Isotope:
  $^{232-241}$U(10)
- Np Isotope:
  $^{235-239}$Np(5)
- Pu Isotope:
  $^{236-244,246}$Pu(10)
- Am Isotope:
  $^{241-244m,242m}$Am(6)

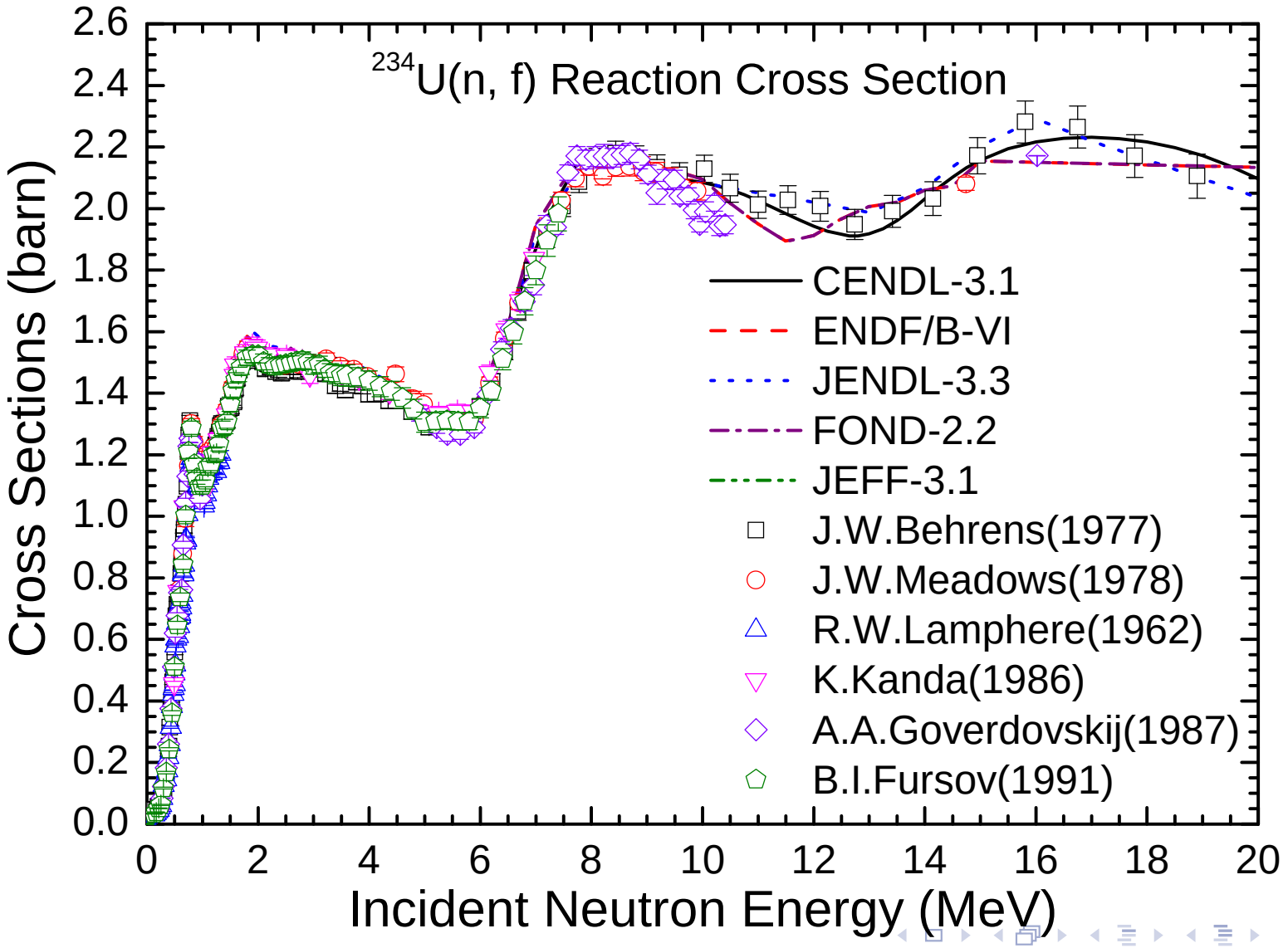
Evaluation Results

- ^{234}U(n, f) reaction XS



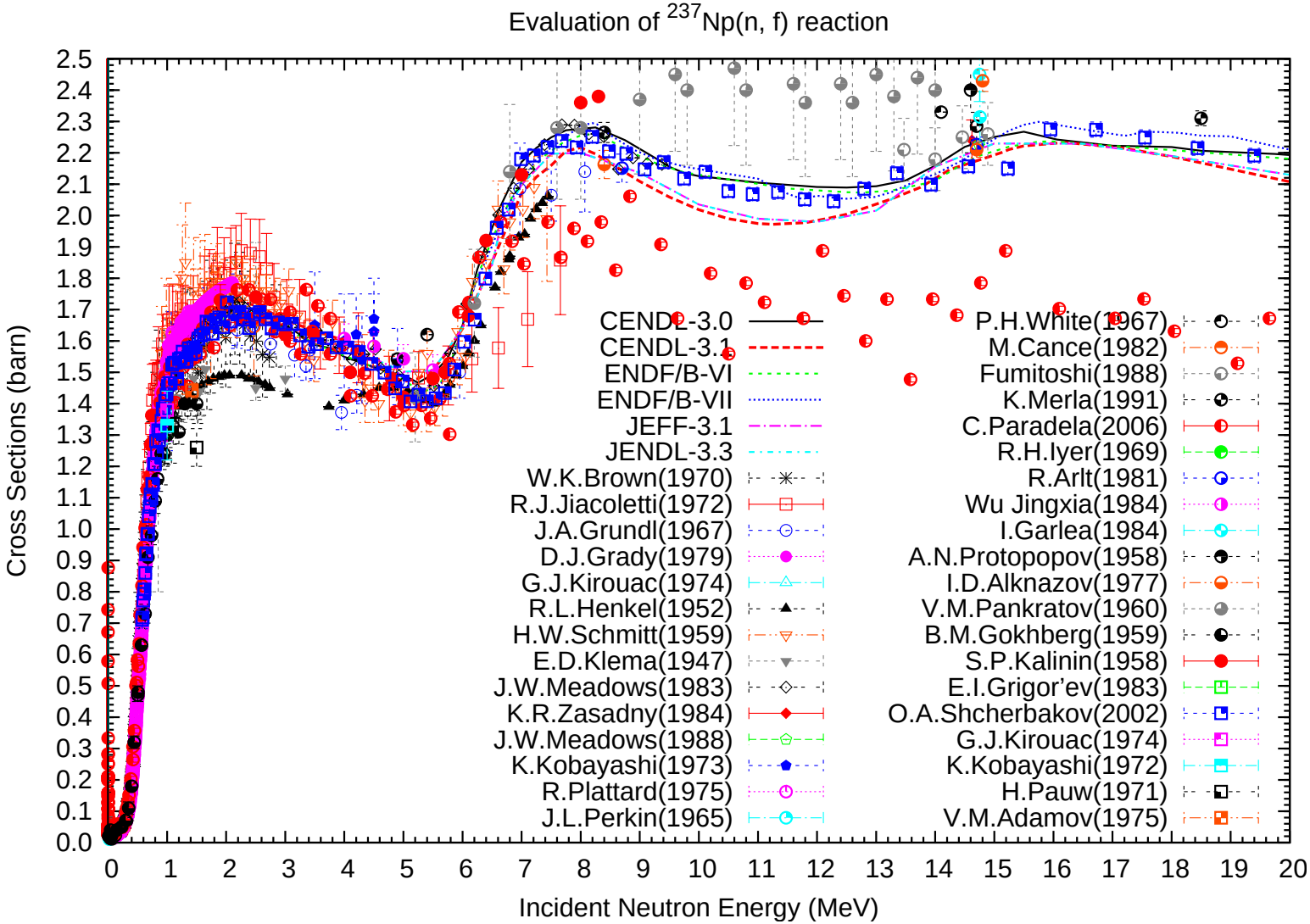
Evaluation Results

- ^{234}U(n, f) reaction XS



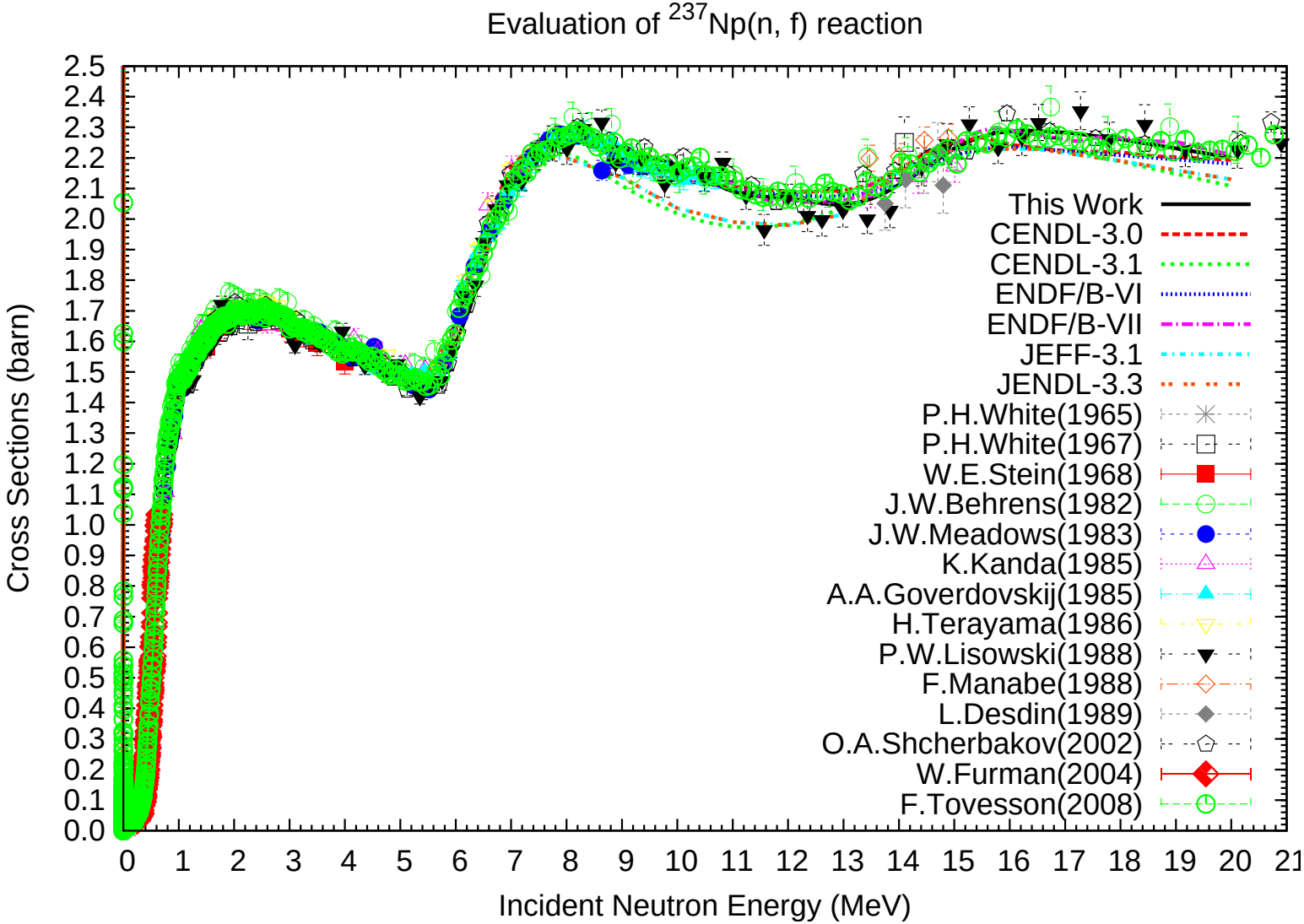
Evaluation Results

- ^{237}Np(n, f) reaction XS



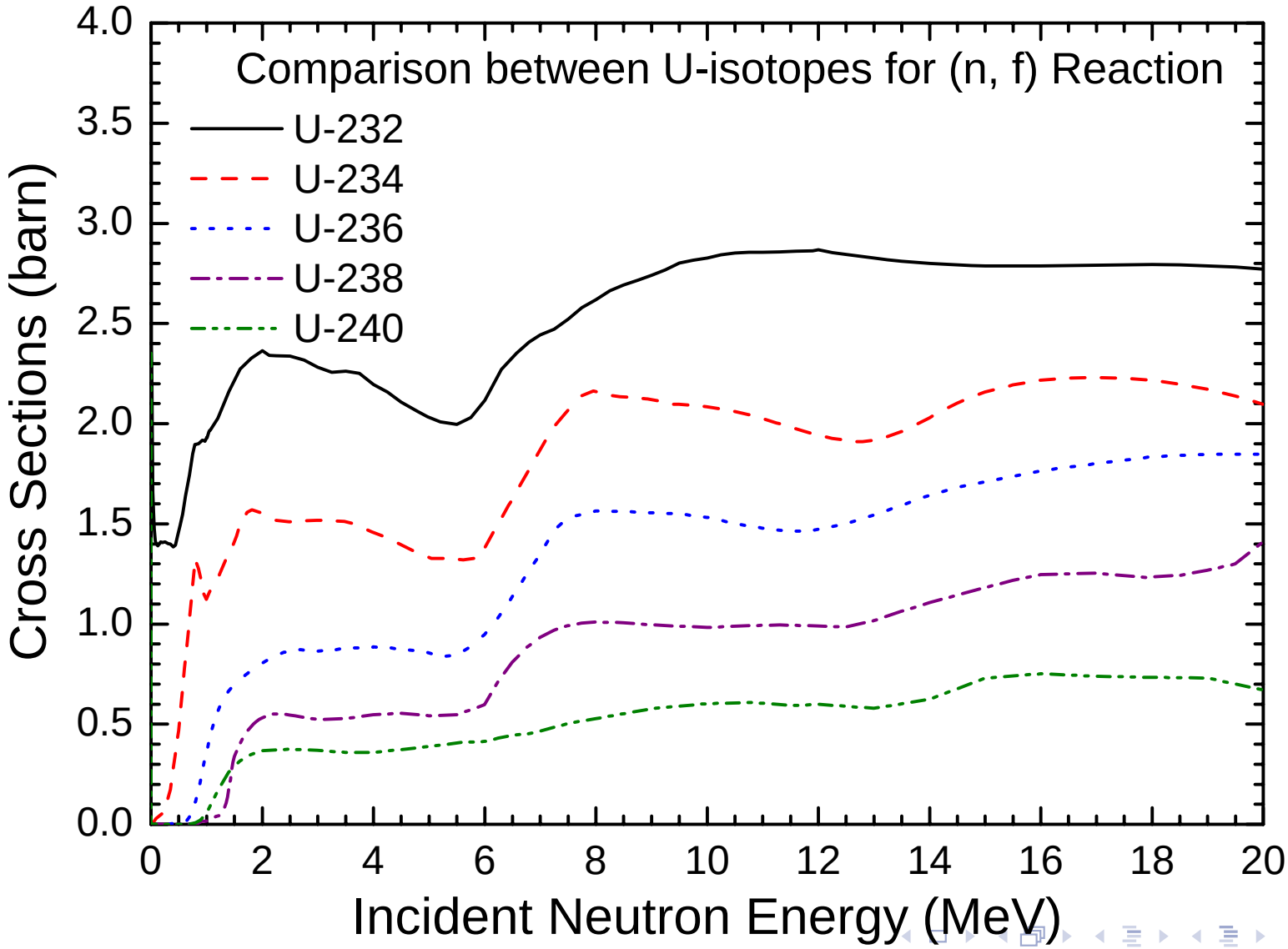
Evaluation Results

- ^{237}Np(n, f) reaction XS



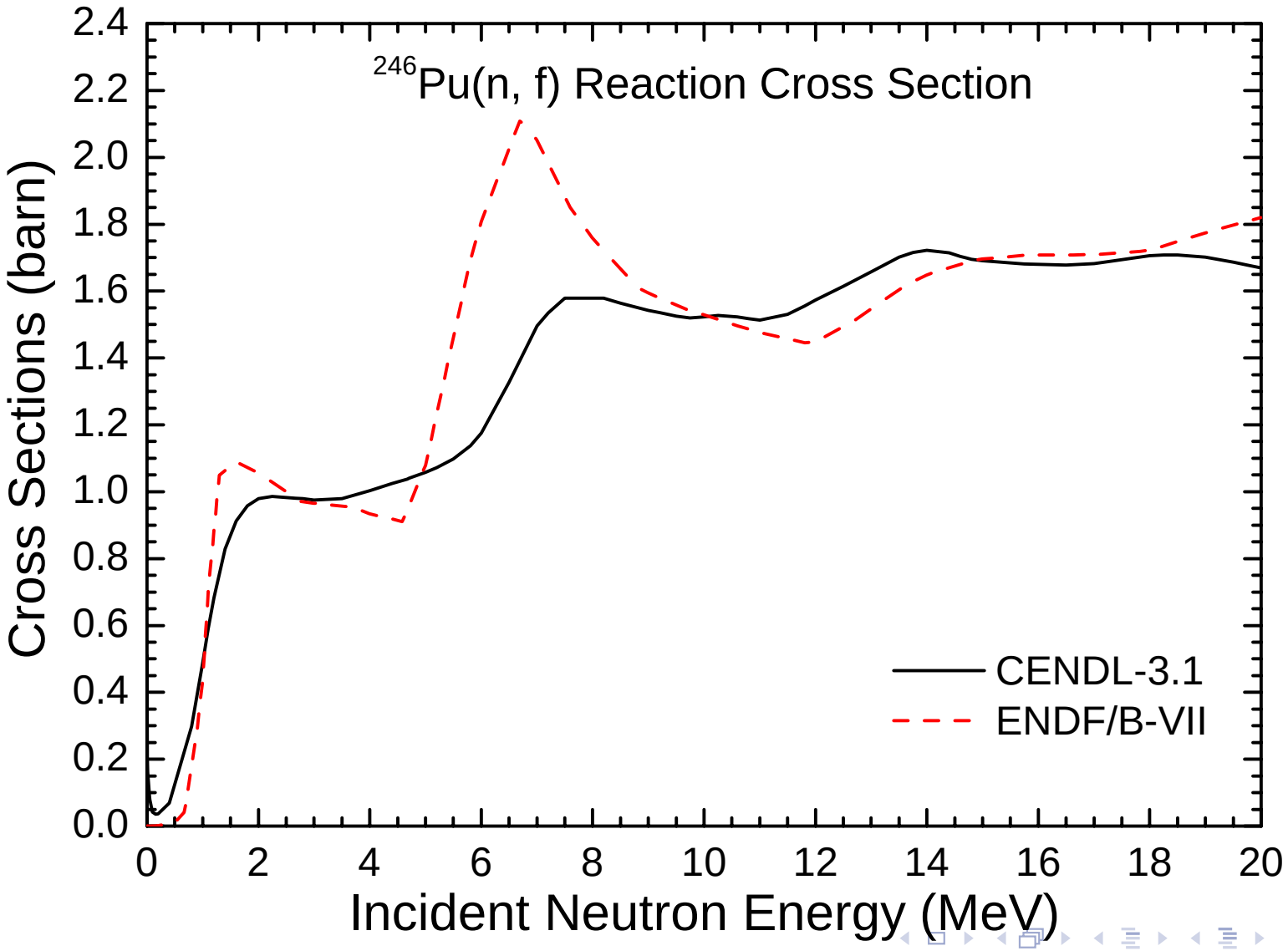
Evaluation Results

- U(n, f) reaction XS



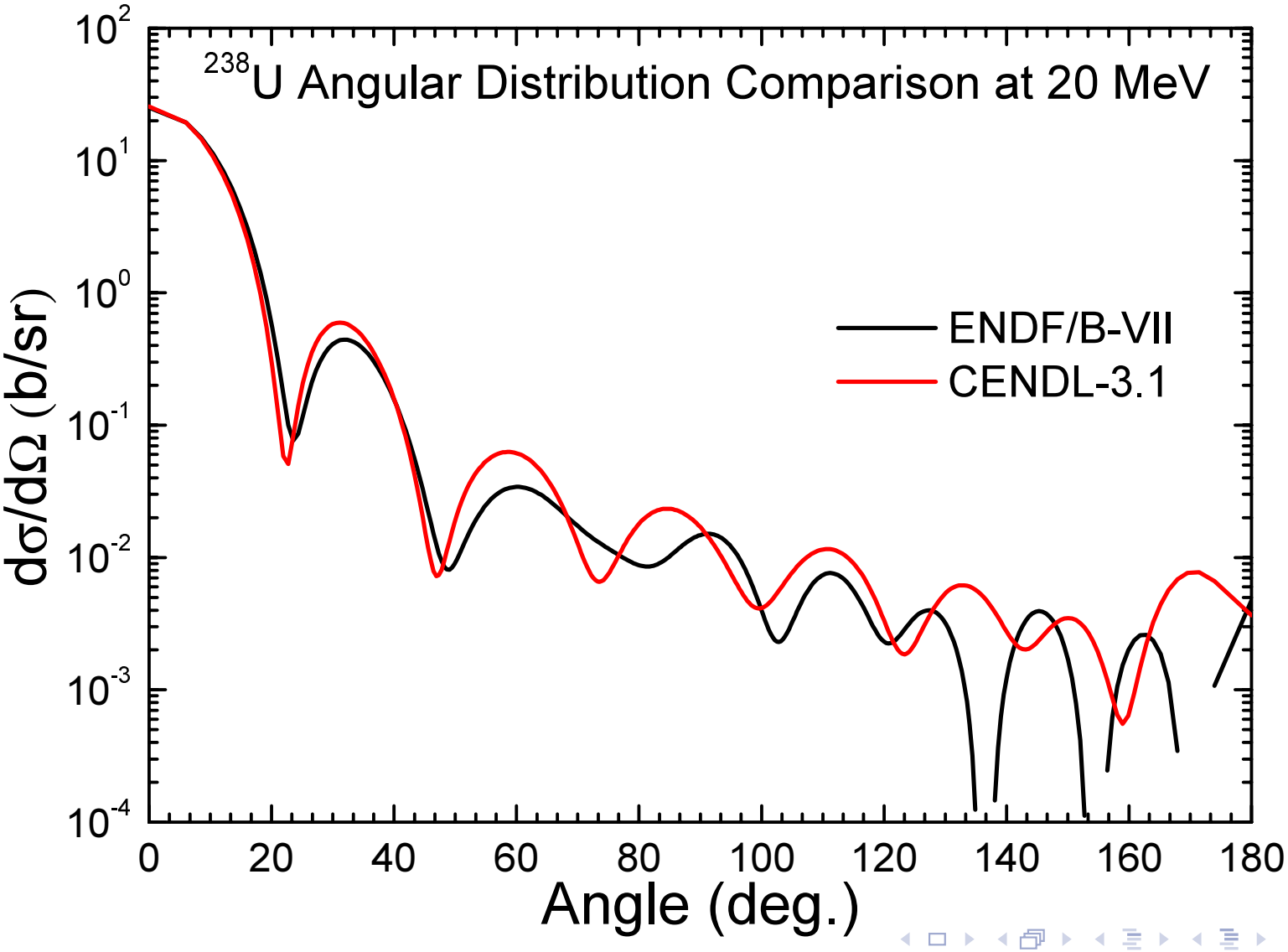
Evaluation Results

- ^{246}Pu(n, f) reaction XS



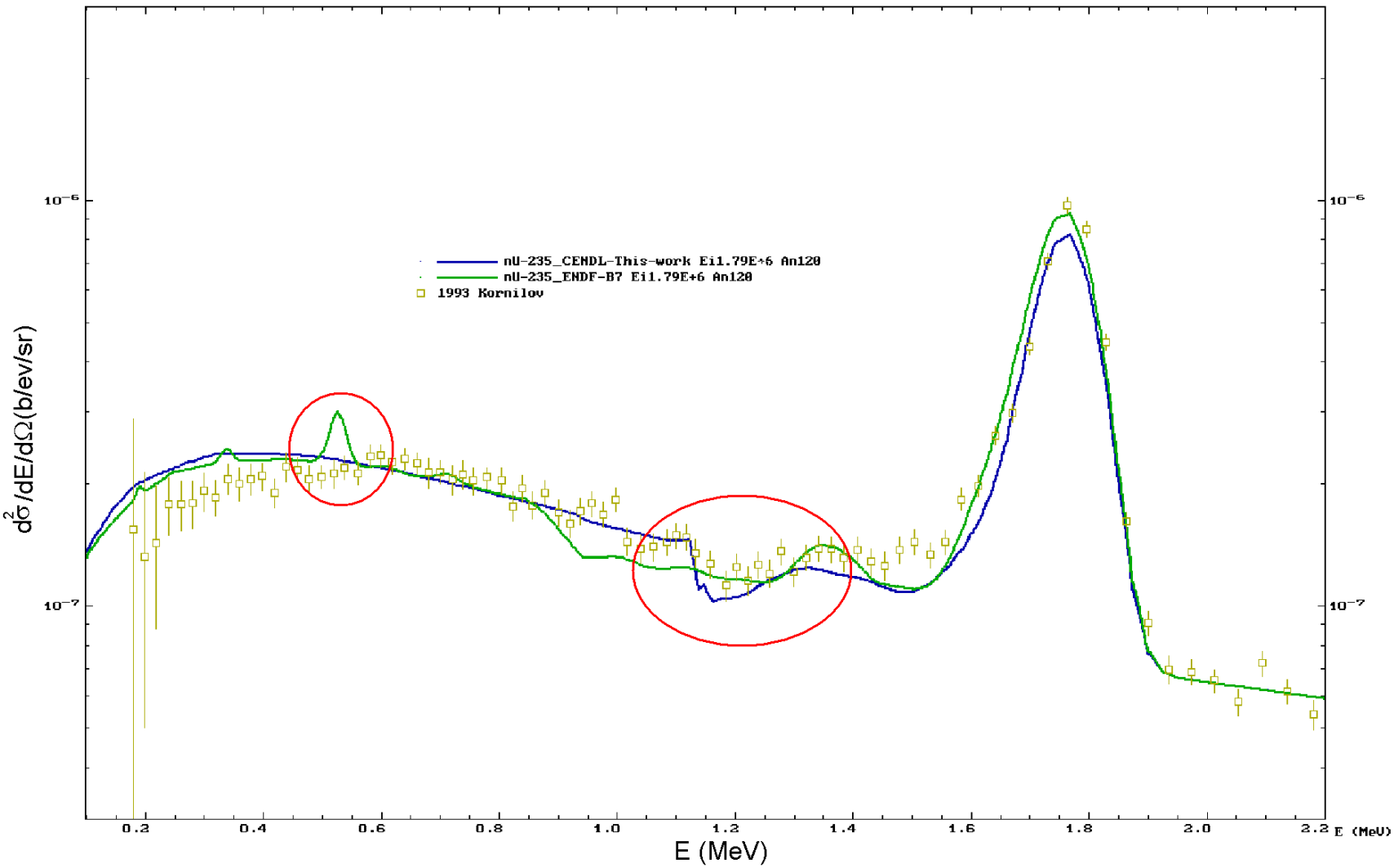
Evaluation Results

- ^{238}U Elastic scattering angular distribution



Evaluation Results

- ^{235}U neuton emission DDX (E_n=1.79 MeV; θ=120°)



Contents

Summary

1. CENDL-3.1 was released in 2009
2. 31 actinoid nuclides from U to Am were evaluated in the neutron energy range from 10^{-5} eV to 20 MeV
3. Actinoid nuclear data in CENDL-3.1 were widely revised and improved
4. 25 new actinoid nuclear data were evaluated and added in comparison with CENDL-2.1
5. Continue to revise actinoid nuclear data for application

Thank you for your attention!