



WPEC 2004
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Present Status of JENDL Project

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Organization of Japanese Nuclear Data Committee (JNDC)

- Subcommittee on Nuclear Data
 - High Energy Nuclear Data Evaluation,
 - Evaluation and Calculation System WG,
 - FP Nuclear Data Evaluation WG,
 - Evaluation WG on Astrophysics.
- Subcommittee on Reactor Constants
 - Reactor Integral Test WG,
 - Shielding Integral Test WG,
 - Standard Group Constants WG,
 - Medium and High Energy Nuclear Data Integral Test WG.



Organization of JNDC (2)

- Subcommittee on Nuclear Fuel Cycle
 - Decay Heat Evaluation WG,
 - WG on Nuclide Generation and Depletion,
 - Fission Yield Evaluation WG.
- Standing Groups
 - ENSDF Group,
 - JENDL Compilation Group,
 - CINDA Group,
 - Group on Atomic, Molecular and Nuclear Data for Medical Use,
 - Editorial Group of “Nuclear Data News”,
 - High Priority Request List Group



General Purpose File (JENDL-4)

- Scope:
 - High burn-up,
 - MOX utilization,
 - ADS system,
 - Medical Use such as BNCT (Boron Neutron Capture Therapy),



JENDL-4

- Incident particles and maximum energy
 - Mainly neutron,
 - Proton, Charged particle and Photon,
 - Standard maximum energy: 20 MeV,
 - To be extended when needed.
- Contents
 - More accurate MA and FP data,
 - More covariance data,
 - More secondary gamma production data,
 - Number of nuclides included is similar to that of JENDL-3.3.
- Completion year: 2008-2009



JENDL-4

Nuclear Database for Next Generation Nuclear Energy

JENDL-4

Expansion of
Application Fields



R & D of
Inovative Nuclear Reactor

Compilation of Nuclear Data

- ★ **Nuclear Data Evaluation**
MA and FP
Uncertainties and secondary γ 's
Charged particle and photon-induced reactions
- Extension of Max. Energy
- ★ **Integral Test**
Benchmark calculation

Integrated
Computer
System

Utilization of Nuclear Data

- ★ **Group Constants**
Multigroup transport
Continuous Monte Carlo
Burnup calc.
- ★ **Quality Assurance**
Confirmation of Accuracy

Japanese Standard Nuclear Data Library

JAERI/NDC



JENDL Special Purpose Files

- High Energy File
- Photonuclear Data File
- PKA/KERMA File
- (α ,n) Reaction Data File
- Actinide File
- Others:
 - Fusion File, Activation Cross Section File, Dosimetry File and FP Decay Data File



High Energy File

- Neutron & Proton File up to 3 GeV.
(Total: 122 nuclides)
- To be used for the design of high energy proton accelerator and R & D of ADS system.
- A part of the data file was released in March 2004 as High Energy File 2004. (66 nuclides)
- The file for IFMIF will be produced from this file. (Up to 50 MeV)



High Energy File

Total: 122 Nuclides

1 st priority (40 nuclides)	H-1, C-12, N-14, O-16, Al-27, Cr-50,52,53,54, Fe-54,56,57,58, Ni-58,60,61,62,64, Cu-63,65, W-180,182,183,184,186, Au-197, Hg-196,198,199,200,201,202,204, Pb-204,206,207,208, Bi-209, U-235,238
2 nd priority (45 nuclides)	H-2, Be-9, B-10,11, Mg-24,25,26, Si-28,29,30, K-39,41, Ca-40,42,43,44,46,48, Ti-46,47,48,49,50, V-51, Mn-55, Co-59, Zr-90,91,92,94,96, Nb-93, Mo-92,94,95,96,97,98,100, Ta-181, Pu-238,239,240,241,242
3 rd priority (37 nuclides)	Li-6,7, C-13, F-19, Na-23, Cl-35,37, Ar-35,38,40, Zn-64,66,67,68,70, Ga-69,71, Ge-70,72,73,74,76, As-75, Y-89, Th-232, U-233,234,236, Np-237, Am-241,242,242m,243, Cm-243,244,245,246

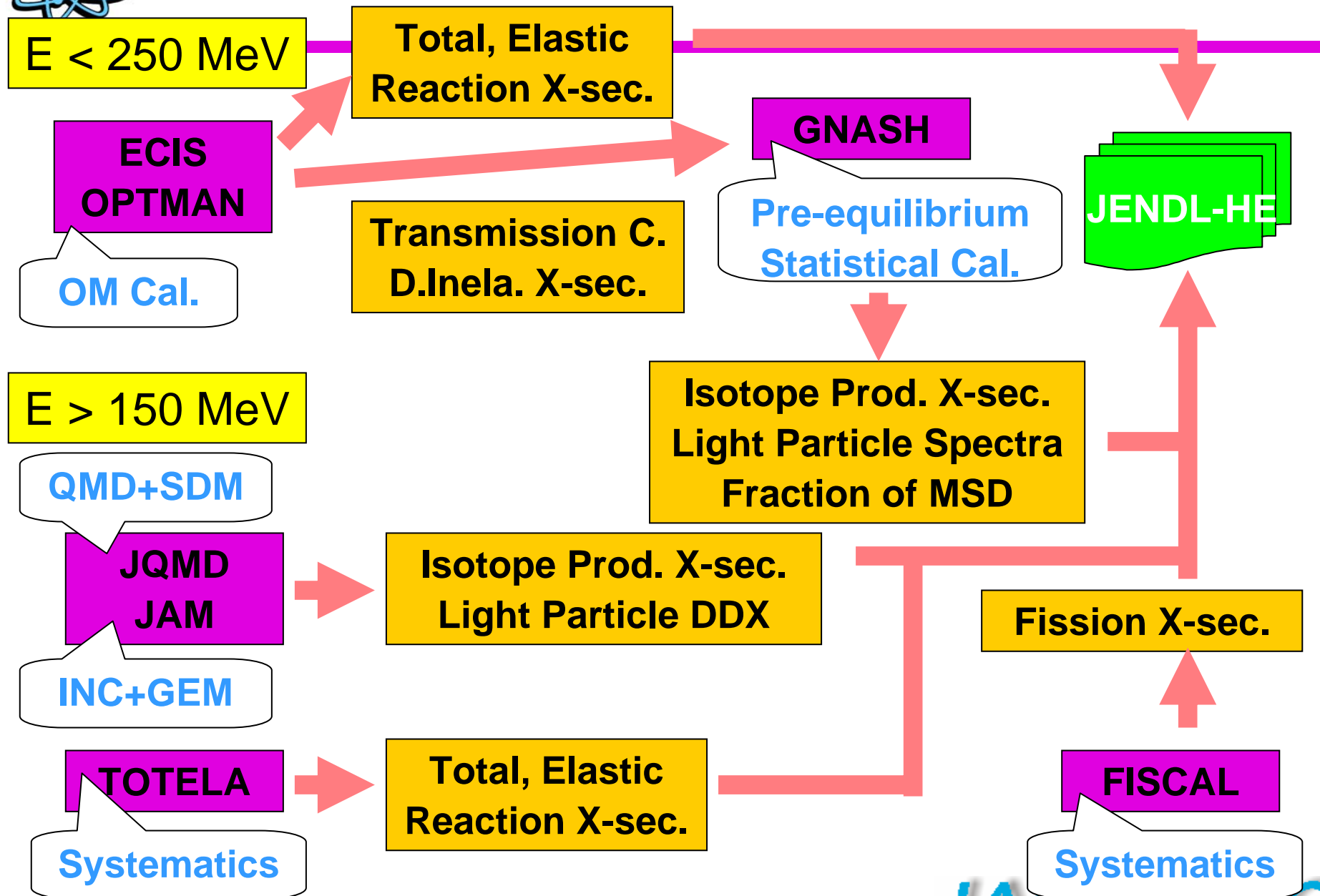
Red: released in March 2004 (66 Nuclides)

Green: under compilation,

Black: under evaluation

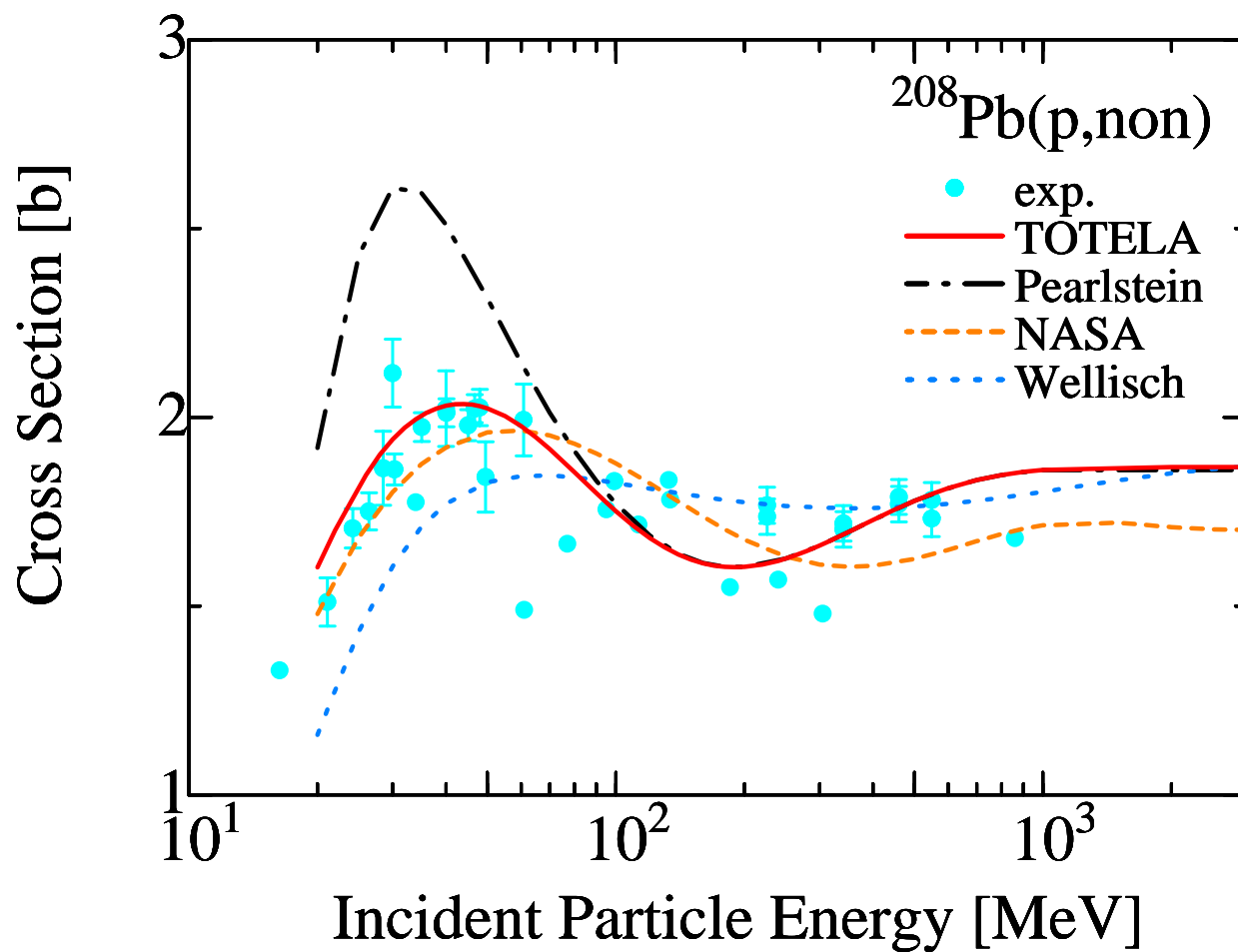


Evaluation Methods and Tools





TOTELA Calculation





Photonuclear Data File

- Released in March 2004.
- Maximum energy: 140 MeV.
- Photo reaction data for 68 nuclides:
 - ▶ ^2H , ^3He , $^{6,7}\text{Li}$, ^9Be , $^{10,11}\text{B}$, ^{12}C , ^{14}N , ^{16}O , ^{19}F , ^{23}Na ,
 $^{24,25,26}\text{Mg}$, ^{27}Al , $^{28,29,30}\text{Si}$, ^{31}P , $^{40,48}\text{Ca}$, ^{46}Ti , ^{51}V , ^{52}Cr ,
 ^{55}Mn , $^{54,56}\text{Fe}$, ^{59}Co , $^{58,60}\text{Ni}$, $^{63,65}\text{Cu}$, ^{64}Zn , ^{90}Zr , ^{93}Nb ,
 $^{92,94,96,98,100}\text{Mo}$, ^{133}Cs , $^{152,154,155,156,157,158,160}\text{Gd}$, ^{181}Ta ,
 $^{182,184,186}\text{W}$, ^{197}Au , $^{196,198,199,200,201,202,204}\text{Hg}$, $^{206,207,208}\text{Pb}$,
 ^{209}Bi , $^{235,238}\text{U}$, ^{237}Np .
- Data of other nuclides will be taken from KAERI's evaluated data.



PKA/KERMA File & (α ,n) File

- PKA/KERMA
 - Not yet compiled.
 - After the compilation of the file for IFMIF, the data will be created from the file.
- (α ,n) File
 - Released in February 2003 for 13 nuclides.
 - ${}^6,7\text{Li}$, ${}^9\text{Be}$, ${}^{10,11}\text{B}$, ${}^{12,13}\text{C}$, ${}^{14,15}\text{N}$, ${}^{17,18}\text{O}$, ${}^{19}\text{F}$, ${}^{23}\text{Na}$.
 - Total of 32 nuclides were expected but it is rather difficult to complete the whole evaluation.



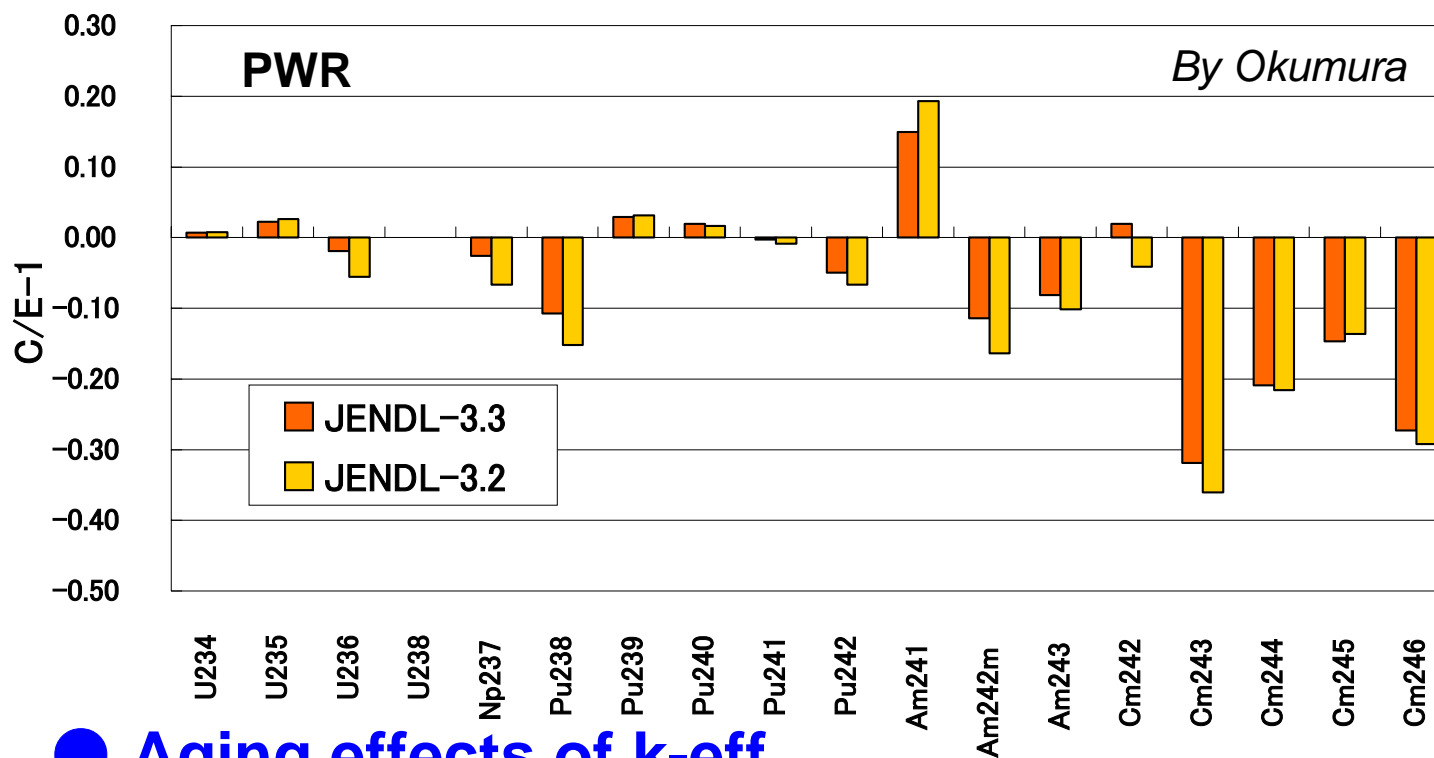
Actinide File

- The data in JENDL-3.3 are being re-evaluated.
- Problem of JENDL-3.3
 - Inconsistency with PIE data,
 - Inconsistency with recent measurement.
- Only actinides data are included.
(62 nuclides at present)



Problems of Current Actinide Data

● Discrepancies in Post Irradiation Experiments



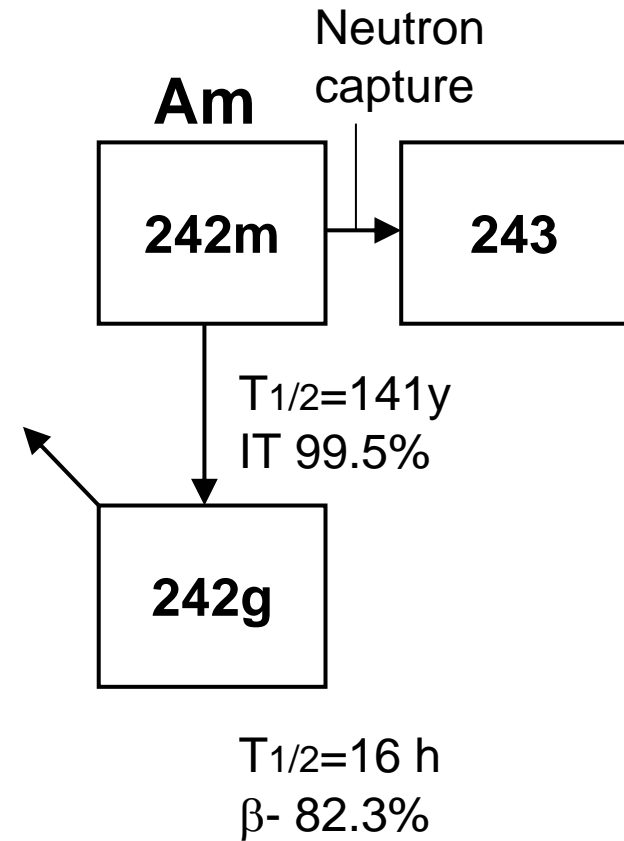
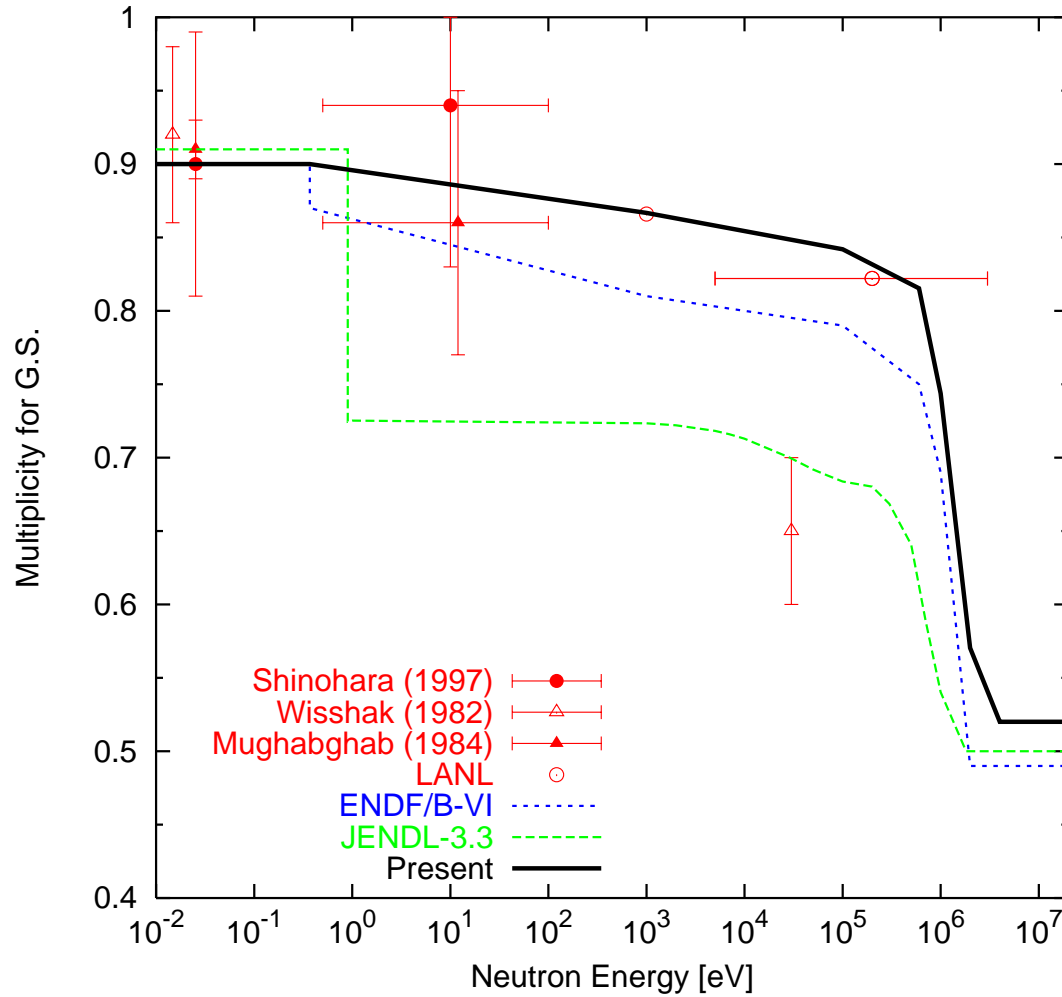
● Aging effects of k-eff

Larger amount of Am241 → Larger C/E of k-eff



Isomeric Ratio of Am241 Capture

By Kawano (LANL)





Cross Sections in the Thermal and Resonance Region

Nuclides	s-fis	s-cap	Reson. Params.	<i>By Nakagawa</i>
Np237	Δ^1	Δ^2	500 eV	1) not agree with KULS 2) discrepancies
Pu238	Δ	Δ^1	500 eV	1) old exp.
Pu242	\times	\bigcirc	1900 eV	
Am241	\bigcirc	Δ^1	150 eV	1) discrepancies
Am242m	Δ^1	\times	43 eV	1) discrepancies
Am243	Δ^1	Δ^2	250 eV	1) discrepancies, 2) old
Cm242	\times	Δ^1	275 eV	1) old exp (absorption)
Cm243	Δ	Δ	100 eV	old exp.
Cm244	Δ	Δ	1000 eV	old exp.
Cm245	\bigcirc	Δ	100 eV	old exp.
Cm246	Δ	Δ	400 eV	old exp.

\bigcirc : good, Δ : not enough, \times : no experimental data



Cross Sections above Resonance Region

Nuclides	s-fis	s-cap	<i>By Nakagawa</i>
Np237	Δ^1	Δ^2	1) discrepancies: $E < 100\text{keV}$. 2) not enough: $E > 100\text{keV}$
Pu238	Δ^1	Δ^2	1) discrepancies. 2) old exp, no data: $E > 100\text{keV}$
Pu242	\bigcirc^1	Δ^2	1) no exp.: $E < 100\text{keV}$. 2) no exp.: $E > 100\text{keV}$
Am241	\bigcirc	Δ^1	1) no exp.: $E > 100\text{keV}$
Am242m	Δ^1	\times	1) discrepancies
Am243	Δ^1	Δ	1) discrepancies
Cm242	Δ^1	\times	1) no exp. in MeV region
Cm243	Δ^1	\times	1) no exp.: $E < 100\text{keV}$
Cm244	Δ^1	\times^2	1) discrepancies. 2) no exp.: $E > 10\text{ keV}$
Cm245	\bigcirc	\times	
Cm246	\bigcirc	\times	

\bigcirc : good, Δ : not enough, \times : no experimental data



2003 Symposium of Nuclear Data

- Date: 27th and 28th Nov. 2003.
- Place: JAERI, Tokai
- Topics:
 - Nuclear data for ADS system.
 - Data needs for next generation reactors and future JENDL plan.
 - Frontier of Nuclear Physics Study, Advanced Science Study and so on.
- Attendee: Total 121
- Presentation:
 - Oral: 18 papers.
 - Poster: 26 papers.



Tutorial for Nuclear Data

- First tutorial for nuclear data.
- Date: 26th Nov. 2003.
The day before the 2003 symposium.
- Participants: 48 persons.
- Topics: Evaluation and Processing of Nuclear Data.
- Most of the participants had good feeling and wanted to have a tutorial in next year.



Development of CONDUCT System

- CONDUCT: Combined System for Nuclear Data Utilization, Calculation and Transfer.
- A part of a project on MA nuclear data measurements for advanced nuclear reactor.
- Special fund by Ministry of Education, Culture, Sports, Science and Technology (MEXT)
- Five year project from 2002-2006.

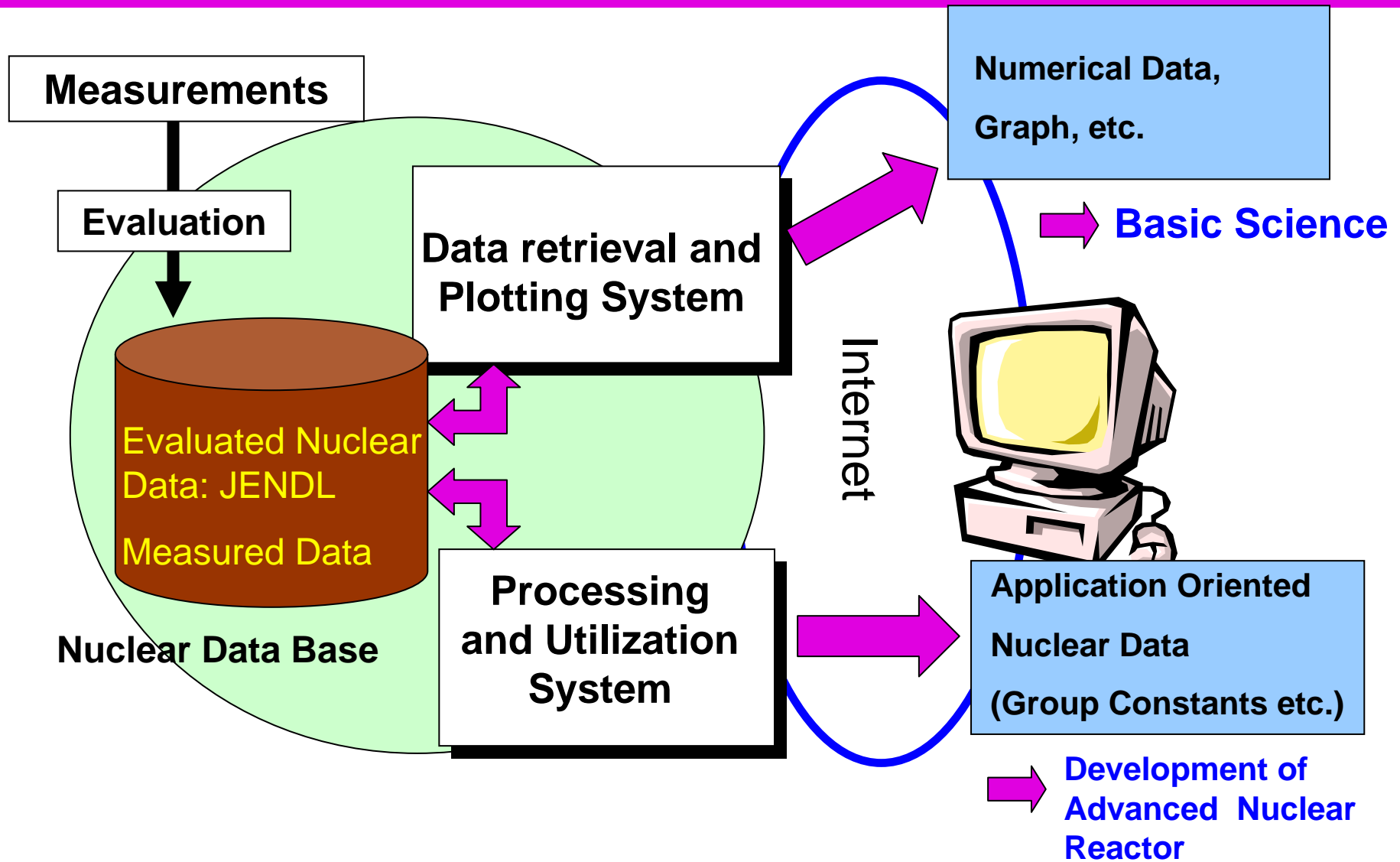


Project Members

- Development of Detectors:
 - JAERI, JNC, Tokyo Institute of Technology, Osaka University, Kyoto University, Chiba Institute of Technology
- Cross Section Measurement:
 - Tokyo Institute of Technology, JAERI, JNC, Osaka University, Kyoto University, Tohoku University
- Evaluation & Development of Data Utilization System:
 - JAERI, Hokkaido University, Tokyo Institute of Technology



CONDUCT



CONDUCT (2)

Hardware : PC Cluster

Research for Utilization:

Retrieval, Plotting, Providing results

Managing system

Retrieval and plotting system

Measured data

Evaluated data

Processing and utilization system

Group Constants

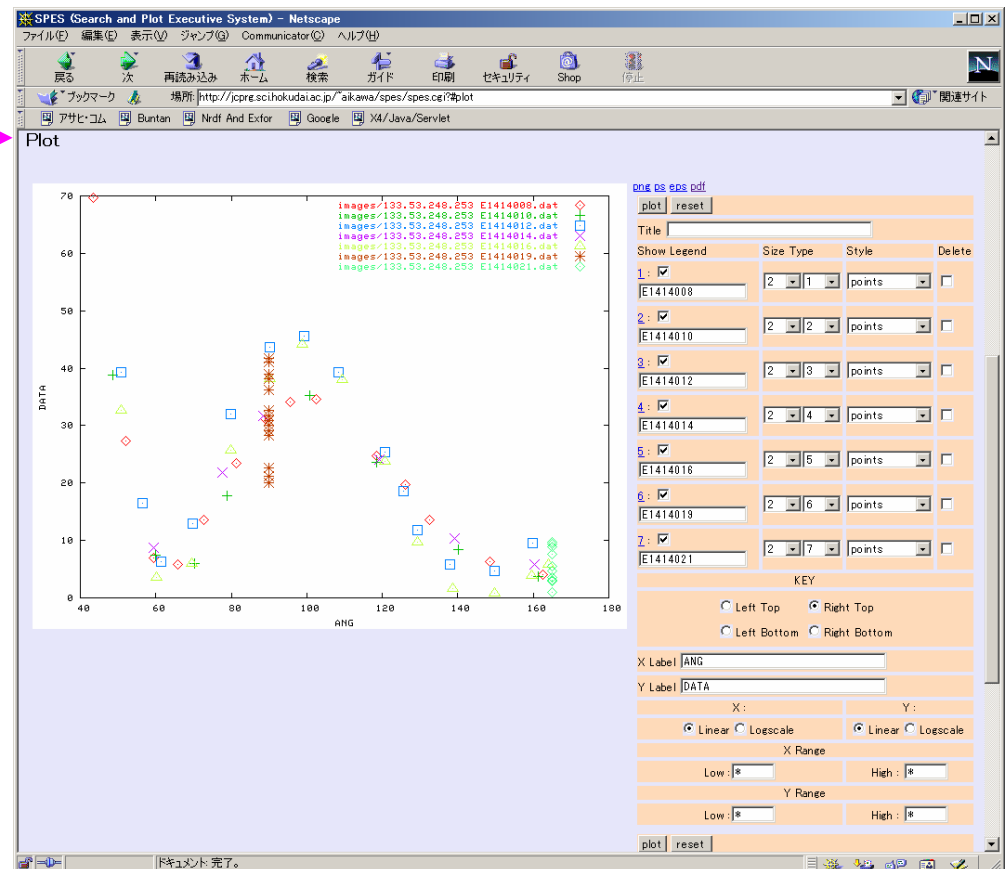
Benchmark Test

Completed

Prototype

Discussing

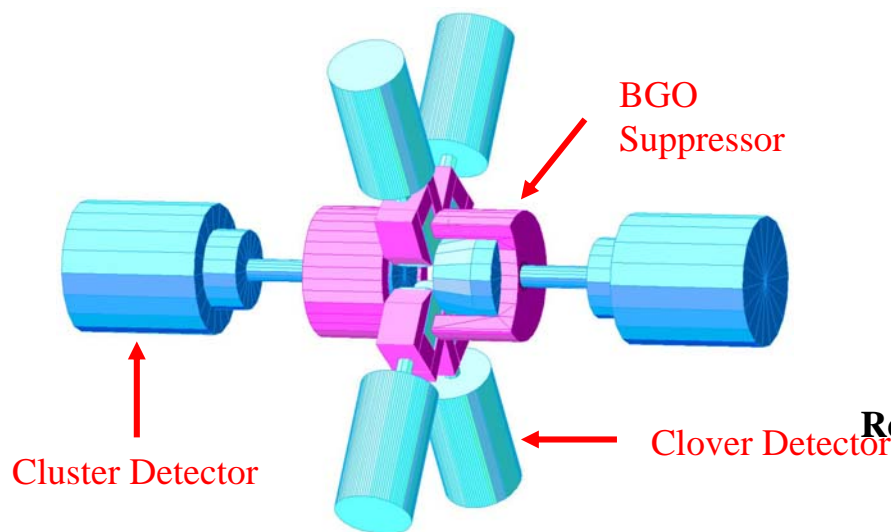
Retrieval and Plotting





Development of Detector System

Newly developed Detector



Cluster Detectors: 2

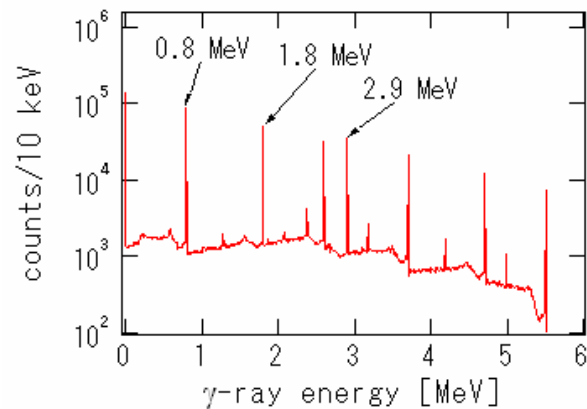
- 6 segments: 1
- Surrounding detectors: 6

Clover Detectors: 4

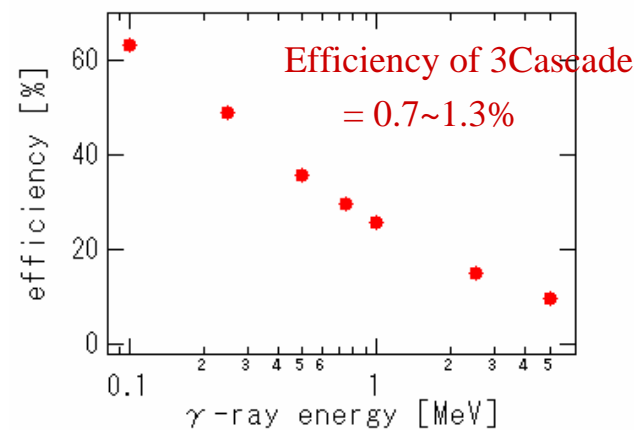
- 4 Crystal Cube Detectors: 4

BGO Compton Suppressor

Results of Simulation



Response functions for 3 Cascade γ rays (0.8-1.8-2.9 MeV)



Energy Dependence of Absolute Efficiency



Summary

- Organization of Japanese Nuclear Data Committee
- JENDL General Purpose File (JENDL-4)
- JENDL Special Purpose Files
 - High Energy File
 - Photonuclear Data File
 - PKA/KERMA and (α, n) Reaction Data Files
 - Actinide File
- 2003 Symposium on Nuclear Data
- Development of CONDUCT System