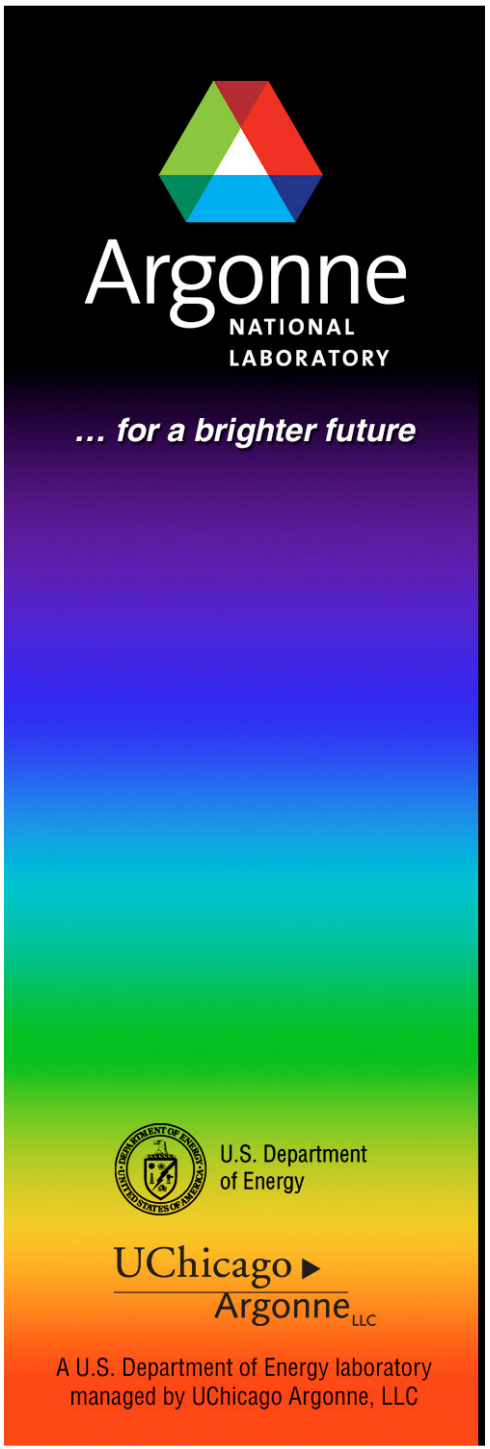

Status of ETOE-2/MC^2-2 Processing Code System

2008 CSEWG Meeting
Brookhaven National Laboratory
November 5, 2008

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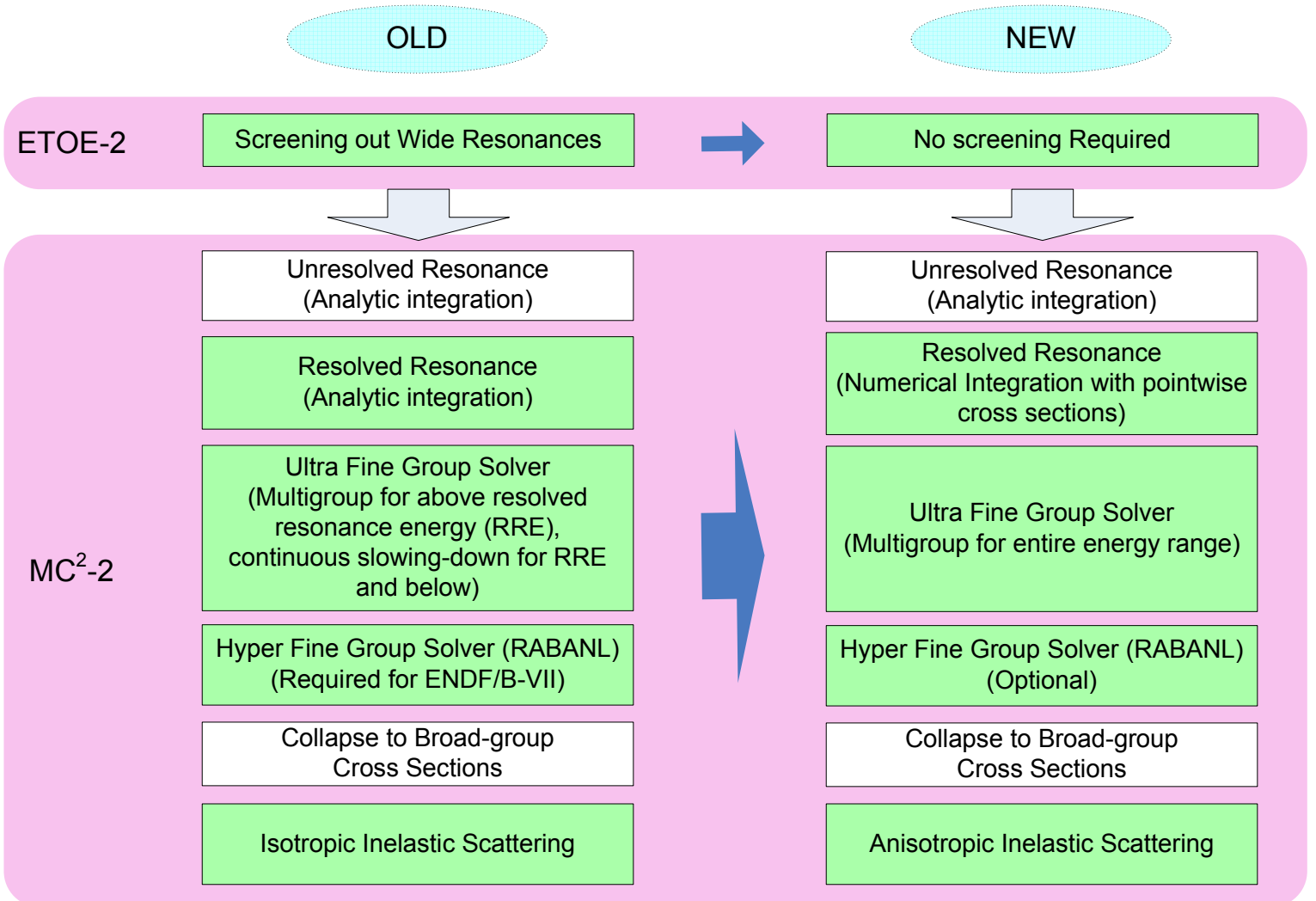
Improvements of ETOE-2/MC²-2

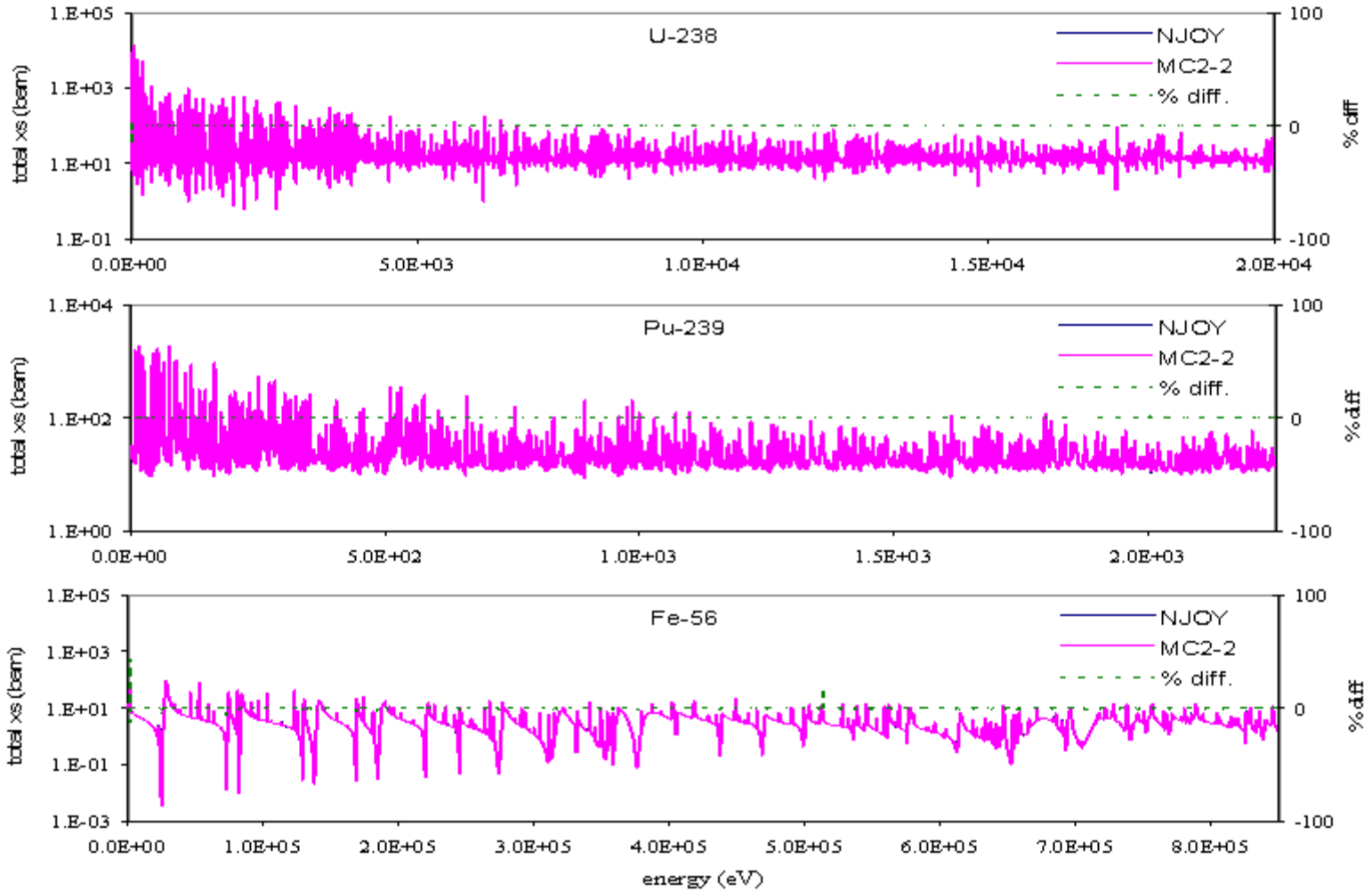
- **Update ETOE-2 to process ENDF/B-VII data**
  - Completed processing of ENDF/B-VII.0 data for all major actinides, intermediate, and light isotopes

- **Update MC²-2 to improve accuracy**
  - Ultra-fine-group spectrum calculation
    - *Consistent P_1 multi-group calculation for the entire energy region*
    - *No continuous slowing-down calculation for resolved resonance region*
  - Resolved resonance treatment for self-shielded UFG cross section generation
    - *Numerical integration of point-wise cross sections*
    - *Eliminate the resonance tailing effects of the previous generalized resonance integral approach*
    - *Eliminate the need to screen out wide resonances in ETOE-2*
  - Addition of anisotrpic inelastic scattering treatment
    - *Anisotropic inelastic scattering transfer matrices produced with NJOY*

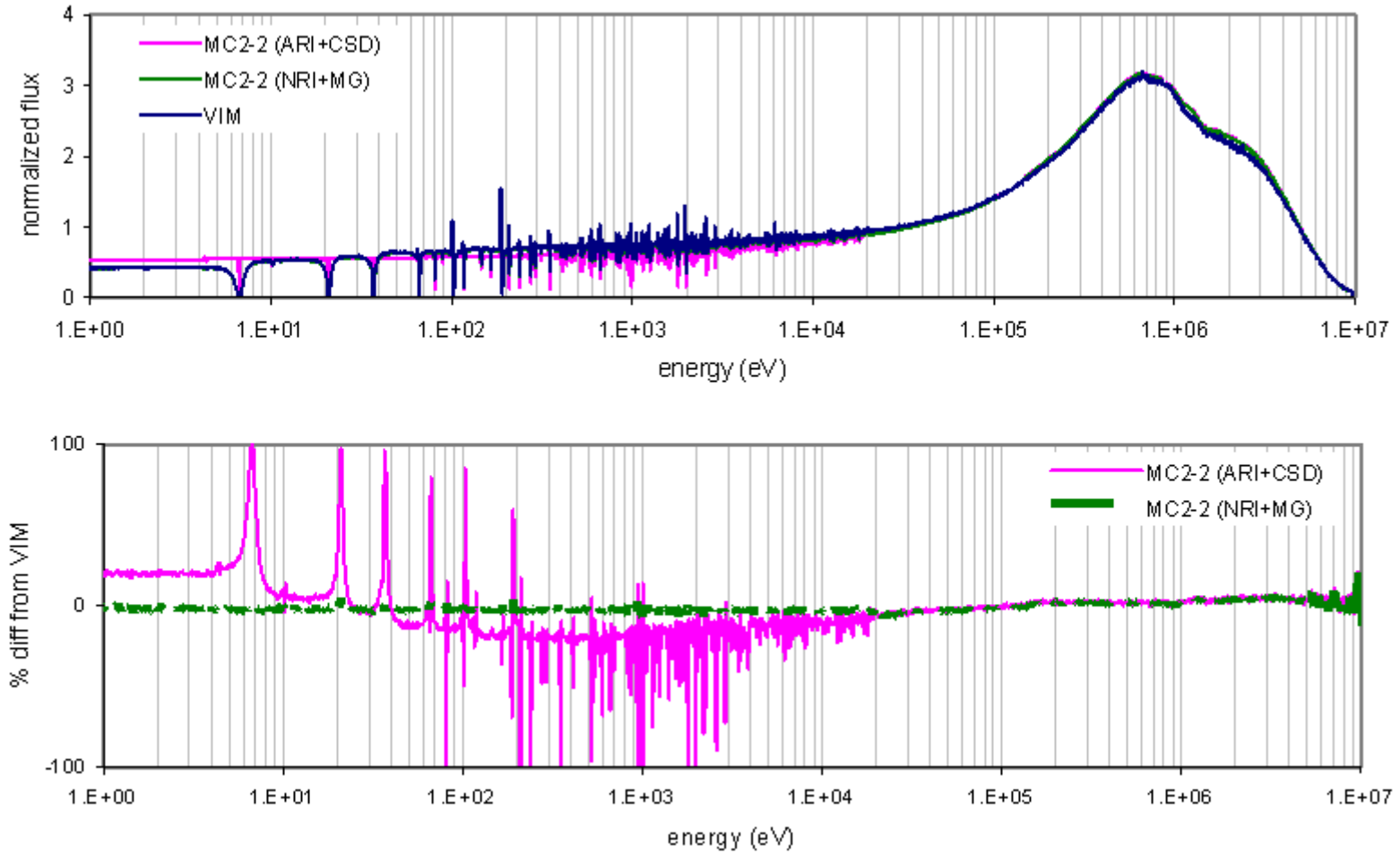
New Procedure for Multigroup Cross Section Generation



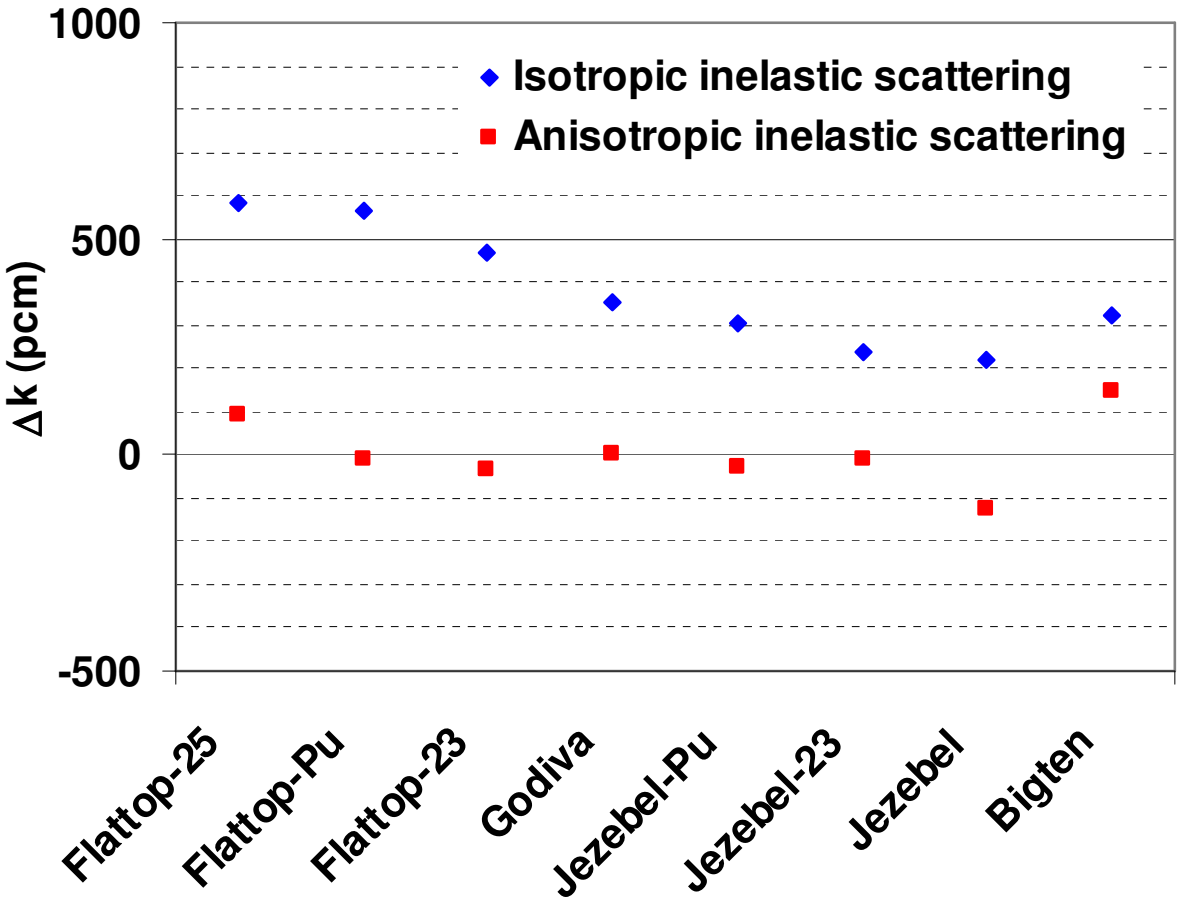
Reconstruction of Pointwise Cross Sections for Numerical Integration (ENDF/B-VII.0)



Spectrum of U-238 and Hydrogen Mixture



LANL Critical Assemblies

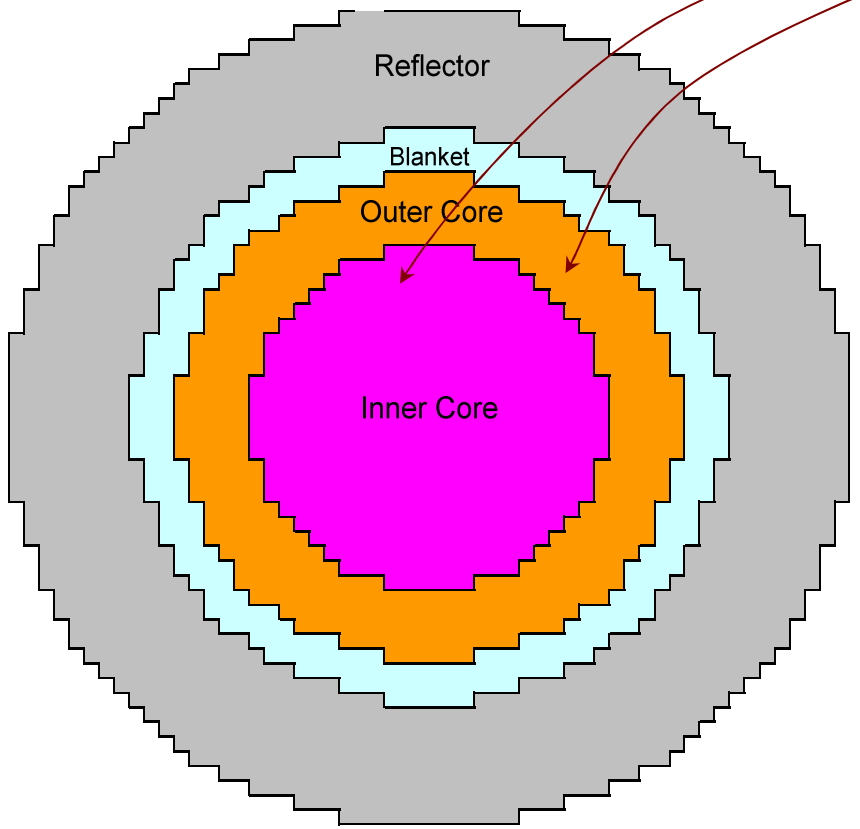


- Multiplication factors are in an excellent agreement within 0.15% Δρ by taking into account the anisotropy of inelastic scattering

ZPR-6 Assembly 6A

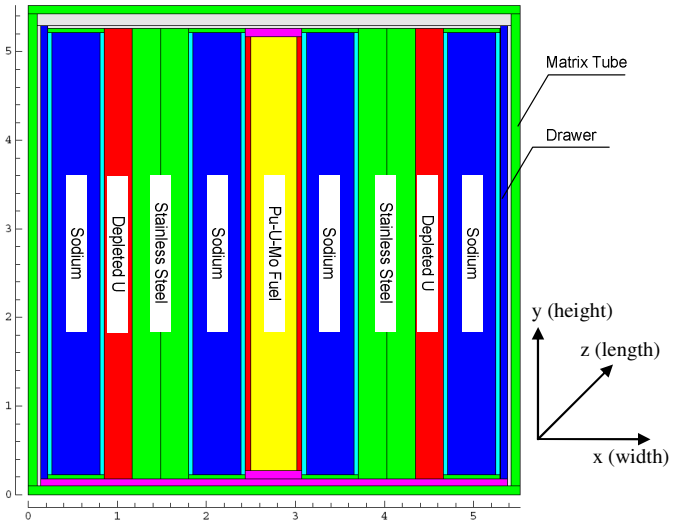
Region	VIM	MC^2-2 (RABANL+CSD) Δk, pcm	MC^2-2 (NRI+MG) Δk, pcm
Inner Core	1.22945 ±0.00038	162	7
Outer Core	1.22482 ±0.00048	122	-31
Radial Blanket	0.33513 ±0.00043	-20	-59
Axial Blanket	0.33215 ±0.00048	17	-22
Core	**0.99609 ±0.00036**	**100**	**33**

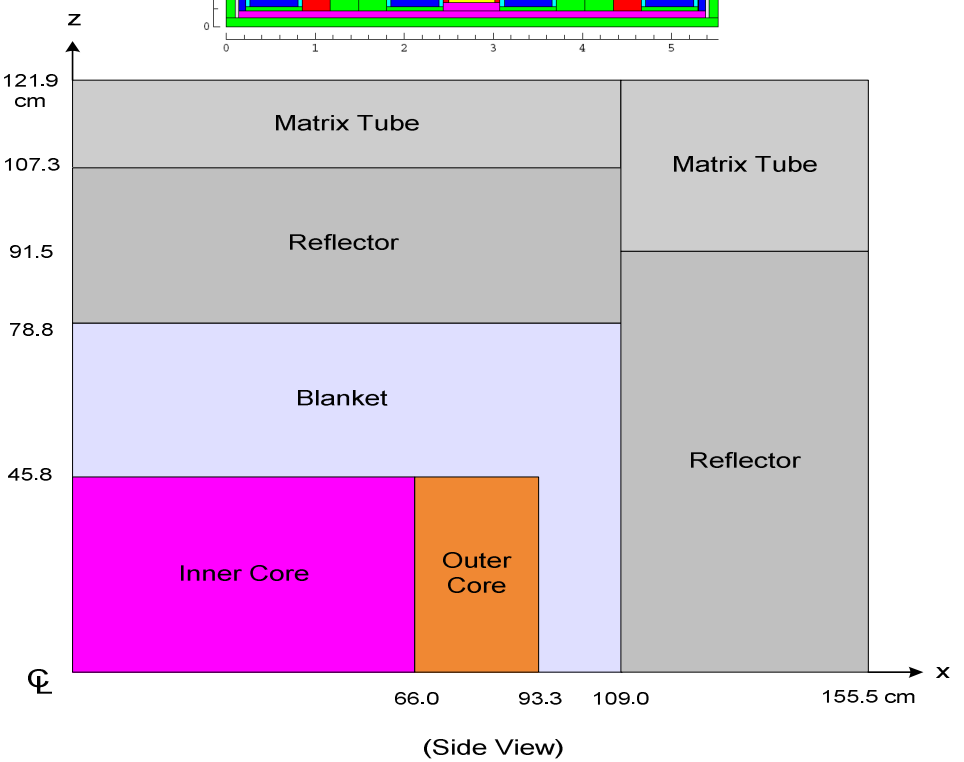
ZPPR-15 Phase A



(Top View)

Unit Cell





(Side View)

ZPPR-15 Critical Experiments

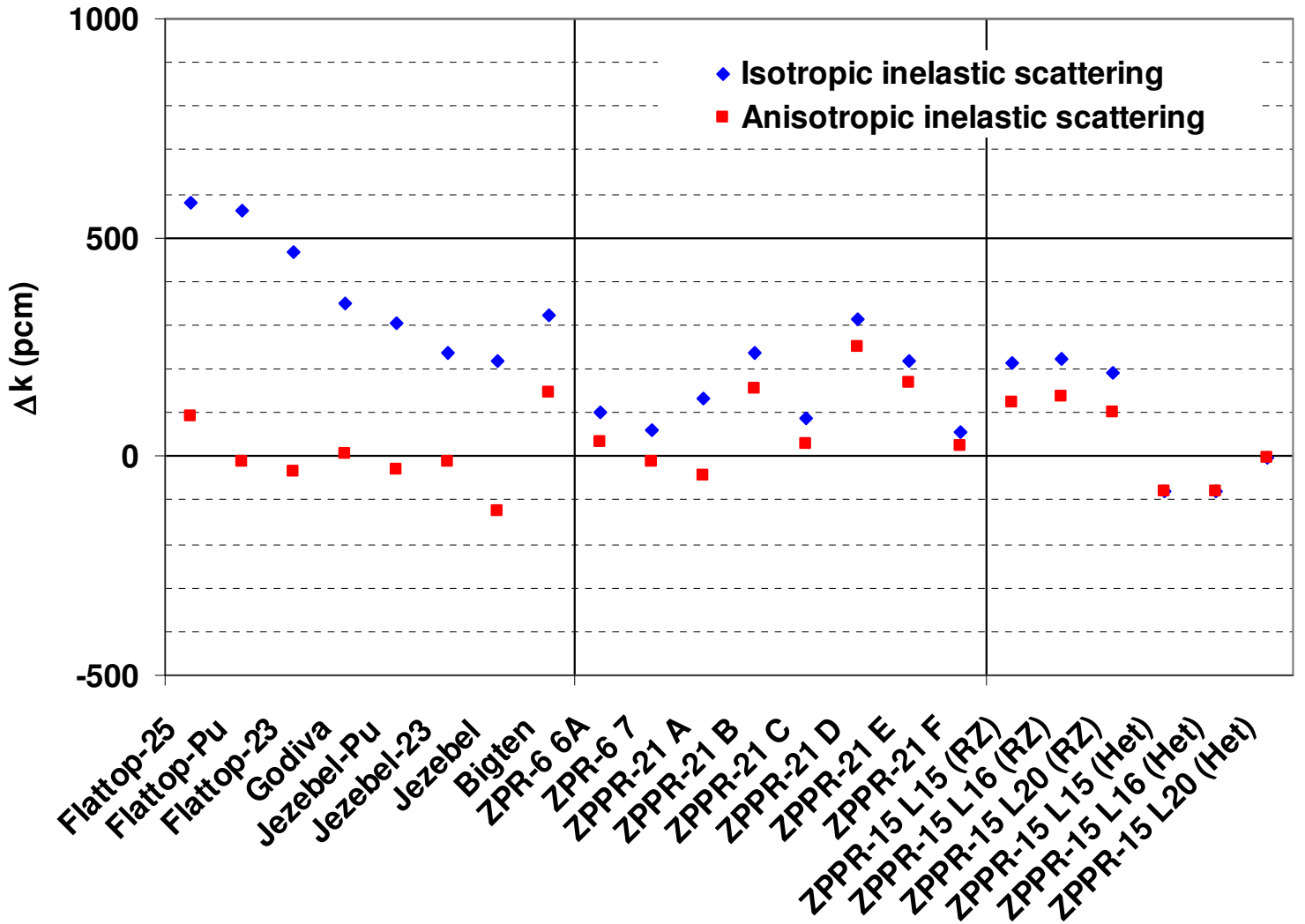
- **Three loading configurations of ZPPR-15 Phase A were analyzed**
  - Loading 15: initial criticality
  - Loading 16: a reference configuration for sodium void worth measurement
  - Loading 20: a configuration with an 18” sodium void in part of inner core

- **Heterogeneous X-Y-Z Model**

				VIM - Exp		DIF3D - VIM
Data	Configuration	Experiment	VIM	Δk, pcm	DIF3D	Δk, pcm
ENDF/B-V.2	L15	1.00046	0.99647	-399	0.99525	-122
	L16	0.99627	0.99200	-427	0.99104	-96
	L20	0.99853	0.99529	-324	0.99428	-101
	Void Worth (pcm)	226	329		324	
ENDF/B-VII.0	L15	1.00046	0.99985	-61	0.99905	-80
	L16	0.99627	0.99571	-56	0.99489	-82
	L20	0.99853	0.99742	-111	0.99741	-1
	Void Worth (pcm)	226	171		252	

* Standard deviations of Experiment and VIM $\leq$ 0.00021

MC^2-2/TWODANT vs. Monte Carlo Results



Summary

- ETOE-2/MC^2-2 were updated to process ENDF/B-VII.0 data
- MC^2-2 has been upgrade for improved modeling
  - Numerical integration of resolved resonances
  - Consistent P_1 multi-group calculation for the entire energy region
  - Anisotropic inelastic scattering
- Verification and validation analyses of LANL critical assemblies and ZPR-6/6A, ZPPR-15, and ZPPR-21 experiments showed very good agreement with Monte Carlo solutions

- Future work
  - Incorporation of anisotropic inelastic scattering treatment into MC^2-2
  - Generation of MC^2-2 libraries using NJOY (?)
  - Completion of rewriting MC^2-2 for coupling with the UNIC code within the SHARP framework