Data Evaluation at ORNL

Nuclear Data and Criticality Safety Group

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^{56}Fe Resonance Evaluation up to 2.0 MeV

- Motivation for evaluating ^{56}Fe in the resolved resonance Region;
- Evaluation description;
- Use RML option of the SAMMY code (R-matrix Limited Format);
- Experimental Data;
- Preliminary results;

Motivation for evaluating ^{56}Fe in the Resolved Resonance Region

- New high resolution transmission measurements done at the RPI extending the resonance region up to 5 MeV;
- New inelastic cross-section measurements done at GEEL;
- Use the SAMMY/RML feature to include inelastic channel in the R-matrix analysis;
- Improve the results of benchmark systems calculations;

paradigm shift

Evaluation Features

- Extend the resolved resonance region from 850 keV to 2.0 MeV;
- Include new transmission measurements and inelastic cross section data
- Use the extended R-matrix formalism in the SAMMY code for fitting the experimental data
- Compare the cross section processed with SAMMY, NJOY, AMPX and PREPRO using the evaluated iron resonance parameters; (Thanks to Red Cullen and Bob MacFarlane for their effort)

Experimental Data for the n+^{56}Fe Interaction

Reference	Energy Range	Facility	TOF (meters)	Measurement
Harvey (1987)	20 keV – 2 MeV	ORELA	201.575	Transmission
Perey (1990)	120 keV – 850 keV	ORELA	201.575	Transmission
Cornelis (1982)	500 keV – 2 MeV	GELINA	387.713	Transmission
Danon (2012) (three thicknesses)	500 keV – 2 MeV	RPI	249.740	Transmission
Perey (1990)	850 keV – 1.5 MeV	ORELA	201.575	Inelastic
Plompen (2011)	850 keV – 2 MeV	GELINA	198.686	Inelastic
Spencer (1994)) (two thicknesses)	10 eV – 650 KeV	ORELA	40.0	Capture
Perey (1990)	850 keV – 1.5 MeV	ORELA	200.191	elastic
Cabé (1967)	500 keV – 1.2 MeV	Université de Louvain	~ 1	elastic
O.A.Shcherbakov (1977)	0.001 eV – 10 eV	TOF/Russia	9.5	Total
O.A.Shcherbakov (1977)	0.001 eV – 10 eV	TOF/Russia	9.5	Capture
RPI DD Xsec	800 keV – 2 MeV	RPI	30	Elastic/Inelastic
RPI	200 keV – 1.5 MeV	RPI	40.116	Capture

Thermal Cross Section

Coherent Scattering Length includes potential and resonance parts defined as

$$a_{coh} = a_{pot} + a_{res}$$ where

$$a_{pot} = \lim_{E \to 0} \left(\frac{\sigma_s}{4\pi} \right)^{1/2}$$ For T = 0 K

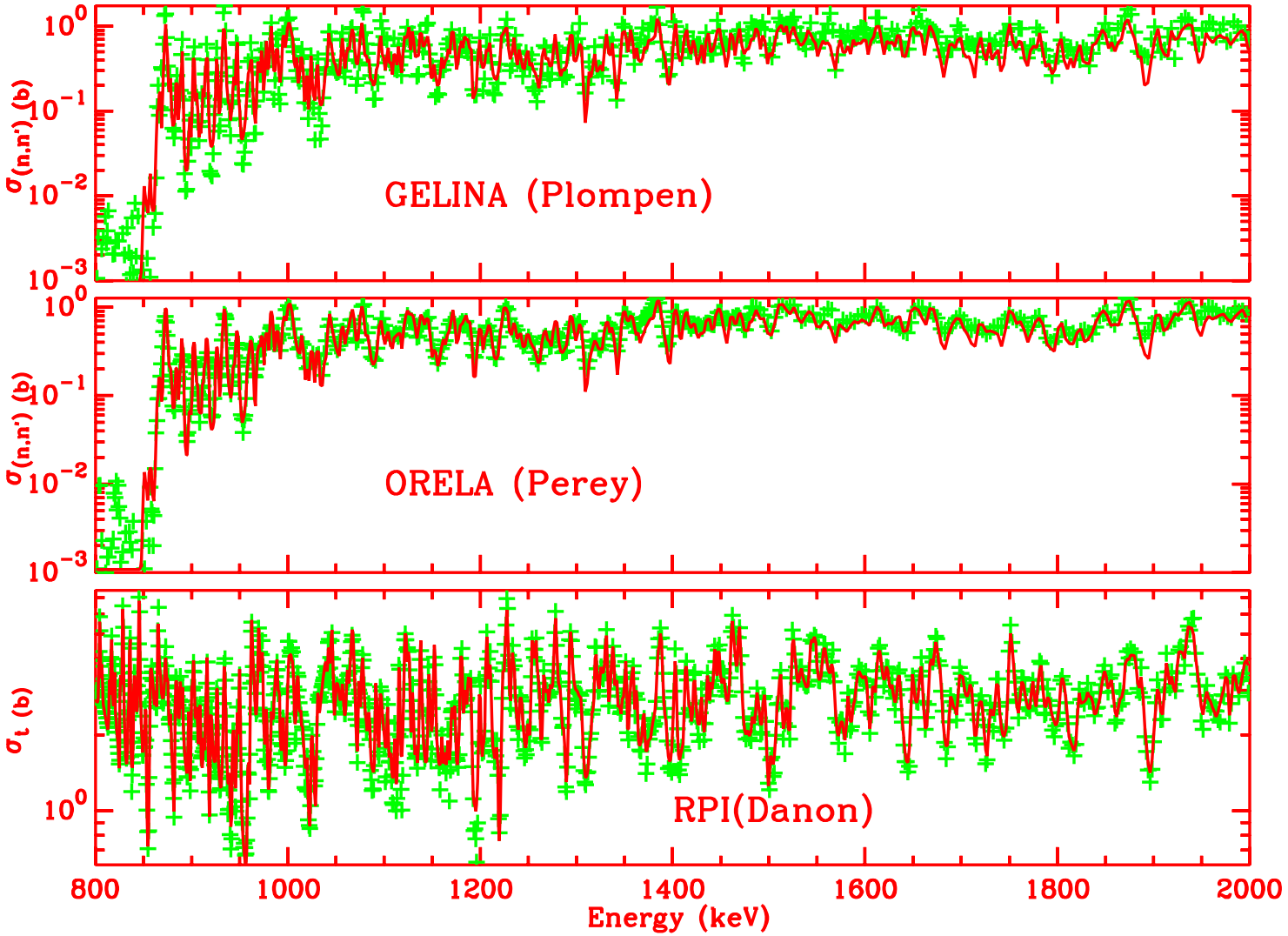
For s-wave based on the SLBW formalism

$$a_{res} = \sum_r \frac{\Gamma_n^r}{2k_r \left[(E - E_r) + \frac{i\Gamma}{2} \right]}$$

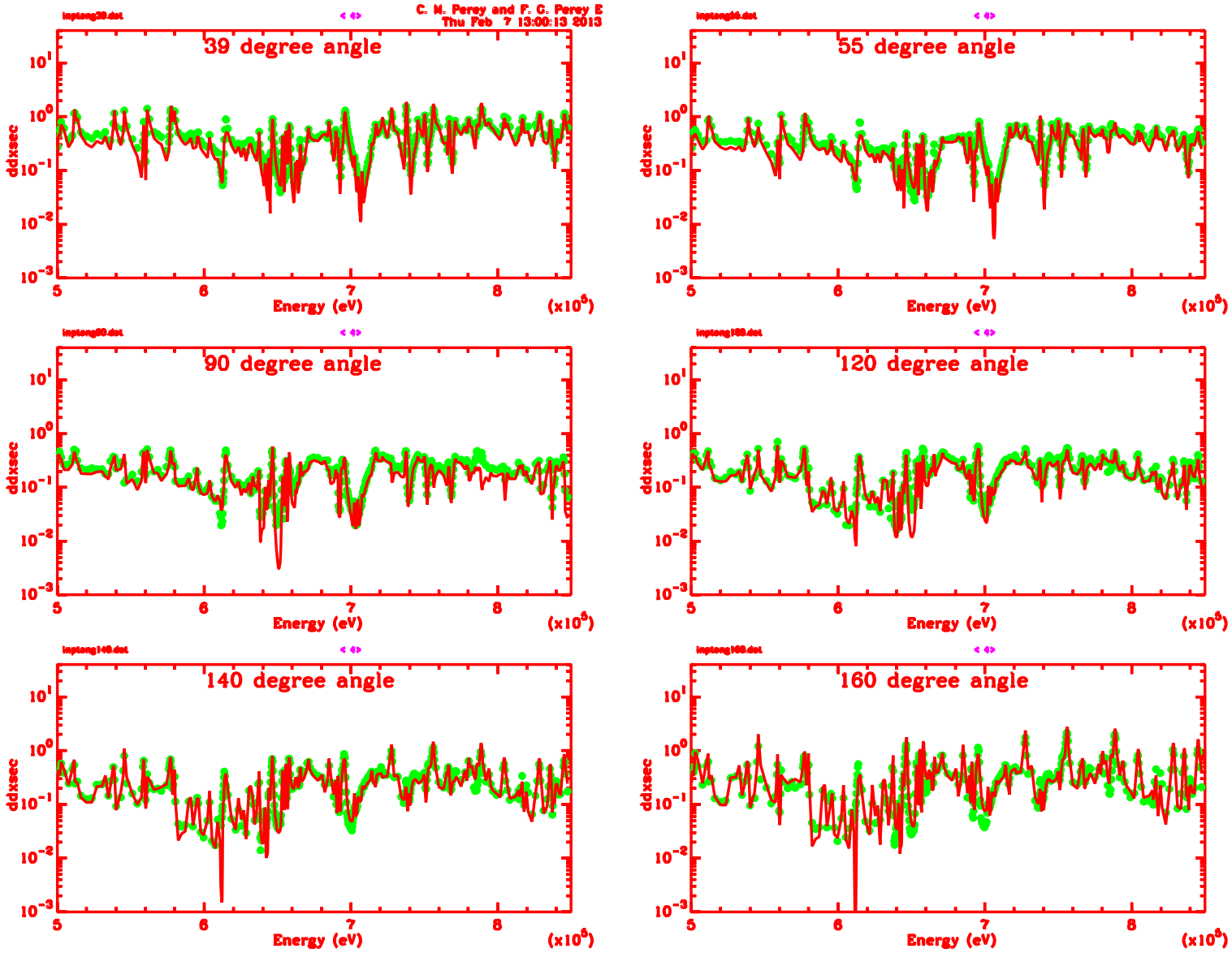
Thermal Cross Section

Cross section (barns)	This evaluation	Atlas
Capture	2.59 ± 0.21	2.59 ± 0.14
Scattering	12.77± 0.35	12.62 ± 0.49
Total	15.36 ± 0.48	15.21 ± 0.51*
Coherent scattering length (fm)		
b_n	10.07 ± 0.22	10.10 ± 0.20

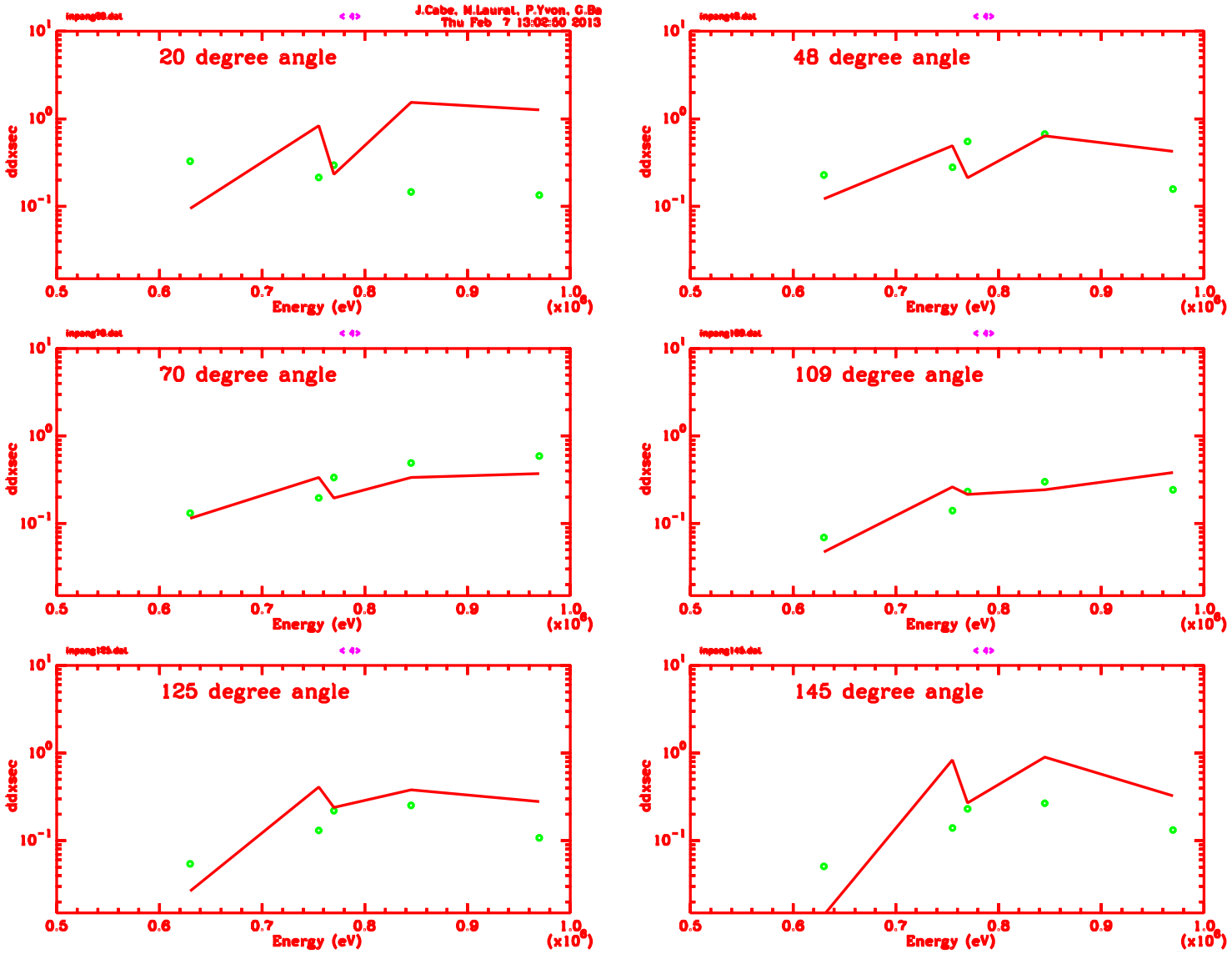
* Calculated value



Comparison of SAMMY predictions of Total and inelastic data.



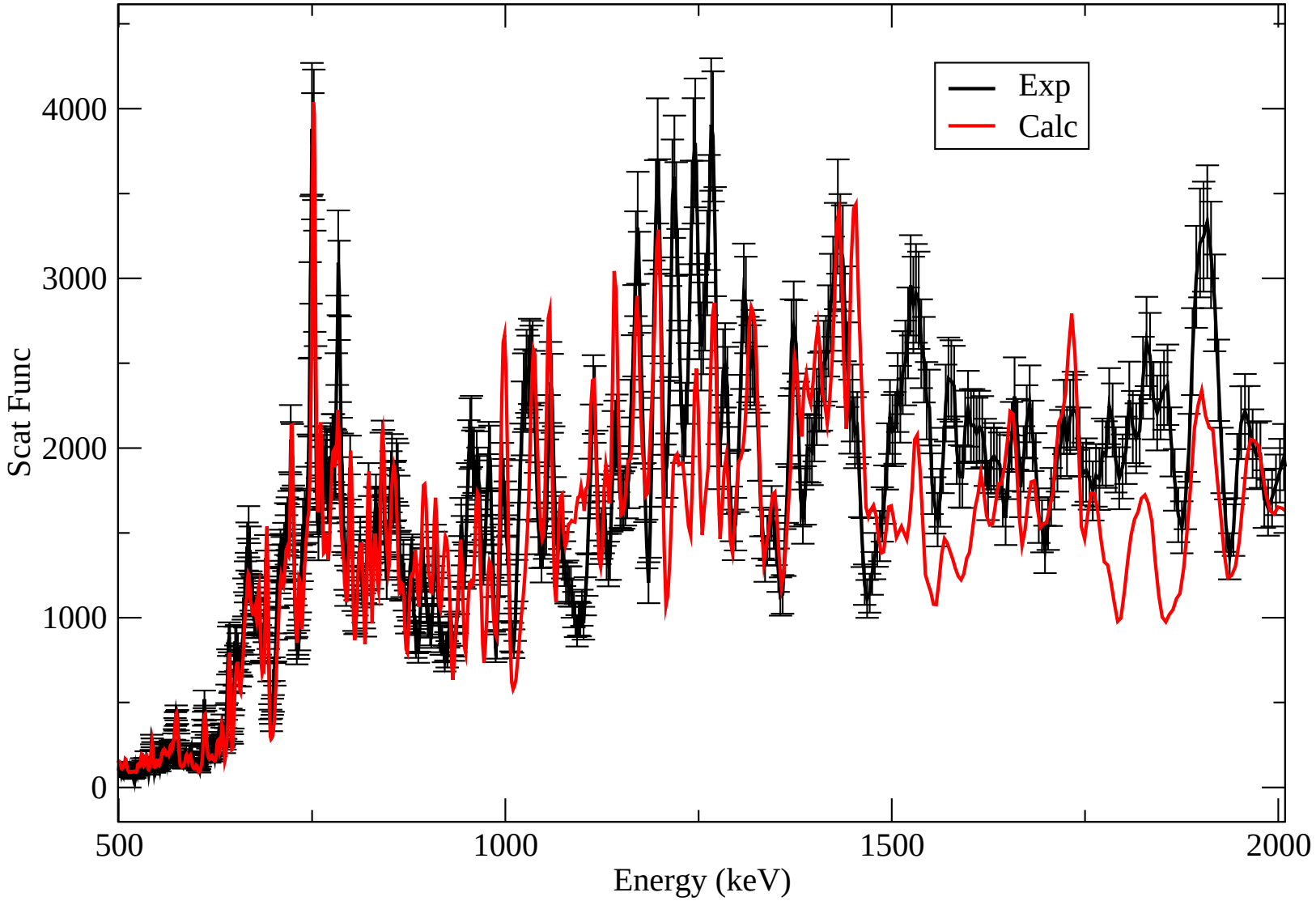
Comparison of SAMMY predictions to differential elastic data of Perey.



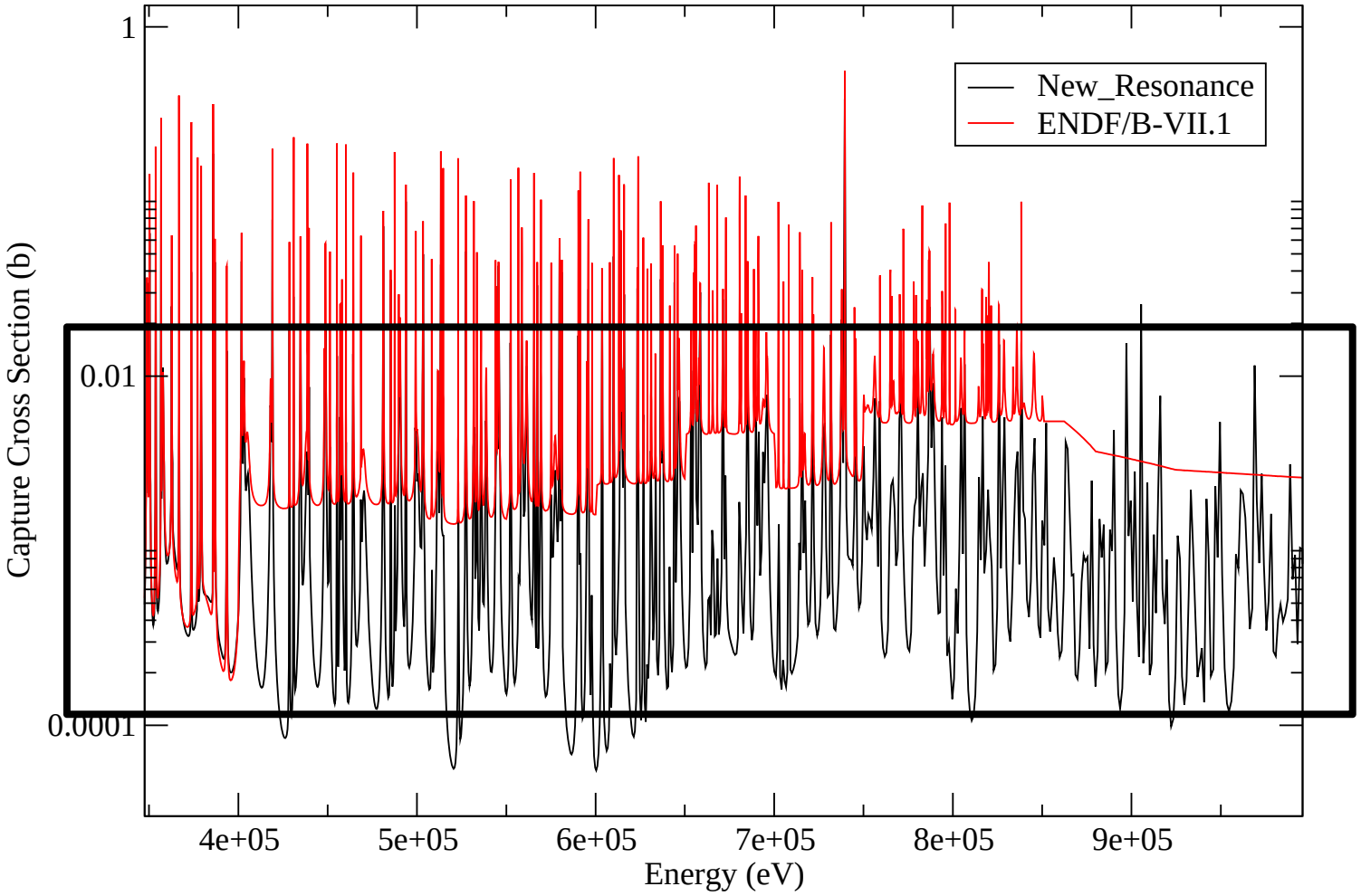
Comparison of SAMMY predictions to differential elastic data of Cabé .

SAMMY fitting or RPI Ang Data

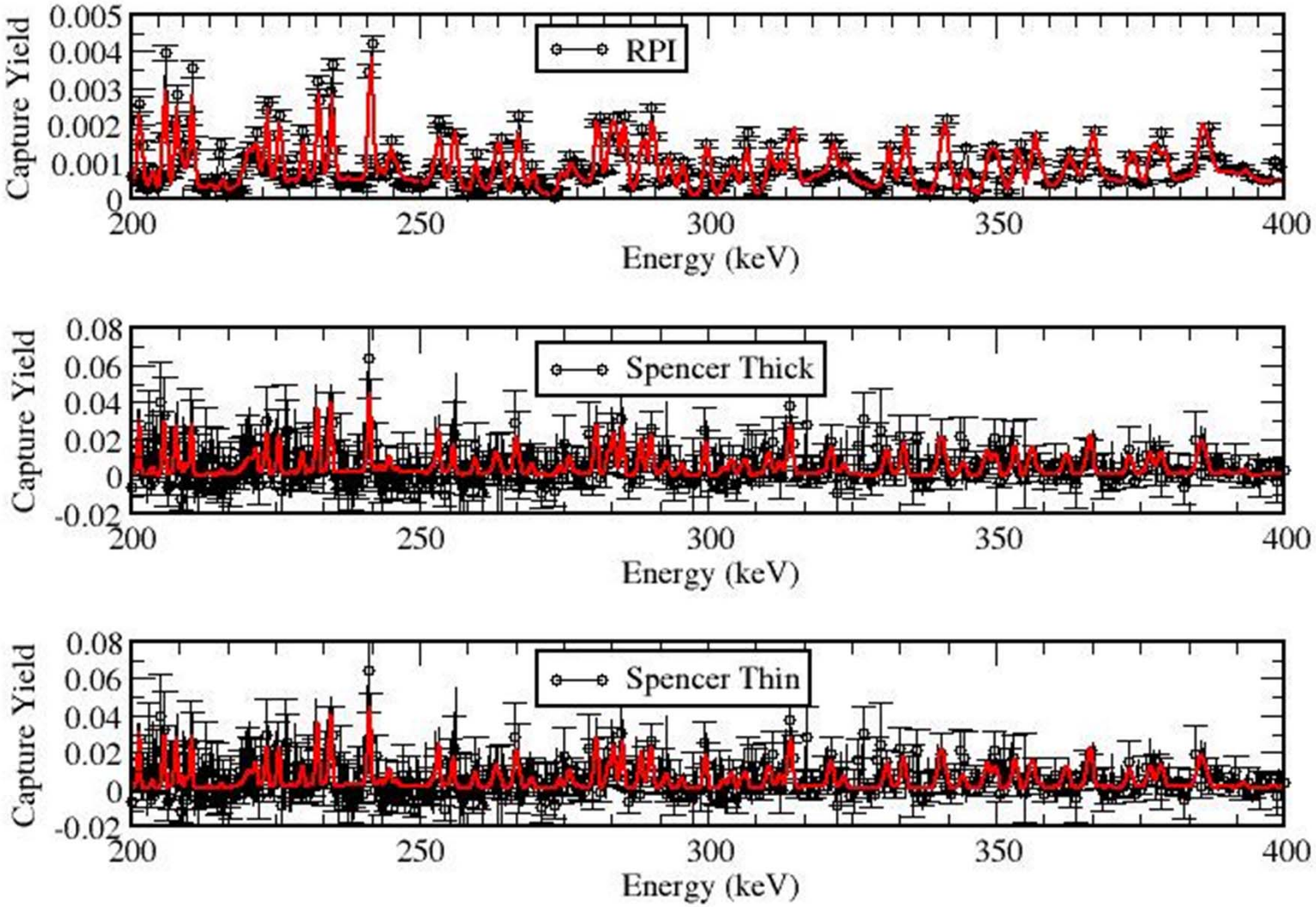
153 deg



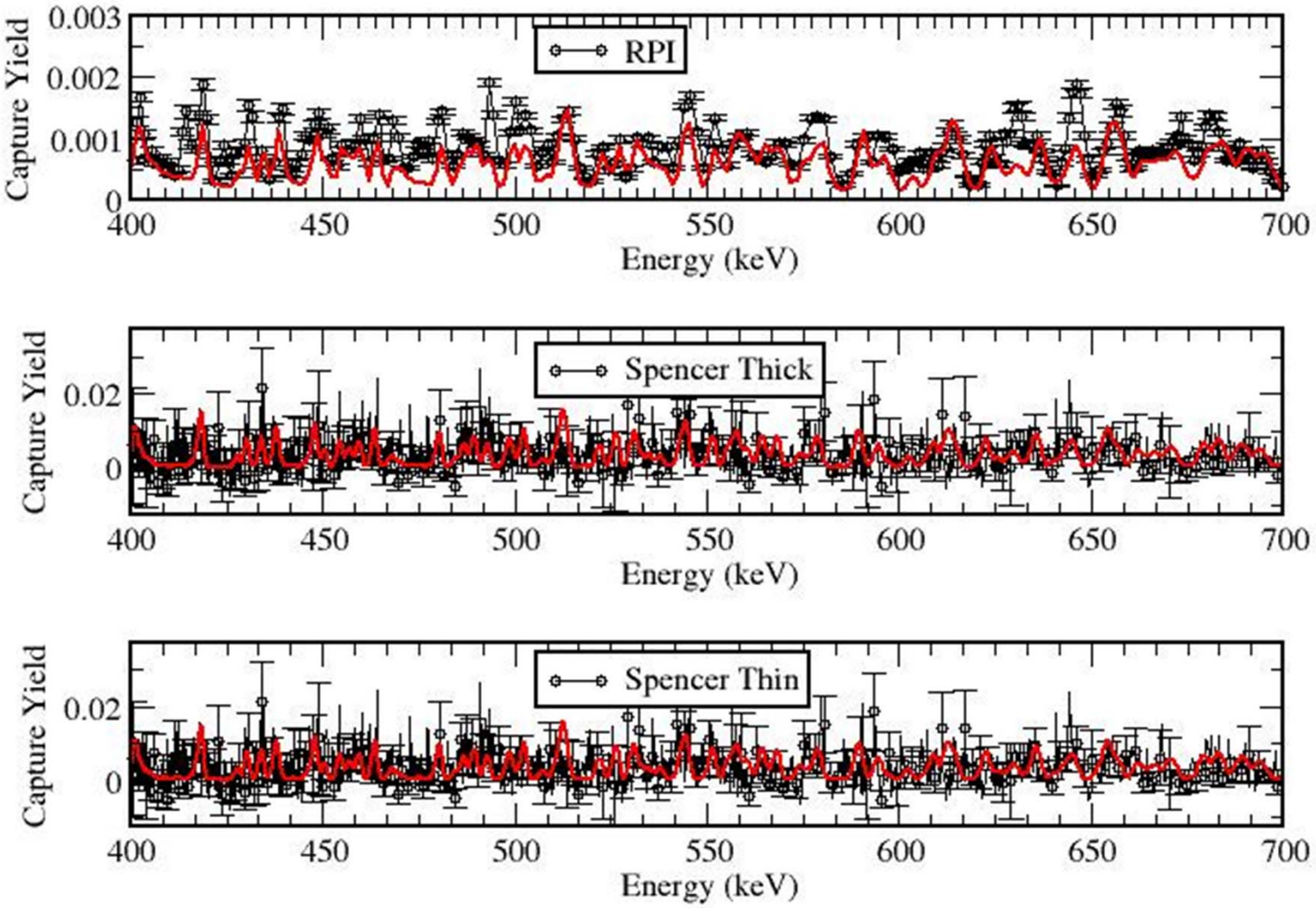
Issues with Fe-56 capture cross-section



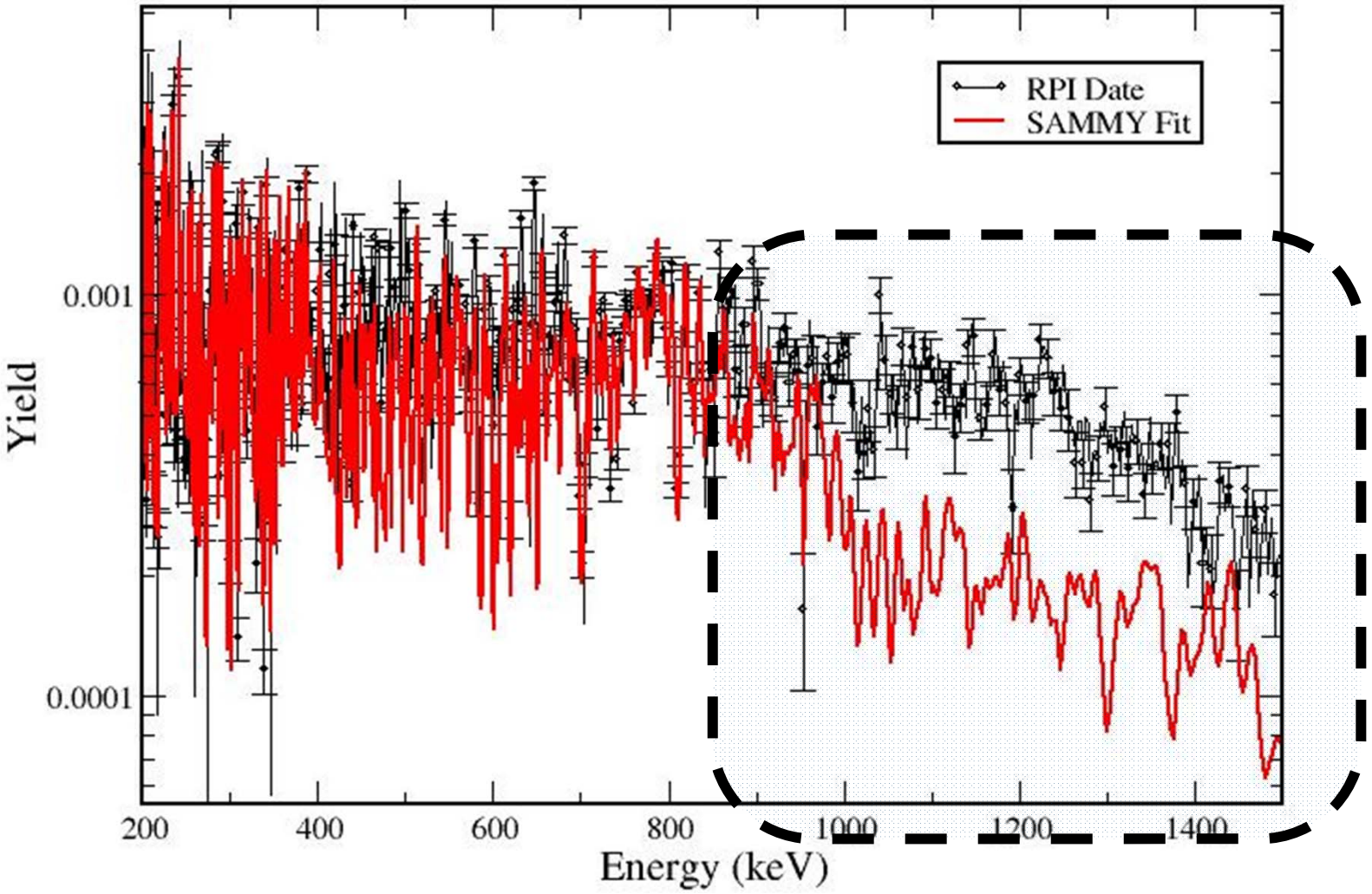
^{56}Fe capture cross-section data of Spencer and RPI



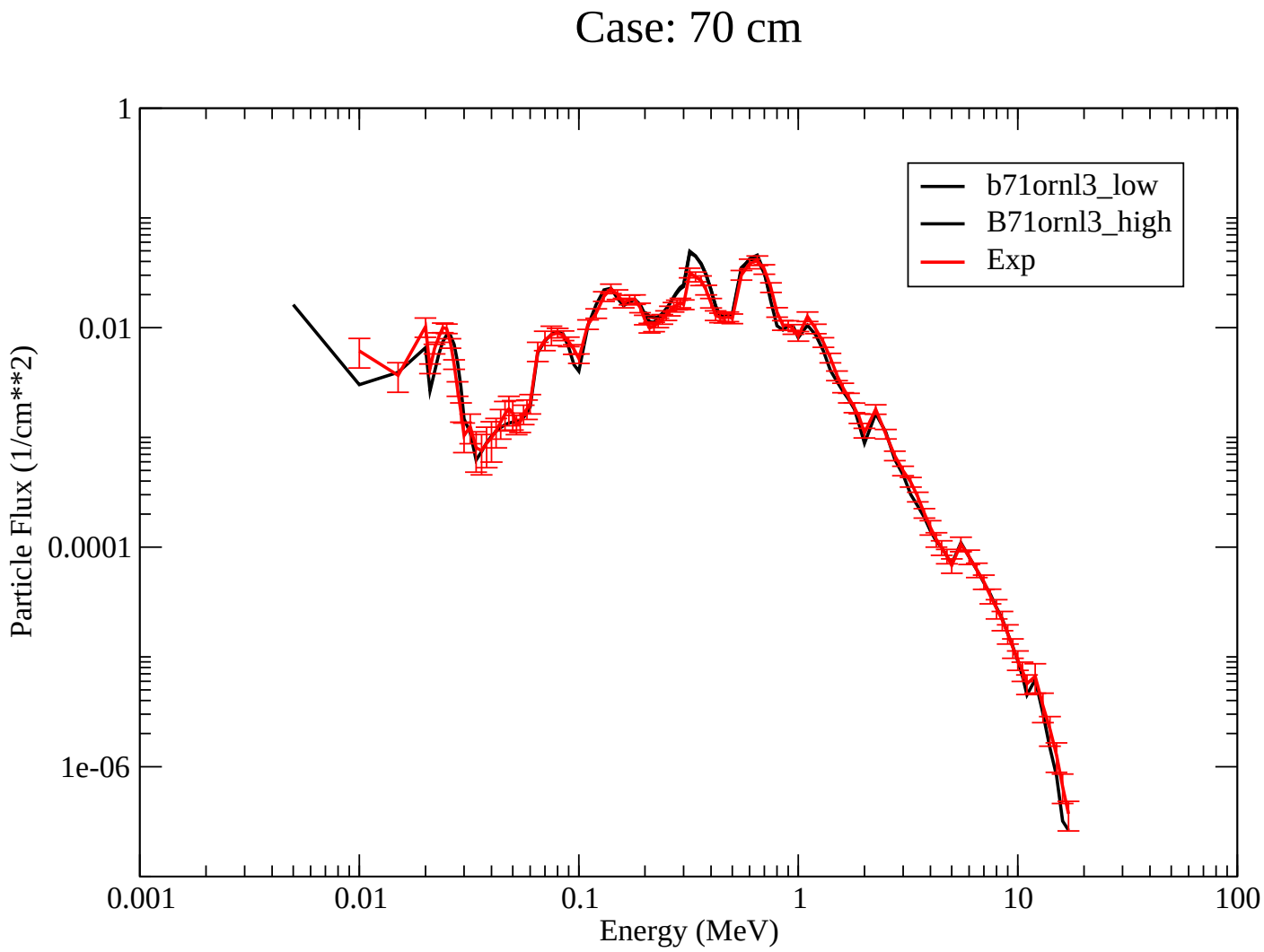
^{56}Fe capture cross-section data of Spencer and RPI



^{56}Fe capture cross-section data of RPI



^{56}Fe Benchmark Calculations Performed at IRSN with the help of Evgeny Ivanov



Conclusion

- Issue with RPI capture above 900 keV;
- Good representation of capture data up 650 keV;
- Angular data well fitted up to 1 MeV
- Continue work to improve angular representation of RPI elastic and inelastic data above 1 MeV;
- Deliver evaluation by November 2015;