^{56}Fe Resonance Evaluation

Working Party on International Nuclear Data Evaluation Co-operation (WPEC)
NEA Headquarters, May 24-25

Outline

- Motivation for re-evaluating ^{56}Fe in the resolved resonance Region;
- New evaluation description;
- Use RML option of the code SAMMY
- Experimental Data;
- Preliminary results;
- Concluding remarks;

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 (Danon);
- New inelastic cross section measurements done at GEEL (Plompen);
- Use the SAMMY/RML feature to include inelastic channel in the R-matrix analysis;
- Improve benchmark results for Iron benchmark calculations;

New Evaluation Features

- Extend the resolved resonance region from 850 keV to 2 MeV;
- Include new transmission and inelastic cross section data;
- Use the extended R-matrix formalism in the SAMMY code for fitting the experimental data (RML);
- Compare the cross section processed with SAMMY, NJOY, AMPX and PREPRO;

EXPERIMENTAL DATA

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	200.0	Inelastic
Spencer (1994)	10 eV – 650 KeV	ORELA	40.0	Capture

Fe-56

Elastic Channel

Name=N+56Fe   Pa=neutron

Pb=56Fe   Zb= 26   Mb= 55.935000   Sb= 0.0+

Inelastic Channel

Name=N+56Fe 1 Pa=neutron

Pb=L1_56Fe   Zb= 26   Mb= 55.935000   Sb= 2.0+

Threshold energy=   846753.00

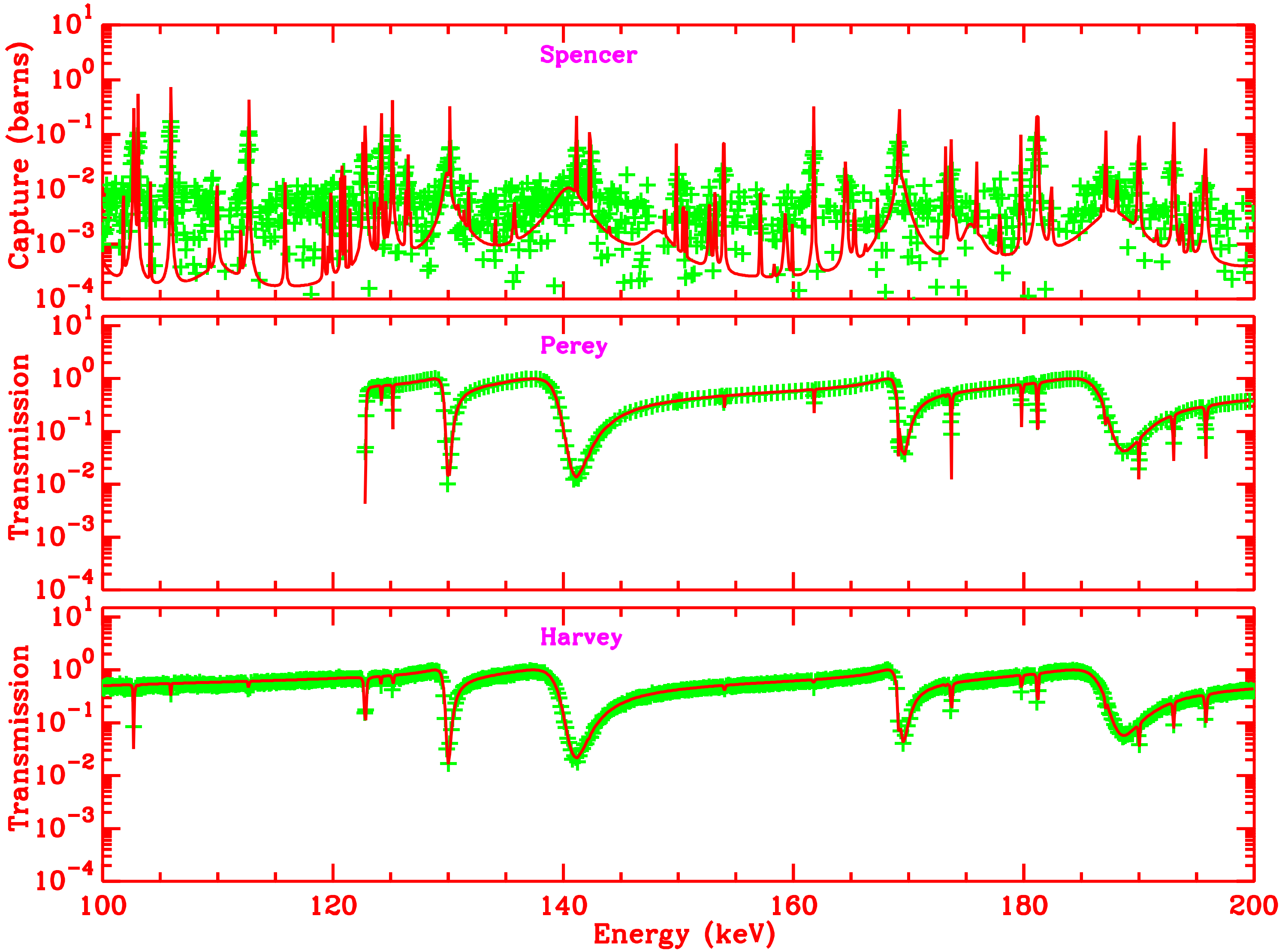
Fe-56

1	1	2	0.5	1.000000	56Fe
1	N+56Fe	0	0.5		elastic
2	N+56Fe 1	2	1.5		inelast 1
3	N+56Fe 1	2	2.5		inelast 1
2	1	2	-0.5	1.000000	56Fe
1	N+56Fe	1	0.5		elastic
2	N+56Fe 1	1	1.5		inelast 1
3	N+56Fe 1	3	2.5		inelast 1
3	1	4	-1.5	1.000000	56Fe
1	N+56Fe	1	0.5		elastic
2	N+56Fe 1	1	1.5		inelast 1
3	N+56Fe 1	1	2.5		inelast 1
4	N+56Fe 1	3	1.5		inelast 1
5	N+56Fe 1	3	2.5		inelast 1
4	1	3	1.5	1.000000	56Fe
1	N+56Fe	2	0.5		elastic
2	N+56Fe 1	0	1.5		inelast 1
3	N+56Fe 1	2	1.5		inelast 1
4	N+56Fe 1	2	2.5		inelast 1
5	1	3	2.5	1.000000	56Fe
1	N+56Fe	2	0.5		elastic
2	N+56Fe 1	0	2.5		inelast 1
3	N+56Fe 1	2	1.5		inelast 1
4	N+56Fe 1	2	2.5		inelast 1
6	1	4	-2.5	1.000000	56Fe
1	N+56Fe	3	0.5		elastic
2	N+56Fe 1	1	1.5		inelast 1
3	N+56Fe 1	1	2.5		inelast 1
4	N+56Fe 1	3	1.5		inelast 1
5	N+56Fe 1	3	2.5		inelast 1
7	1	3	-3.5	1.000000	56Fe
1	N+56Fe	3	0.5		elastic
2	N+56Fe 1	1	2.5		inelast 1
3	N+56Fe 1	3	1.5		inelast 1
4	N+56Fe 1	3	2.5		inelast 1

Ex: One elastic channel
Four Inelastic channels

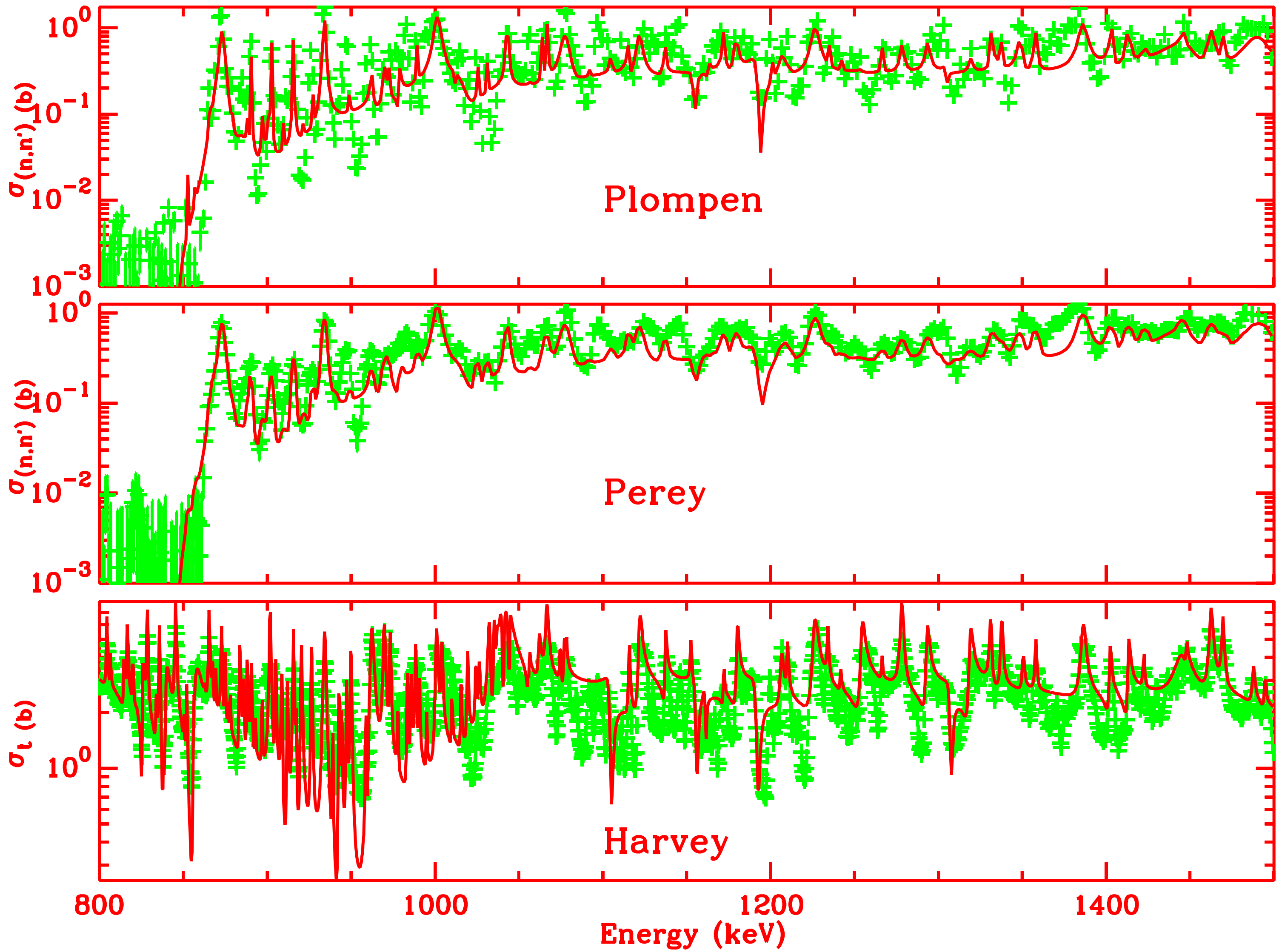
3	1	4	-1.5	1.000000	56Fe
1	N+56Fe	1	0.5		elastic
2	N+56Fe 1	1	1.5		inelast 1
3	N+56Fe 1	1	2.5		inelast 1
4	N+56Fe 1	3	1.5		inelast 1
5	N+56Fe 1	3	2.5		inelast 1

SAMMY Fit to the Experimental Data

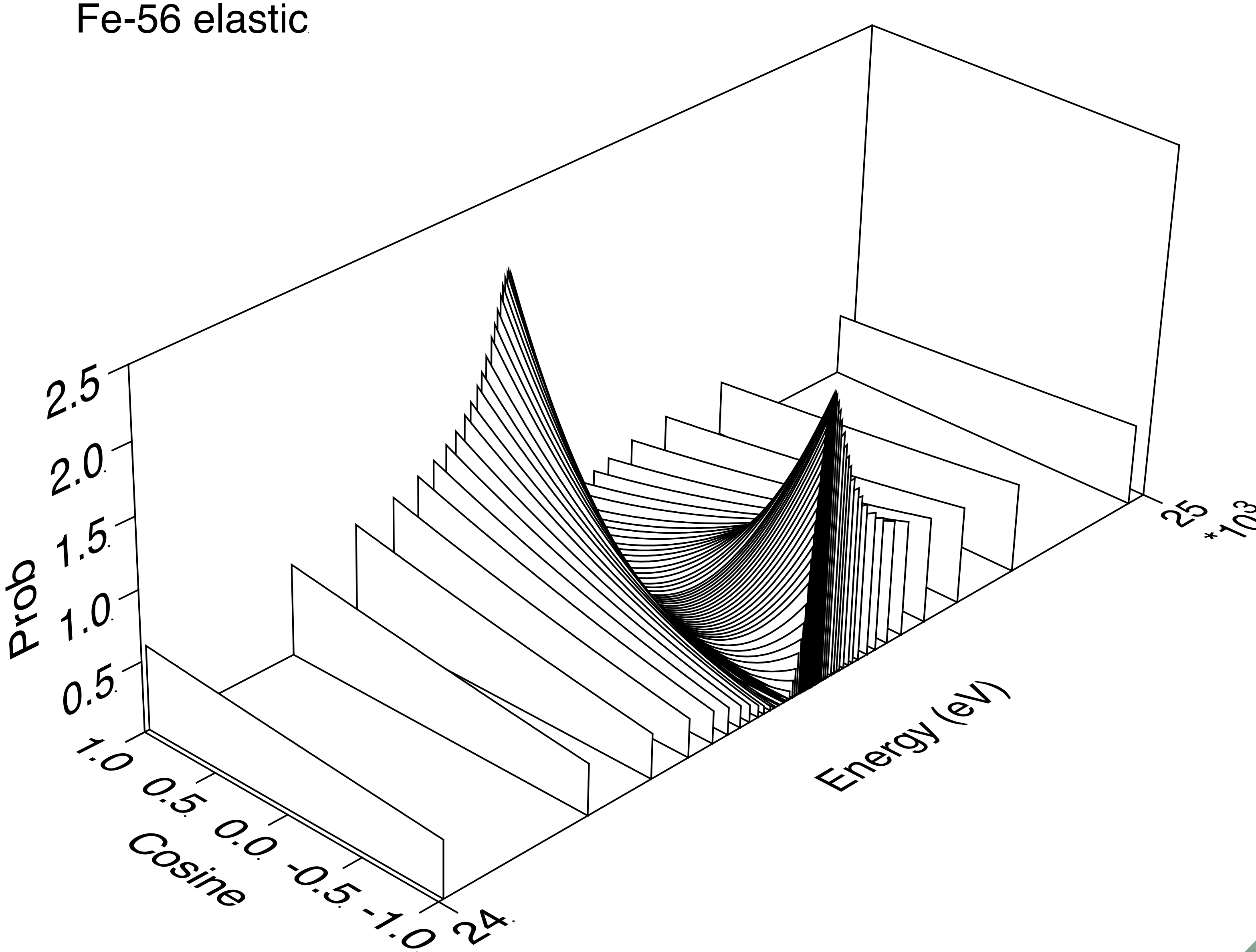


OAK RIDGE National Laboratory

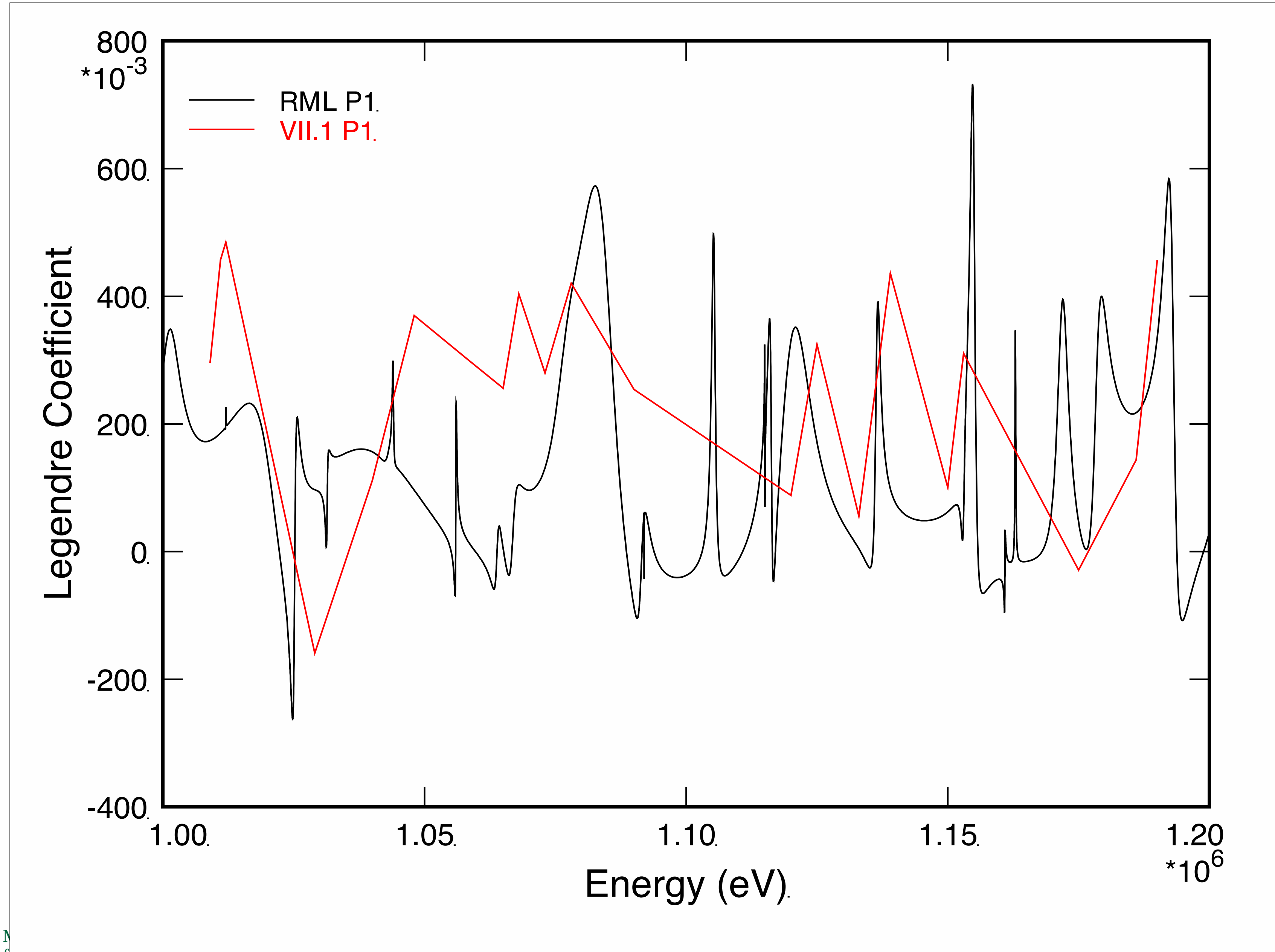
SAMMY Fit to the Experimental Data



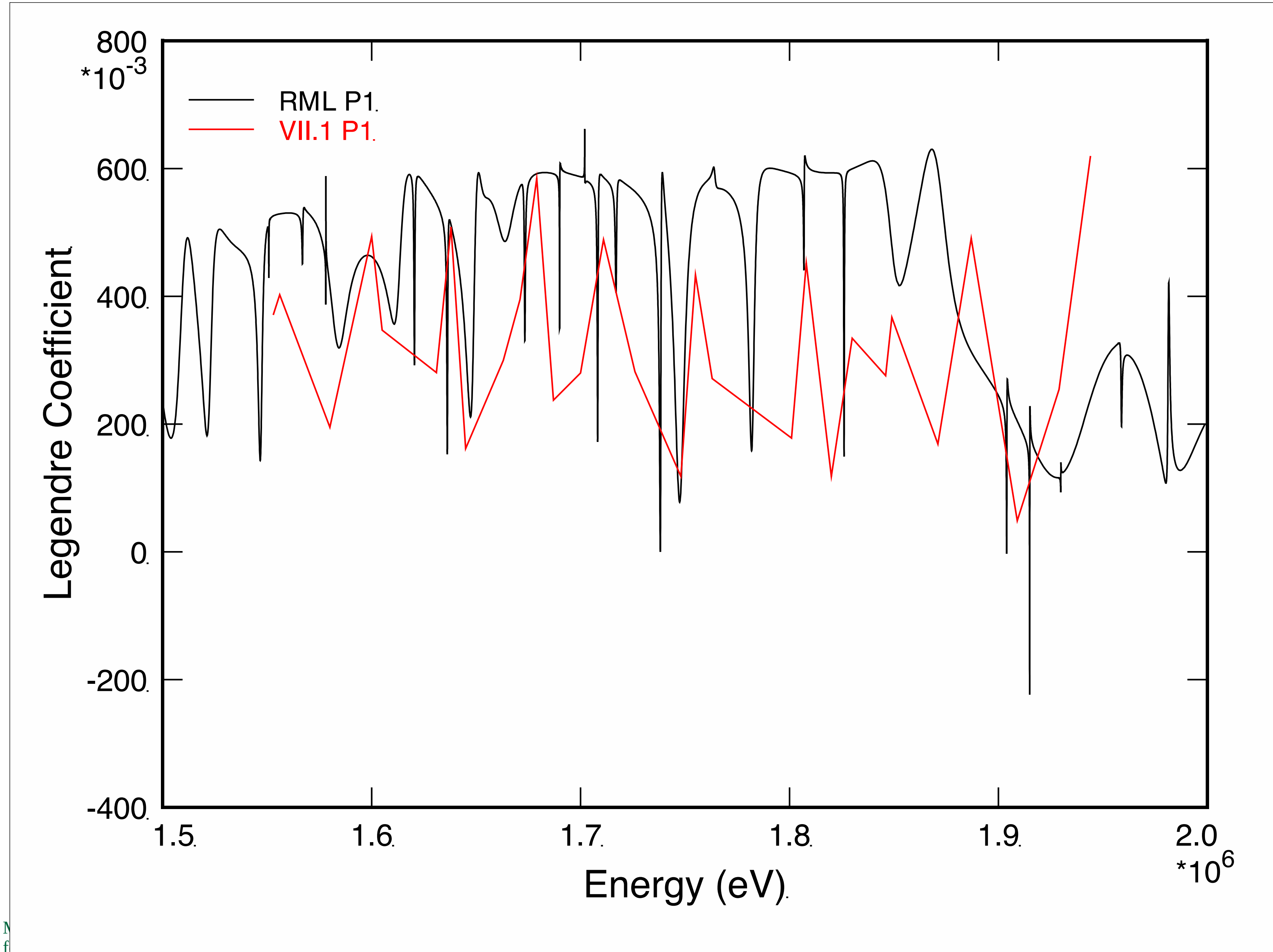
Angular Distribution (Bob MacFarlane)



Angular Distribution (Inelastic)



Angular Distribution (elastic)



Roadblocks and Findings

- Are there any good inelastic differential cross section measurements in the resonance region in EXFOR or the literature?
- Cross-checking the results of fitting codes such as SAMMY, CONRAD, REFIT for the energy and angular dependent inelastic cross section will be needed;
- Bob MacFarlane, Red Cullen, and Goran Arbanas have been working hard to get a good agreement on the processed cross section (energy and angle) using the extended R-Matrix formalism;
- Bob MacFarlane has made some benchmark calculations which demonstrate the sensitivity of keff on the detail of the angular distribution;
- Data uncertainty and covariance for resonance parameter with the extended R-Matrix may pose a challenge;