DATA EVALUATION

Nuclear Data Group
Nuclear Science and Technology Division
Oak Ridge National Laboratory

L. Leal, H. Derrien, G. Arbanas, N. Larson, and R. Sayer

CSEWG Meeting

November 6 - 8, 2006

^{239}Pu Resonance Parameters revisited

CURRENT EVALUATION released in 1993 (work performed at ORNL and JAERI from 1985 to 1993, Derrien, de Saussure, Nakagawa)

Three separated energy ranges: 0 to 1 keV

1 to 2 keV

2 to 2.5 keV

Resonance parameters covariance not available
Evaluation adopted for ENDF/B-VI, JEF, and JENDL

^{239}Pu Resonance Parameters revisited

- EVALUATION RESARTED at ORNL (Derrien, Leal, Larson, 2006) in order to obtain the resonance parameter covariance file in the energy range 0 to 2.5 keV

  Three energy ranges merged in a single range 0 to 2.5 keV

  Reevaluation of the external resonance parameters

  SAMMY analysis of an updated experimental data base

  Normalization of the fission cross section according to the 1990-1993 work of Weston (ORNL) and Wagemans (GELINA)

Results

- Thermal cross sections:

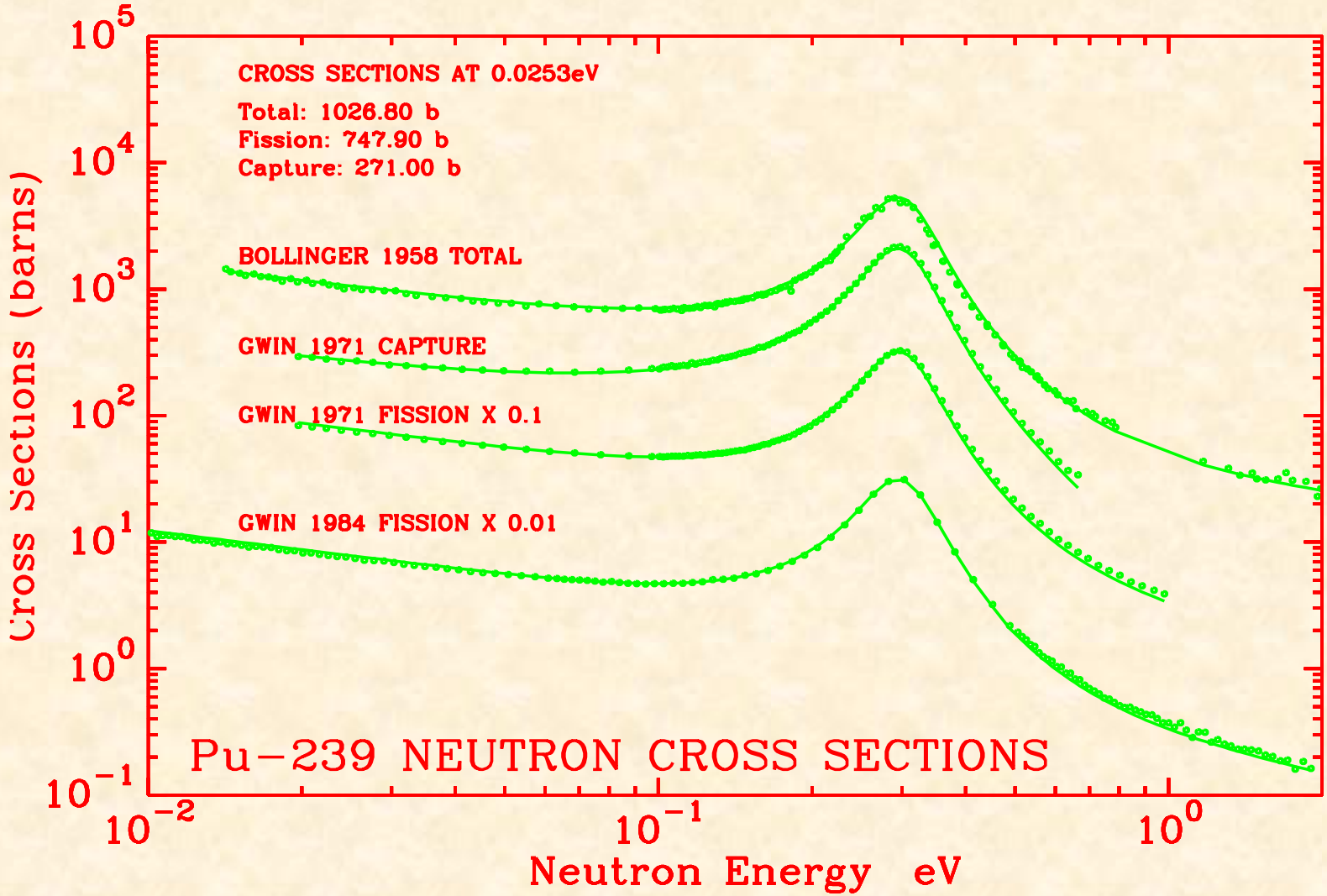
		Standard
Total	1026.80 b	1027.30 ± 5.00 b
Fission	747.90 b	747.99 ± 1.87 b
Capture	271.00 b	271.43 ± 2.14 b

Results

- Average fission cross sections:

Energy Range		Standard	
0.1 to 1.0 keV	10.25 b	10.39 b	1.4%
1.0 to 2.0 keV	4.42 b	4.47 b	1.1%

Total, Capture and Fission Cross Sections



^{239}Pu Covariance Matrix

Full covariance has been generated in the energy range from 10^{-5} eV to 2.5 keV (RR)

SAMMY memory size estimation

No. of resonances = 1045

No. of varied parameters per resonance = 5

No. of data points = 20,000

Mem= (1045 × 5 × 20,000) × 8

Memory needed = 2 × Mem ~ 1.7 Gbytes

Resonance Covariance for ^{239}Pu

Space storage needed for ^{239}Pu covariance

$N_{res}=1045$

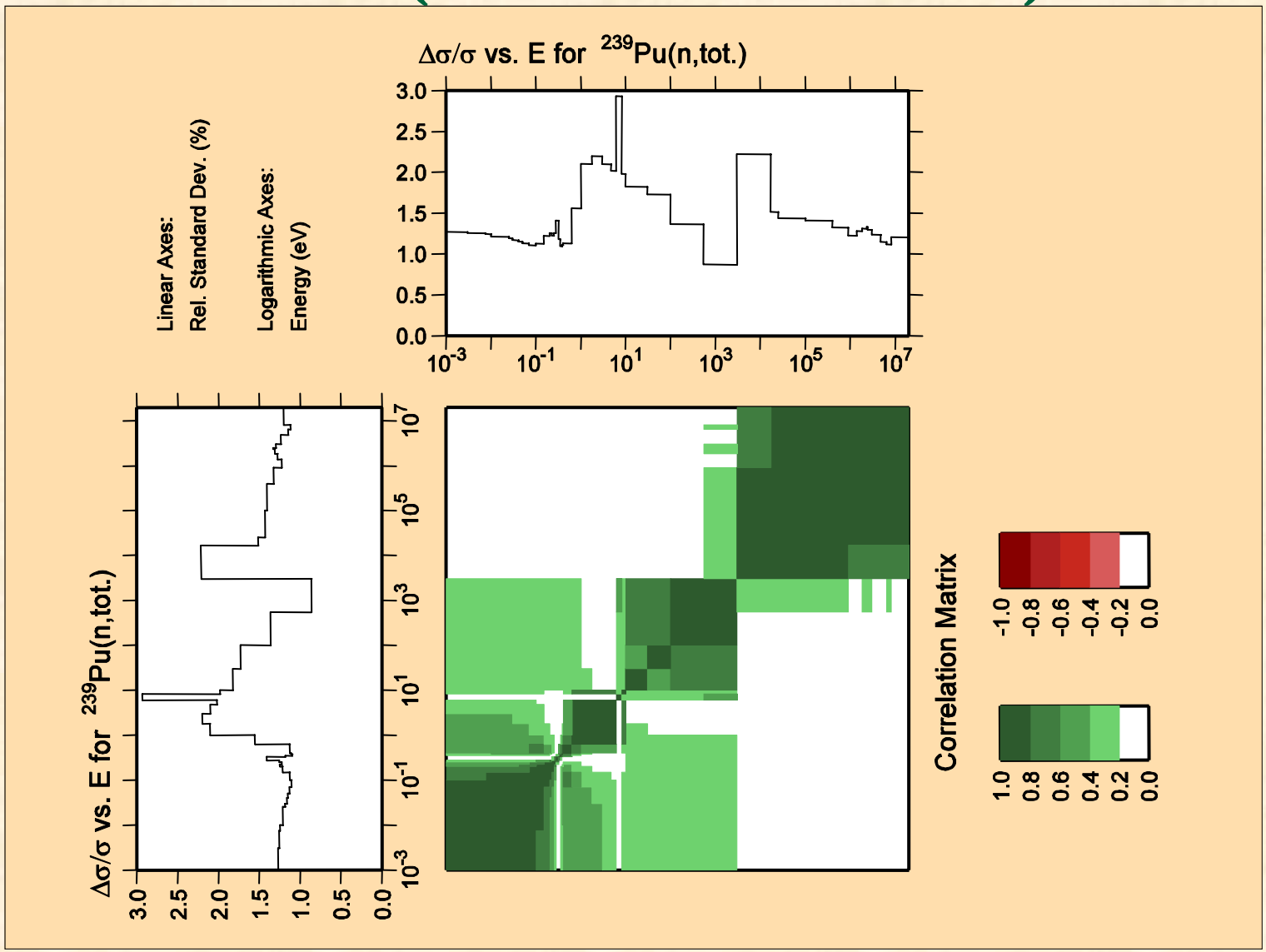
$N_{par}=5$

$N=N_{res} \times N_{par}$

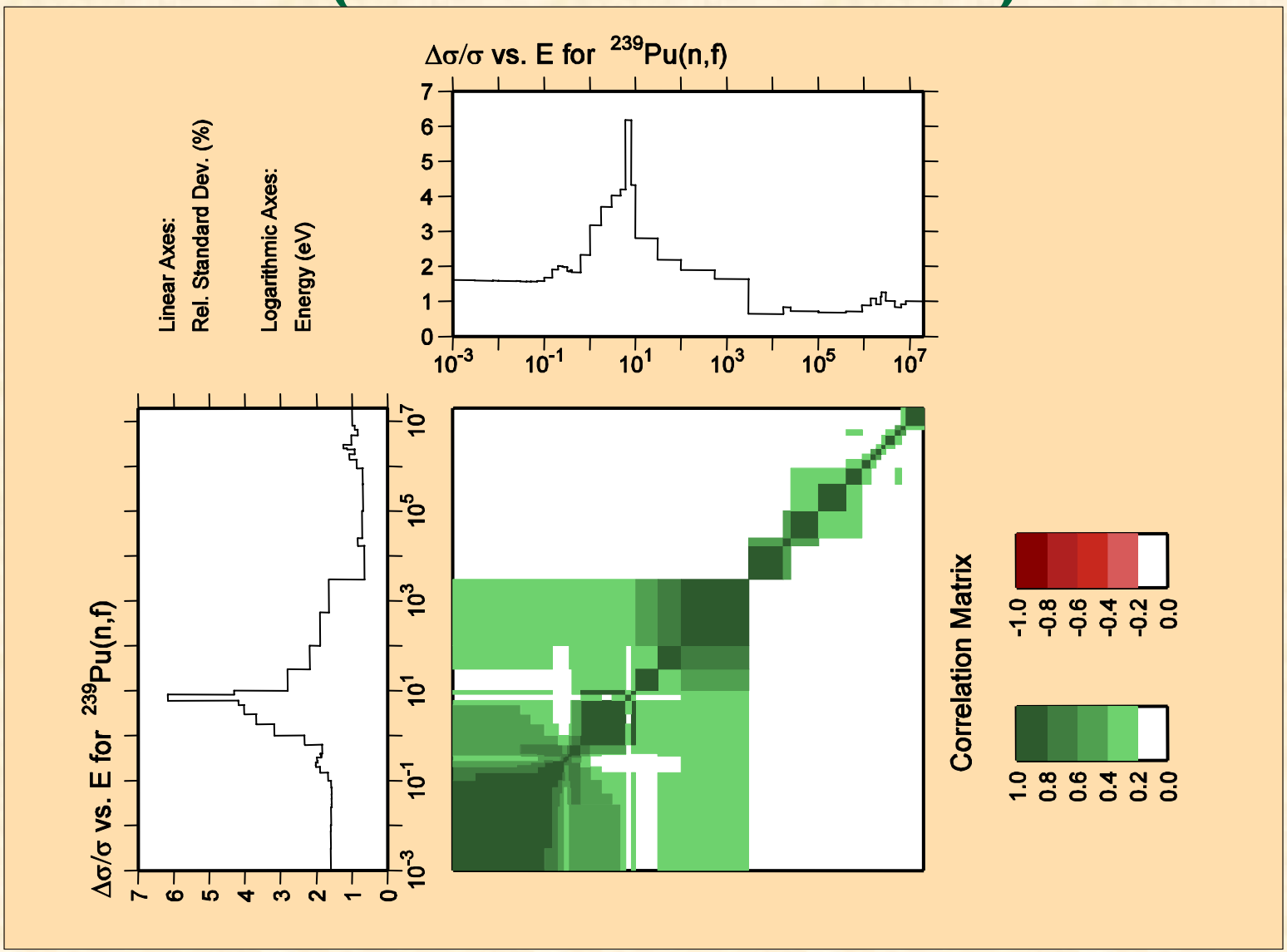
$N_s = (N^2/2 + N/2) \times 14$

$N_s \sim 190$ Mbytes

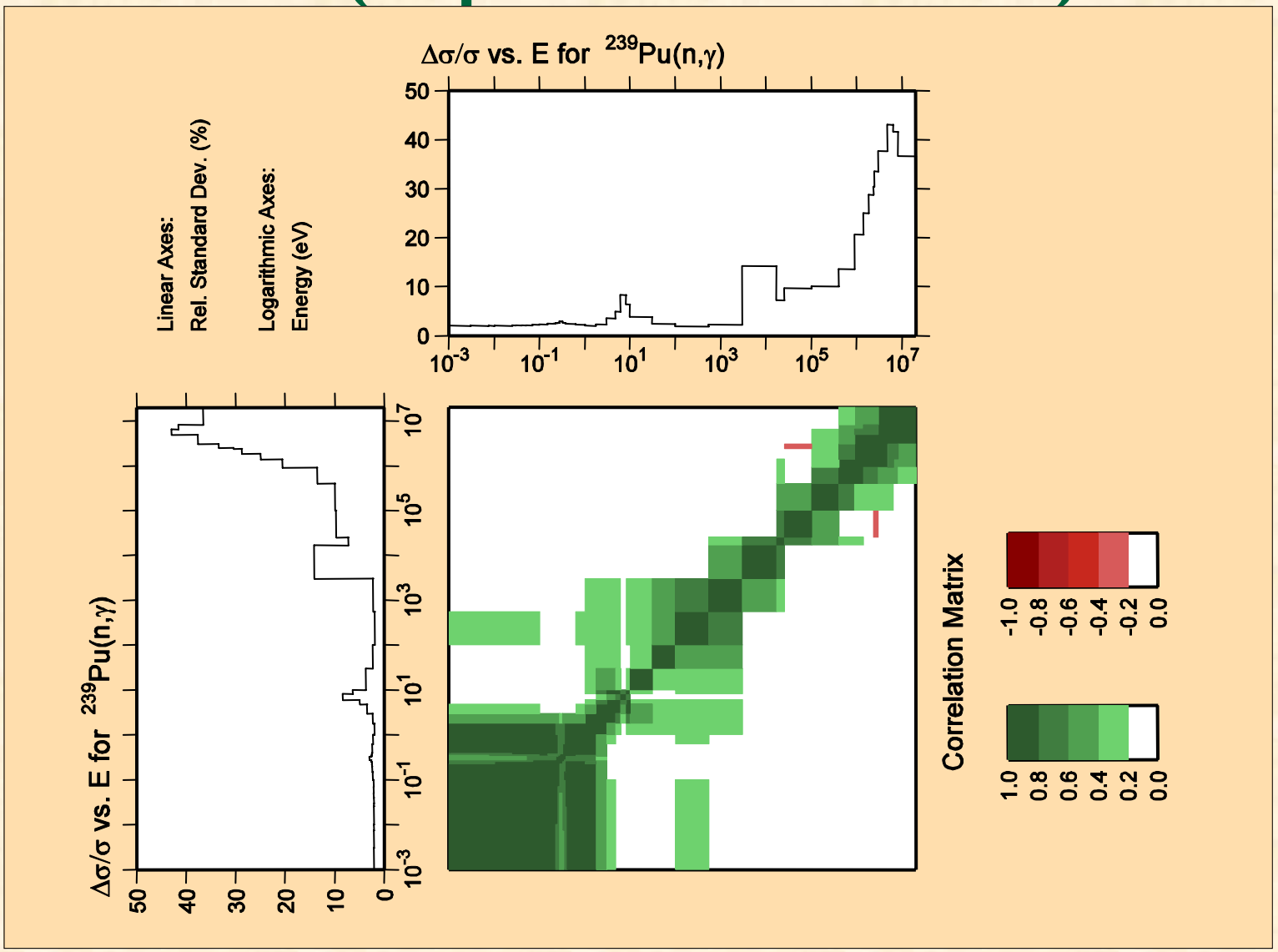
ERRORJ Processed Covariance (Total Cross Section)



ERRORJ Processed Covariance (Fission Cross Section)



ERRORJ Processed Covariance (Capture Cross Section)



Evaluation of the ^{55}Mn resonance parameters in the energy range 0 to110 keV

EXPERIMENTAL DATA BASE

Neutron transmission , ORELA, Harvey 1989

Sample thickness 0.042 at/b, TOF at 80 m

Energy range 1 keV to 200 keV

Neutron transmission, GELINA, 2005

Sample thickness 0.118 at/b, TOF at 26.45 m

Energy range up 1 MeV

Neutron capture, GELINA, 2005

Sample thickness 0.019 at/b, TOF at 58.6 m (Not normalized)

Evaluation of the ^{55}Mn resonance parameters in the energy range 0 to110 keV

EXPERIMENTAL DATA BASE

Average capture cross section measurement, Cadarache, Lerigoleur,1975 (used for normalization purpose)
Energy range 20 keV to 140 keV

Thermal range:
Total cross section, Rainwater 1947
Total cross section, Cote, 1964
Capture cross section, Widder 1975

	Mughabghab	Preliminary
Capture	13.36 ± 0.05 b	13.90 b
Scattering	2.06 ± 0.03 b	1.62 b
Total:	15.42 ± 0.07 b	15.72 b

SAMMY ANALYSIS

Sequential Bayes analysis of ORELA transmission and GELINA capture

Problem of normalization of the capture cross section due to strong experimental effects in the s-wave resonances at low energy;

Poor statistic in the high energy range of the transmission data; the neutron widths not accurately determined in the small resonances;

The preliminary values obtained for the average capture cross sections in the energy range 20 keV to 140 keV are 20% to 50% smaller than Lerigoleur values;

SAMMY ANALYSIS

Above 80 keV, GELINA transmission data show serious problem of normalization and experimental resolution

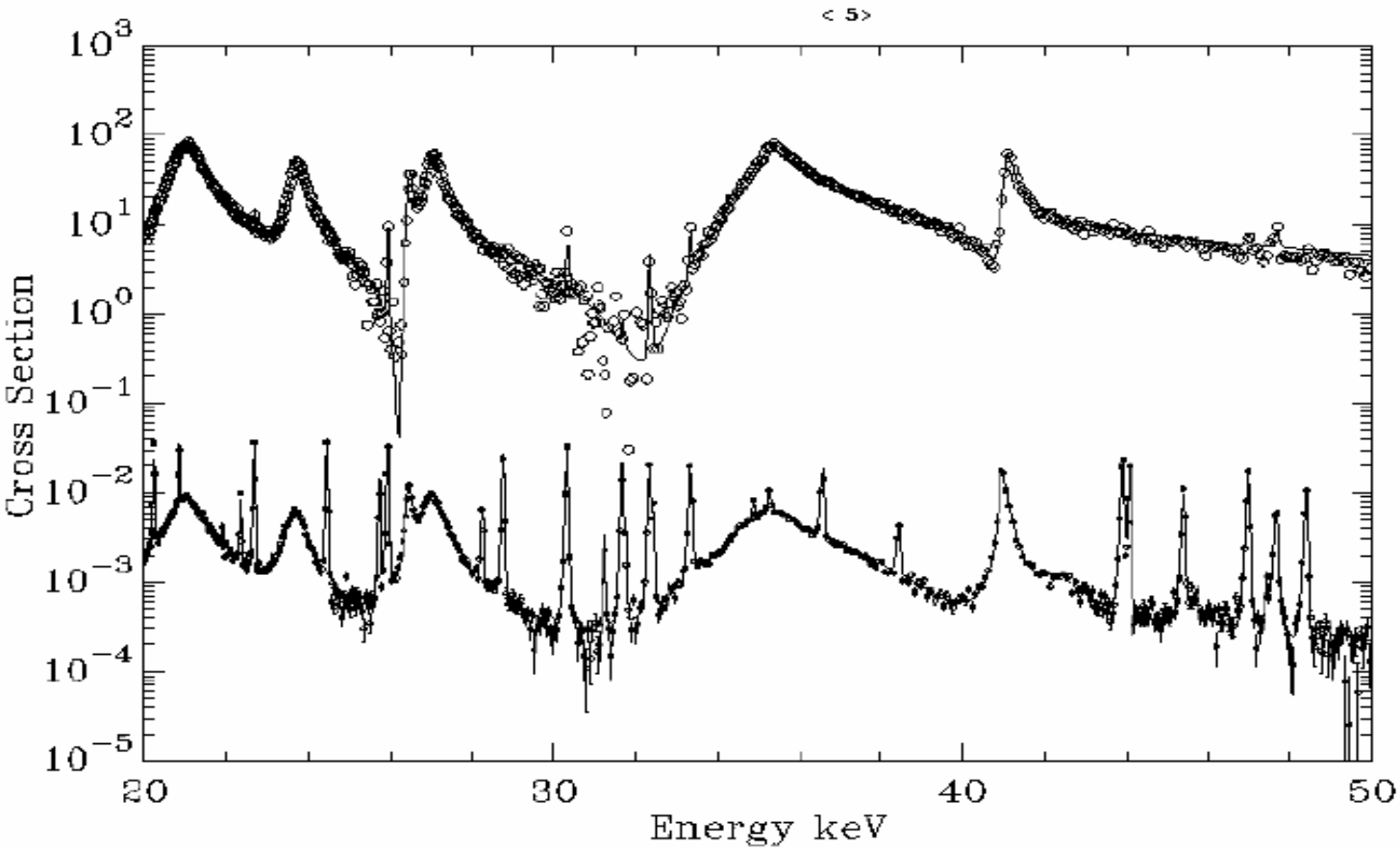
Could not be integrated in the data base for sequential analysis.

COVARIANCE MATRIX OF THE RESONANCE PARAMETERS

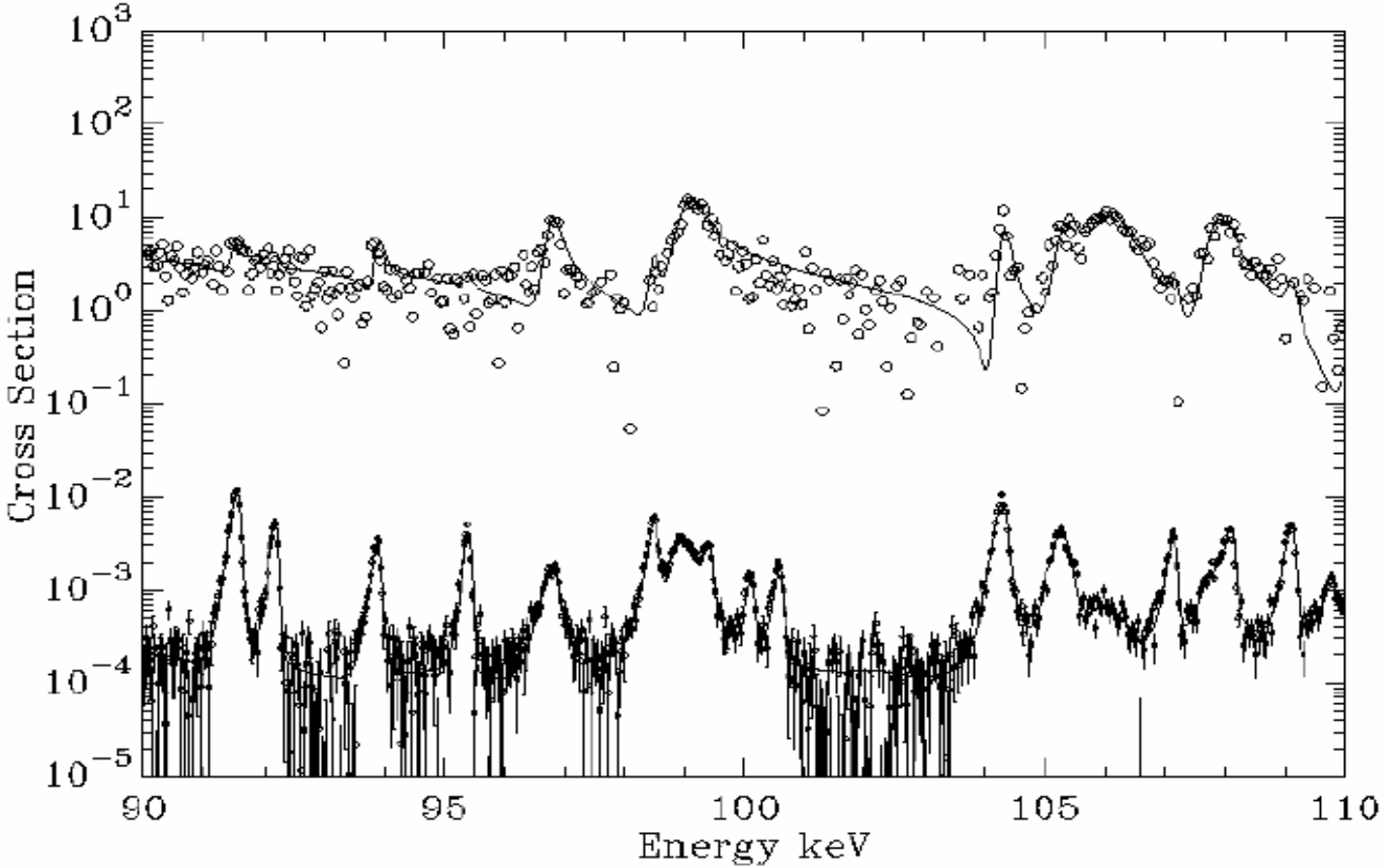
A preliminary covariance matrix was obtained from the preliminary SAMMY analysis of ORELA transmission and GELINA capture

Work is underway to convert SAMMY covariance matrix into ENDF format for processing with PUFF and ERRORJ

Total and Capture Sections
(ORELA transmission and GELINA Capture)_



Total and Capture Sections
(ORELA transmission and GELINA Capture)_



Evaluation of the ^{103}Rh resonance parameters in the energy range 0 to 8 keV

EXPERIMENTAL DATA BASE

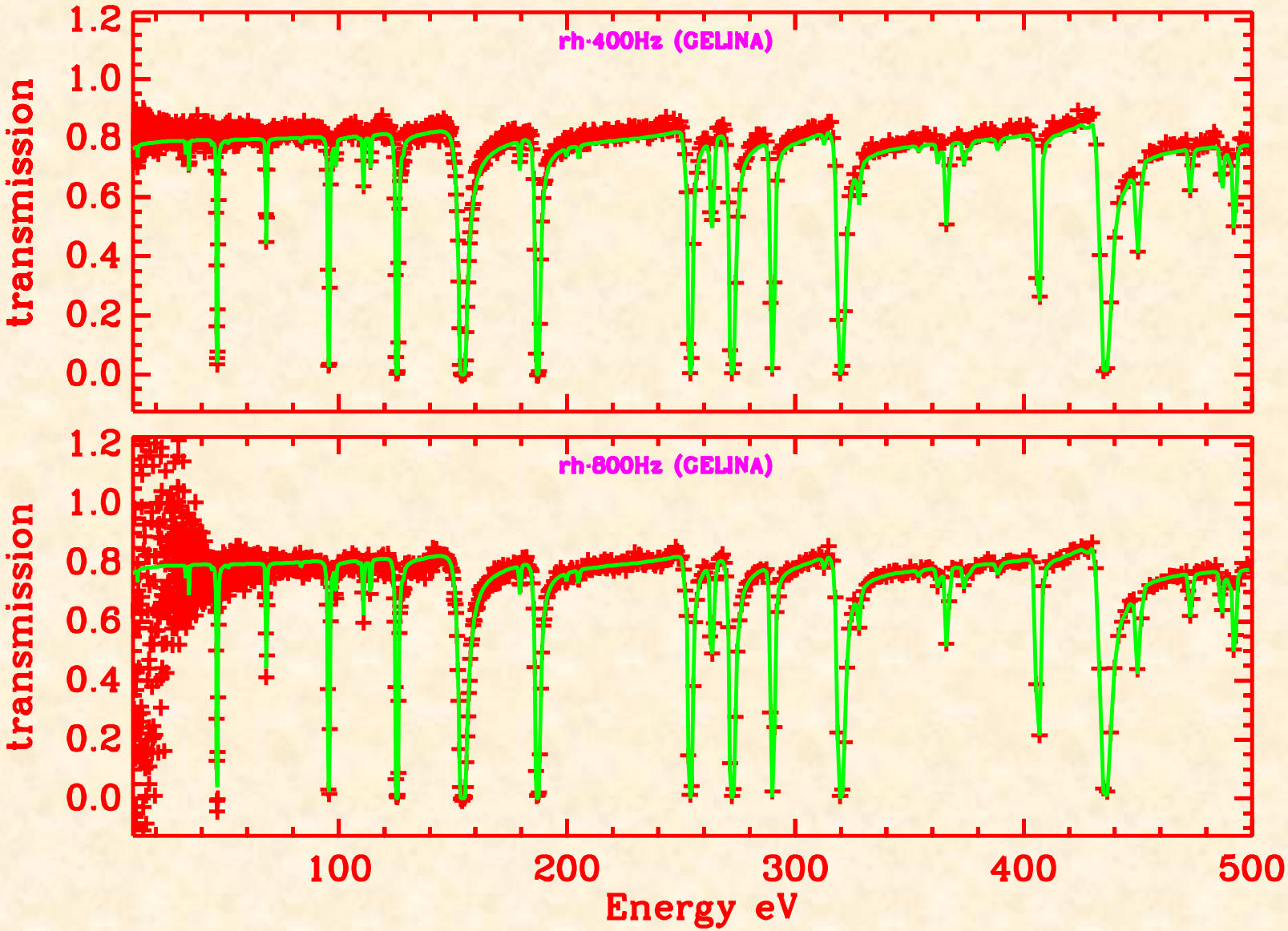
Total Cross Sections by Ribon (Saclay) from 0 to 4 keV (77 K)

Four transmission measurements done at GELINA from 0 to 8 keV

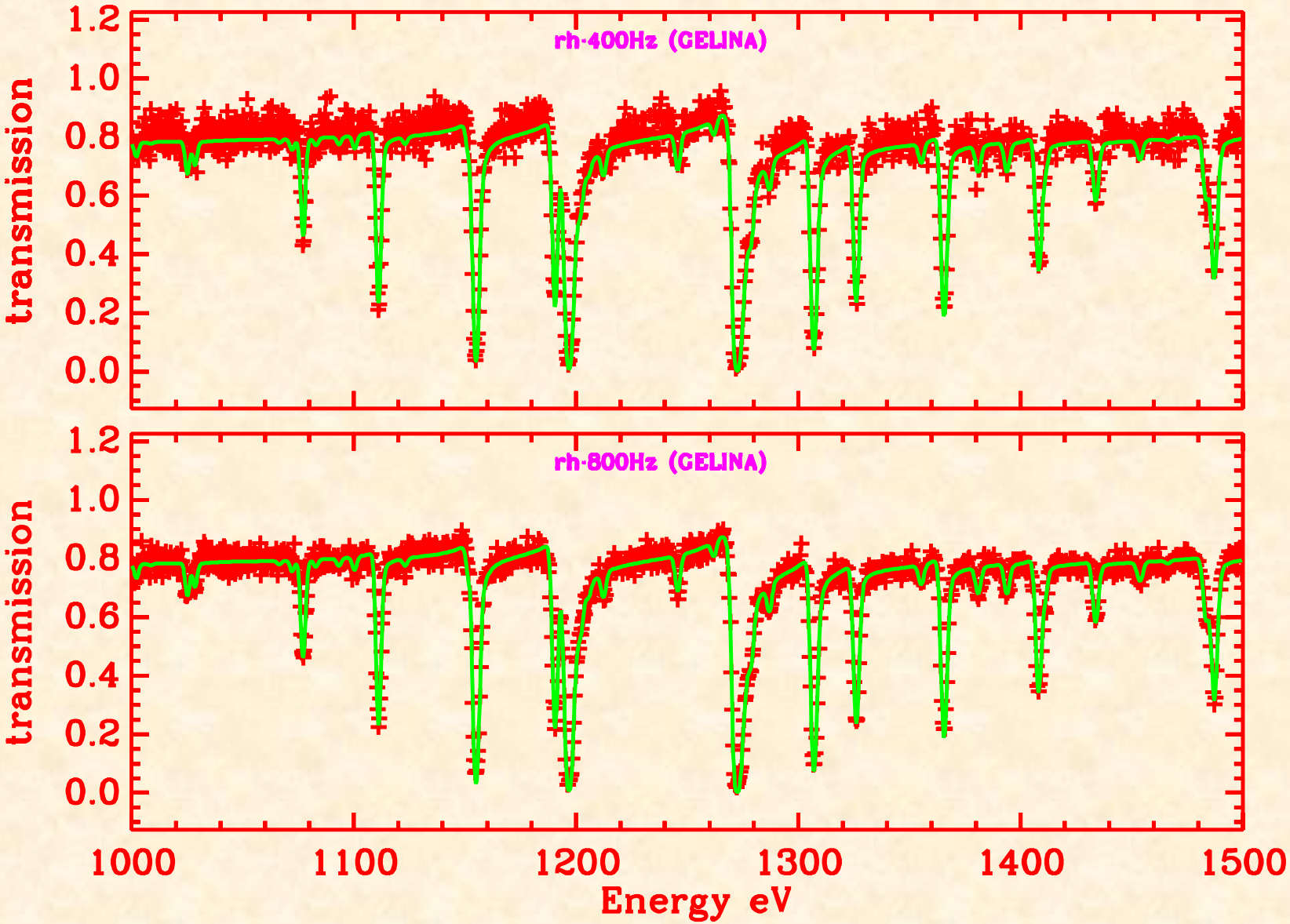
Two capture cross section measurements done at GELINA from 0 to 8 keV

Thermal and Low Energy (< 20 eV)
Havens total cross section (1952)
Sailor total cross section (1953)
Dilg total cross section (1974)
Lee capture cross sections (2003)

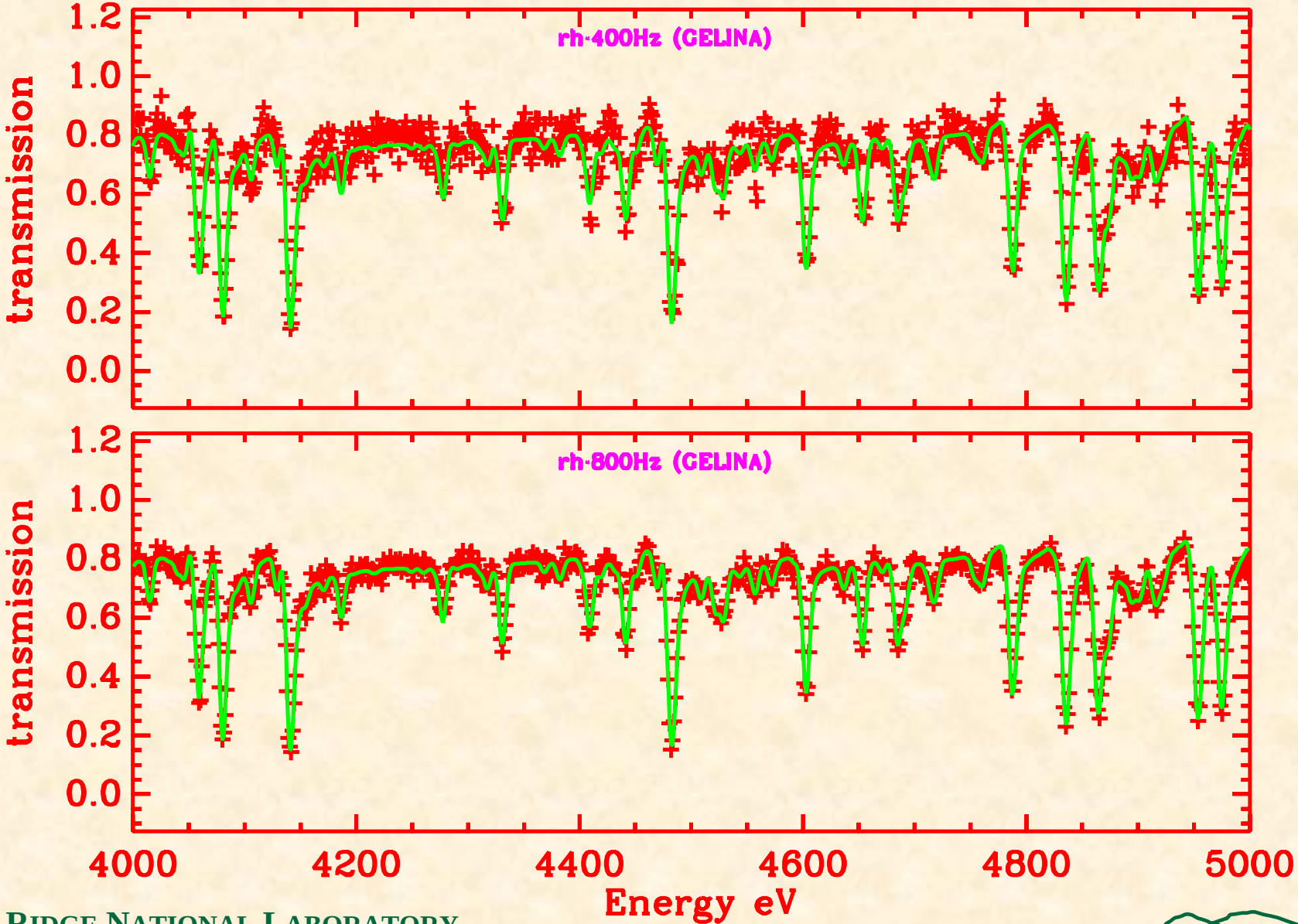
Transmission (GELINA)_



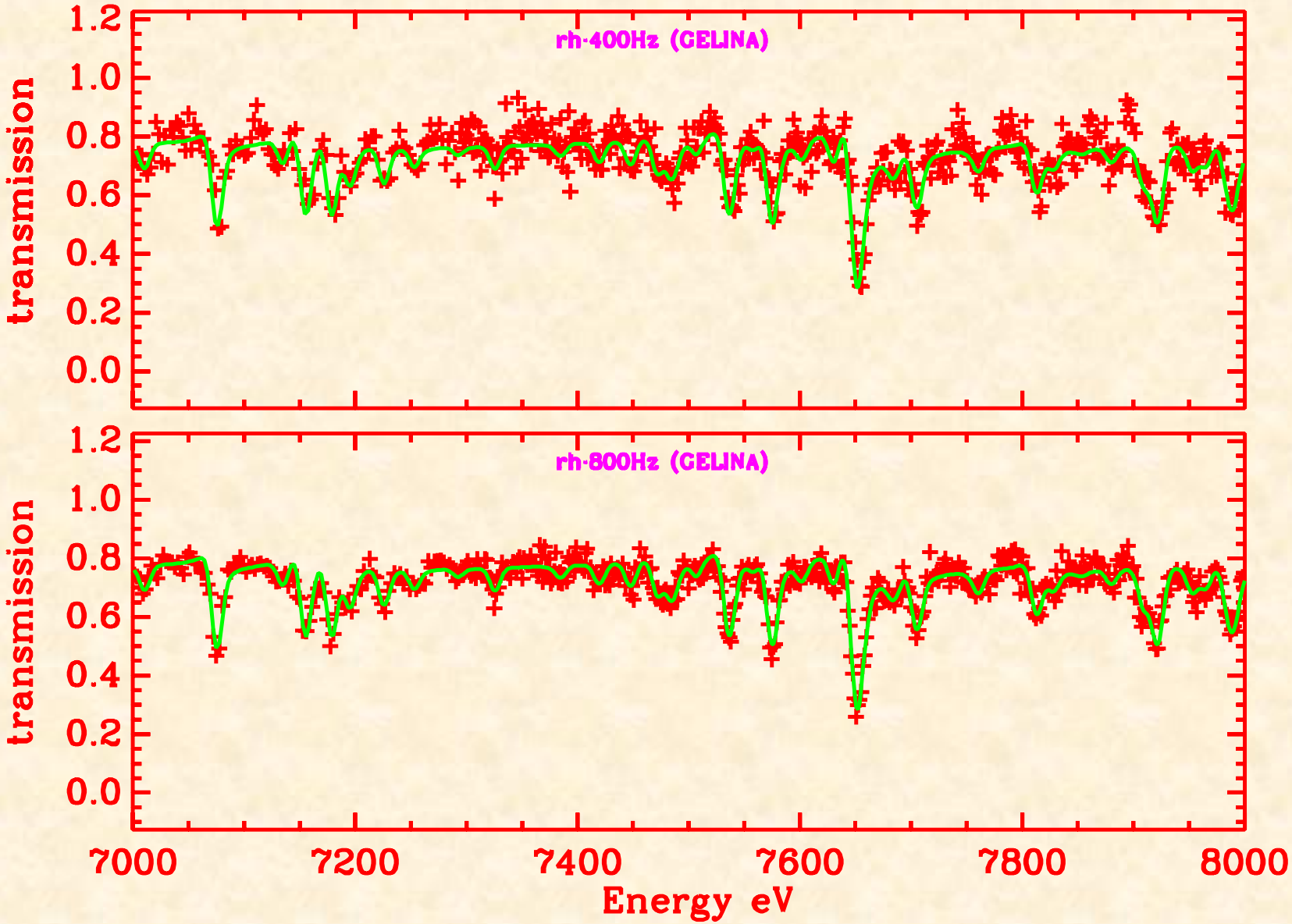
Transmission (GELINA)_



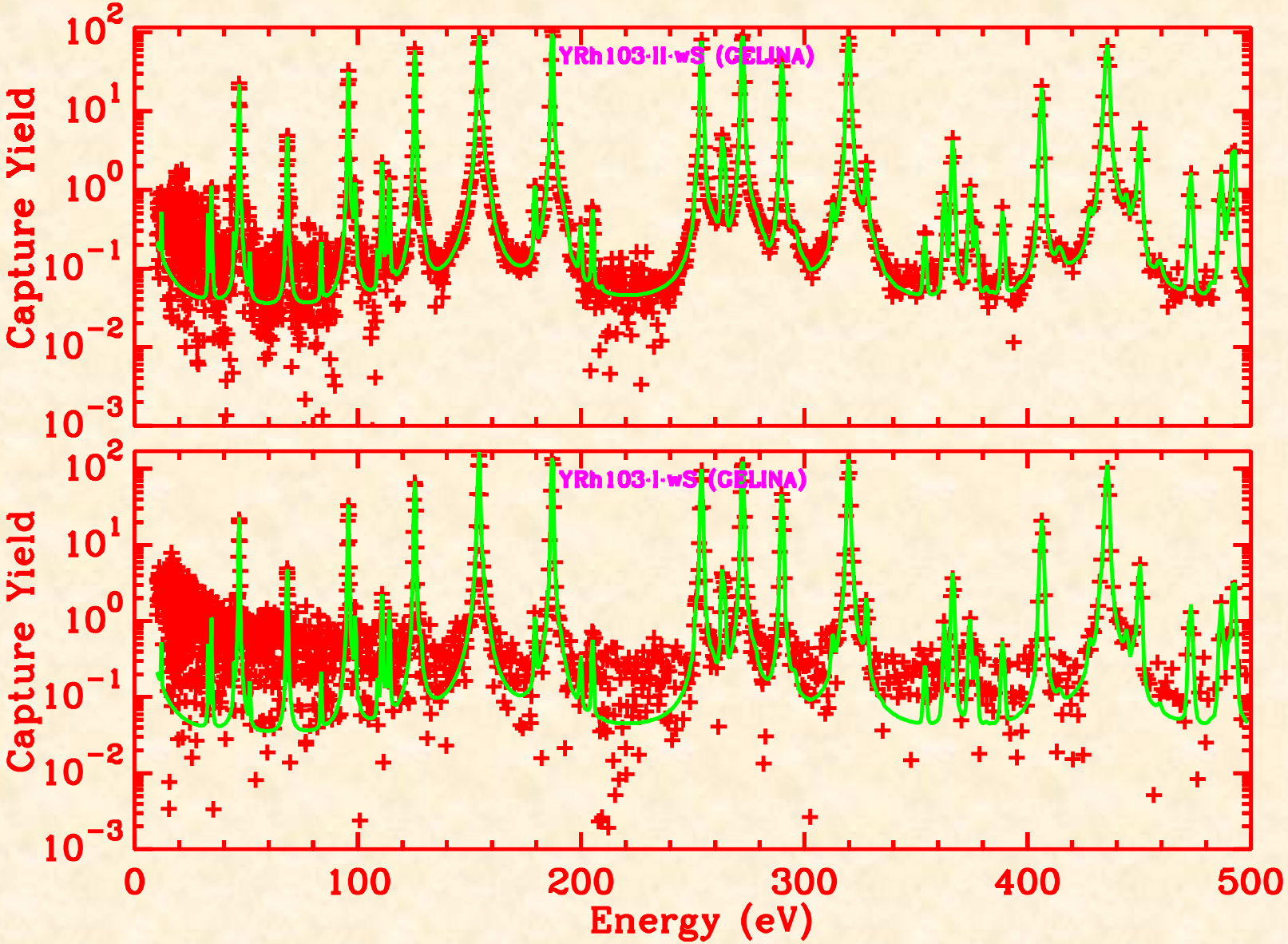
Transmission (GELINA)_



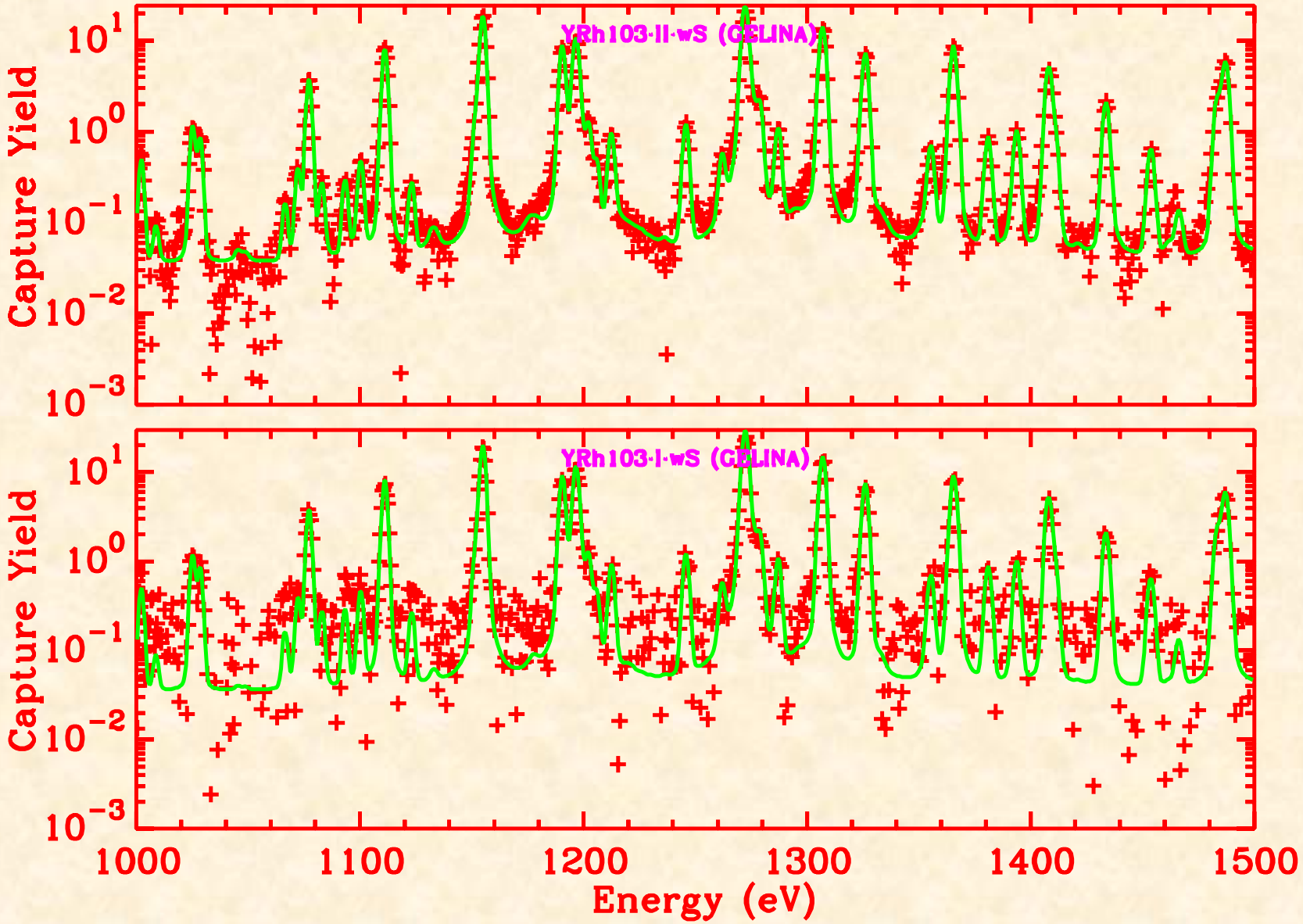
Transmission (GELINA)_



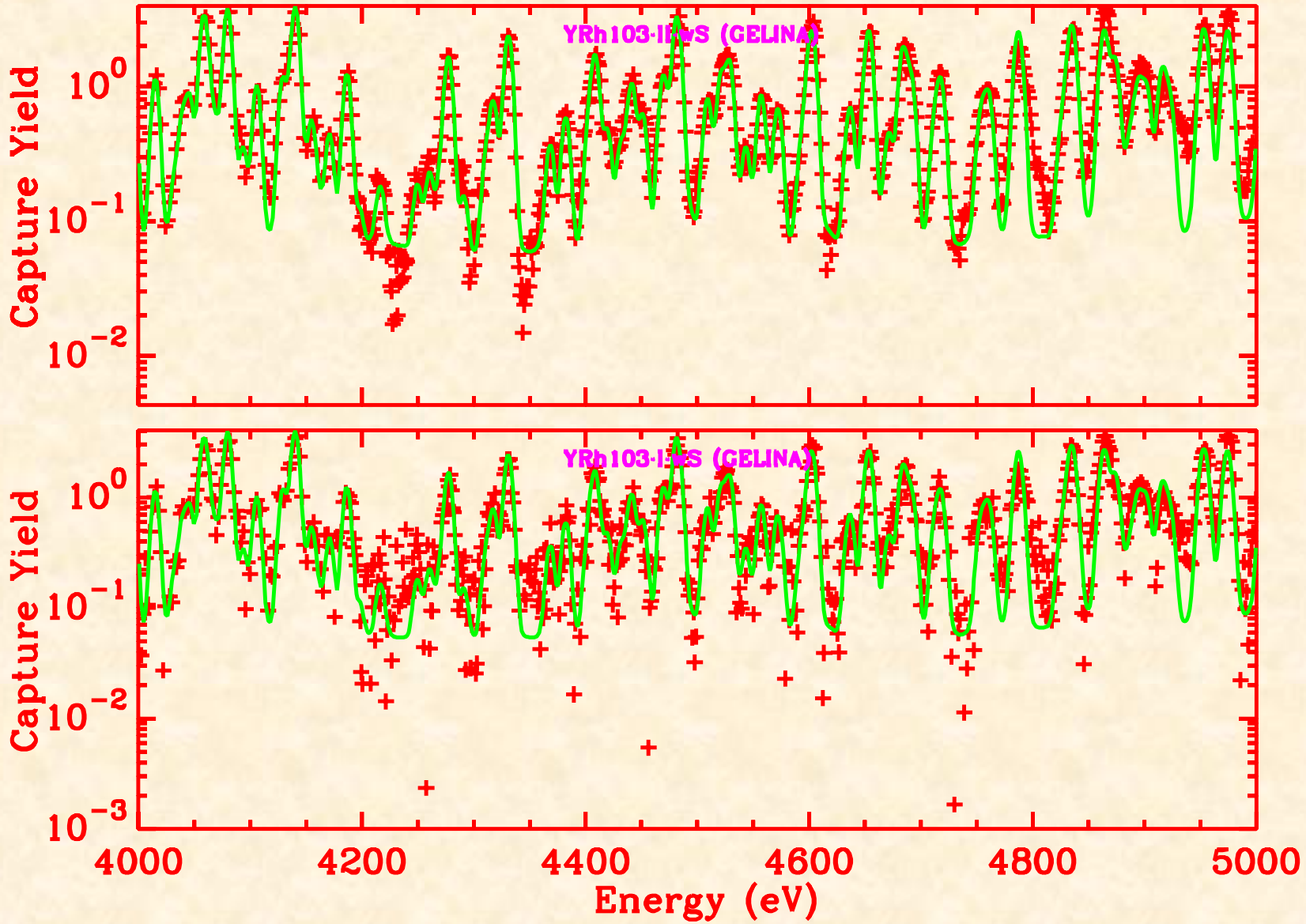
Capture Yield (GELINA)_



Capture Yield (GELINA)_



Capture Yield (GELINA)_



UT-BATTELLE

$^{39, 41}$K Evaluation Status

R. O. Sayer, K. H. Guber, L. C. Leal, and N. M. Larson
Oak Ridge National Laboratory

Nov 1, 2006

^{39,41}K Evaluation - Data

Type	Authors	Facility	Flight Path (m)	Min. Energy (keV)	Max. Energy (keV)	Atoms/barn
^{NAT}K Transmission	Guber et al 2001	ORELA	79.82	0.036	624	0.1052 0.01337
$^{NAT}K_2CO_3$ Capture	Guber et al 2001	ORELA	40.11	0.03	600	0.00887
^{39}KCl, ^{41}KCl Transmission	Harvey et al 1973	ORELA	78.20	5.0	1074.	0.0336, 0.0367
^{39}KCl, ^{41}KCl Transmission	Harvey et al 1973	ORELA	78.20	0.1	14.	0.00812, 0.00806
^{NAT}K Total	Singh et al 1973	Columbia cyclotron	202.05	0.1	400	0.004 - 0.408
^{NAT}K Scattering	Fermi et al 1947	Argonne - Crystal		0.000036		
^{NAT}K Total	Cierjacks et al 1969	KFK cyclotron	57.54	360	3700	0.1860
^{NAT}K Total	Joki et al 1955	MTR crystal spect.		0.00002	0.0106	
$^{41, NAT}K_2CO_3$ Capture	Macklin 1984	ORELA Res params	40	~0.8	152	

^{39,41}K Evaluation - Thermal σ in barns

Nuclide	Abundance	Elastic	Capture	Σ (n,p)	Σ (n,α)	Total
^{39}K	0.932581	2.0893	2.0984	0.0	0.0043	4.1921
^{40}K	0.000117	2.7862	30.0072	4.4	0.39	37.583
^{41}K	0.067302	2.5985	1.4593	0.0	0.0	4.0577
^{NAT}K (ENDF)	1.	2.2265	2.1	0.051	0.0046	4.3822
^{NAT}K (ORNL)	1.	2.1237	2.0589	0.00051	0.0041	4.187

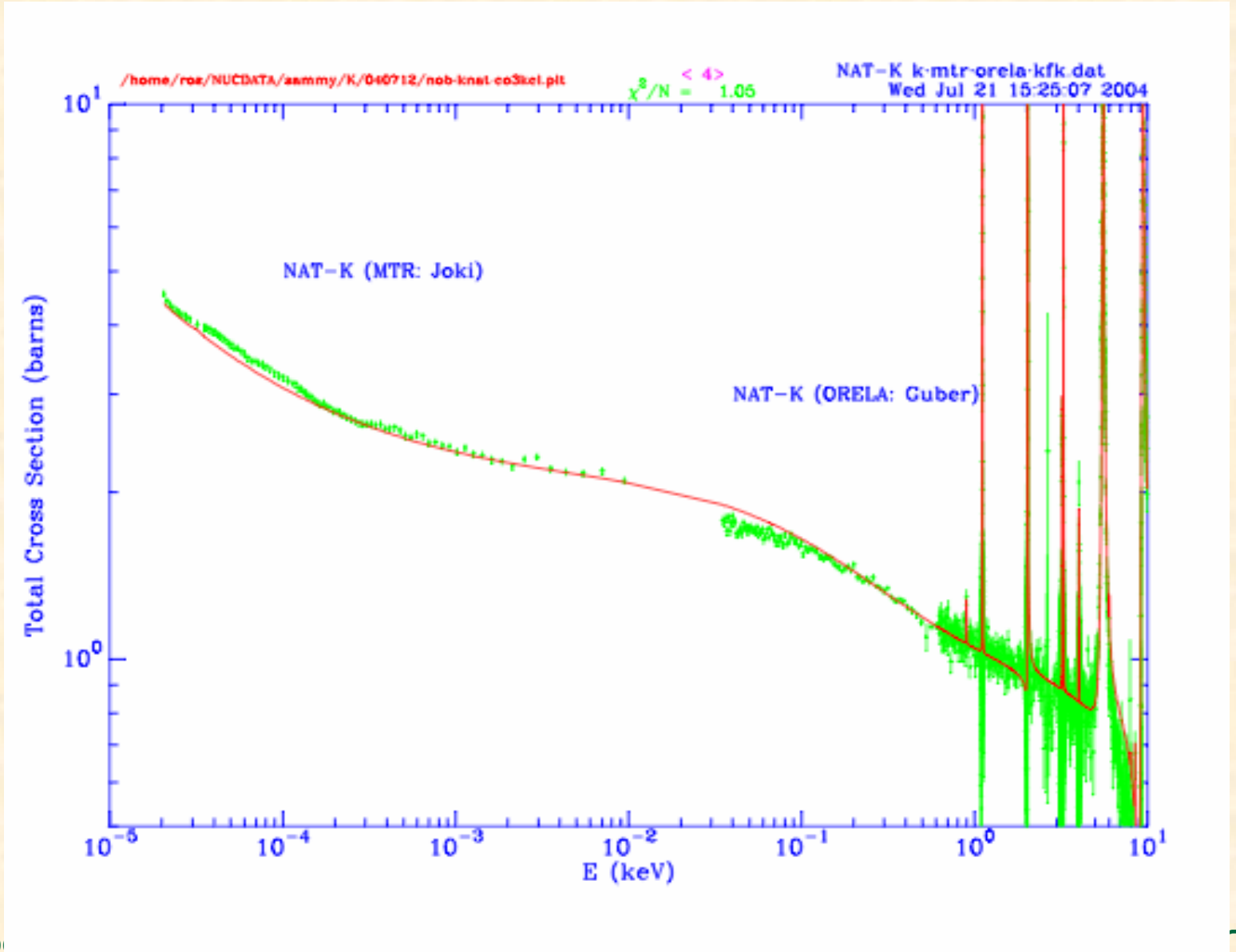
^{39,41}K Evaluation - Status

- Evaluation energy range: thermal to 1 MeV
  - ^{39,41}K: $J^{\pi} = 3/2^{+}$. s-wave: $J^{\pi} = 1^{+}, 2^{+}$. p-wave: $J^{\pi} = 0^{-}, 1^{-}, 2^{-}, 3^{-}$.
  - SAMQUA: d-waves probably negligible
  - Inelastic, (n,p), (n,α), negligible
- ORELA data
  - 1984: $^{NAT,41}K_2CO_3$ capture (Macklin; resonance params only)
    - "old" capture experimental setup; stops at 152 keV
  - 1973: ^{39,41}KCl transmission: ^{41}KCl has normalization problem.
  - 2001-2003: ^{NAT}K metal transmission, $^{NAT}K_2CO_3$ capture.
  - 2006: ^{41}KCl capture measurement - new experimental setup.

^{39,41}K Evaluation - Status, cont.

- ORELA ^{NAT}K transmission, $^{NAT}K_2CO_3$ capture; fit to 600 keV
  - ~ 500 Potassium resonances. Thermal values reproduced.
  - 419 Cl resonances. Total of 36 spin groups.
- To Do
  - Extend evaluation to 1 MeV using KFK (Cierjacks) data
  - Include ^{41}KCl capture data in evaluation.
  - Short ^{41}KCl transmission measurement for normalization

^{NAT}K Total Cross Section



SAMMY Fits to ORELA K Capture and Transmission Data