PAUL SCHERRER INSTITUT

PSI

D. Rochman

Overview of changes from JEFF-3.2 to 3.3T1

JEFF meeting, evaluation WG, Apr. 25, 2016, OECD Headquarters, Paris, France

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Contents

- A short history JEFF-3.3T1
- Major changes for actinides
- Feedback from checking programs/people
- Conclusions

A very short history and feedback

- JEFF-3.2: released on March 2014, 472 isotopes

- JEFF-3.3: see details in C. Diez presentation
  - T0: released on February 2016,
  - T1: released on March 2016, 559 isotopes

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JEFF-3.3T1 Test Library

The Joint Evaluated Fission and Fusion File is an evaluated library produced via an international collaboration of Data Bank member countries under the auspices of the NEA Data Bank.

JEFF-3.3T1 neutron **test library** includes the following proposed changes and candidate files:

April 15, 2016

- TRIPOLI.tar.gz: JEFF-33T1 Tripoli files processed available for download;

April 6, 2016

- JEFF33T1_ACE.zip : JEFF-33T1 ACE files processed with NJOY-2012 available for download;
- JEFF33T1_NJOY_INPS.zip : NJOY-2012 input files used for processing available for download;

March 1, 2016

JEFF-33T1 distributed, **Only change from T0 is the Cr-52 file reverted to JEFF-3.2 version**

Major changes: overview

- Details in C. Diez presentation

- 559 isotopes
- New U235, U238, Pu239 (CEA, IRSN),
- New O16 (ENDF/B-VII.1),
- New Cu63,65 (ENDF/B-VII.1),
- New Hf isotopes (CEA/AMEC),
- ^{nat}V removed and changed to isotopic
- and more …

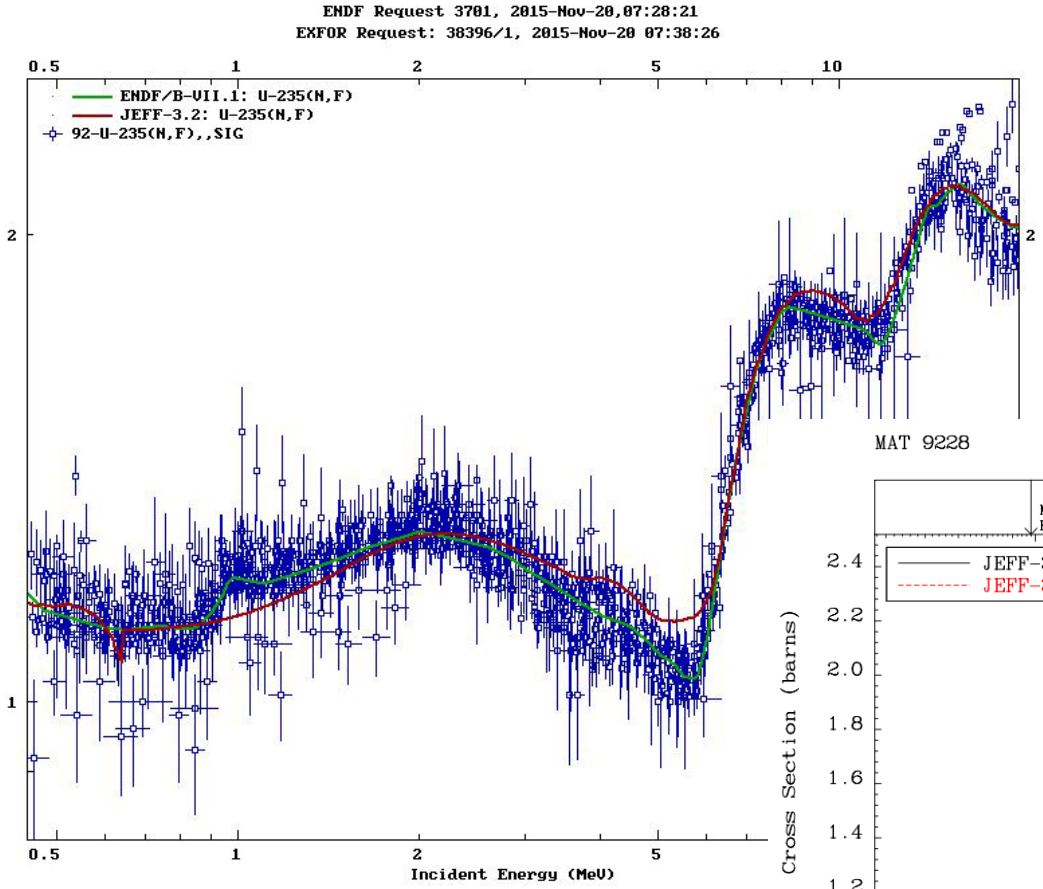
- Unchanged 68 isotopes from JEFF-3.2,
- From TENDL-2015: >300 isotopes

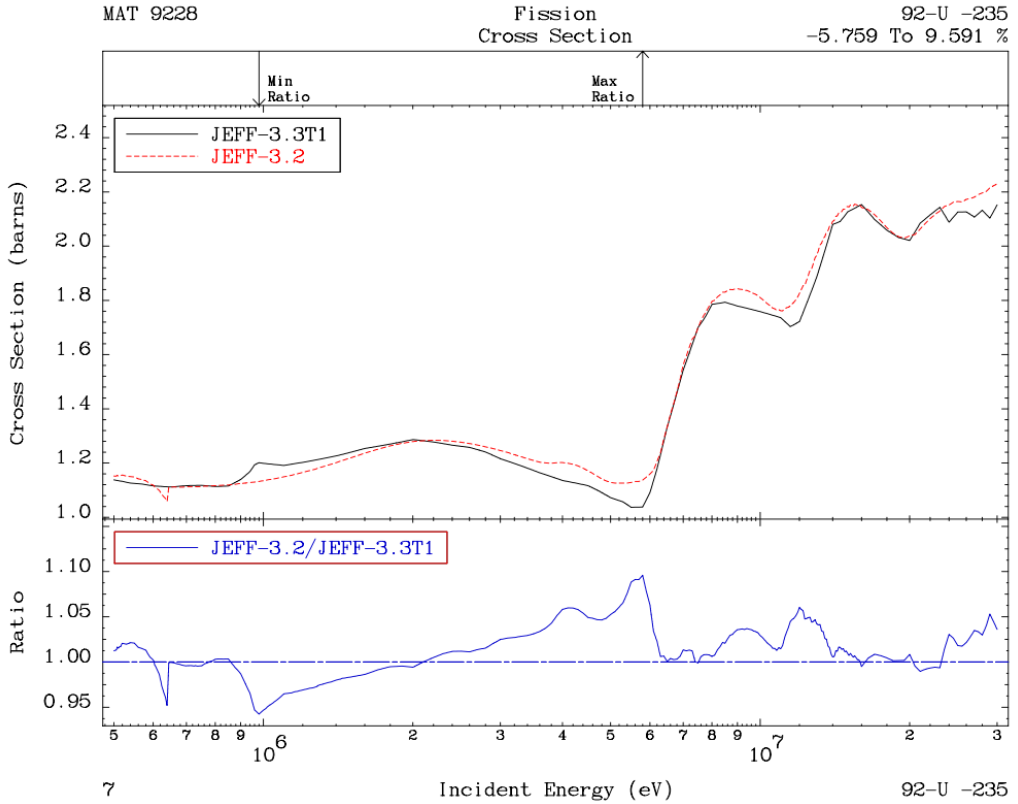
Major changes U-235

- New Evaluation of December 2014: collaboration of IRSN/CEA
- CIELO file of April 2014

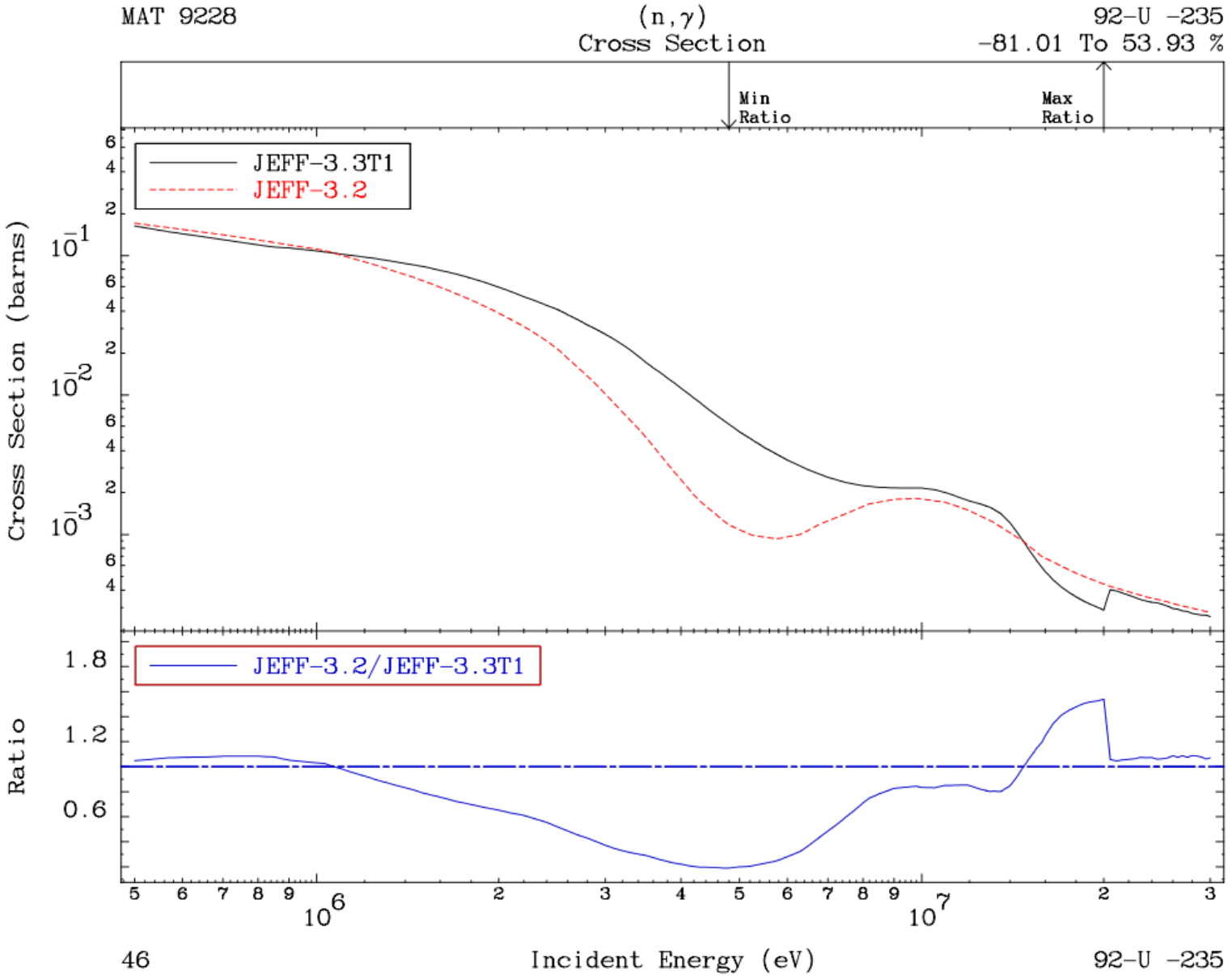
```
 1  JEFF33T0   gen. purp. file: neutron  + U -235  1.e-5 eV -  30 MeV  99 0  0    0
 2  9.223500+4 2.330248+2          1          1          0          19228 1451    1
 3  0.000000+0 0.000000+0          0          0          0          69228 1451    2
 4  1.000000+0 3.000000+7          1          0         10          09228 1451    3
 5  0.000000+0 0.000000+0          0          0        452        2179228 1451    4
 6  92-U -235 IRSN-CEA   EVAL-DEC14 IRSN-CEA DAM/DEN COLLAB.          9228 1451    5
 7  JEFF33T0             DIST-                                       9228 1451    6
 8 ----JEFF33T0          MATERIAL 9228                               9228 1451    7
 9 -----INCIDENT NEUTRON DATA                                        9228 1451    8
10 ------ENDF-6 FORMAT                                              9228 1451    9
11 ____________________________________________________________     9228 1451   10
12  92-U -235 CIELO for testing                                     9228 1451   11
13            DIST - APRIL2014                                      9228 1451   12
14                                                                  9228 1451   13
15  This U-235 library was created for testing benchmark results in 9228 1451   14
16 the thermal and epithermal energy regions. It uses JENDL4 as the 9228 1451   15
17 template. A resonance evaluation performed at ORNL based on cap  9228 1451   16
18 data taken at LANCE and RPI were used in the evaluation in the   9228 1451   17
19 resolved resonance region (Leal et al.). In the unresolved energy 9228 1451  18
20 region it uses an update done by Noguere et al.                  9228 1451   19
21 Preliminary results indicate improvements in calculate benchmark 9228 1451   20
22 in the intermediated energy region. More benchmark testing are   9228 1451   21
23 needed. Void reactivity calculations done by our Japanese        9228 1451   22
24 colleagues will be more than welcome.                            9228 1451   23
25  Again, this library is for testing purpose for the WPEC/CIELO   9228 1451   24
26 effort. We will refer to this lib as U235_ver4.dat               9228 1451   25
27                                                                  9228 1451   26
28           L. C. Leal, G. Noguere                                 9228 1451   27
29           ----------------------                                 9228 1451   28
30                                                                  9228 1451   29
```

Major changes U-235

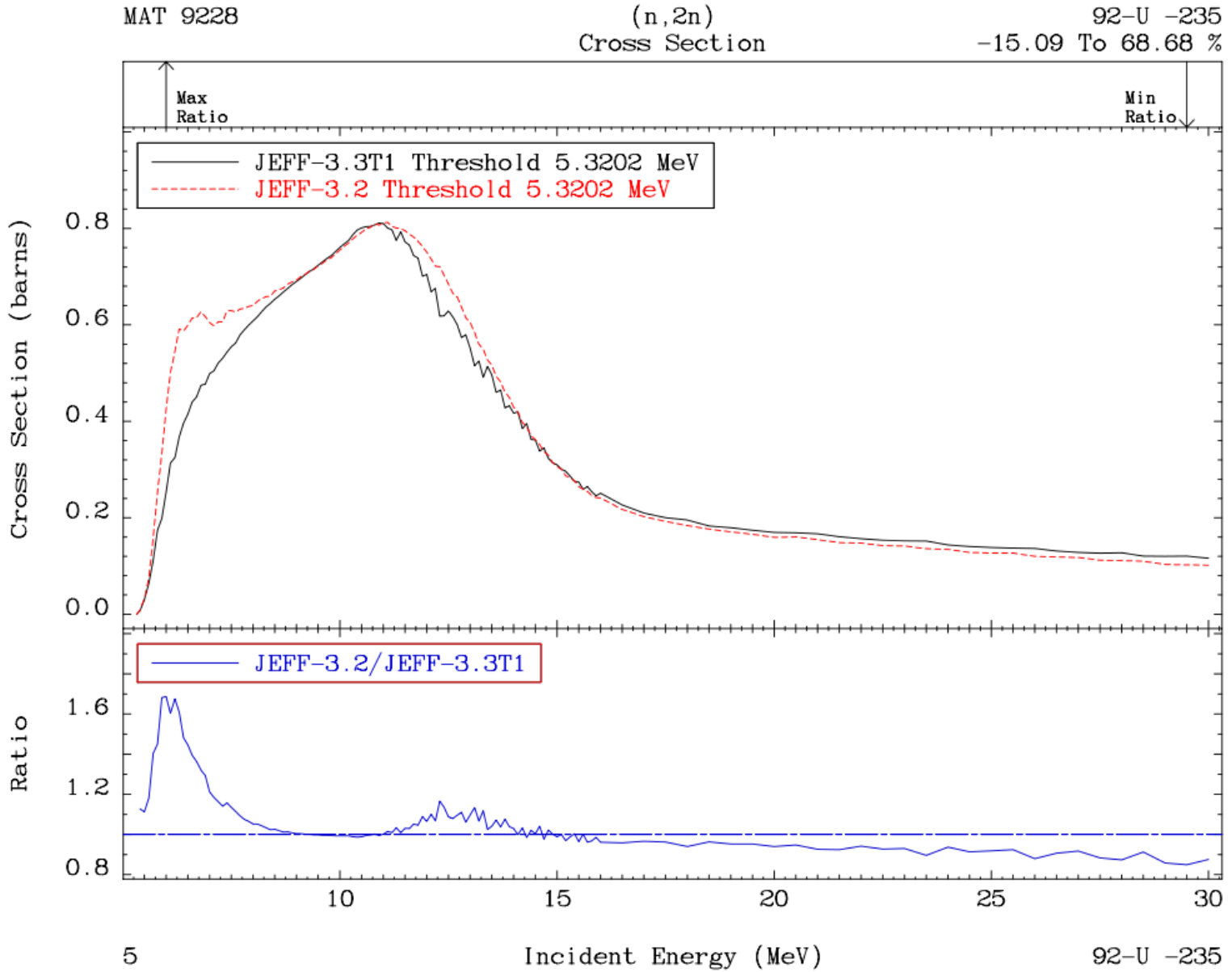




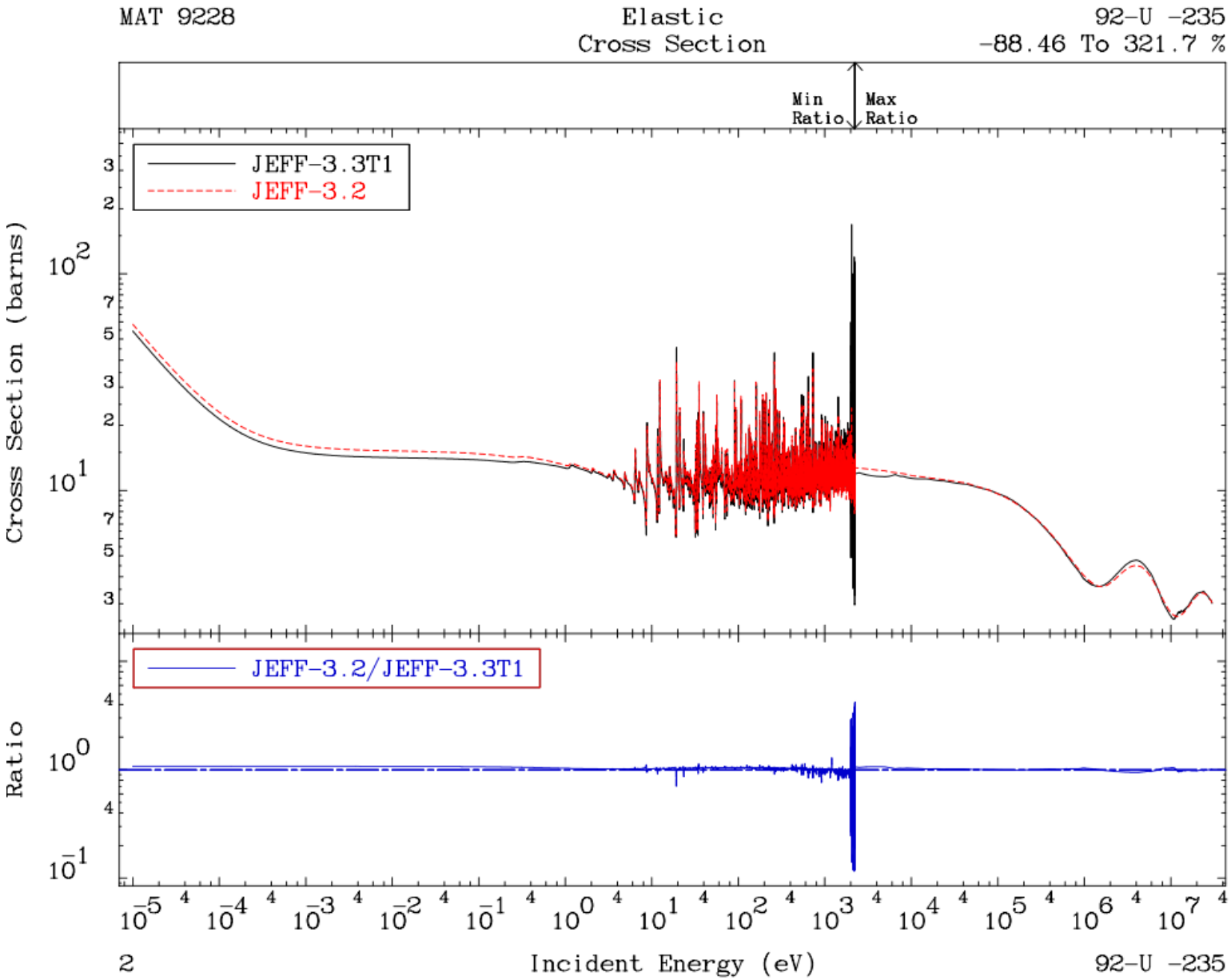
Major changes U-235



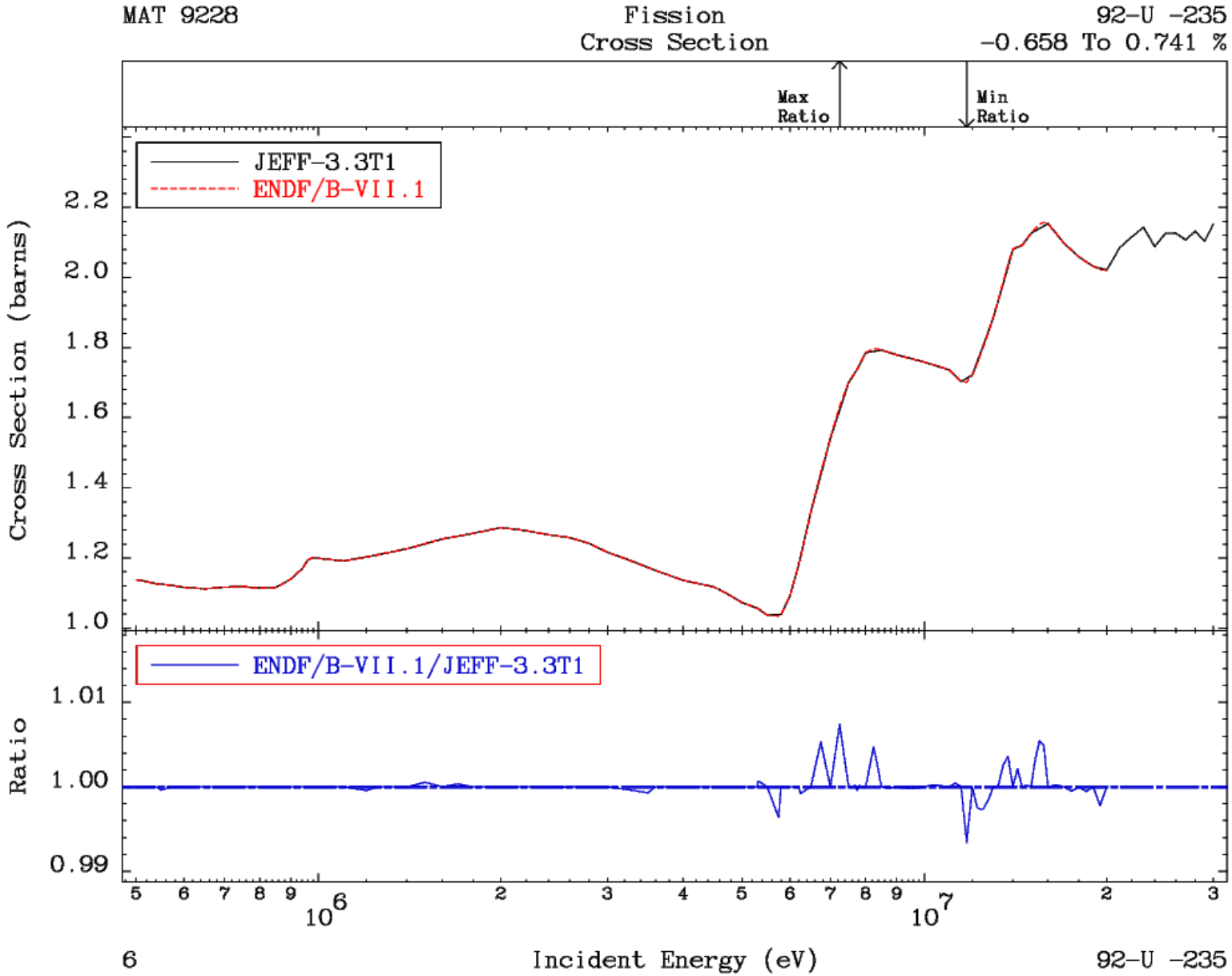
Major changes U-235



Major changes U-235

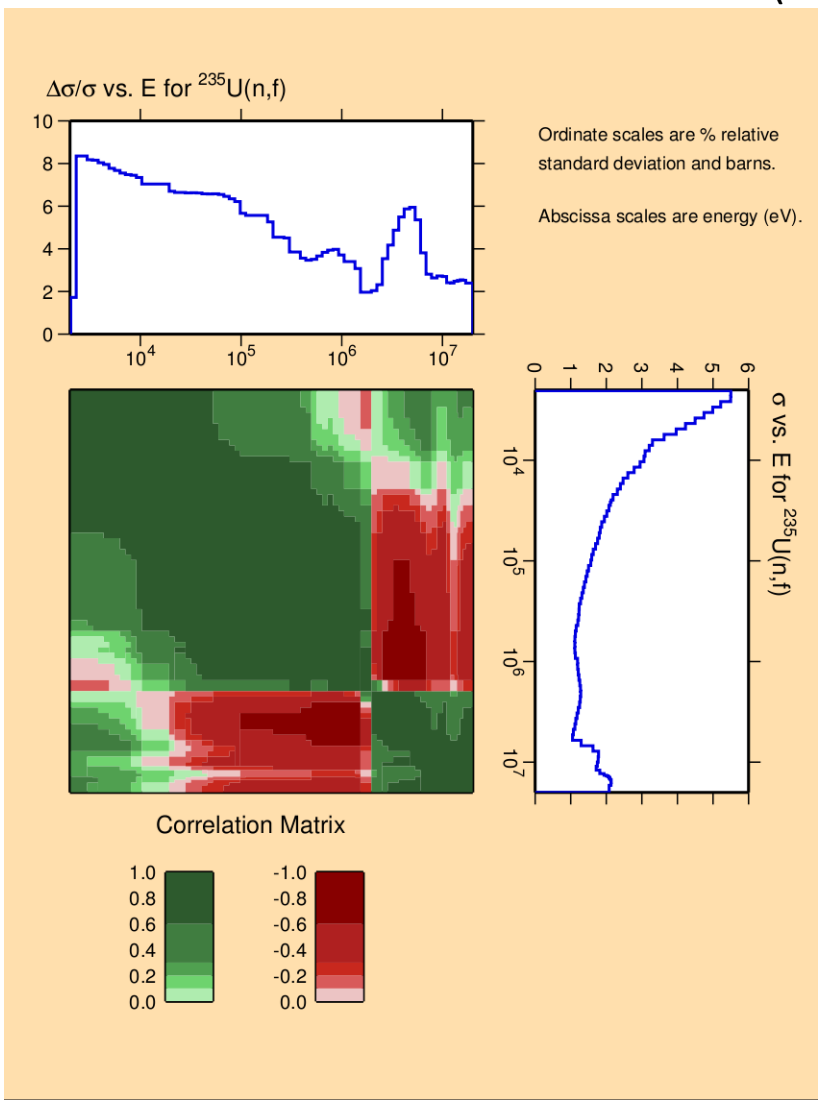


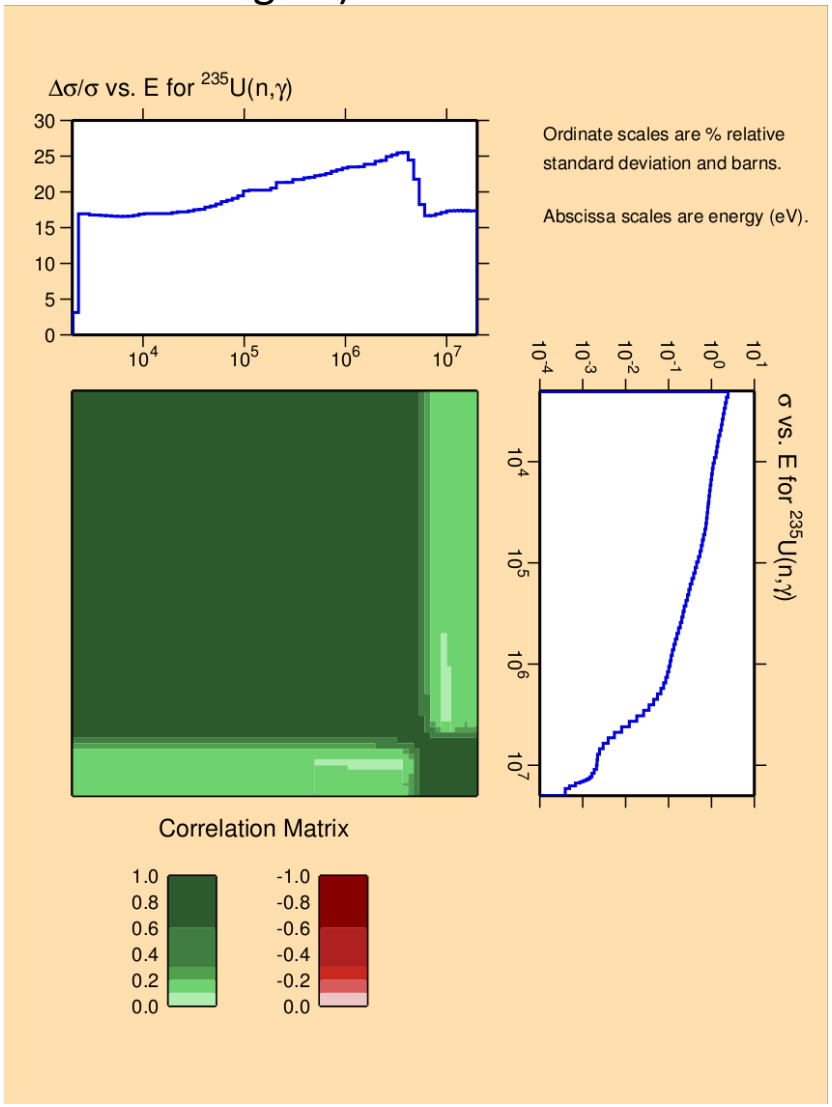
Major changes U-235



Major changes U-235

- New covariances MF-33 and MF-40 (no resonance region)





Major changes U-238

- New Evaluation of February 2016: collaboration of CEA DEN & DAM
- New high energy part

```
 1  JEFF33T0   gen. purp. file: neutron  + U-238   1.e-5 eV -  30 MeV  99 0  0    0
 2  9.223800+4 2.360058+2          1          1          0          19237 1451    1
 3  0.000000+0 0.000000+0          0          0          0          69237 1451    2
 4  1.000000+0 3.000000+7          1          0         10          09237 1451    3
 5  0.000000+0 0.000000+0          0          0        379        2159237 1451    4
 6  92-U -238   CEA      EVAL-FEV16 CEA/DAM CEA/DEN COLLABORATION    9237 1451    5
 7  JEFF33T0             DIST-                                       9237 1451    6
 8 ----JEFF33T0          MATERIAL 9237                               9237 1451    7
 9 -----INCIDENT NEUTRON DATA                                        9237 1451    8
10 ------ENDF-6 FORMAT                                              9237 1451    9
11                                                                   9237 1451   10
12 **************************   JEFF-3.3T0    **********************9237 1451   11
13 ** Evaluation built from contributions of several individuals in**9237 1451   12
14 ** various laboratories.                                        **9237 1451   13
15 **                                                             **9237 1451   14
16 ** 1.e-5 eV to 20 keV: RRR                                     **9237 1451   15
17 ** original data taken from JEFF-3.2                           **9237 1451   16
18 **                                                             **9237 1451   17
19 ** 20 keV to 150 keV: URR                                      **9237 1451   18
20 ** original data taken from JEFF-3.2                           **9237 1451   19
21 **                                                             **9237 1451   20
22 ** MF=33 MT=1,2,4,16,18,102                                    **9237 1451   21
23 ** Covariance matrices in a 44 energy group are produced with  **9237 1451   22
24 ** CONRAD using standard recommendations for fission cross     **9237 1451   23
25 ** section. Data taken from the COMAC covariance database.     **9237 1451   24
26 ** CEA/DEN (Cadarache)                                         **9237 1451   25
27 **                                                             **9237 1451   26
28 **                                                             **9237 1451   27
29 ** 1)  Above URR a new neutron transport file was made by      **9237 1451   28
30 **           P. Romain, B. Morillon, H. Duarte                 **9237 1451   29
31 **       using the TALYS code [kon07]  (version 1.4)           **9237 1451   30
32 **     The calculated fission cross section was replaced       **9237 1451   31
33 **     by the IAEA standard fission cross section.             **9237 1451   32
34 **                                                             **9237 1451   33
35 ** 2) We used the same ENDF-6 formatting procedures as TENDL   **9237 1451   34
36 ** from: A.J. Koning and D. Rochman, NRG Petten, The Netherlands**9237 1451   35
37 **                                                             **9237 1451   36
```

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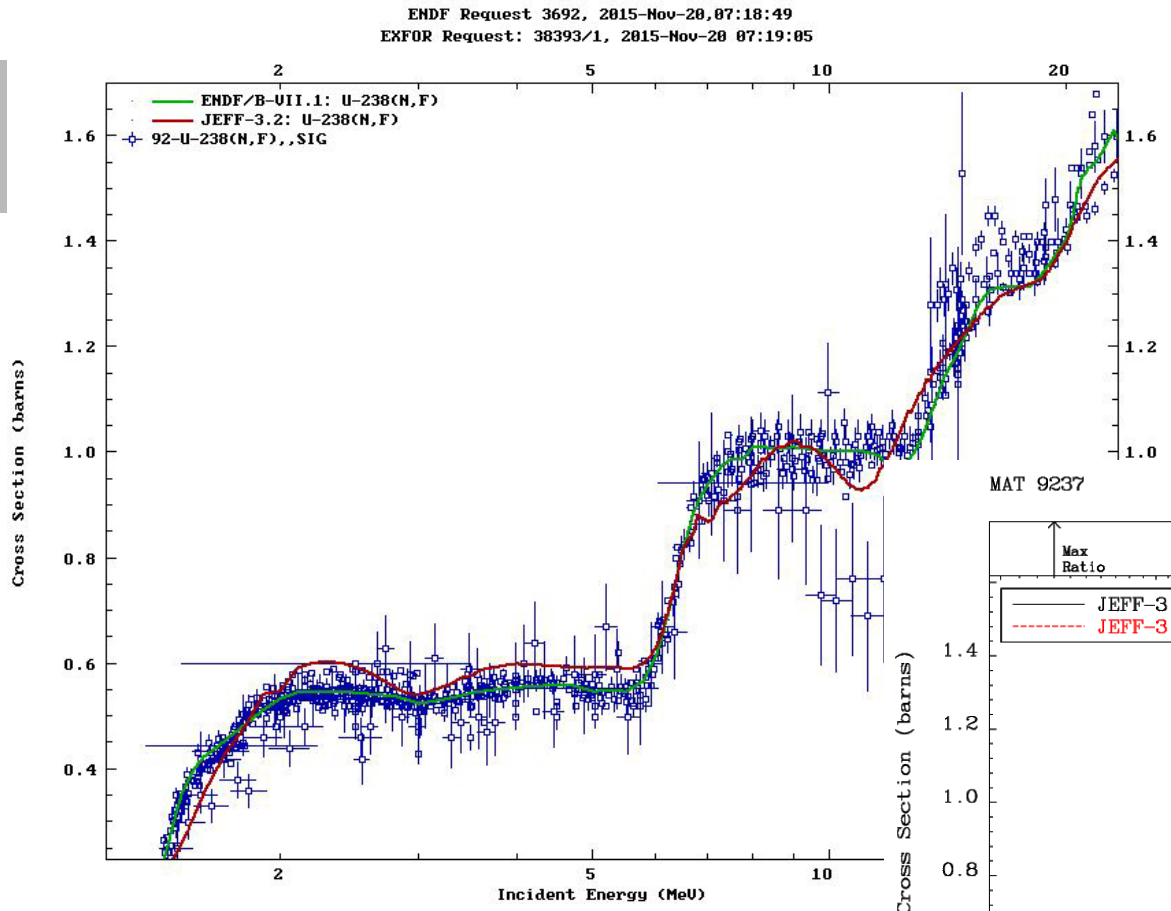
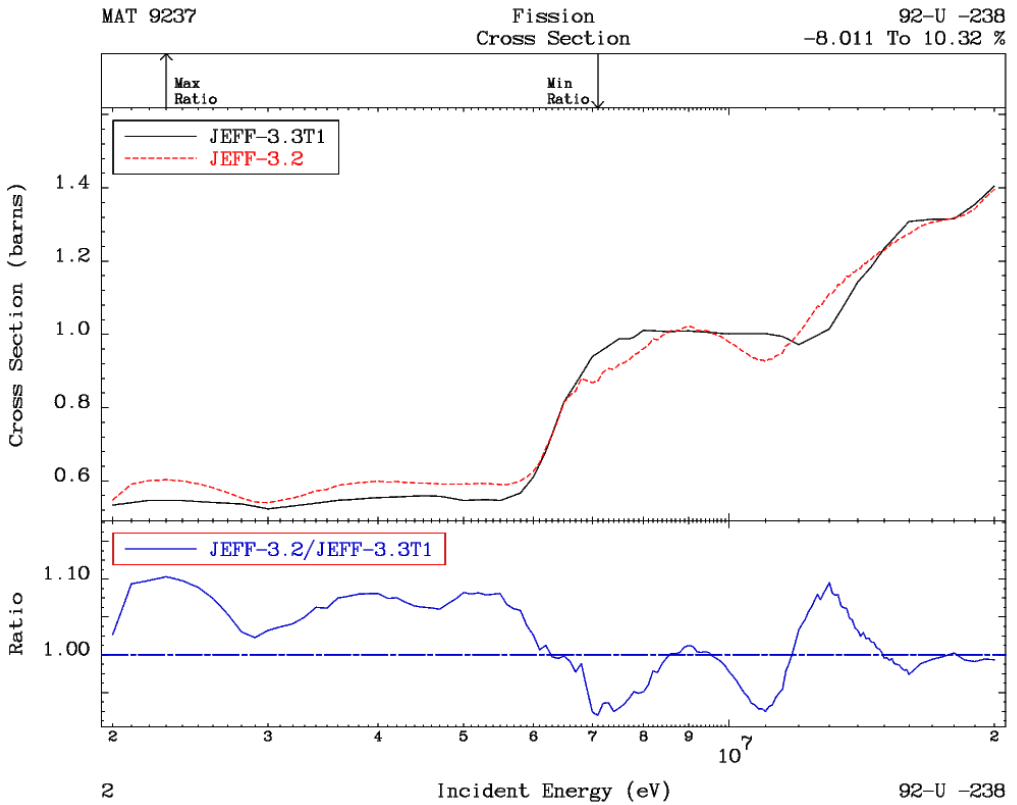
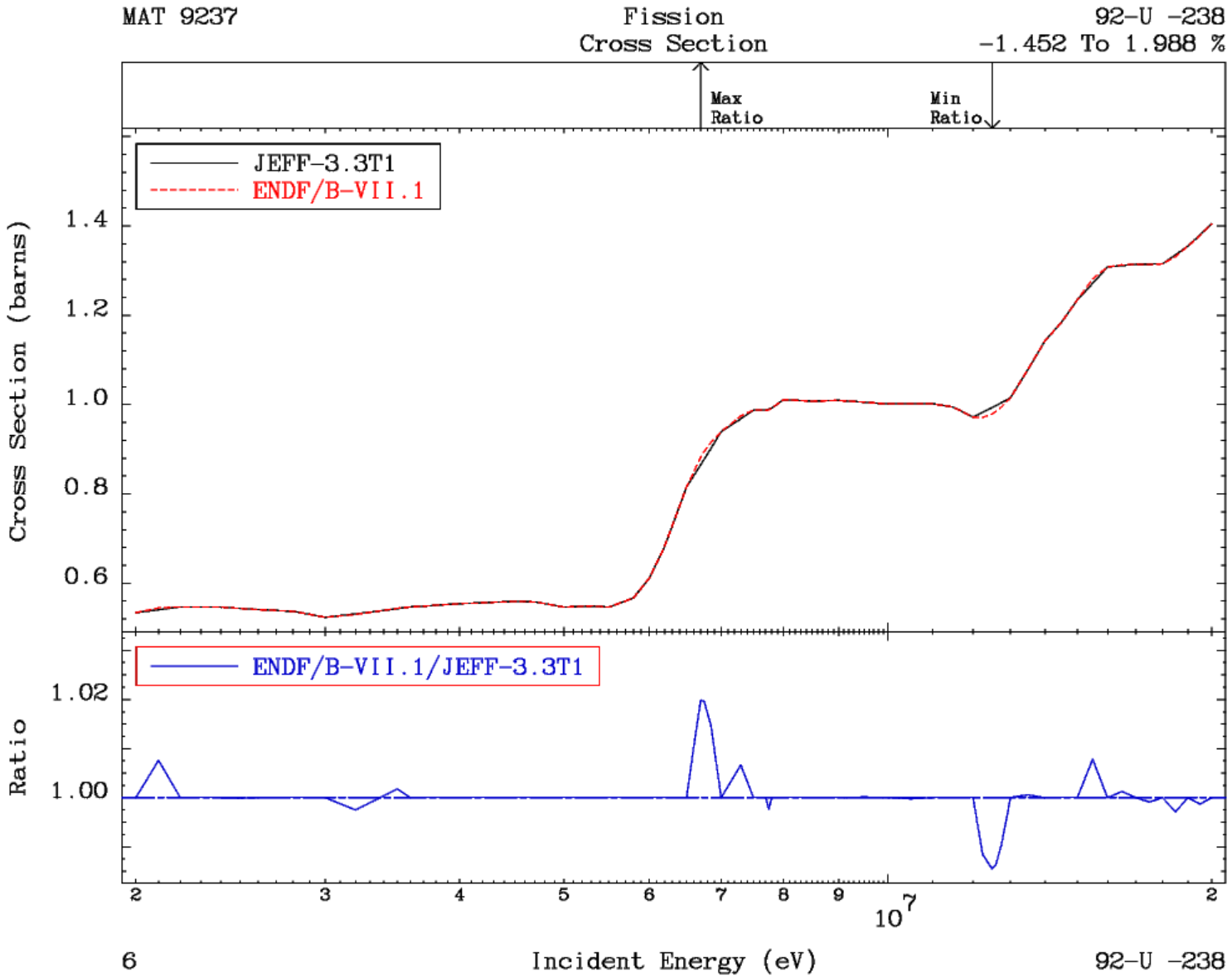
Major changes U-238

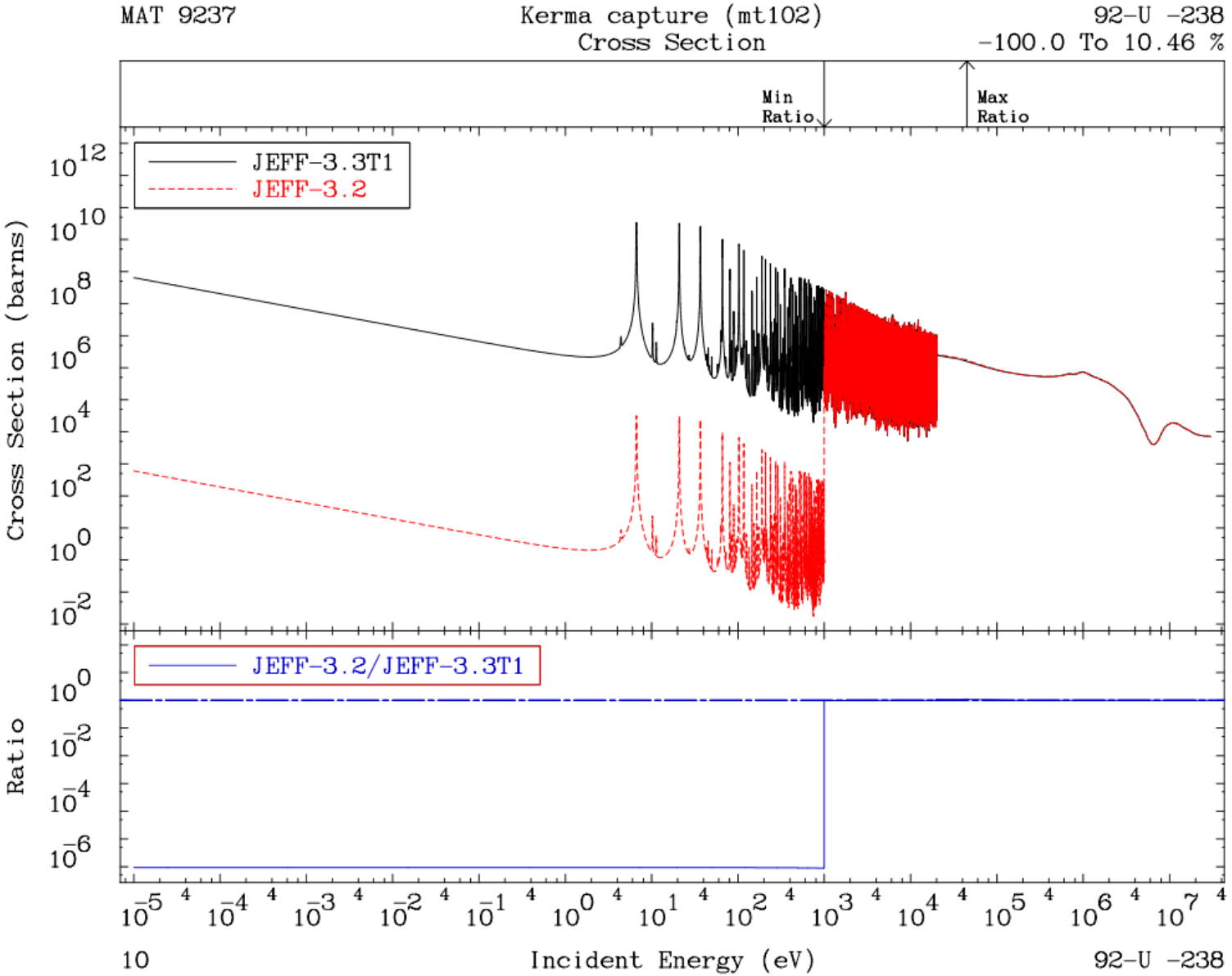




Major changes U-238

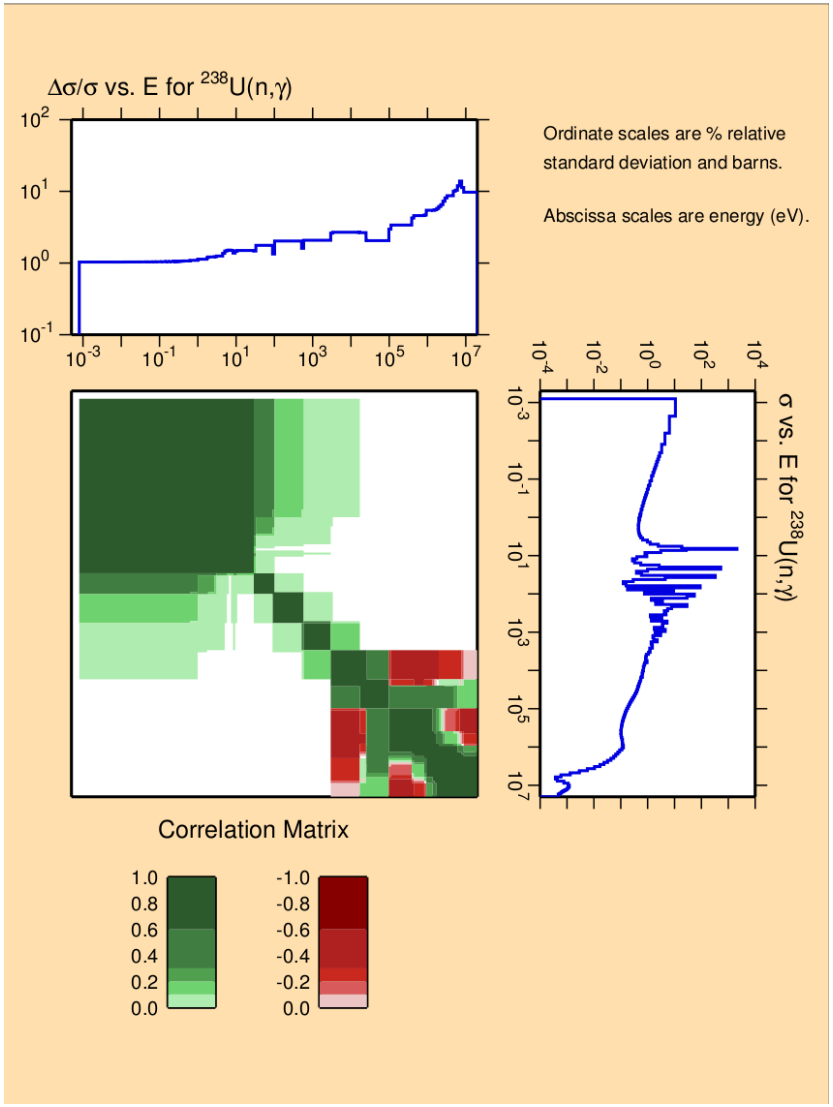


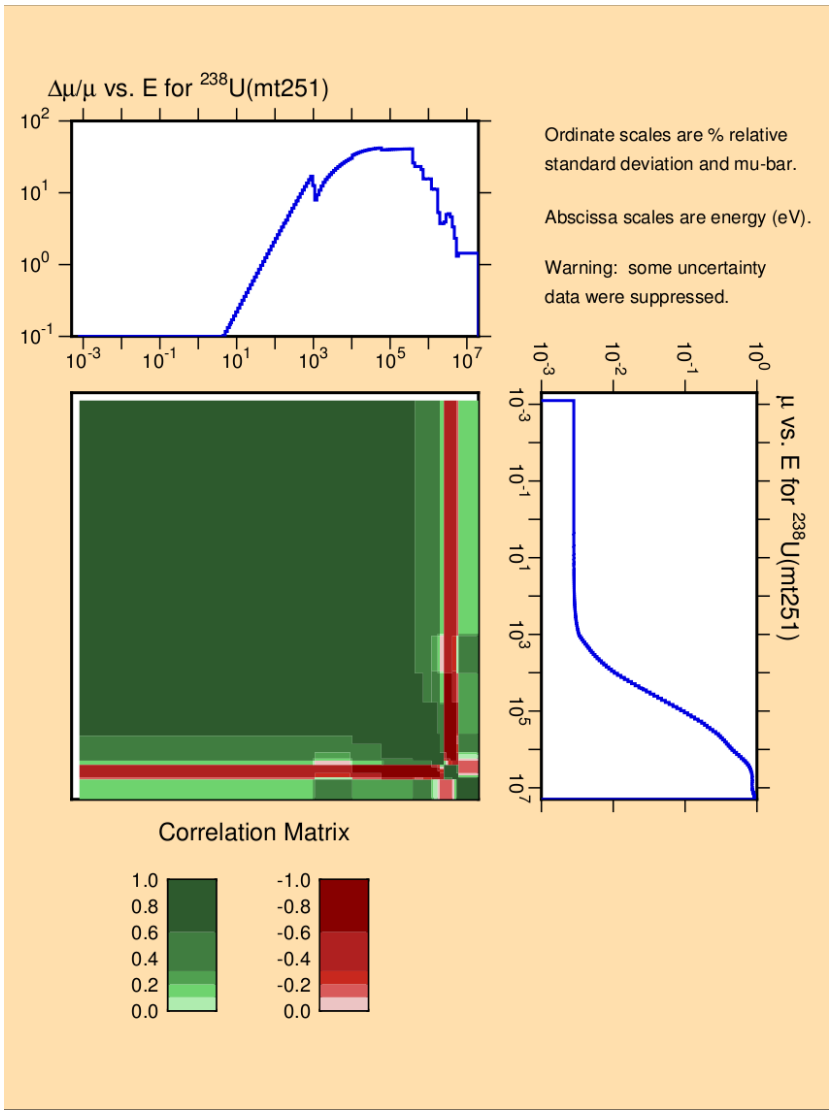
Major changes U-238



Major changes U-238

- New covariances MF-33 and MF-40



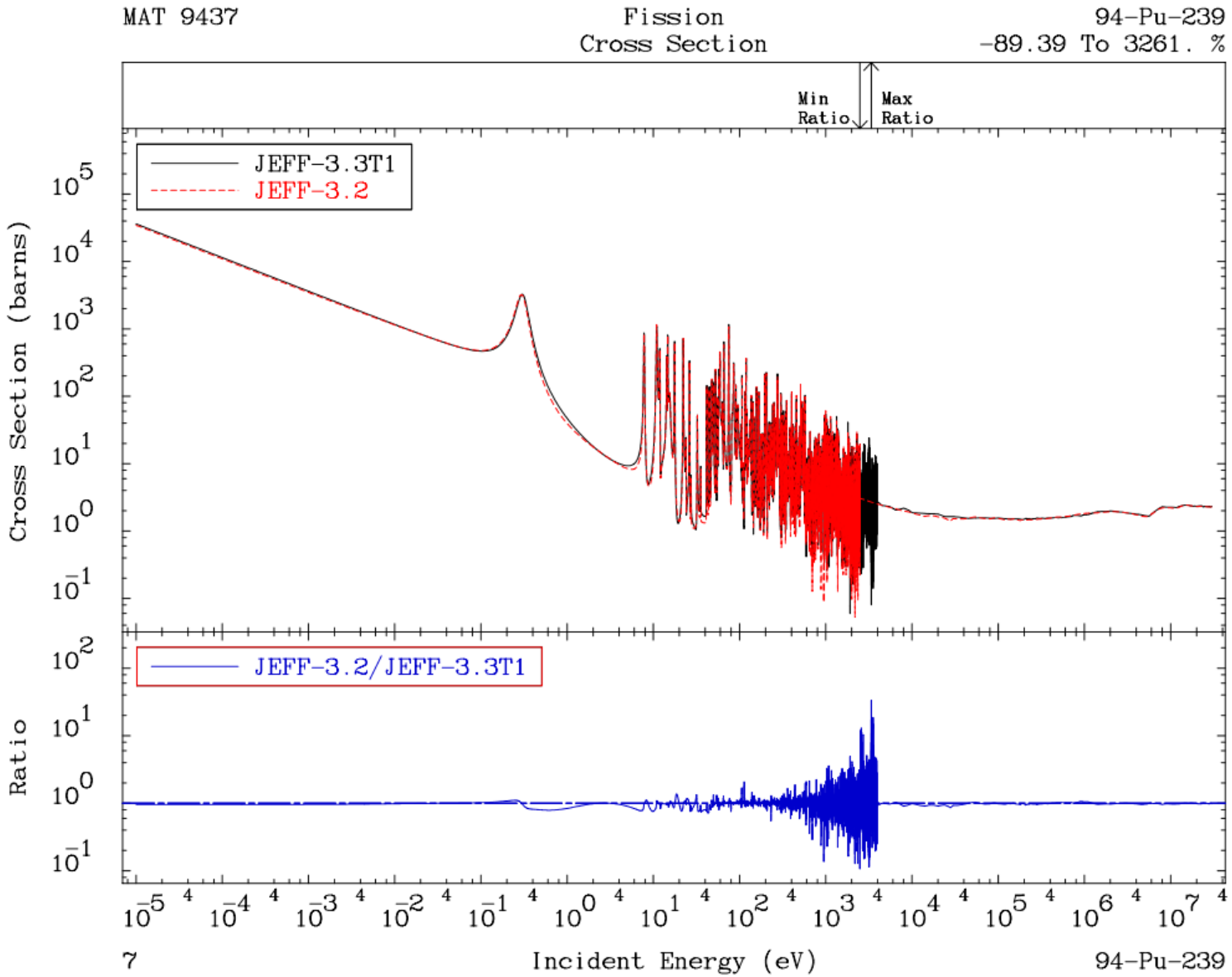


Major changes Pu-239

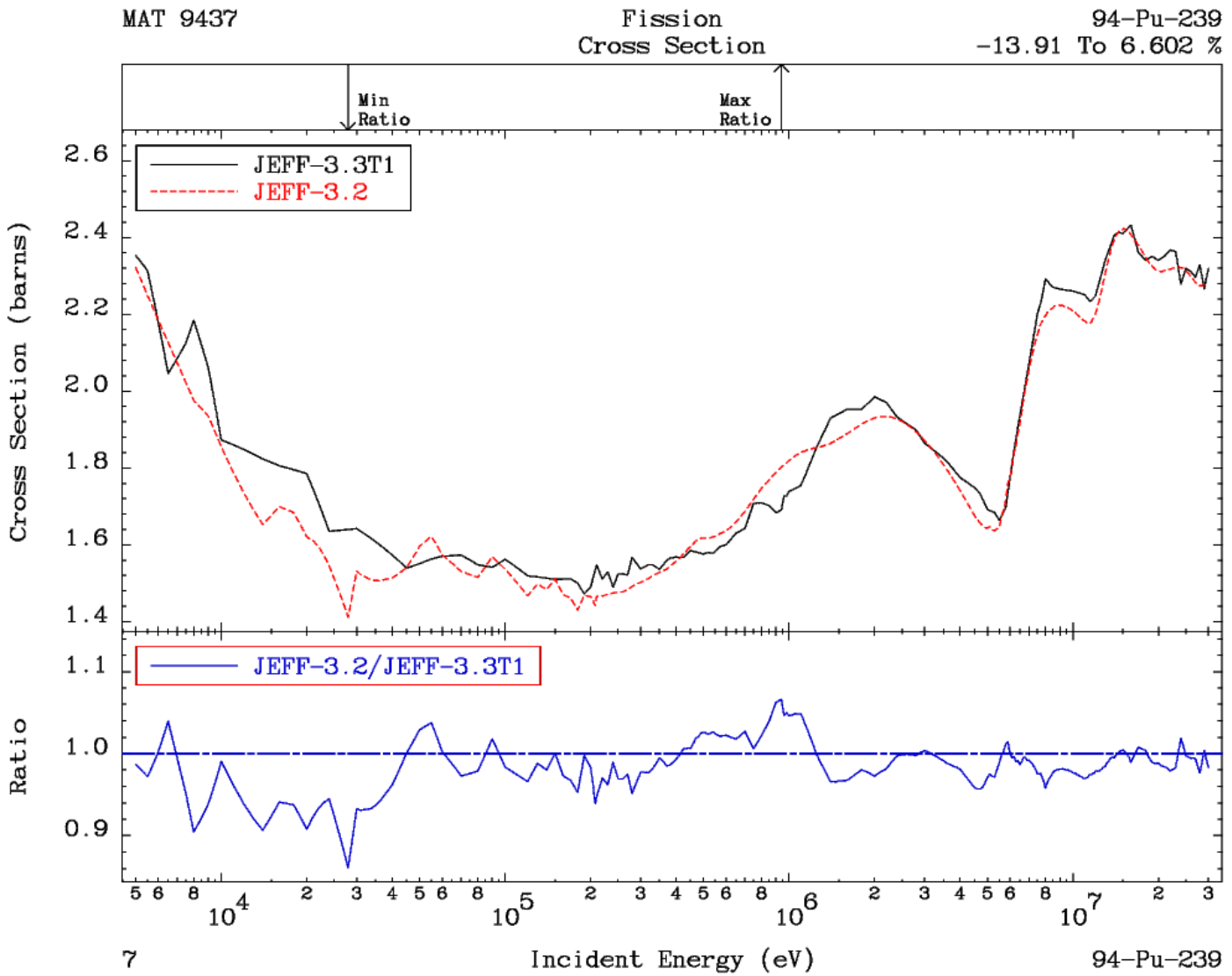
- New Evaluation of February 2016: collaboration of IRSN/CEA

```
 1  JEFF33T0   gen. purp. file: neutron  + Pu-239  1.e-5 eV -  30 MeV  99 0  0    0
 2  9.423900+4 2.369986+2          1          1          0          19437 1451    1
 3  0.000000+0 0.000000+0          0          0          0          69437 1451    2
 4  1.000000+0 3.000000+7          1          0         10          09437 1451    3
 5  0.000000+0 0.000000+0          0          0        463        2189437 1451    4
 6  94-Pu-239 IRSN-CEA   EVAL-FEV16 IRSN-CEA DAM/DEN COLLAB.          9437 1451    5
 7  JEFF33T0             DIST-                                       9437 1451    6
 8 ----JEFF33T0          MATERIAL 9437                               9437 1451    7
 9 -----INCIDENT NEUTRON DATA                                        9437 1451    8
10 ------ENDF-6 FORMAT                                              9437 1451    9
11                                                                   9437 1451   10
12 **************************   JEFF-3.3T0    **********************9437 1451   11
13 ** Evaluation built from contributions of several individuals in**9437 1451   12
14 ** various laboratories.                                        **9437 1451   13
15 **                                                             **9437 1451   14
16 ** 1.e-5 eV to 30 keV:                                         **9437 1451   15
17 ** new evaluation from IRSN+CEA/DEN (Cadarache)                 **9437 1451   16
18 **                                                             **9437 1451   17
19 ** MF=2 MT=451                                                 **9437 1451   18
20 ** RRR 1.e-5 eV to 4 keV:  extension of the Resolved Resonance  **9437 1451   19
21 ** Range from 2.5 keV to 4 keV + update of the resonance       **9437 1451   20
22 ** parameters to take into account both WPEC SG 34 and standard **9437 1451   21
23 ** recommendations                                             **9437 1451   22
24 **                                                             **9437 1451   23
25 ** MF=2 MT=451                                                 **9437 1451   24
26 ** URR 4 keV to 30 keV:  new evaluation of the Unresolved      **9437 1451   25
27 ** Resonance Range to take into account both new changes in RRR **9437 1451   26
28 ** and fast energy range                                       **9437 1451   27
29 **                                                             **9437 1451   28
30 ** MF=33 MT=1,2,4,16,18,102,103,107                           **9437 1451   29
31 ** Covariance matrices in a 33 energy group are produced with  **9437 1451   30
32 ** CONRAD using standard recommendations for fission cross     **9437 1451   31
33 ** section. An integral data assimilation of JEZEBEL experiment **9437 1451   32
34 ** has also been performed. Data taken from the COMAC covariance**9437 1451   33
35 ** database. CEA/DEN (Cadarache)                               **9437 1451   34
36 **                                                             **9437 1451   35
37 **                                                             **9437 1451   36
38 **                                                             **9437 1451   37
39 ** 1)  Above URR a new neutron transport file was made by      **9437 1451   38
40 **           P. Romain, B. Morillon, H. Duarte                 **9437 1451   39
41 **       using the TALYS code [kon07]  (version 1.4)           **9437 1451   40
42 **     The calculated fission cross section was replaced       **9437 1451   41
43 **     by the IAEA standard fission cross section.             **9437 1451   42
```

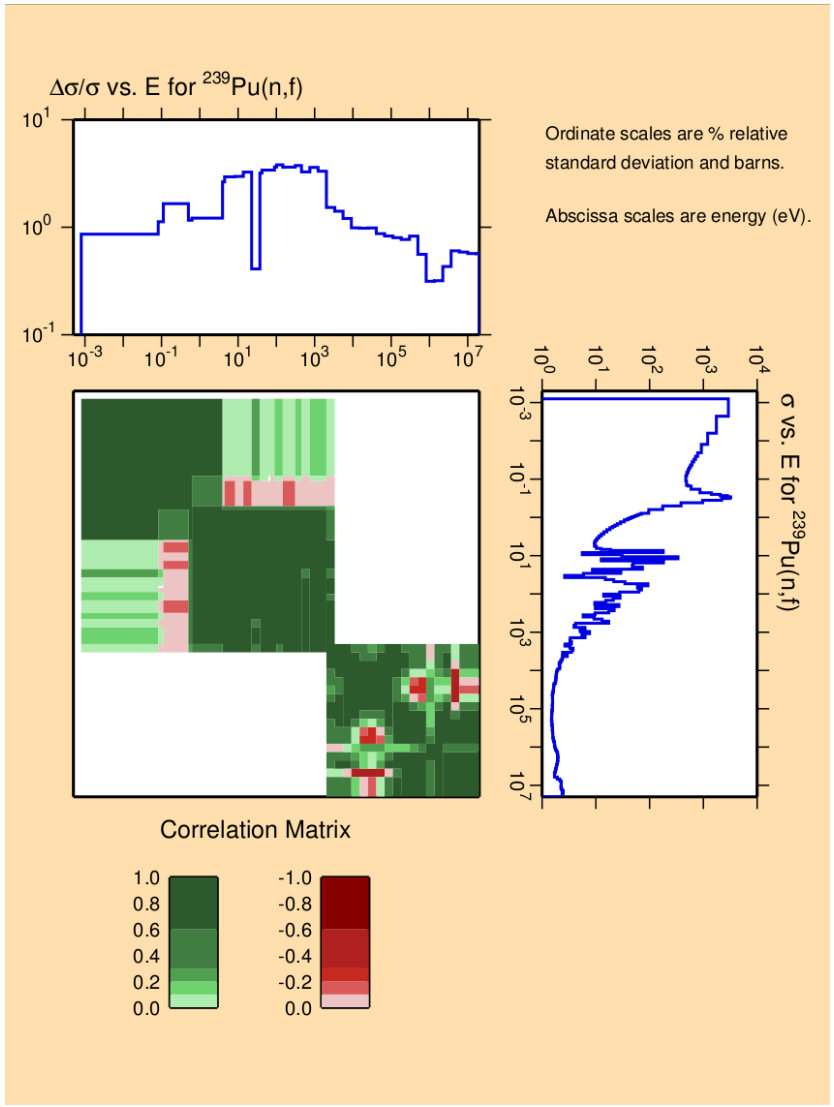
Major changes Pu-239

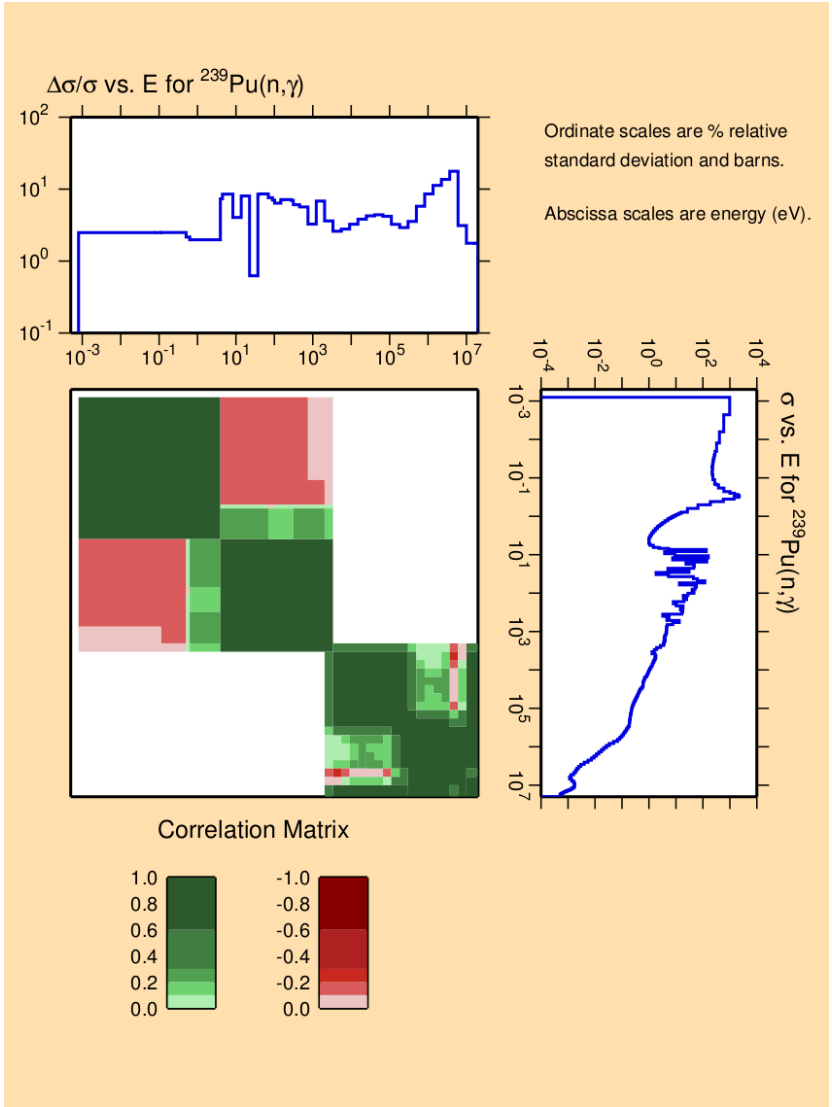


Major changes Pu-239



Major changes Pu-239





Feedback from format checking (1/4)

- From C. Jouanne:

  - MF15/12/13: about 50 isotopes with problematic emitted gamma energy
  - MF6: 477 files contain one, two or three of the following problems:
    (1) difference in threshold energies between MF3 and MF6,
    (2) emitted energies different than the available energy,
    (3) gamma yields not normalized.
    There are 559 files in JEFF-3.3 T1, So almost all MF6 files are concerned, all from either TENDL, ENDF/B-VII.1 or JENDL-4.0. A possible fix for part of the problems is changing the interpolation law from 2 to 22.
  - MF5: 5 Cd evaluations with emitted energies different than available energies,
  - MF4: Pb208: wrong normalization of angular distributions above 1MeV. 20 evaluations with negative angular distributions
  - MF3: 46 evaluations with reaction threshold different than Nubase 2003
  - MF2: 6 evaluations with problematic spin assignments.
  - MF1: 13 evaluations with masses different than Nubase 2003
  - Specific comments related to Am241 and Am242G (names, MF1 and MF8)
  - Specific comments related to Am241, U236 and U237 and gamma production (replacing MF6 by MF12 and MF15). Cedric has sent proposed corrected files.

Feedback from format checking (2/4)

- From W. Haeck (with NJOY and GAIA):
  - MF2: negative elastic cross section for 5 isotopes
  - ACER NJOY2012.50 failed on Sn116 and Sn117, but 99.259 works.
  - MF2: probability tables with negative cross sections for 5 isotopes. Possible solution: don't use PURR.
  - MF2: duplicated incident energies for 20 isotopes
  - Wim found a bug in NJOY2012.50 (related to the URR): discussion with JC Sublet and O. Cabellos

Feedback from format checking (3/4)

- From O. Cabellos (with FUDGE)
  - MF8: problematic residual level energy for 122 isotopes
  - MF32: difference in resonance energies for 94 isotopes and wrong matrix index for 13 isotopes
  - MF33: 2 isotope with wrong MF33
  - MF40: 1 isotope with wrong MF40 (Am241)
  - MF12: final energy errors for Pu239
  - Crashed FUDGE: Cr52 and Pb205
  - Oscar also found a bug in NJOY2012.50 related to MF32c (all TENDL files MF32c need to be corrected)

Feedback from format checking (4/4)

- From J.C. Sublet:
  - MF2: negative cross sections for 7 isotopes
  - MF2: RRR-URR overlapping energies for 7 isotopes
  - HEATR failed on 3 isotopes
  - Negative probabilities with PURR for 29 isotopes
  - MF2: CALENDF failed for 2 isotopes with lrf=7

Feedback from the JEFF community

- ^{nat}C: see the presentation from C. Diez (might not require additional work)
- ^{197}Au: see the presentation from S. Kopecky (additional work required),
- Cd isotopes: see the presentation from S. Kopecky (additional work required),
- Ag107,109, Gd157: problems with MEND record from A. Stankovskiy (corrections sent, as for JEFF-3.2)
- More to come during this meeting ?

Conclusion

- Can we accept the warnings/problems we have seen ?
- What shall we fix them and who will do it ?
- Let‘s see the benchmarks results
- About covariances: no MF31, 35 for actinides ?