

PFGS updates for actinides Gamma production

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LANL-T2

Outline

◆ ^{235}U

- Thermal fission: use data by Oberstedt, Verbinski
- Same PFGS for all incident energies
- Multiplicities/total gamma-ray energy deposited adjusted to match Drake data

◆ ^{238}U

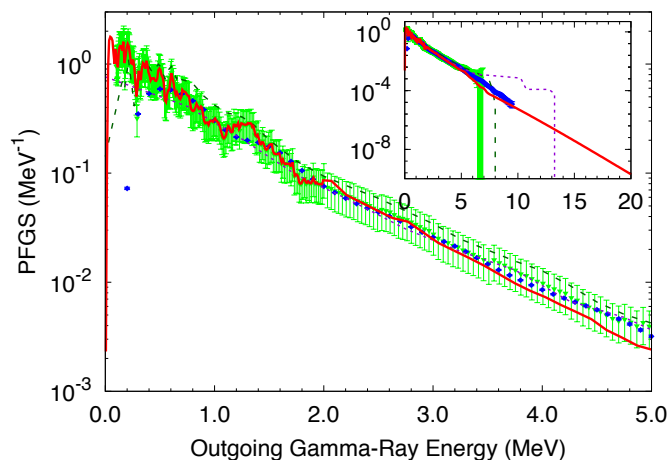
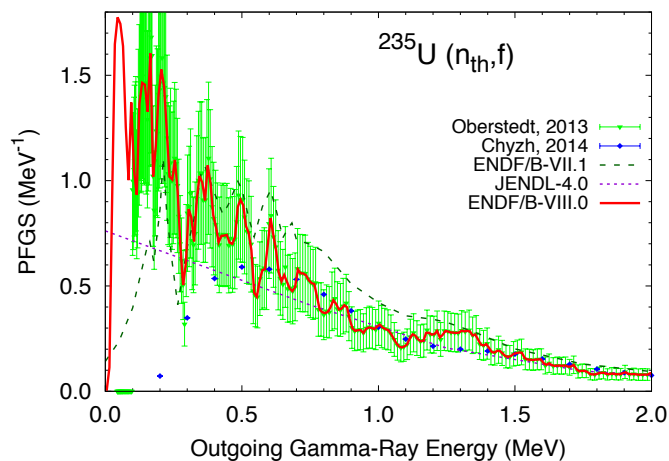
- Work in progress

◆ ^{239}Pu

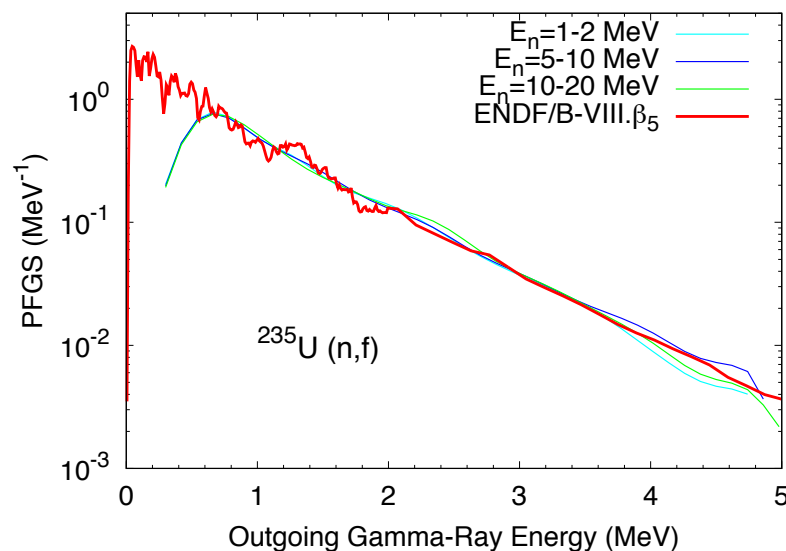
- Thermal fission: use data by Oberstedt, Verbinski
- Same PFGS for all incident energies
- Multiplicities/total gamma-ray energy deposited adjusted to match Drake data

^{235}U

PFGS status for $^{235}\text{U}(n,f)$

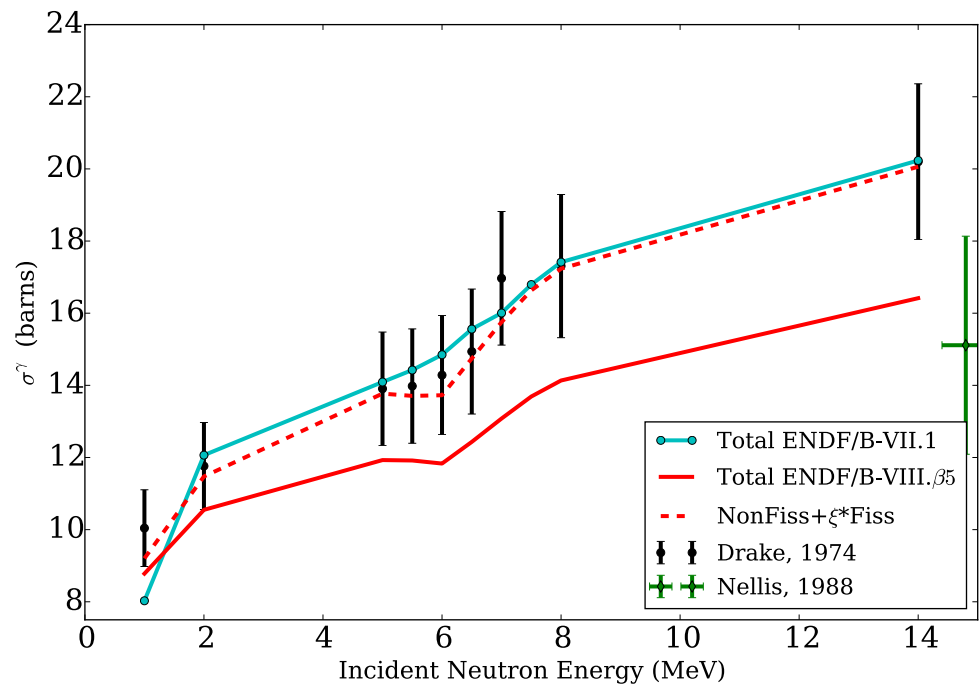


- ◆ 0.1– 2 MeV: use Oberstedt
- ◆ 0-0.1 and 2-6 MeV: use MC-CGMF
 - Below 100keV: to be confirmed
- ◆ >6 MeV: fit CGMF deterministic
- ◆ No incident neutron energy dependence



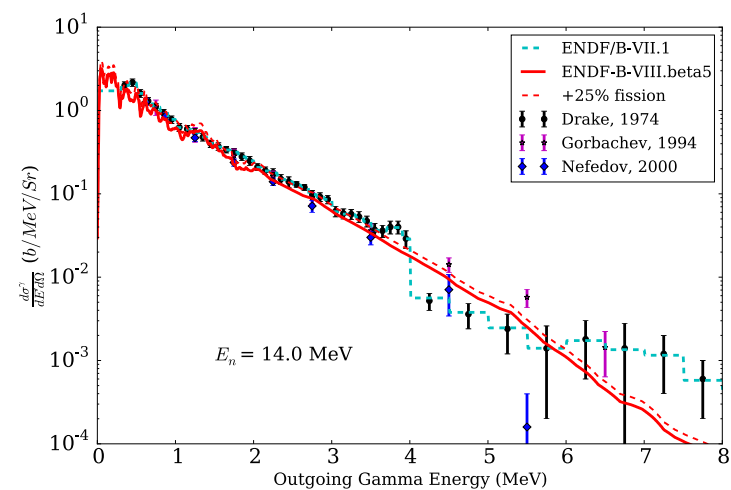
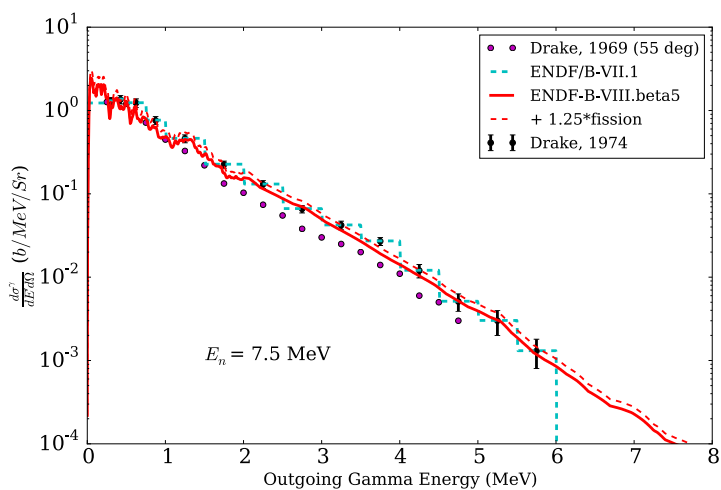
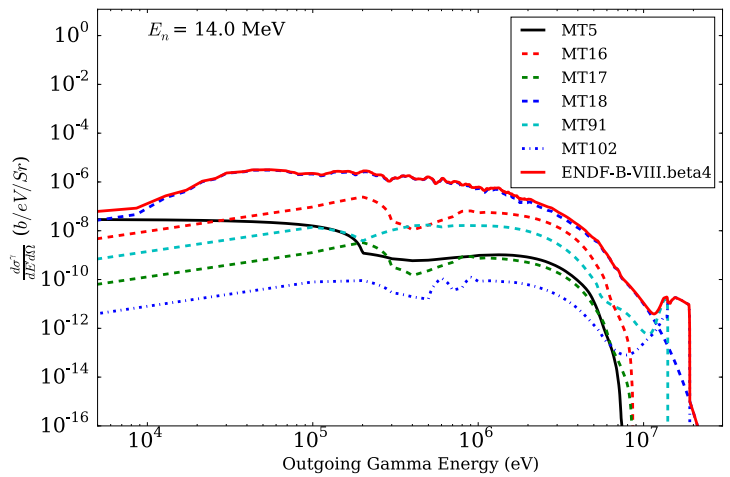
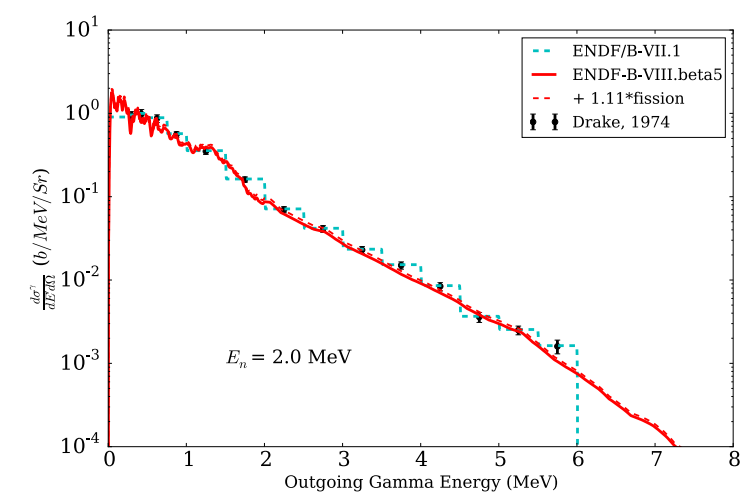
Kwan et. al., NIM A 688, 55 (2012)

Total gamma production for $^{235}\text{U}(n,x\gamma)$



(Other data is systematically lower)

Gamma production spectrum for $^{235}\text{U}(n,xy)$



Spectral shape reproduces well the Drake data with no incident energy dependence of the PFGS

Prompt gamma multiplicity and average gamma-ray energy

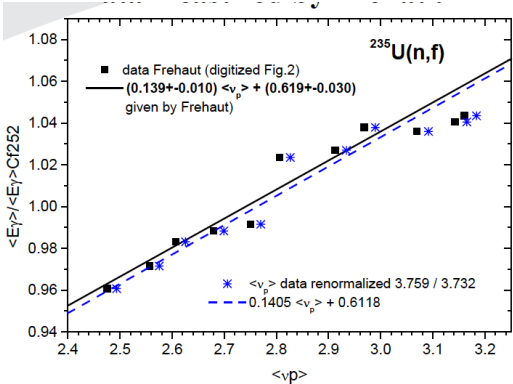
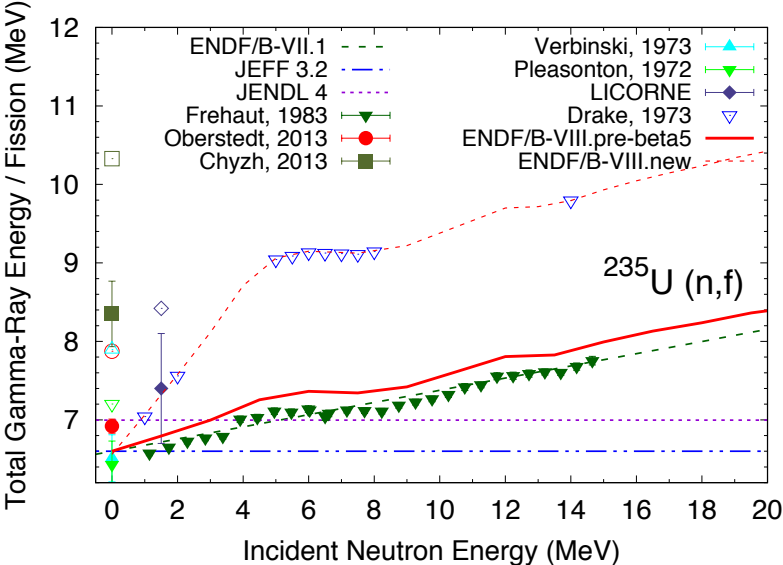
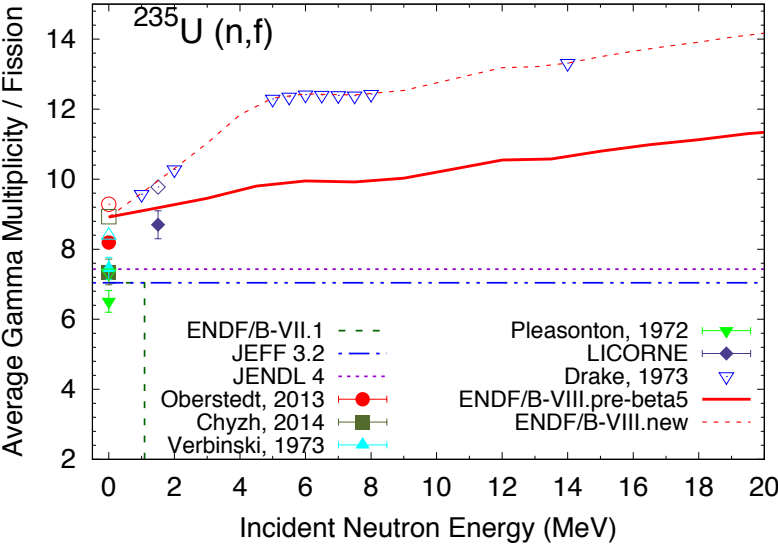
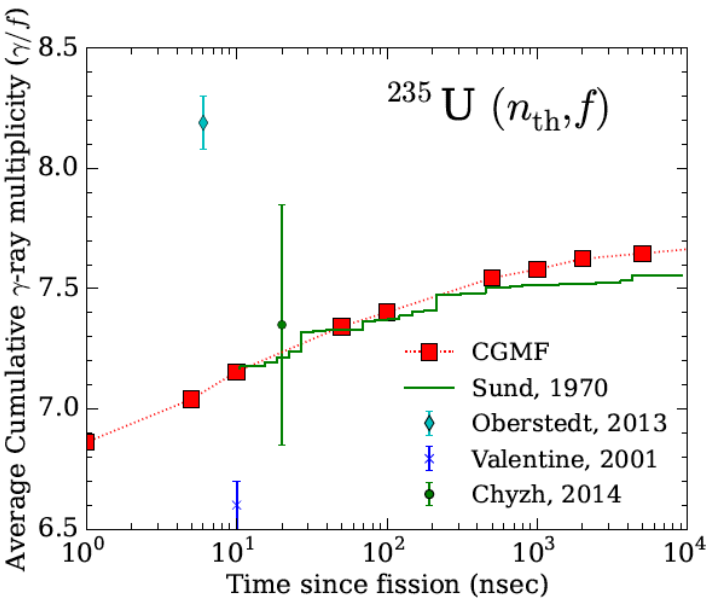


Fig. by A. Tudora, GAMMA2

235U(n,f) evaluation: properties

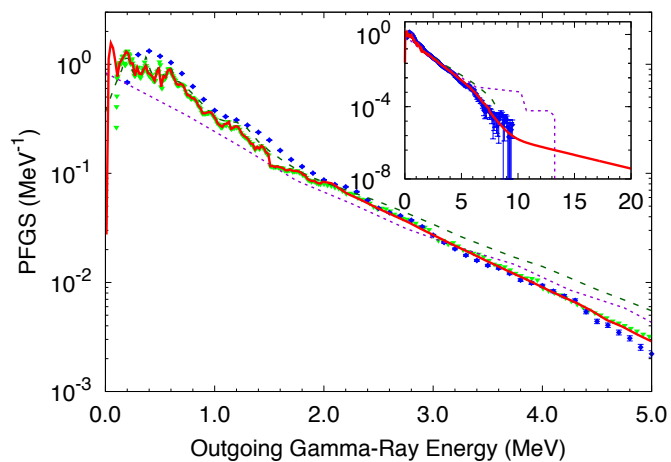
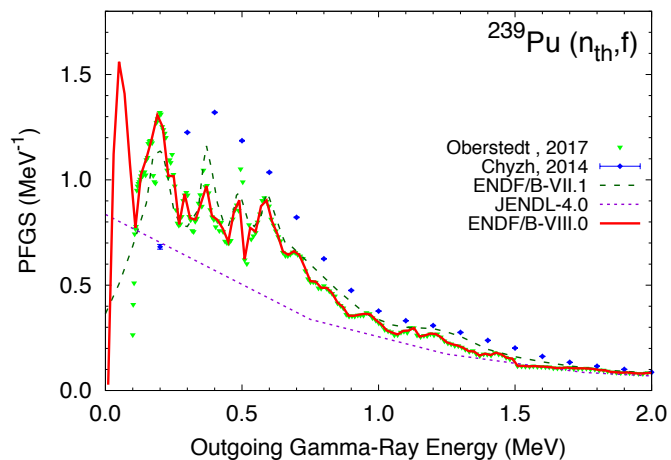
- Average gamma energy: consistent with Oberstedt (100 keV cut)
- Multiplicity: adjusted to reproduce Drake data
- All CGMF calculations assume a 6 ns time-coincidence window



	<M _γ >	<ε _γ >[MeV]	<E _γ >[MeV]
ENDF/B-VIII-b5	8.92	0.73	6.56
ENDF/B-VII.1	7.04	0.94	6.60
JEFF 3.2	7.04	0.94	6.60
JENDL 4	7.43	0.94	6.997
CGMF (0keV)	8.39	0.73	6.42
ENDF/B-VIII-b5	7.93	0.82	6.48
CGMF (100keV)	7.31	0.82	6.35
Oberstedt	8.19(11)	0.84(2)	6.92(9)
Pleasanton	6.51(30)	0.99(7)	6.43(30)
ENDF/B-VIII-b5	7.50	0.86	6.42
CGMF (140 keV)	6.9	0.91	6.32
Verbinski	6.70(30)	0.97(5)	6.51(30)
Chyzh	7.35	(1.14)	8.35
Peele	7.45(35)	0.99(7)	7.18(26)
ENDF/B-VIII-b5	5.07	1.14	5.80
CGMF (400 keV)	4.87	1.19	5.78
Jandel	4.92	1.20	5.89

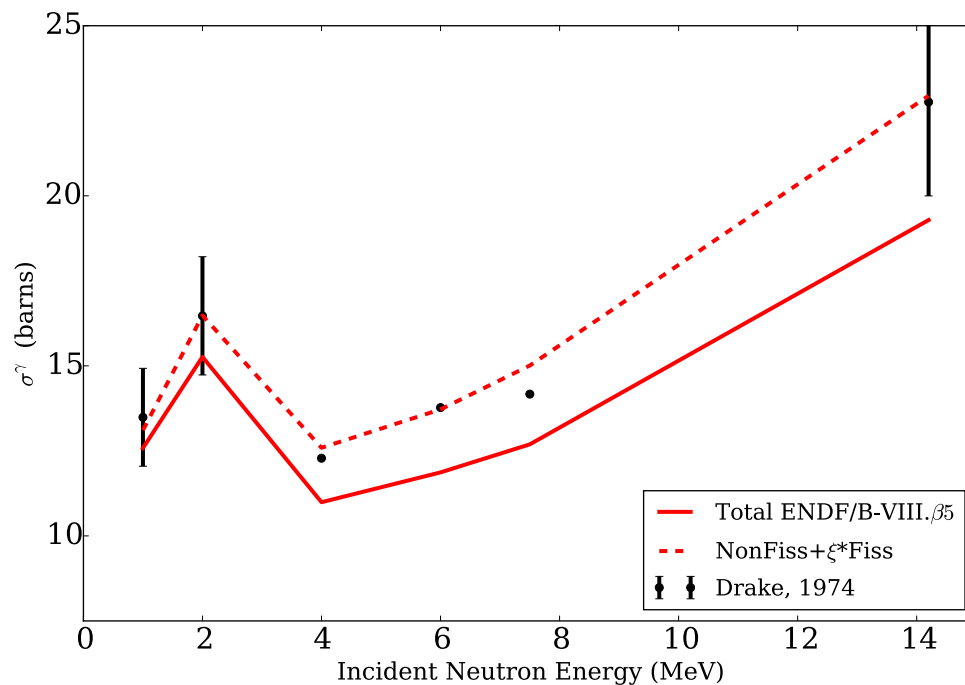
^{239}Pu

PFGS status for $^{239}\text{Pu}(n,f)$



- ◆ 0.1– 2 MeV: use Oberstdet
- ◆ 0-0.1 and 2-6 MeV: use MC-CGMF
- ◆ >6 MeV: fit CGMF deterministic
- ◆ No incident neutron energy dependence

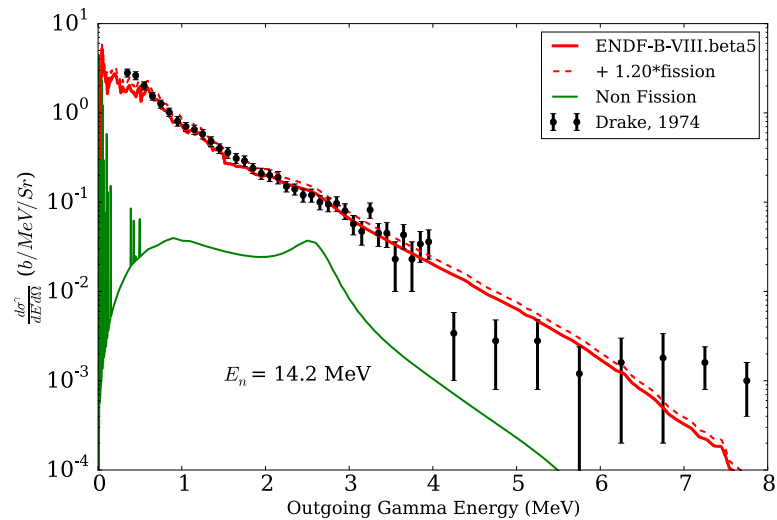
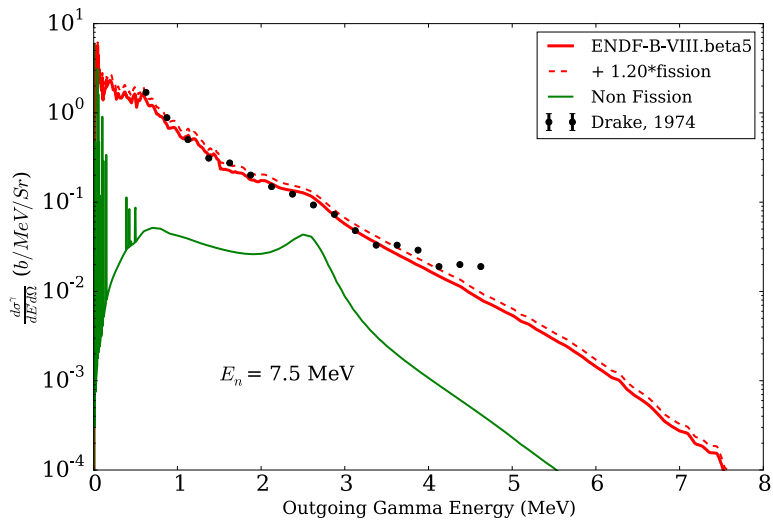
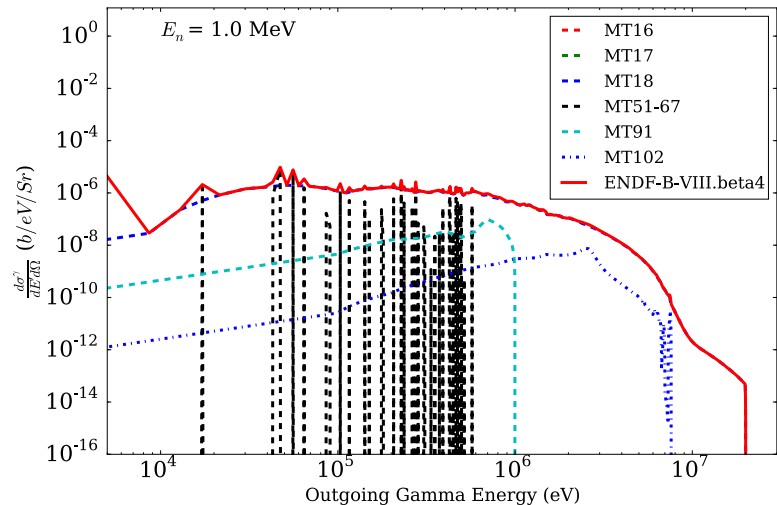
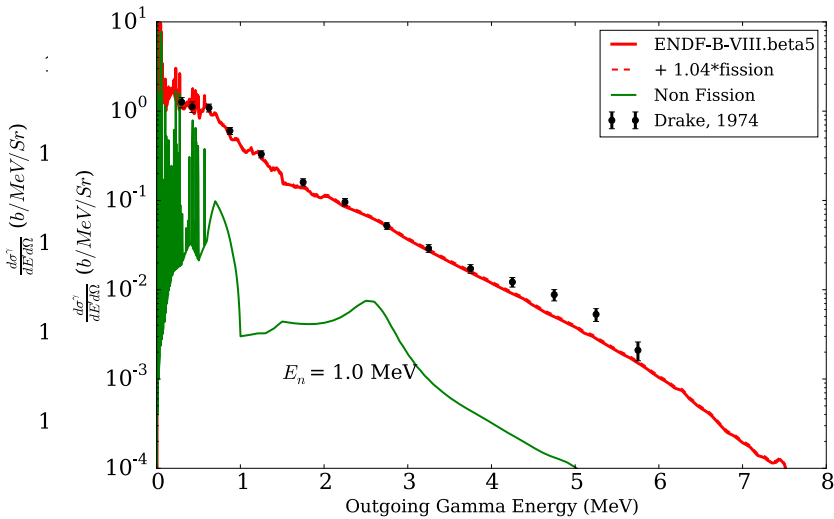
Total gamma production for $^{239}\text{Pu}(n,xy)$



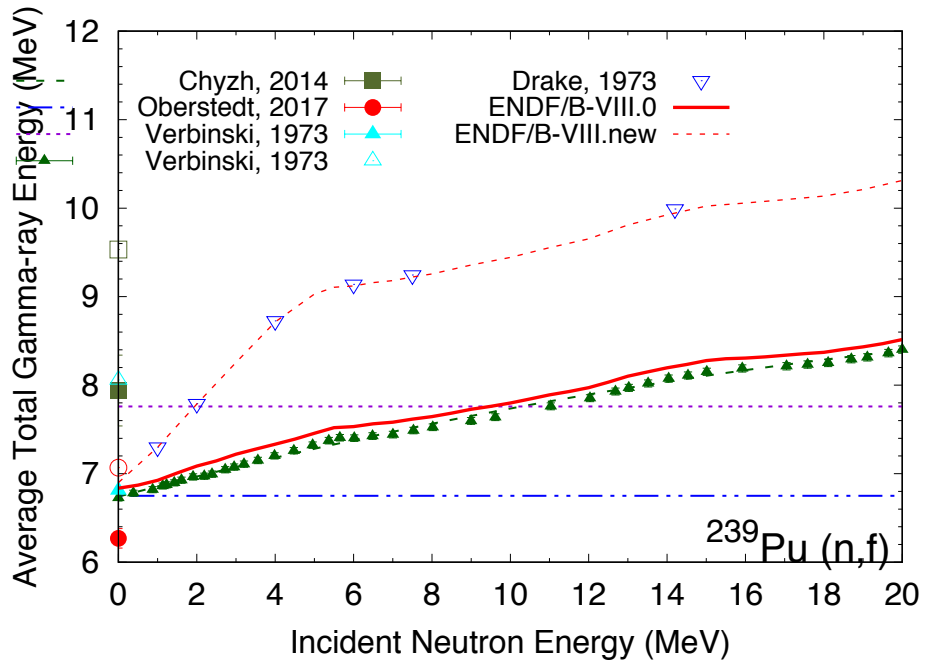
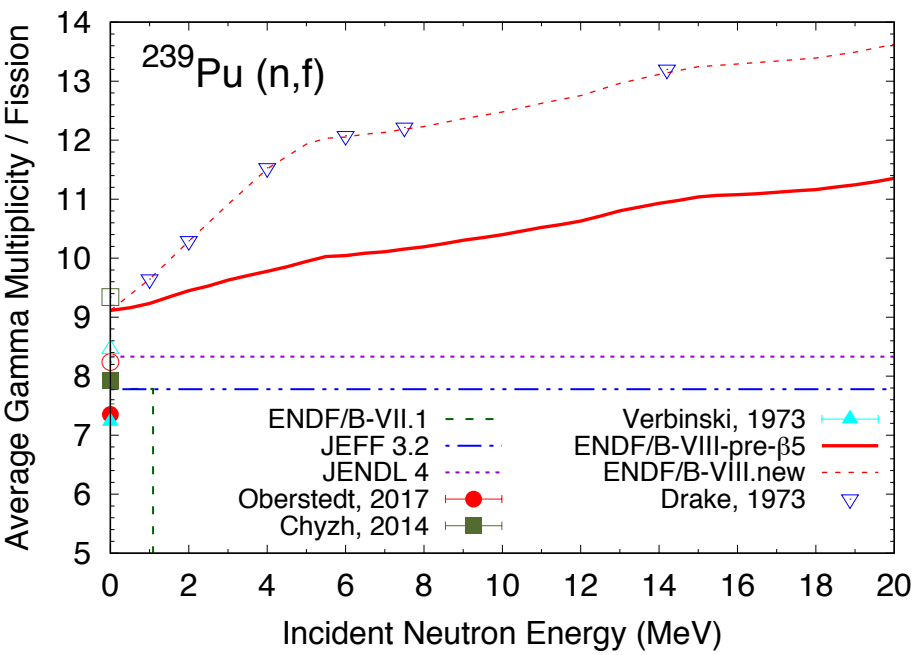
PFG multiplicity:

- Below 4.5 MeV increases between 0 and 20%
- Above 4.5 MeV increased by 20%

Gamma Production Spectrum for $^{239}\text{Pu}(n,xy)$



Average gamma multiplicity and average total gamma-ray energy



Summary $^{239}\text{Pu}(n,f)$ evaluation

- Average gamma energy: comparable with Verbinski (140 keV cut) and Pleasonton (0.122 – 6.13 MeV, 5 ns)
- Oberstedt (100 keV) a bit low
- All CGMF calculations assume a 6 ns time-coincidence window

	$\langle M_\gamma \rangle$	$\langle \epsilon_\gamma \rangle [\text{MeV}]$	$\langle E_\gamma \rangle [\text{MeV}]$
ENDF/B-VIII-b5	9.12	0.90	8.19
ENDF/B-VII.1	7.78	0.87	6.74
JEFF 3.2	7.78	0.87	6.75
JENDL 4	8.34	0.89	7.75
CGMF (0keV)	8.60	0.77	6.77
ENDF/B-VIII-b5	8.18	0.83	6.81
CGMF (100keV)	7.56	0.89	6.71
Oberstedt	7.35(12)	0.85(2)	6.27(11)
Pleasonton	6.88(35)	0.98(7)	6.73(35)
ENDF/B-VIII-b5	7.84	0.86	6.77
CGMF (140 keV)	7.12	0.94	6.66
Verbinski	7.23(30)	0.94(5)	6.81
Ullmann	7.15(9)	(1.04)	7.46(6)
Chyzh	7.93	(1.00)	7.94