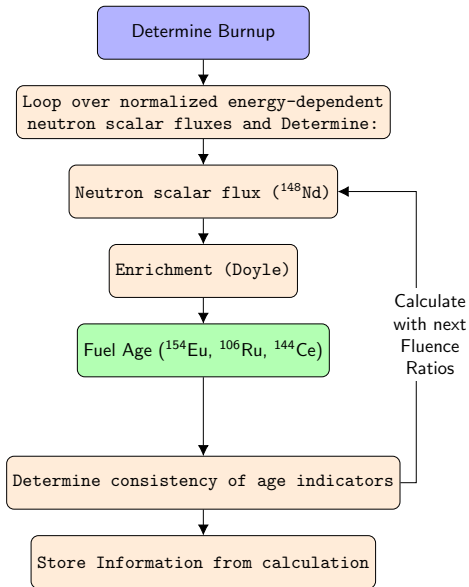


# Program Progress

Paul Mendoza

March 8, 2016

Presented at Research Meeting



# Cross-section calculations

$$\sigma = \frac{\int \sigma(E) \phi(E) dE}{\int \phi(E) dE}$$

$$\phi(E) = C_1 \cdot \frac{E}{E_0^2} \cdot \exp\left(-\frac{E}{E_0}\right) \quad E < E_{max,th}$$

$$= \frac{C_2}{E} \quad E_{max,th} < E < E_{max,epi}$$

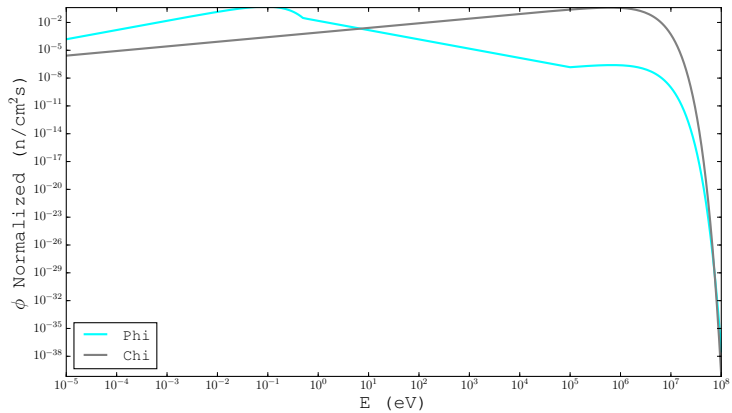
$$= C_3 \cdot \frac{\sqrt{\frac{E}{E_f}}}{E_f} \cdot \exp\left(-\frac{E}{E_f}\right) \quad E > E_{max,epi}$$

$$C_1 = \frac{E_0^2}{E_{max,th}^2} e^{E_{max,th}/E_0}$$

$$C_2 = 1$$

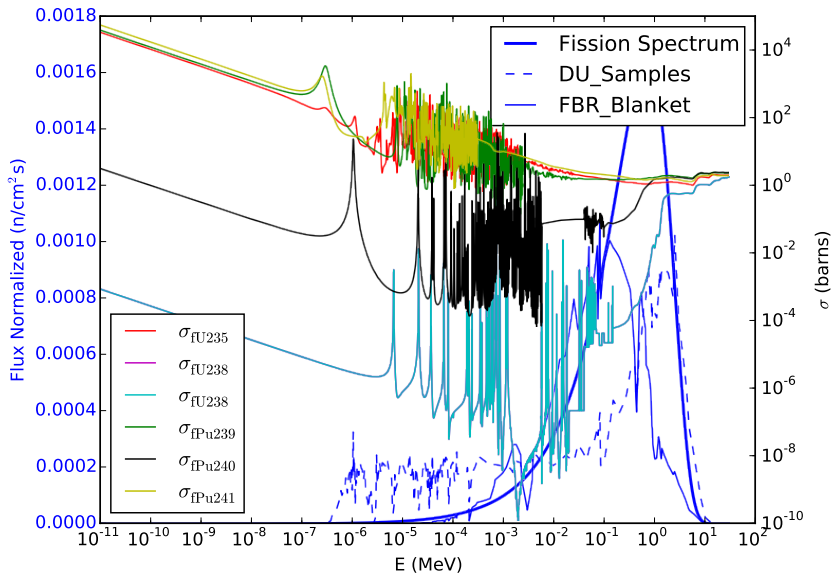
$$C_3 = \frac{E_f}{E_{max,epi}} \cdot e^{\frac{E_{max,epi}}{E_f}} \frac{1}{\sqrt{\frac{E_{max,epi}}{E_f}}}$$

$$E_{max,th} = 0.50 \text{ eV}, E_{max,epi} = 1E5 \text{ eV}, \theta_{th} = 0.09 \text{ eV (764 K)}, \theta_{fis} = 1.35E6 \text{ eV}$$



$$\chi = C_4 e^{-\frac{E}{a}} \sinh(\sqrt{bE})$$

# Flux Plot



# One Group Cross Section Comparison

Isotope <sup>Rxn</sup>	ENDF VII	ORIGEN2	Ratio
<sup>239</sup> Pu <sup>γ</sup>	6.544e+01	6.909E+01	1.06
<sup>240</sup> Pu <sup>γ</sup>	1.521e+02	2.228E+02	1.46
<sup>241</sup> Pu <sup>γ</sup>	4.518e+01	4.202E+01	0.93
<sup>235</sup> U <sup>γ</sup>	9.387e+00	1.068E+01	1.14
<sup>238</sup> U <sup>γ</sup>	4.098e+00	8.872E-01	0.22
<sup>239</sup> Pu <sup>f</sup>	1.179e+02	1.211E+02	1.03
<sup>240</sup> Pu <sup>f</sup>	9.609e-01	5.787E-01	0.60
<sup>241</sup> Pu <sup>f</sup>	1.253e+02	1.259E+02	1.01
<sup>235</sup> U <sup>f</sup>	4.621e+01	4.752E+01	1.03
<sup>238</sup> U <sup>f</sup>	2.091e-01	9.281E-02	0.44

From ORIGEN 2.2 calculation

$$\phi = \frac{6.242 \cdot 10^{18} \cdot P}{\sum_i \chi_i^f \sigma_i^f R_i}$$

$\phi$ =instantaneous neutron flux

$P$ =power (MW)

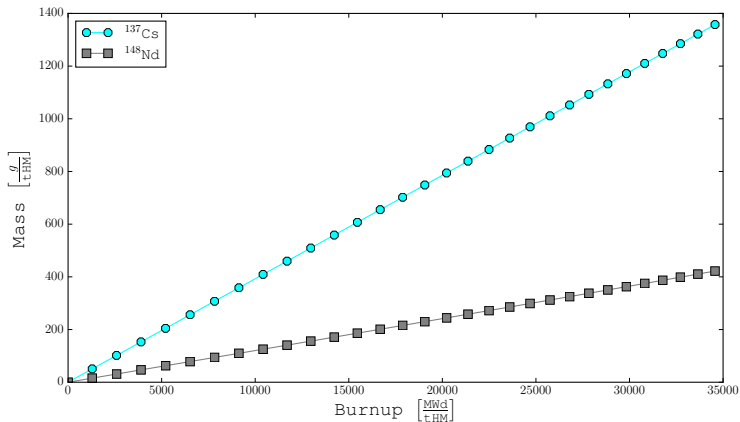
$\chi_i^f$ =amount

$\sigma_i^f$ =microscopic fission cross section for nuclide  $i$

$R_i$ =recoverable energy per fission for nuclide  $i$  (MeV/fission)

$$R_i \text{ MeV/Fission} = 1.29927 \times 10^{-3} (Z^2 A^{0.5}) + 33.12$$

# Bateman Results





# $^{137}\text{Cs}$ Calculation

$$\frac{552.8 \text{ g } ^{137}\text{Cs}}{\text{Mt}} \cdot \frac{6.022E23 \text{ atoms}}{137 \text{ g } ^{137}\text{Cs}} \cdot \frac{\text{Fission}}{0.06 \text{ atoms}} \cdot \frac{200 \text{ MeV}}{\text{Fission}} \cdot \frac{1.602E-19 \text{ MJ}}{1 \text{ MeV}} \cdot \frac{1 \text{ day}}{86400 \text{ s}} =$$
$$15,018 \frac{\text{MWd}}{\text{Mt}}$$

- ❖ All the x-sections