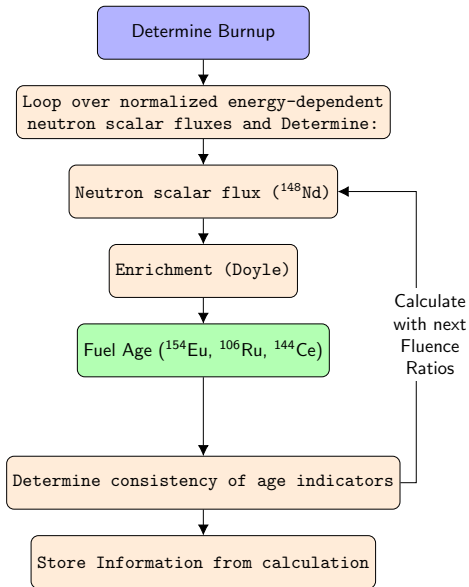# Program Progress

Paul Mendoza

March 8, 2016

Presented at Research Meeting

Cross-section calculations

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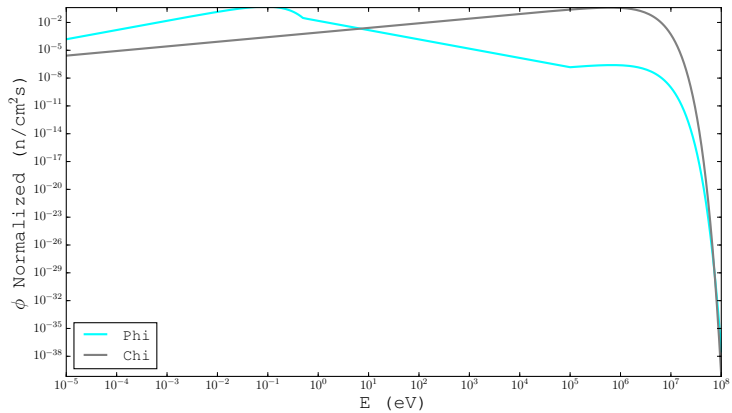
$$\phi(E) = C_1 \cdot \frac{E}{E_0^2} \cdot exp\left(-\frac{E}{E_0}\right) \qquad E < E_{max,th}$$

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

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

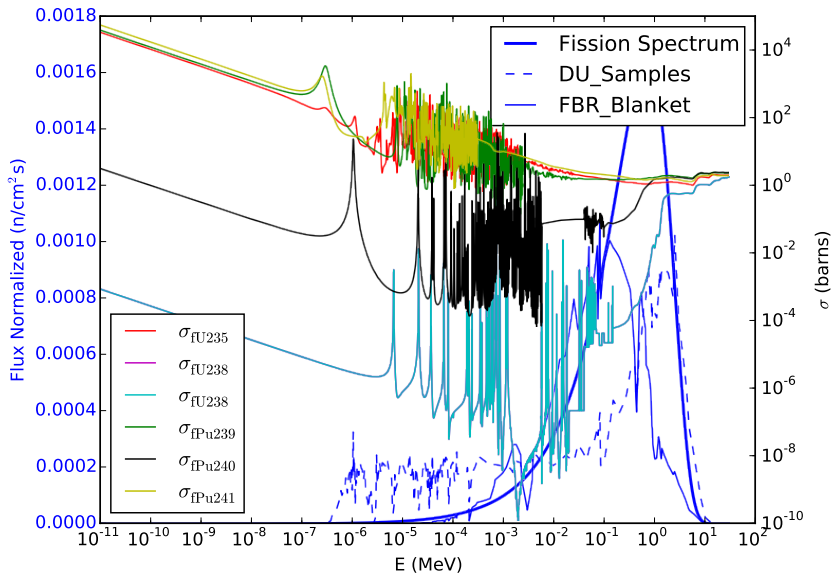$$C_1 = \frac{E_0^2}{E_{max,th}^2} e^{E_{max,th}/E_0}$$

$$C_2 = 1$$

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

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

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

One Group Cross Section Comparison

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

ORIGEN2 Model

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

Constant Power

From ORIGEN 2.2 calculation

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

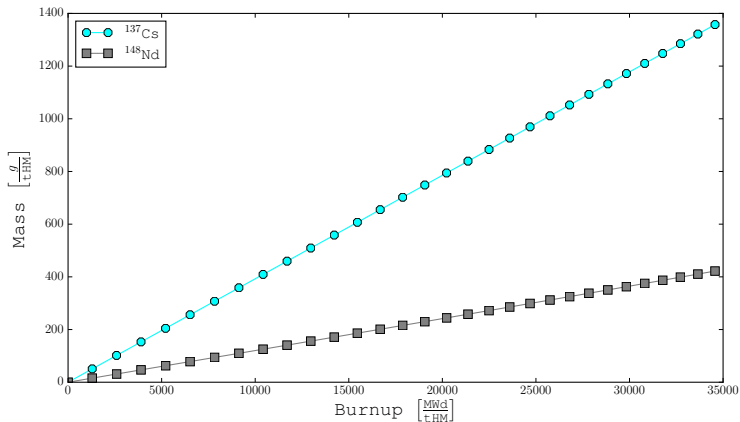ϕ=instantaneous neutron flux

P=power (MW)

χ_i^f=amount

σ_i^f=microscopic fission cross section for nuclide i

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

$$R_i \text{MeV/Fission} = 1.29927x10^{-3}(Z^2 A^{0.5}) + 33.12$$

Bateman Results

Next Week

❖ All the x-sections