# Program Progress

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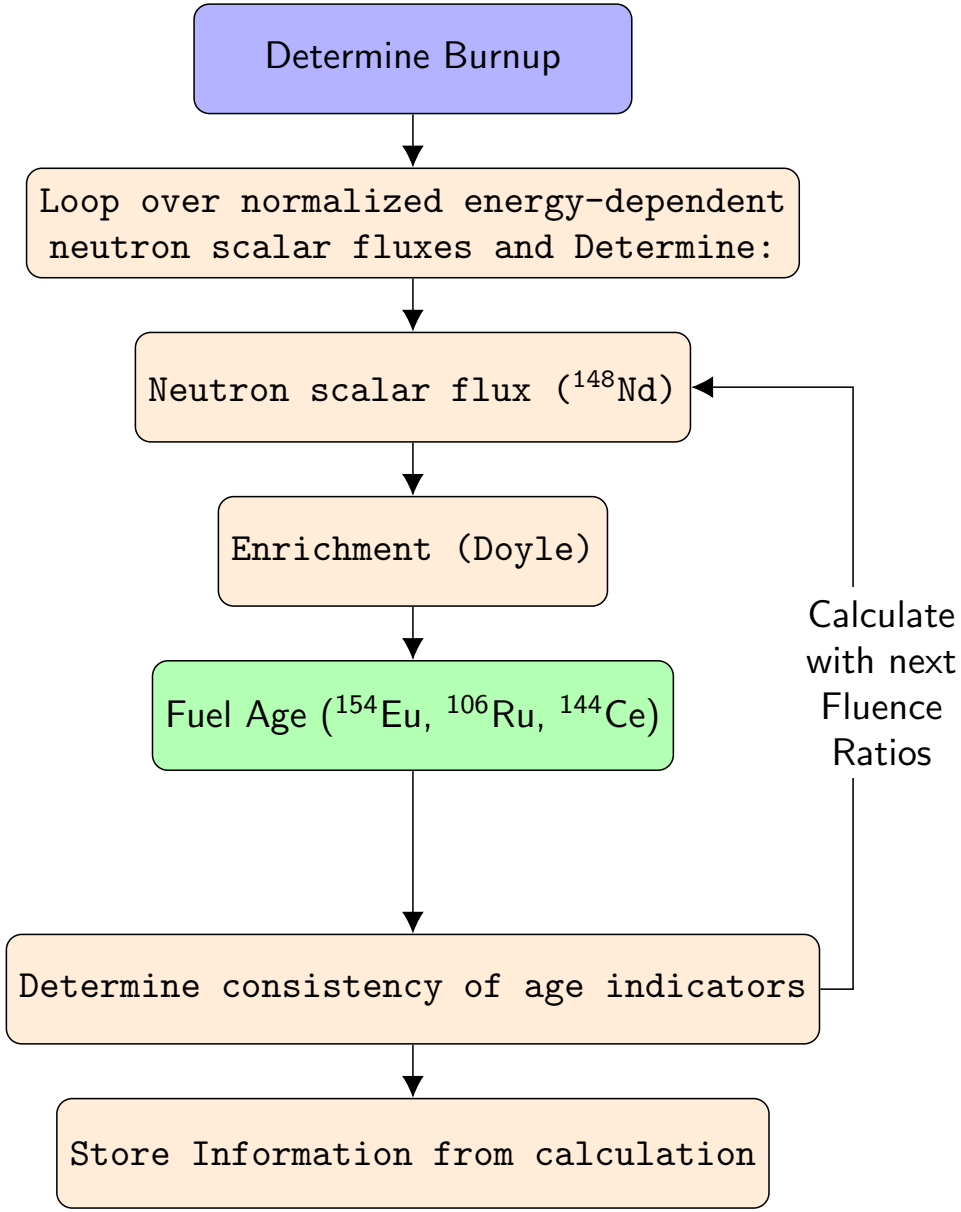
Presented at Research Meeting


Determine Burnup
Loop over normalized energy-dependent neutron scalar fluxes and Determine:
Neutron scalar flux ($^{148}$Nd)
Enrichment (Doyle)
Fuel Age ($^{154}$Eu, $^{106}$Ru, $^{144}$Ce)
Calculate with next Fluence Ratios
Determine consistency of age indicators
Store Information from calculation

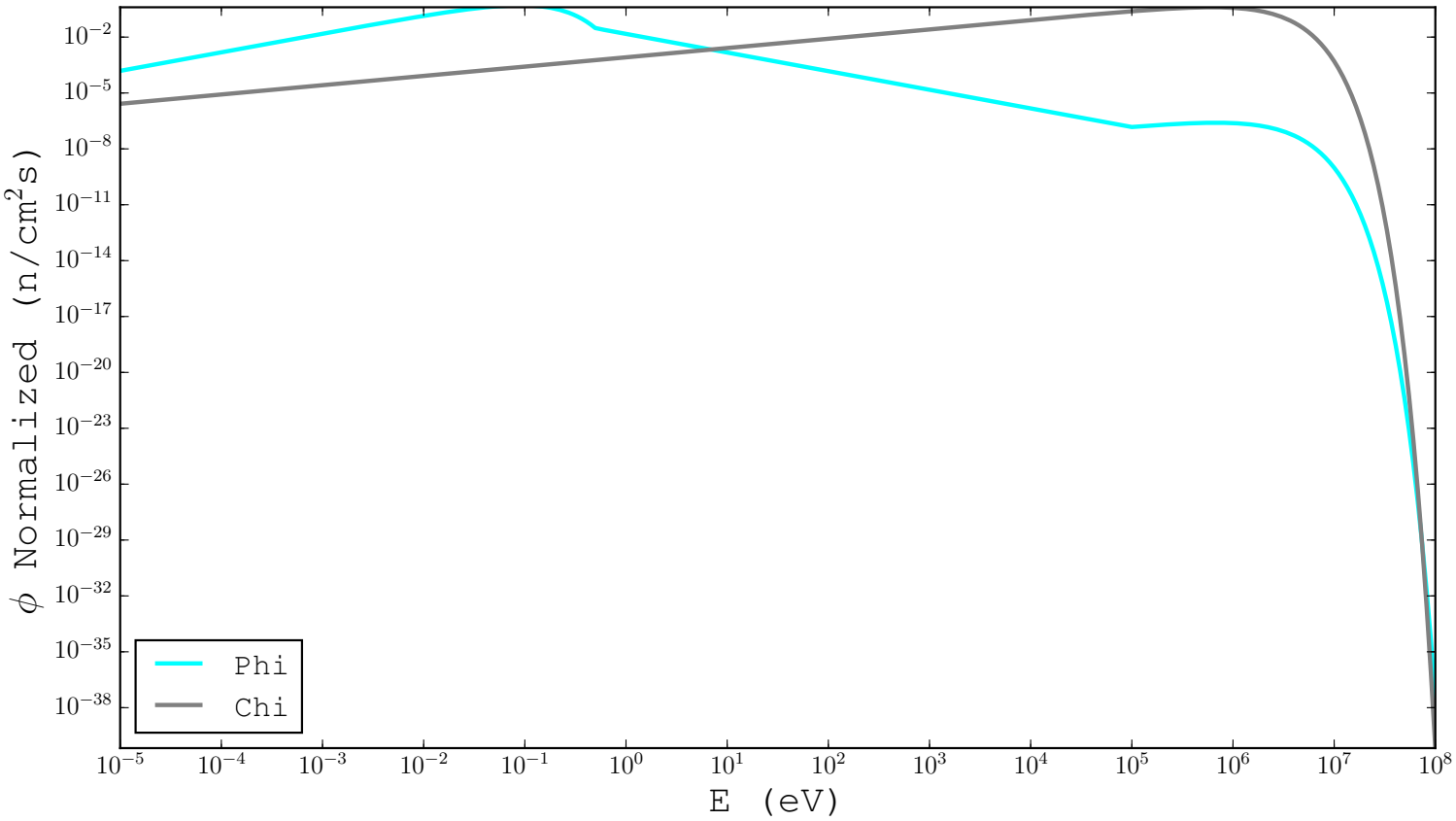
# Cross-section calculations

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

$$\begin{aligned}
\phi(E) &= C_1 \cdot \frac{E}{E_0^2} \cdot exp\left(-\frac{E}{E_0}\right) && E < E_{max,th} \\
&= \frac{C_2}{E} && E_{max,th} < E < E_{max,epi} \\
&= C_3 \cdot \frac{\sqrt{\frac{E}{E_f}}}{E_f} \cdot exp\left(-\frac{E}{E_f}\right) && E > E_{max,epi}
\end{aligned}$$

$$\begin{aligned}
C_1 &= \frac{E_0^2}{E_{max,th}^2} e^{E_{max,th}/E_0} \\
C_2 &= 1 \\
C_3 &= \frac{E_f}{E_{max,epi}} \cdot e^{\frac{E_{max,epi}}{E_f}} \frac{1}{\sqrt{\frac{E_{max,epi}}{E_f}}}
\end{aligned}$$

$E_{max,th} = 0.50$ 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

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

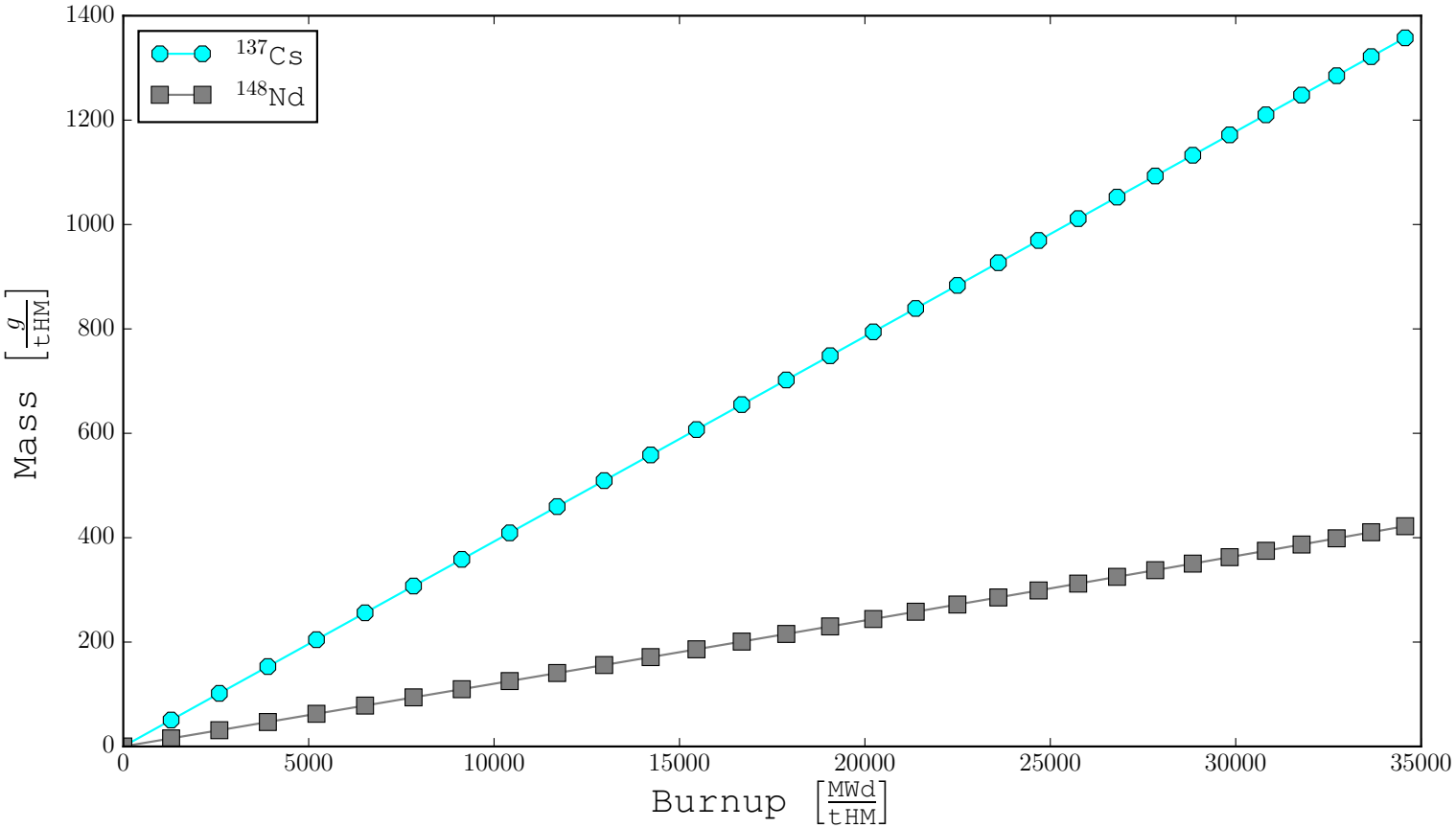
From ORIGEN 2.2 calculation

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

$\phi$=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)

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

# Bateman Results



# Next Week

- All the x-sections