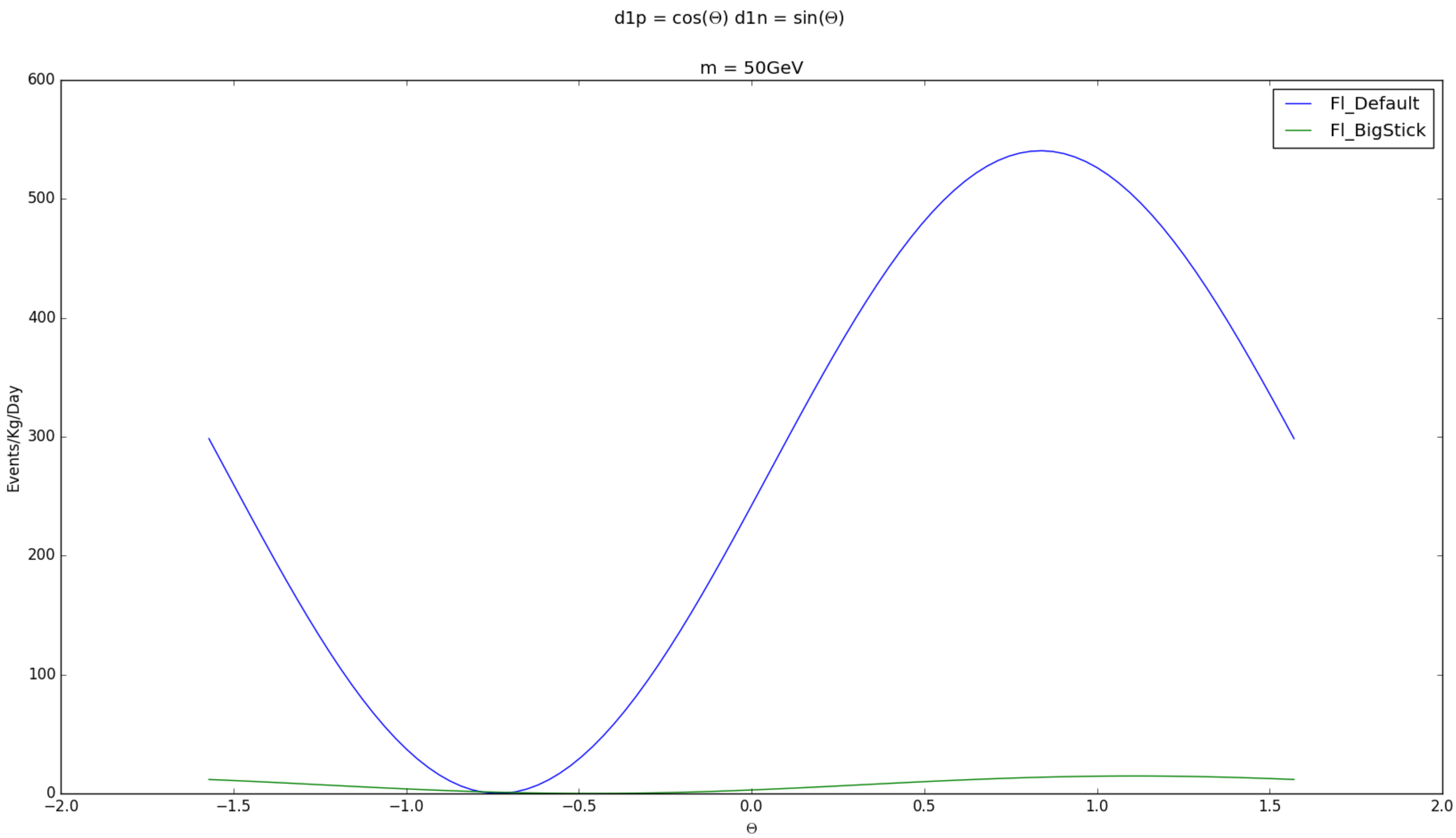
John P. Update

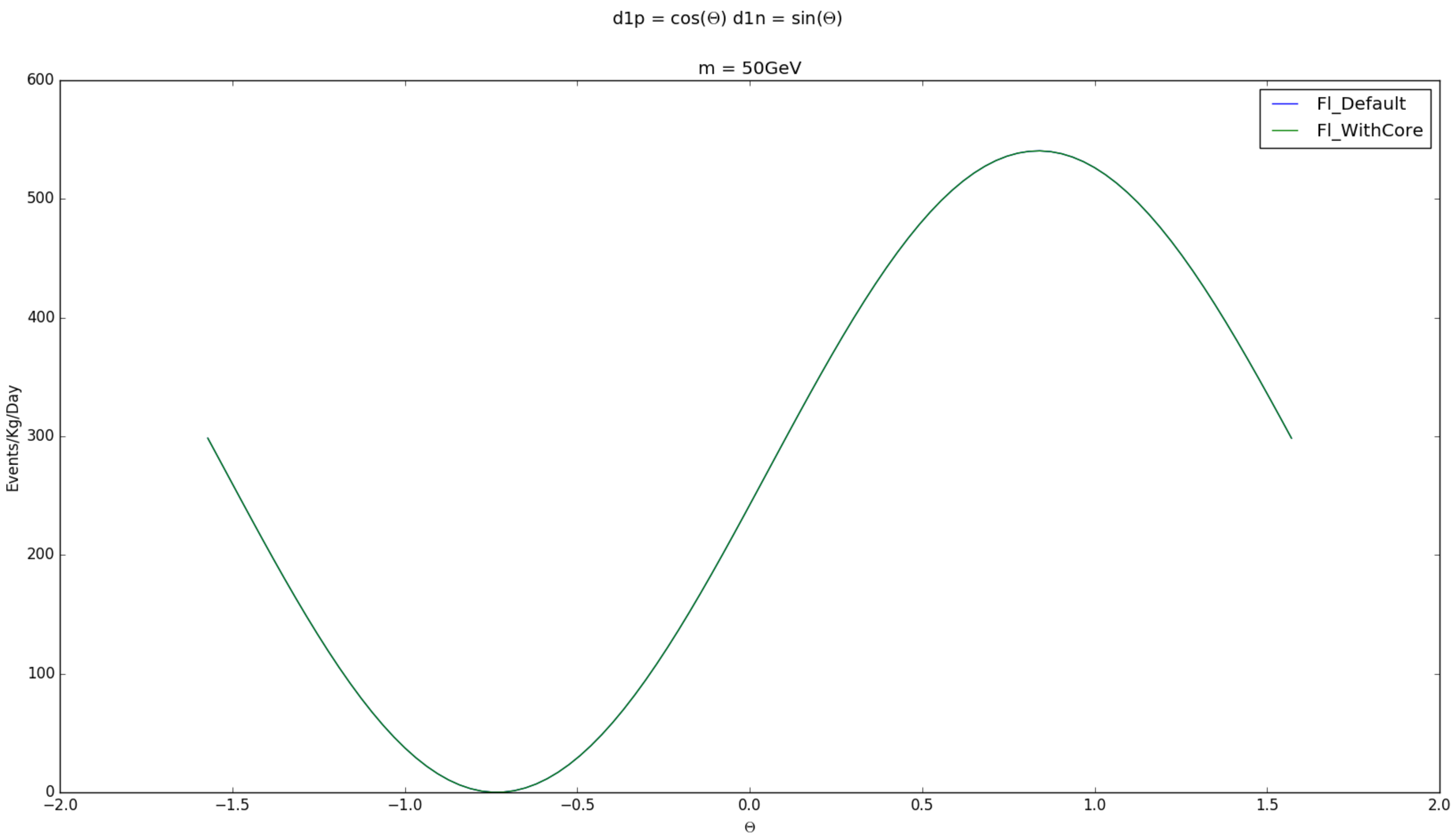
10/25/19

Reading in Density Matrices

- The Mathematica package does read in the density matrix elements correctly.
- Calvin’s fluorine density matrix elements are pretty similar to those hard coded into the Mathematica package (although missing the core states).
- After adding in the core by hand, I got something that looks basically the same as the plot from the default matrix elements (maybe not so surprising).



d1p = cos(Θ) d1n = sin(Θ)
m = 50GeV
Fl_Default
Fl_BigStick
Events/Kg/Day
Θ
0
100
200
300
400
500
600
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0

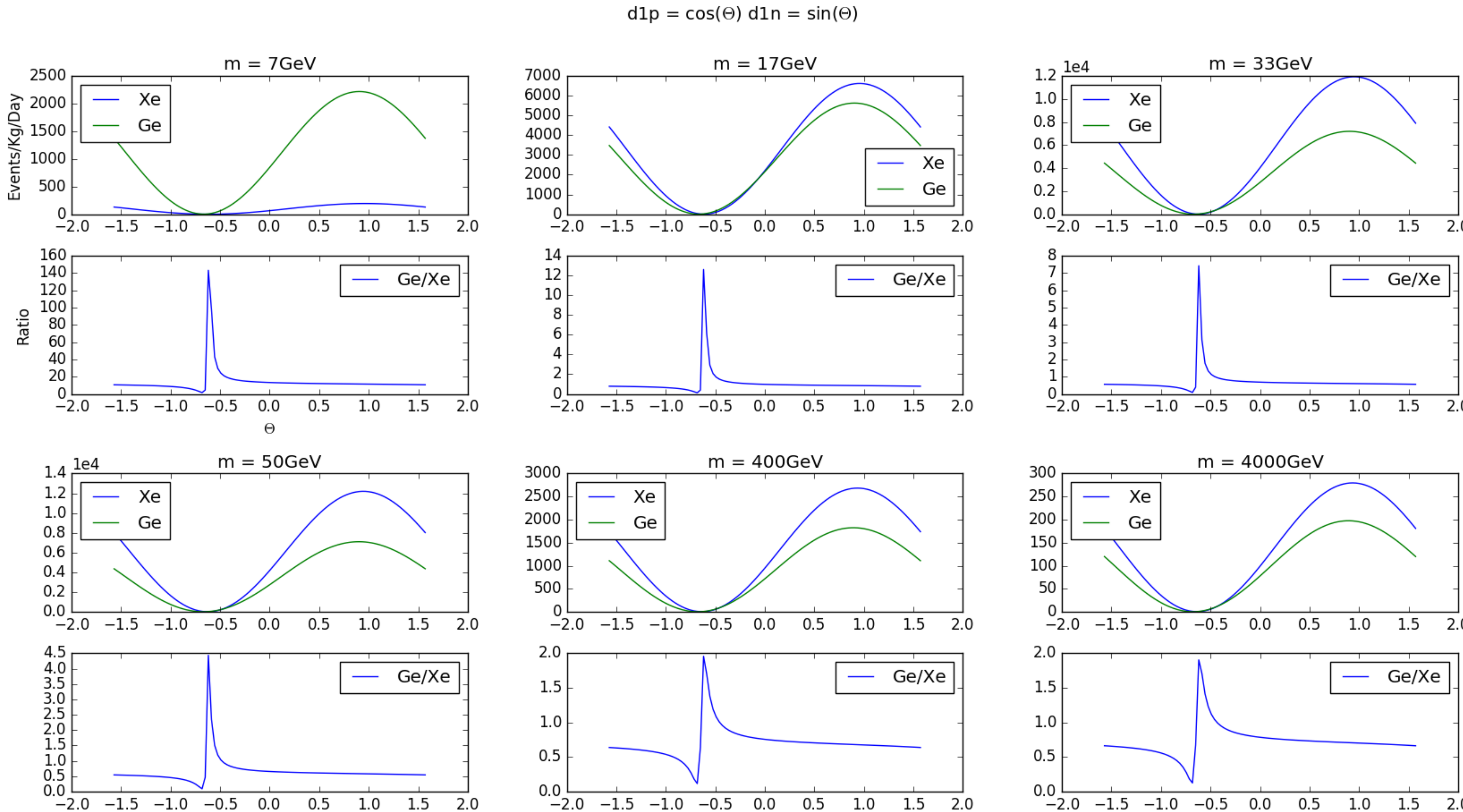

d1p = cos(Θ) d1n = sin(Θ)
m = 50GeV
Fl_Default
Fl_WithCore
Events/Kg/Day
Θ
600
500
400
300
200
100
0
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0

Some more “Heat Maps”

- Made some more heat maps, this time looking into isospin interference.
- Once again, interesting things appear once we take the ratio.

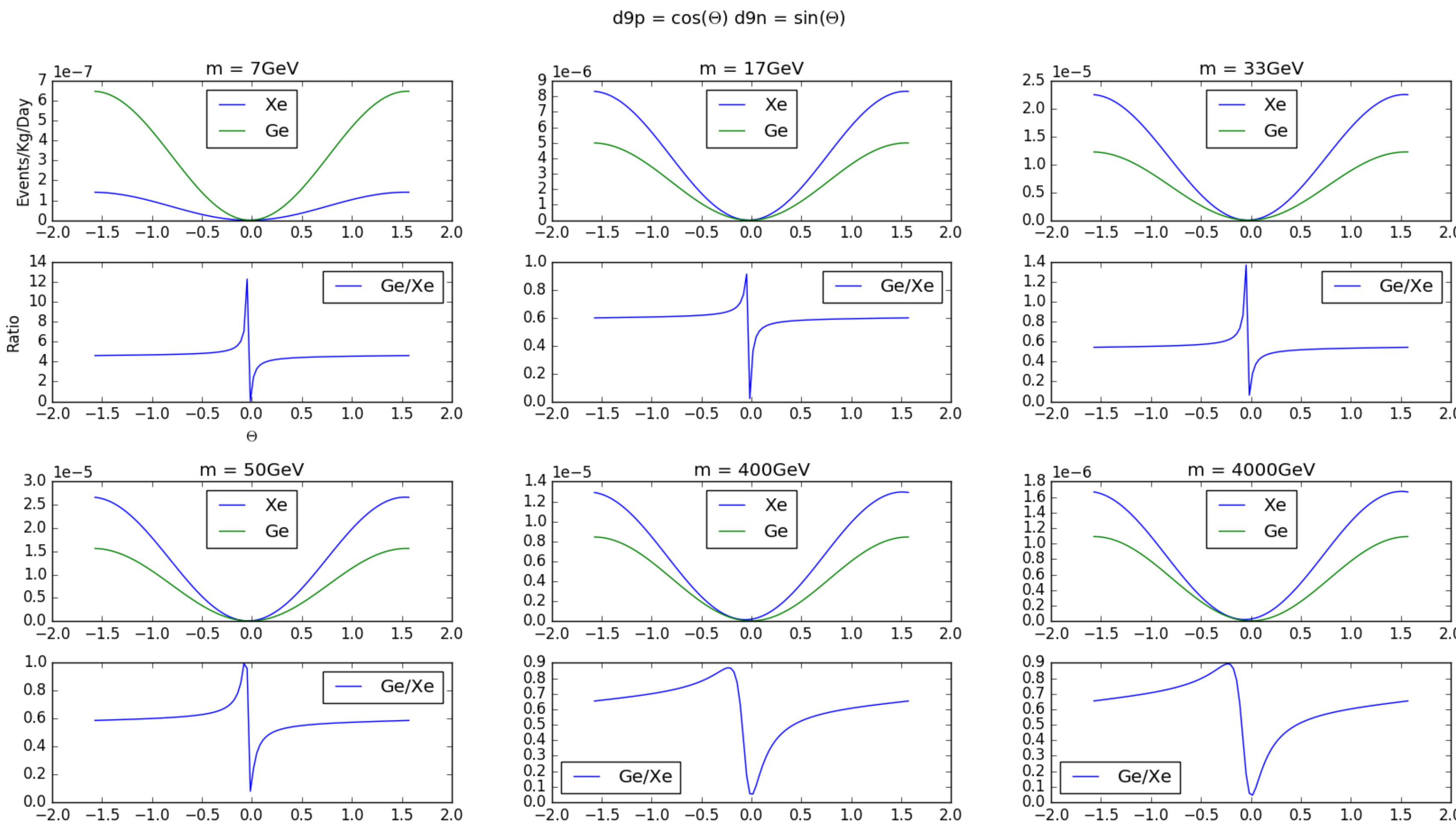
This narrow spike appears on operators with a strong M dependence (1,5,8,11).

M $\quad \frac{1}{\sqrt{4\pi}}\sum_{i=1}^{A} 1(i) \sim Z \text{ or } (A-Z)$ $\quad$ Spin-independent



This shape appears on operators with a strong sigma prime dependence. (4,9)

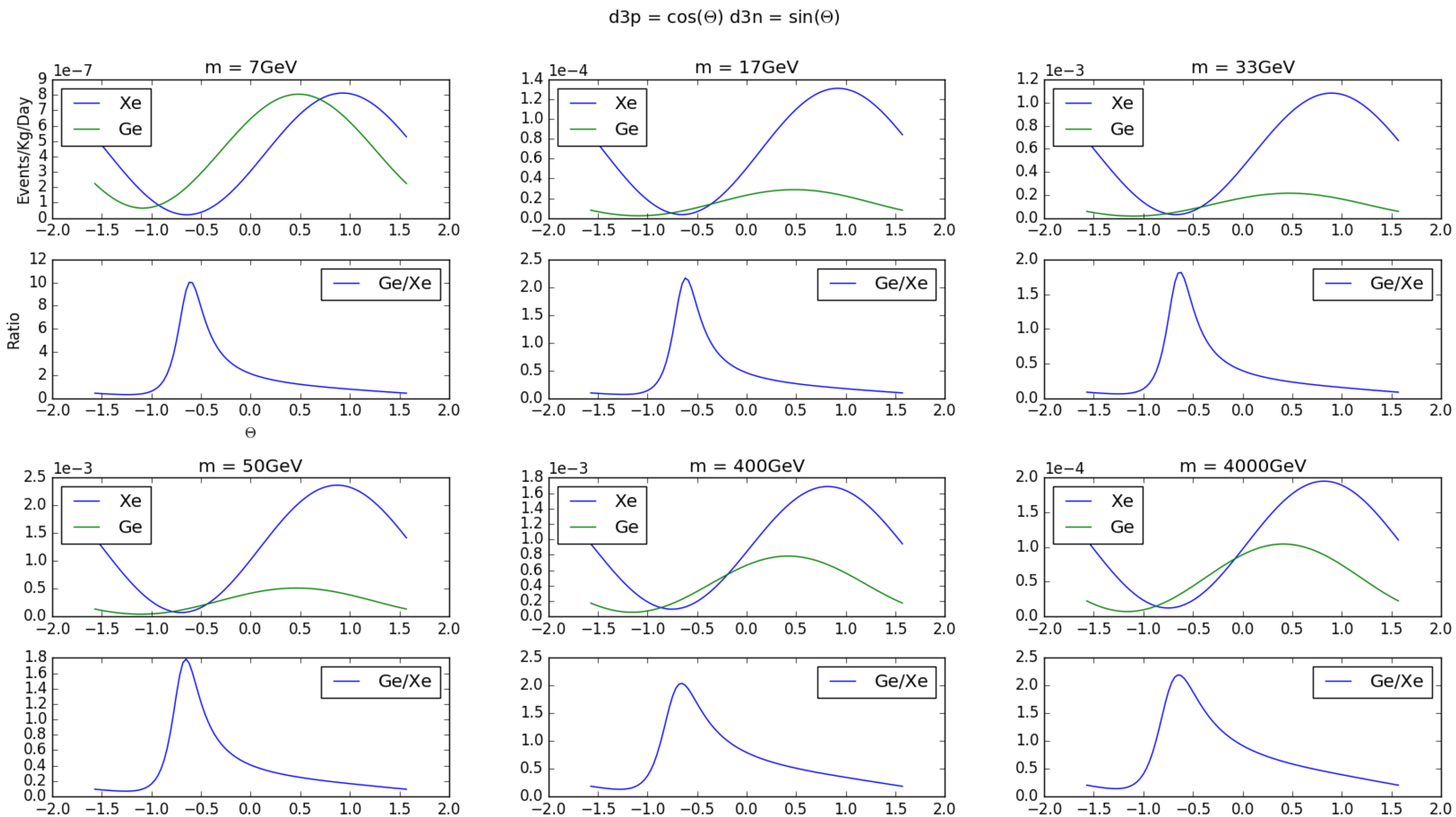
$$\mathcal{O}_9 = i\vec{S}_\chi \cdot (\vec{S}_N \times \vec{q})$$



$$\Sigma' \qquad \frac{1}{\sqrt{6\pi}} \sum_{i=1}^{A} \sigma(i) \sim \langle S_p \rangle \text{ or } \langle S_n \rangle \qquad \text{Spin-dependent (transverse component)}$$

This wide spike appears for operators with dominant spin-orbit dependence. (3, 15, 12)

$$\mathcal{O}_3 \quad = \quad i\vec{S}_N \cdot (\vec{q} \times \vec{v}^{\perp})$$



Φ'' $\quad \frac{1}{3\sqrt{4\pi}} \sum_{i=1}^{A} \vec{\sigma}(i) \cdot \vec{l}_(i)$ $\quad$ Spin-orbit dependent

$\sim \langle \vec{S}_p \cdot \vec{L}_p \rangle$ or $\langle \vec{S}_p \cdot \vec{L}_p \rangle$

In the future

- Continue to learn statistics, work with Shaun to figure out how the statistical analysis should be done.
- Maybe build up the machinery now, then run the actual calculations once we get an idea of the uncertainties from Calvin.
- Continue working with Michael to double check what’s been done so far.
- Try to find a good way to communicate our results once we get them.

$$
\begin{aligned}
\mathcal{O}_1 &= 1 \\
\mathcal{O}_2 &= (v^\perp)^2 \\
\mathcal{O}_3 &= i\vec{S}_N \cdot (\vec{q} \times \vec{v}^\perp) \\
\mathcal{O}_4 &= \vec{S}_\chi \cdot \vec{S}_N \\
\mathcal{O}_5 &= i\vec{S}_\chi \cdot (\vec{q} \times \vec{v}^\perp) \\
\mathcal{O}_6 &= (\vec{S}_\chi \cdot \vec{q})(\vec{S}_N \cdot \vec{q}) \\
\mathcal{O}_7 &= \vec{S}_N \cdot \vec{v}^\perp \\
\mathcal{O}_8 &= \vec{S}_\chi \cdot \vec{v}^\perp \\
\mathcal{O}_9 &= i\vec{S}_\chi \cdot (\vec{S}_N \times \vec{q}) \\
\mathcal{O}_{10} &= i\vec{S}_N \cdot \vec{q} \\
\mathcal{O}_{11} &= i\vec{S}_\chi \cdot \vec{q}
\end{aligned}
$$