The EFT Signal Model

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Recoil Energy Spectrum

- Generated by "DMFormFactor" mathematica package

- Generate an analytic energy recoil spectrum for each isotope of Xenon (isotopes = {128, 129, 130, 131, 132, 134, 136}) as well as each of the following masses:

  – masses = {7,10,12,14,17,21,33,50,100,400,1000,4000}

- Weight the analytic spectra by their isotopic abundance and sum them together for each mass. This leaves one spectrum for each mass

Recoil Energy Spectrum

- These analytic spectra are insanely complicated and difficult (as well as unnecessary) to port to the limits code, so we bin it.
  - Spectrum is integrated (numerically) out to 350 keV (beyond our max energy range for this analysis) to obtain an energy cutoff.
  - Spectrum is then integrated in 1 keV bins from 0 until the total integrated reaches 99% of the total from 0 to 350 keV. This number is recorded and the integration then proceeds to a factor of 1.2 higher in recoil energy. (This is because the standard deviation in the s1 and s2 distributions for a single energy is typically about 6 or 7%)
  - These bins and the values of the integrals are then stored and written to file.

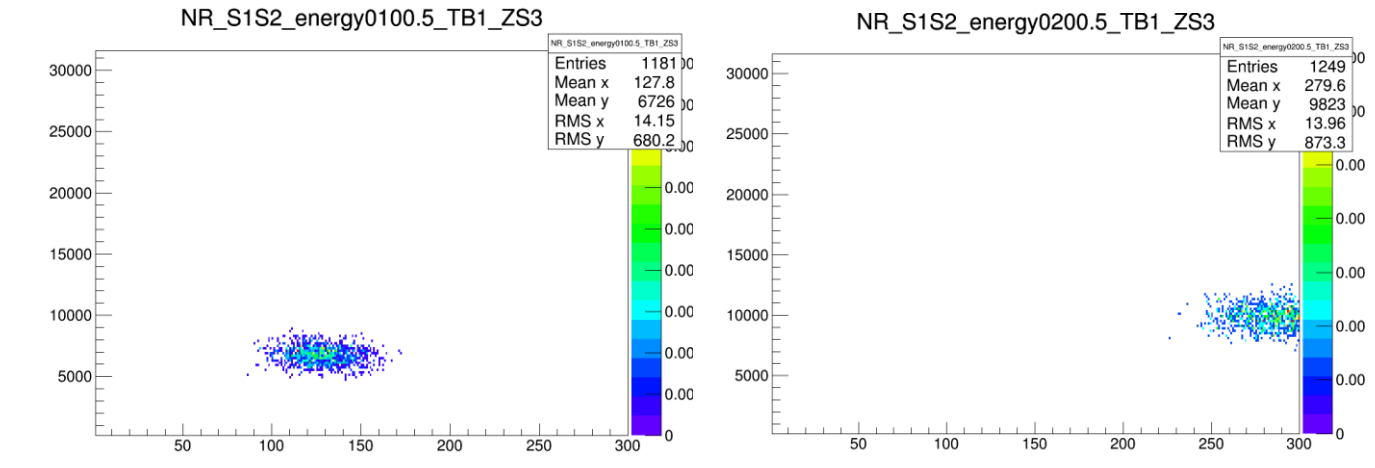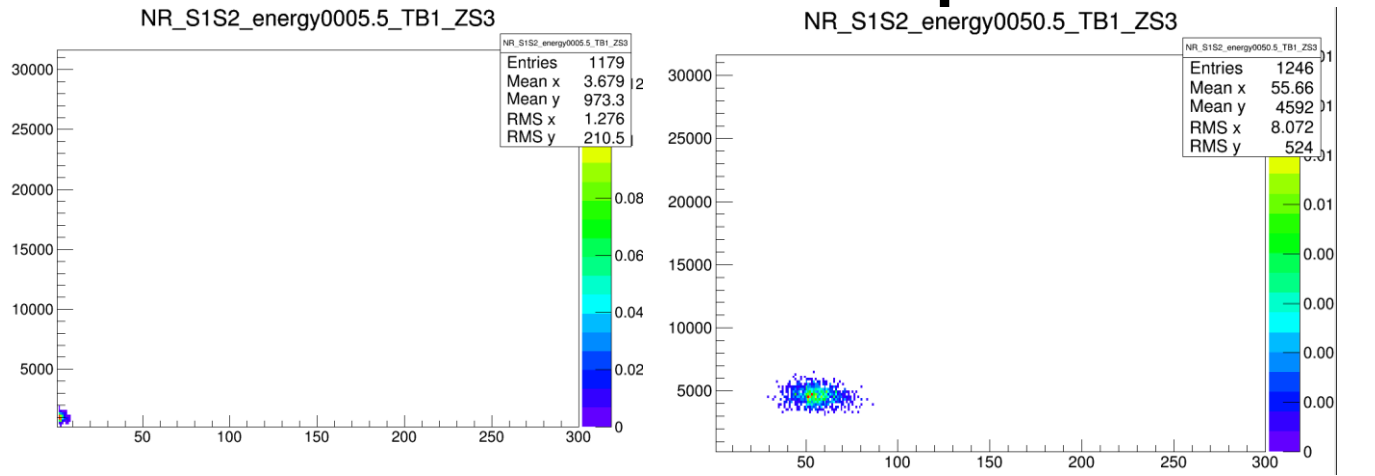# Recoil Energy Spectrum

- Example text output (one for each coupling)

Nuclear Recoil Templates

- Locations are generated randomly (uniformly) in real space.

- Locations are mapped to S2 space using JPM (electric field at the point simultaneously obtained).

- Fiducial cut applied, event is re-generated if the location does not pass.

- NEST is used to generate an s1c and s2c for the event.

- Events are sorted into z-slices based on drift time

- Events generated until each z-slice has at least 10,000 events

- This is done for each energy 0.5 keV to 350 keV in 1 keV increments for each time bin

Nuclear Recoil Templates

Nuclear Recoil Models

- Take the Templates and weight each energy and each time bin and z-slice and weight them by the appropriate number from the Recoil Energy Spectrum and add them together.

- Cut the S1 and S2 off at the mean values associated with the "maxEnergy" number, but add ones from higher energy to account for bleed-in.