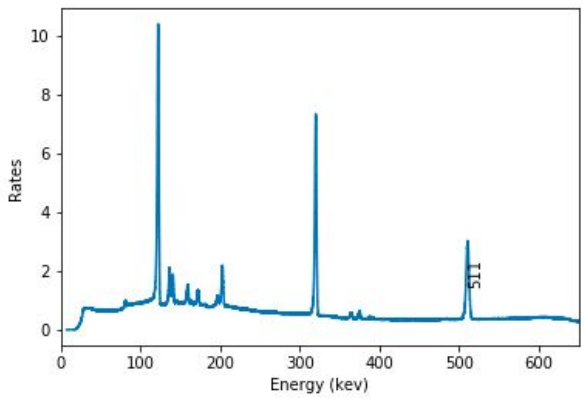# Jan 2020 Xe127 Activation Analysis Summary
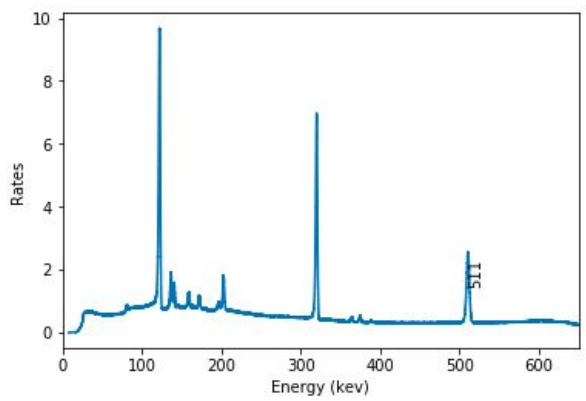
Jacob McLaughlin

Raw Energy Spectra

- Energy calibration on dirty bottles looks good based off 511 line and xenon lines
- Clean bottle has a much smaller compton pedestal
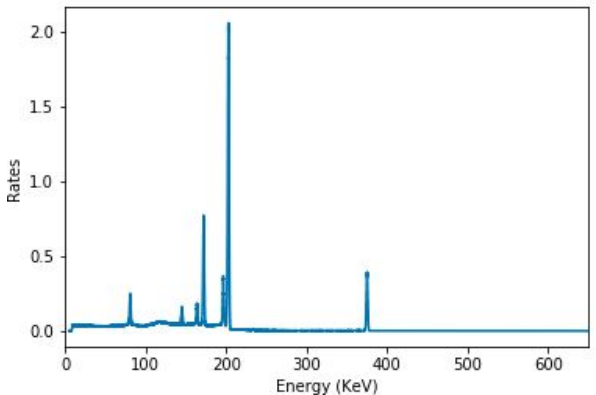 - In dirty bottles can do a linear background subtraction around peaks

Bottle 3

Bottle 2

Bottle 6

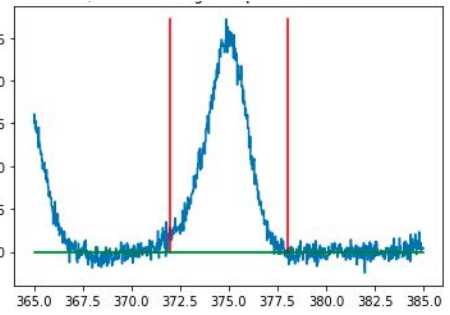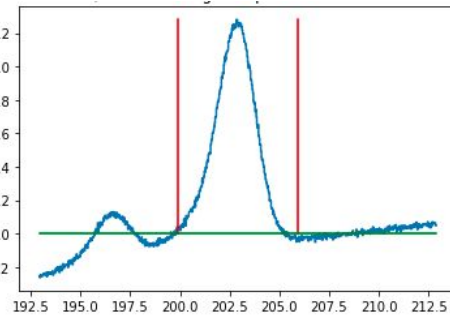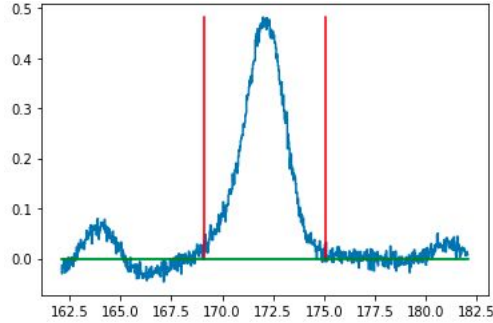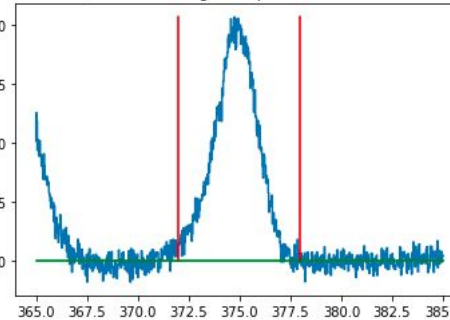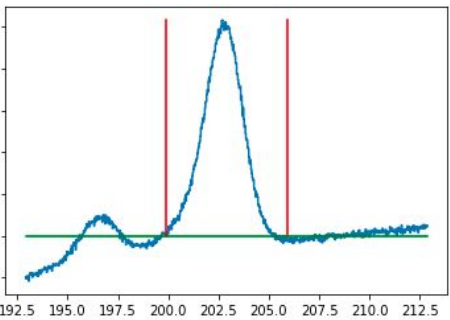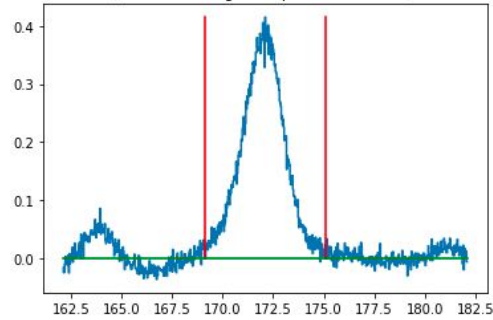Background Subtracted Peaks

Bottle 3

Bottle 2

- Linear background subtraction for each peak. Line built from points 3-8 kev away from nominal peak
  - Corrected peak counted over 3 kev of nominal peak
- 172 and 375 peaks look like best subtraction

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Rates and Errors

- Only statistical errors on rate were included
  - Each bin's error is taken as sqrt(Rate)
- When background subtraction was done errors on slope and intercept were included

$$\sigma_m = \sqrt{\sum_i \left(\left(\frac{E_i - \bar{E}}{\sum_j (E_j - \bar{E})^2}\right)^2 \sqrt{\sigma_{y_i}^2 + \sigma_{y_{bar}}}\right)^2}$$

$$\sigma_{Background} = \sqrt{(E^2 \sigma_m^2 + \sigma_b^2)}$$

$$\sigma_b = \sqrt{\sigma_{\bar{y}}^2 + \sigma_m^2 \bar{E}^2}$$

Sitting on top	172.1 kev	202.9 kev	375.0 kev
Bottle 3	41.9 ± 14.6 Hz	103.7 ± 17.1 Hz	22.5 ± 10.1 Hz
Bottle 2	33.6 ± 14.0 Hz	82.0 ± 15.7 Hz	17.5 ± 9.3 Hz
Bottle 6	57.2 ± 7.6 Hz	143.4 ± 12.0 Hz	28.4 ± 5.3 Hz

MCNP Efficiencies/Geometry Test

- Can check geometry by looking at the falloff between sitting on top and 4cm up
  - Observed Falloff: 2.76
  - Expected Falloff: 2.99   (Based off r = 3.1 cm, Ceiling = -1.1 cm)
- Statistical errors from efficiency calculation are neglected
- Some gamma fluxes seem initially off
  - Can look at activities with and without correction

Line	Expected Intensity/Decay	Simulated Intensity/Decay
172 kev	0.257	0.286
202 kev	0.687	0.747
375 kev	0.173	0.172

Activities (sitting on top only)

	172 kev	202 kev	375 kev
Bottle 3	10.8 ± 3.9 KBq	10.6 ± 1.8 KBq	12.5 ± 5.6 KBq
Bottle 2	8.7 ± 3.6 KBq	8.4 ± 1.6 KBq	9.7 ± 5.2 KBq
Bottle 6	14.8 ± 2.0 KBq	14.7 ± 1.2 KBq	15.8 ± 3.0 KBq

Corrected gamma fluxes

	172 kev	202 kev	375 kev
Bottle 3	12.1 ± 4.3	11.5 ± 1.9	12.5 ± 5.6
Bottle 2	9.7 ± 4.2	9.1 ± 1.7	9.7 ± 5.2
Bottle 6	16.5 ± 2.2	16.0 ± 1.3	15.8 ± 3.0

Activities (combined 4 cm up and sitting on top)

	172 kev	202 kev	375 kev
Bottle 3	10.9 ± 3.9 KBq	10.9 ± 1.8 KBq	13.3 ± 5.7 KBq
Bottle 2	8.6 ± 3.6 KBq	8.5 ±1.6 KBq	10.2 ± 5.2 KBq
Bottle 6	14.3 ± 1.9 KBq	14.5 ± 1.2 KBq	16.4 ± 3.1 KBq

Corrected gamma fluxes

	172 kev	202 kev	375 kev
Bottle 3	12.1 ± 4.3 KBq	11.8 ± 1.9 KBq	13.3 ± 5.7 KBq
Bottle 2	9.7 ± 4.0 KBq	9.3 ± 1.8 KBq	10.2 ± 5.2 KBq
Bottle 6	16.0 ± 2.1 KBq	15.8 ± 1.3 KBq	16.3 ± 3.0 KBq

Conclusions

- Activities in corrected tables seem nicely clustered
  - Errors seem overestimated
  - Could do an averaging to get a single measure
- Some changes in the MCNP geometry are needed to fully model the solid angle falloff
  - Have enough data to do this, just need enough time to actually address it
- Some more analysis of the Xe127 source in MCNP is in order
- Much lower relative errors come from the clean bottle so it's worth keeping around