Update on LIME background simulation

CYGNO simulation meeting – 7/2/2022

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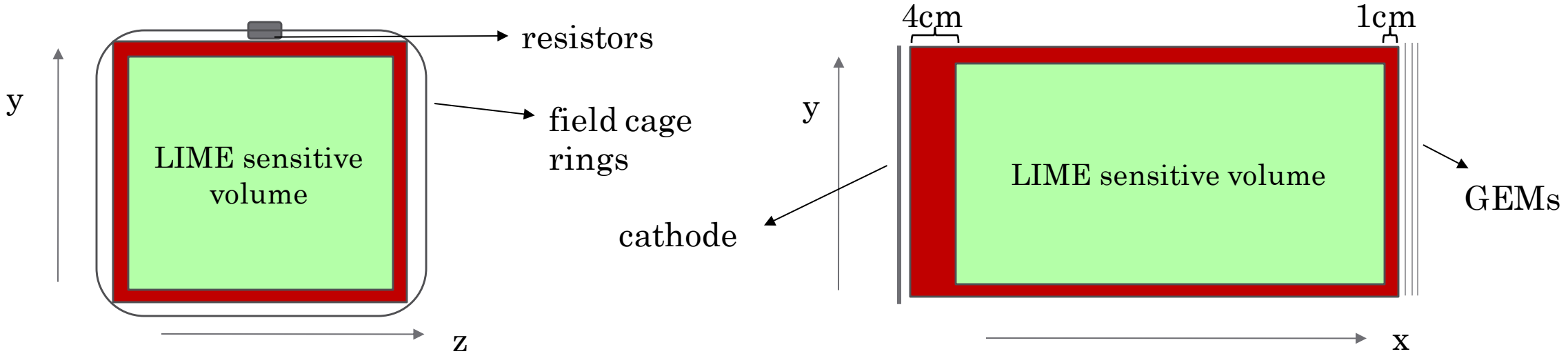
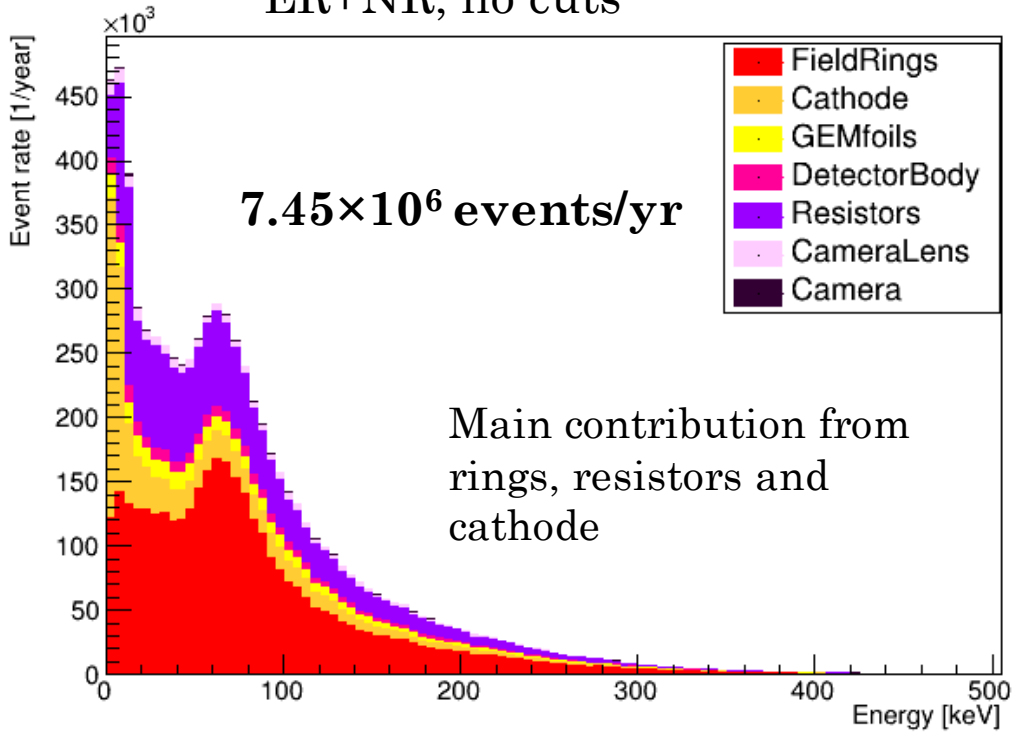
Internal background

- Acrylic box, GEMs, cathode, field cage, resistors, and camera (with shielding) contribution to the internal background are included – radioactivity was measured by M.Laubestein
- Contribution from copper shielding not included (it is of O(10^5) events/yr)
  - It will be recalculated with new design of the shielding
- I compared the spectra with the expected external background (in particular for the neutron flux measurement)
- I applied some geometrical cuts (1cm around border of image + ends of drift region)

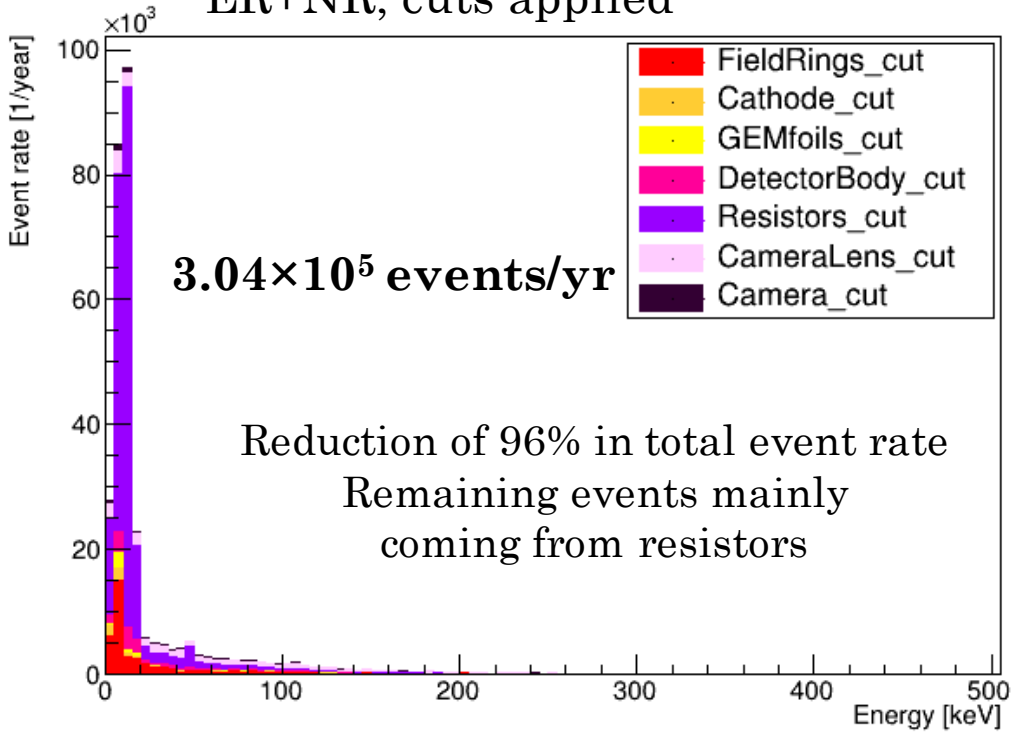


Background spectra – ER+NR

ER+NR, no cuts



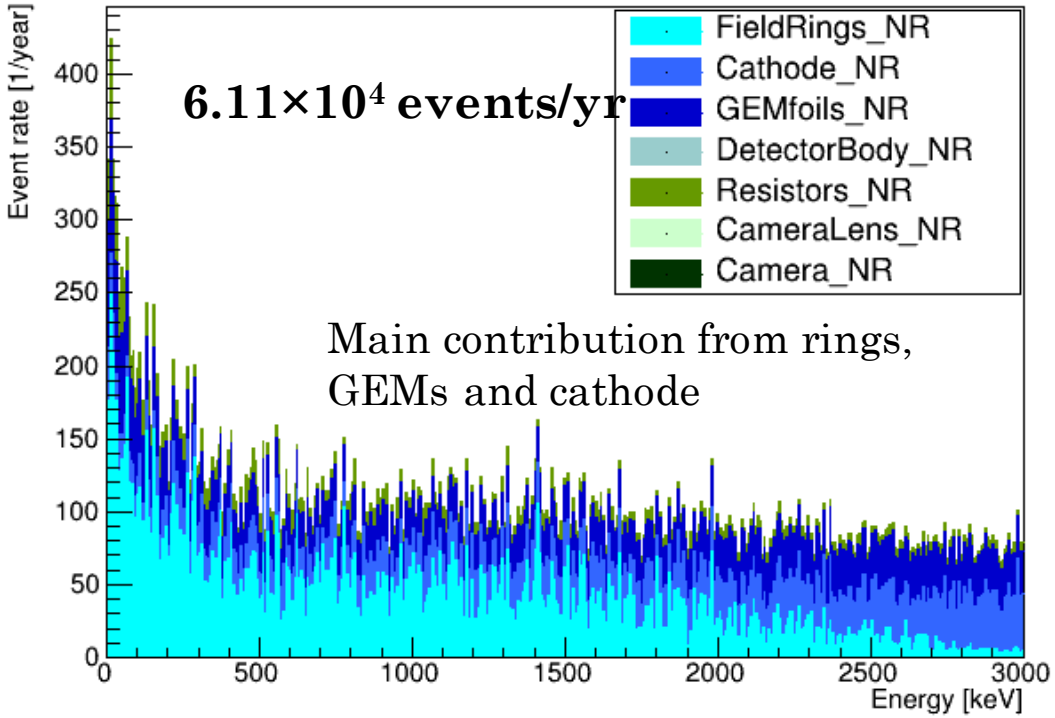
ER+NR, cuts applied



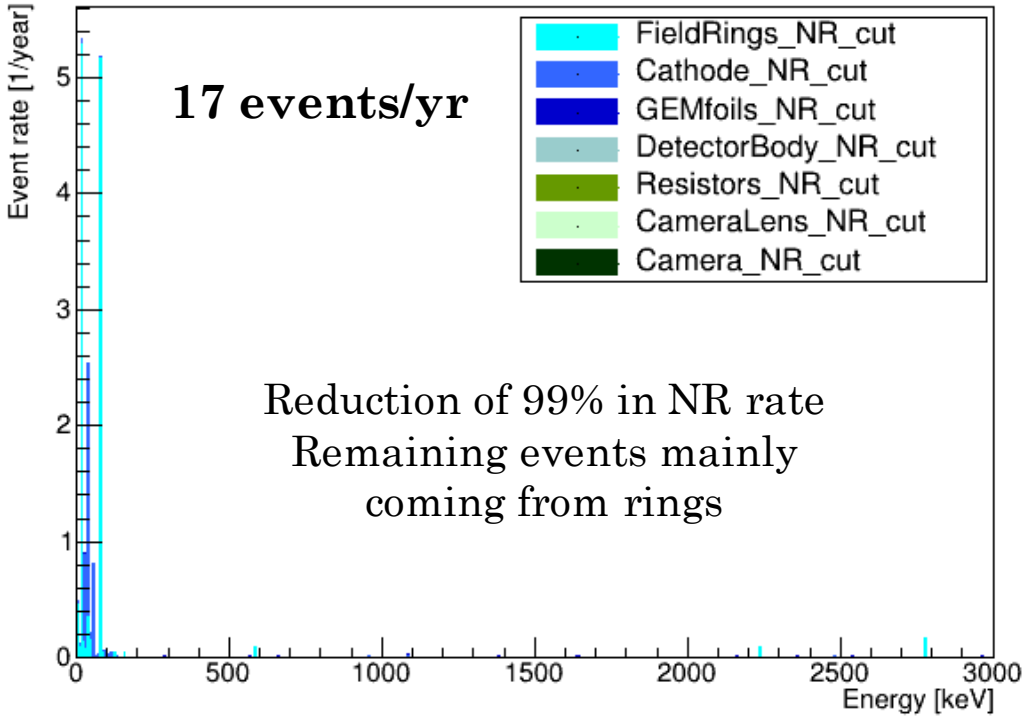
Additional cuts may be applied to reduce the resistors background
Rate above 20keV: **5.84×10⁶ events/yr**, after cuts: **7.1×10⁴ events/yr**

Background spectra – NR only

Only NR, no cuts

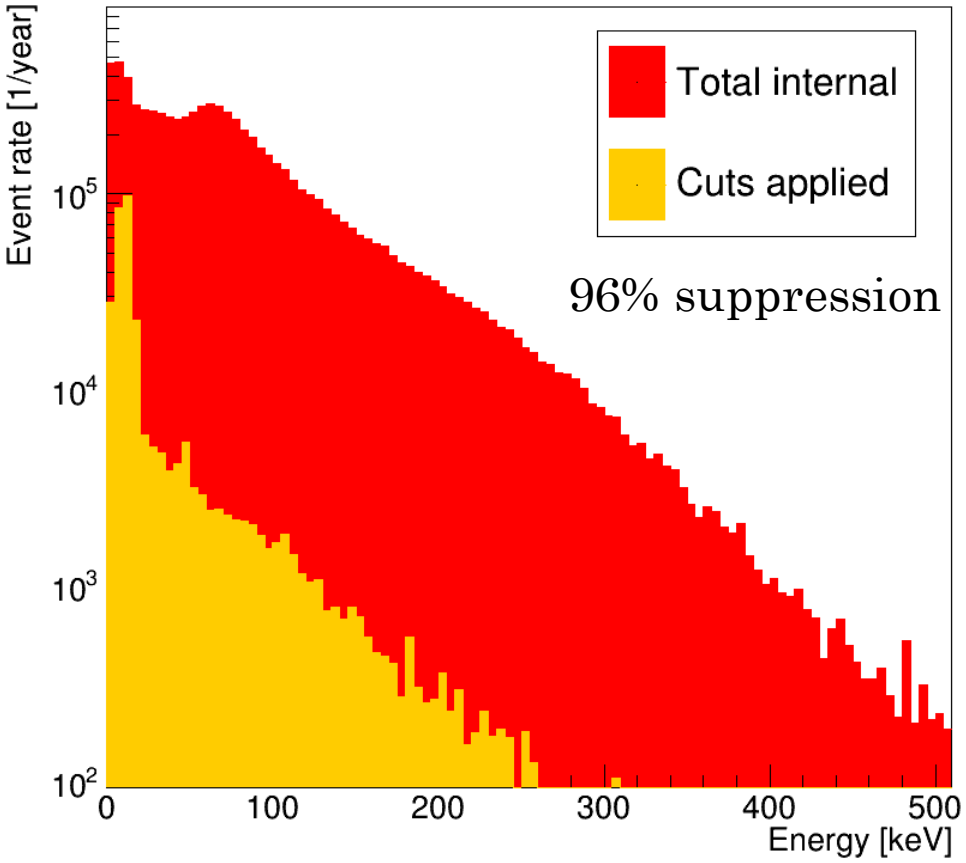


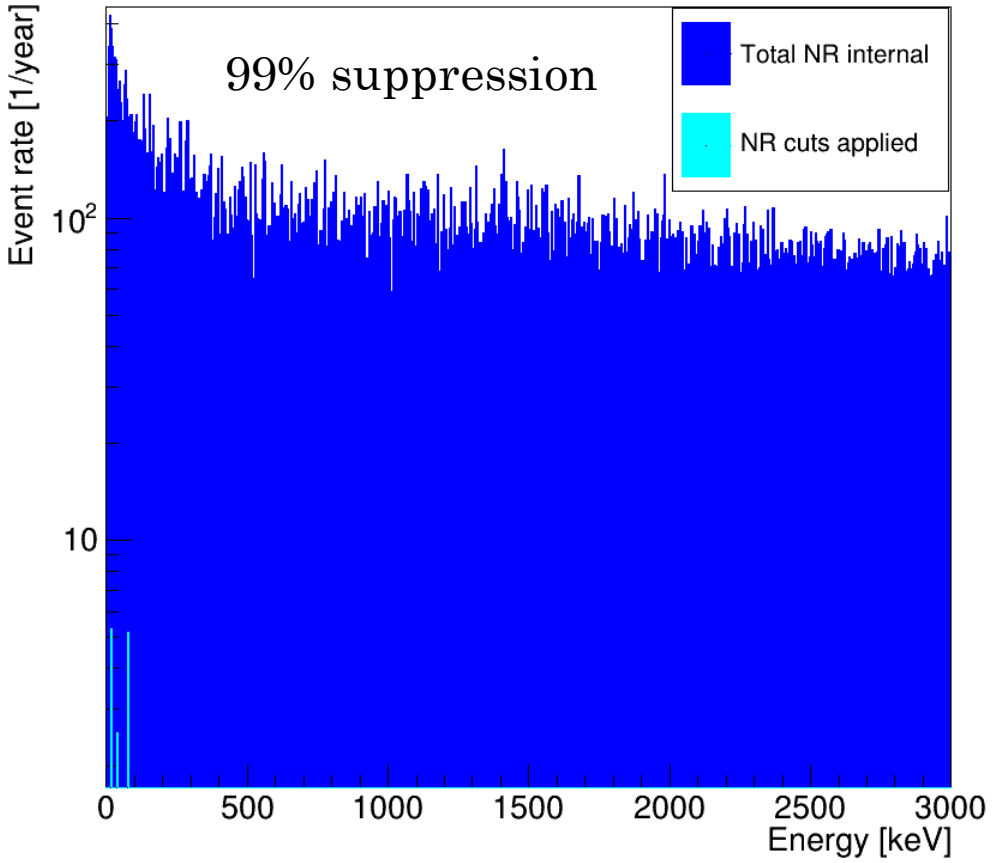
Only NR, cuts applied



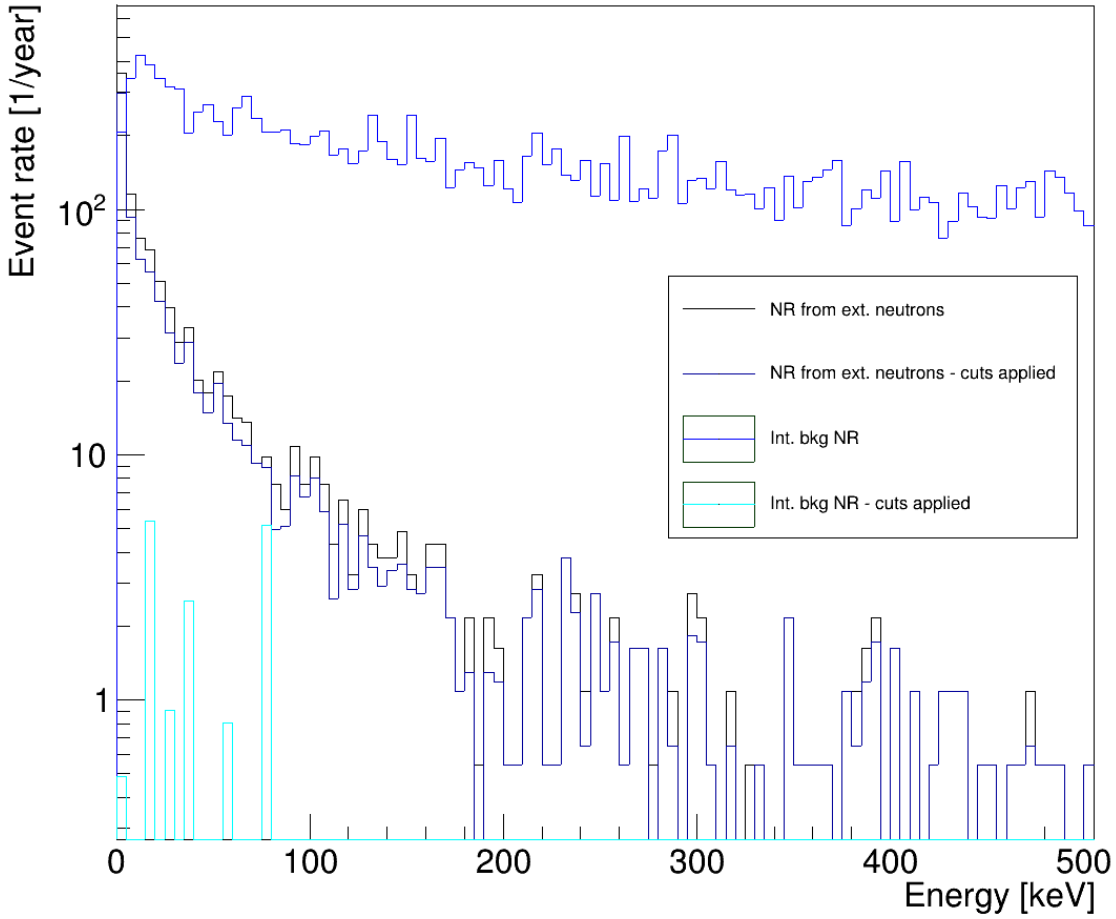
If MC is validated, a simulation with a higher statistics can be done, and the background could be substracted

Background reduction





External background

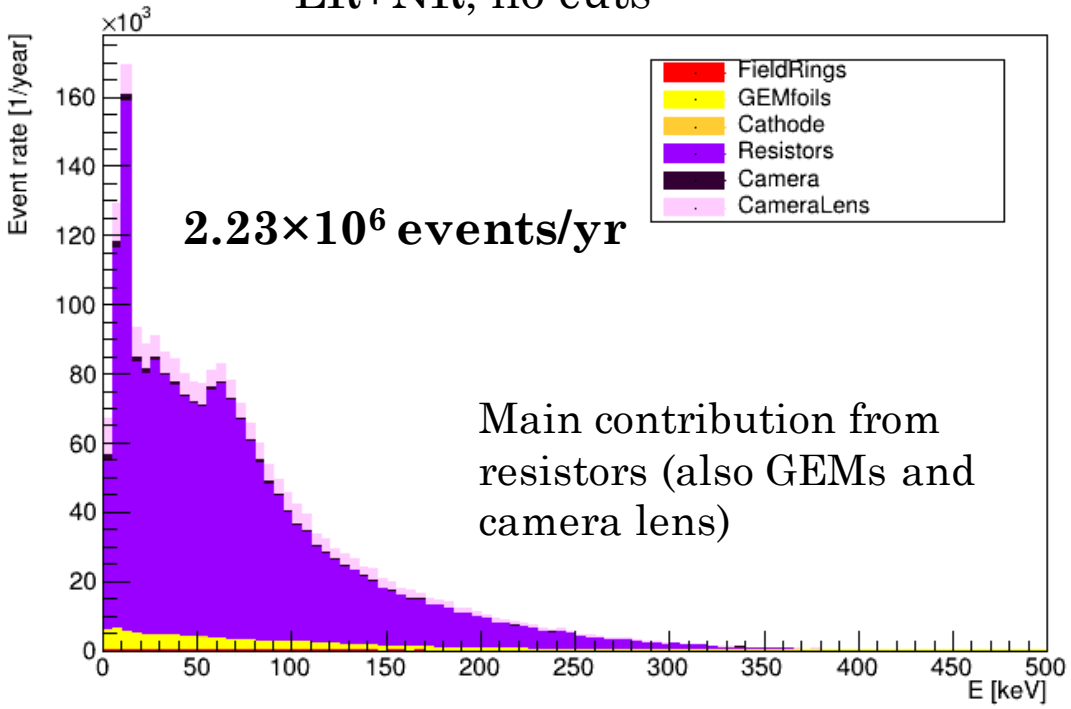


- Comparison with the external neutron induced NR with 10cm copper
- NR from external neutrons are **above** the NR internal background after the cuts are applied

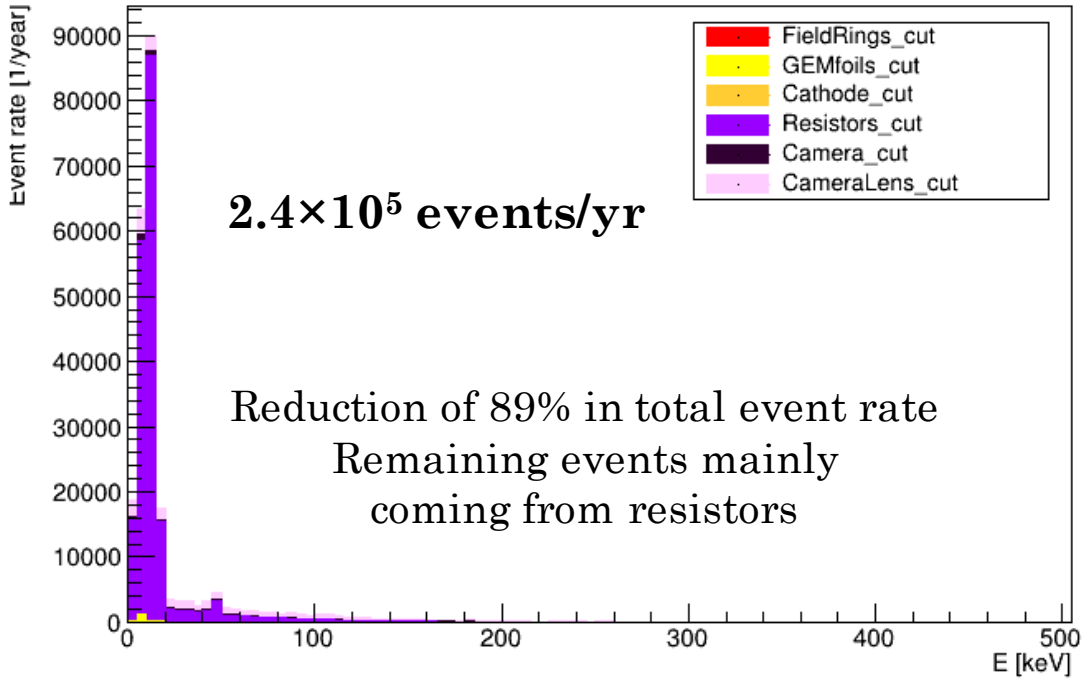
- This was the worst case scenario (radioactivity includes both **measurements and limits** on activity)

Background spectra – ER+NR (only measured)

ER+NR, no cuts



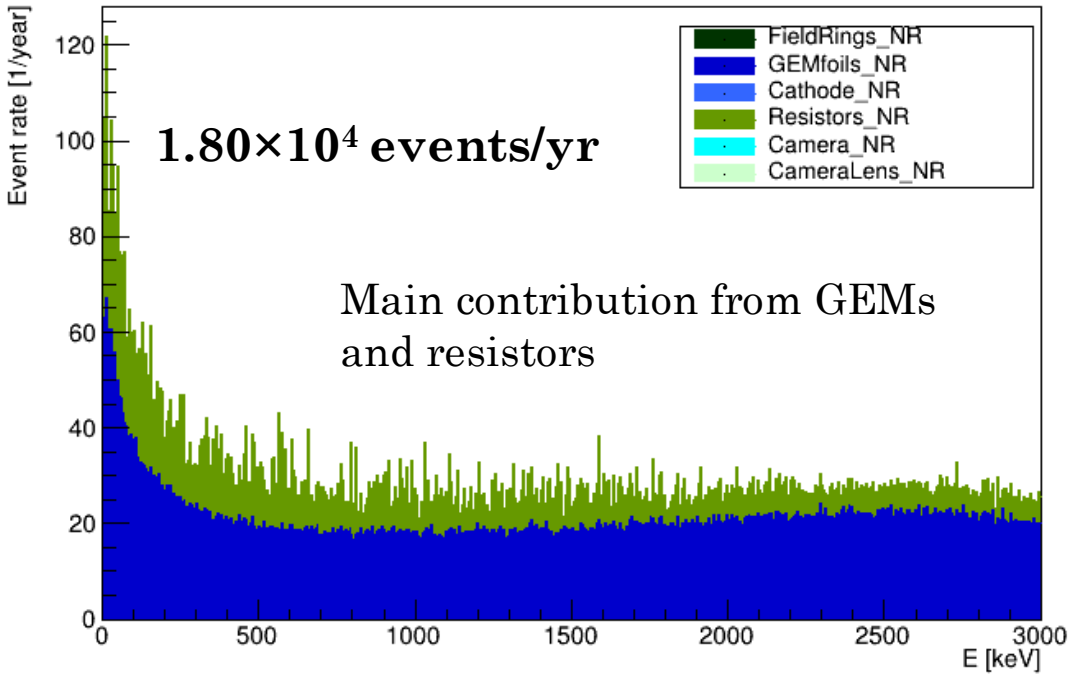
ER+NR, cuts applied



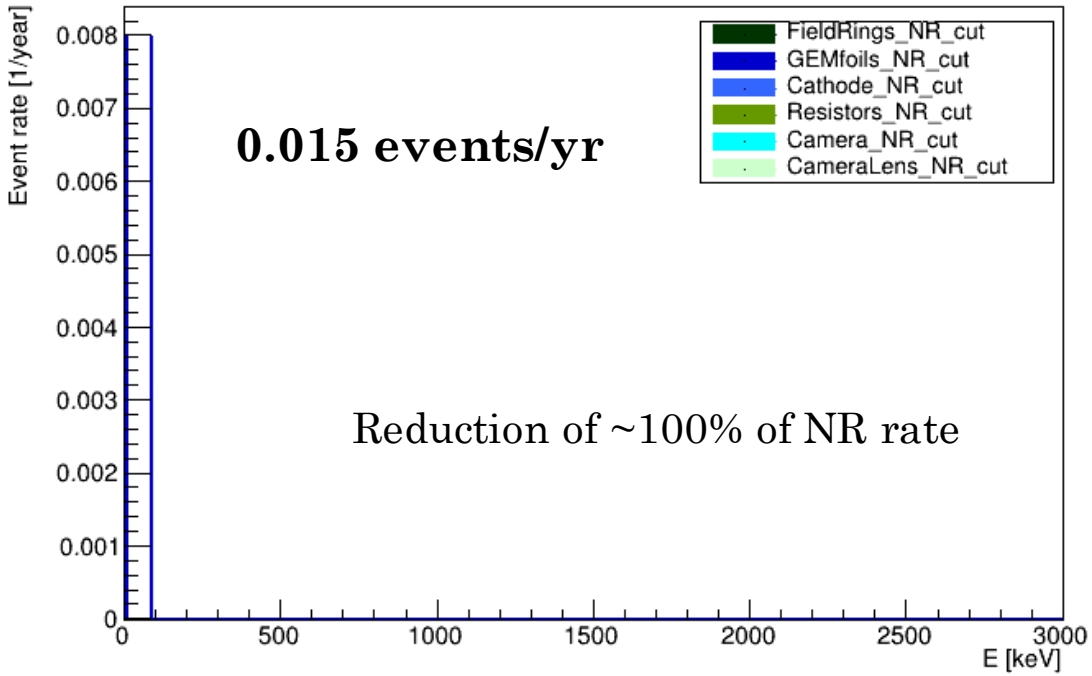
Additional cuts may be applied to reduce the resistors background
Rate above 20keV: **1.77×10⁶ events/yr**, after cuts: **5.0×10⁴ events/yr**

Background spectra – NR only (only measured)

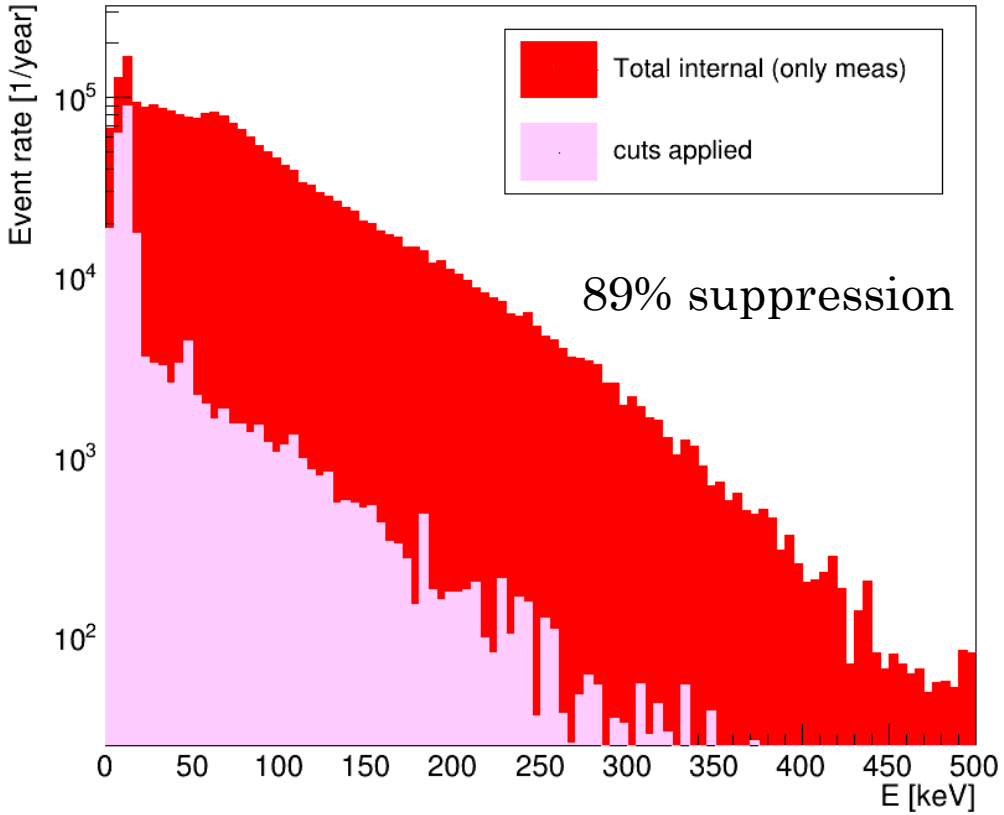
Only NR, no cuts

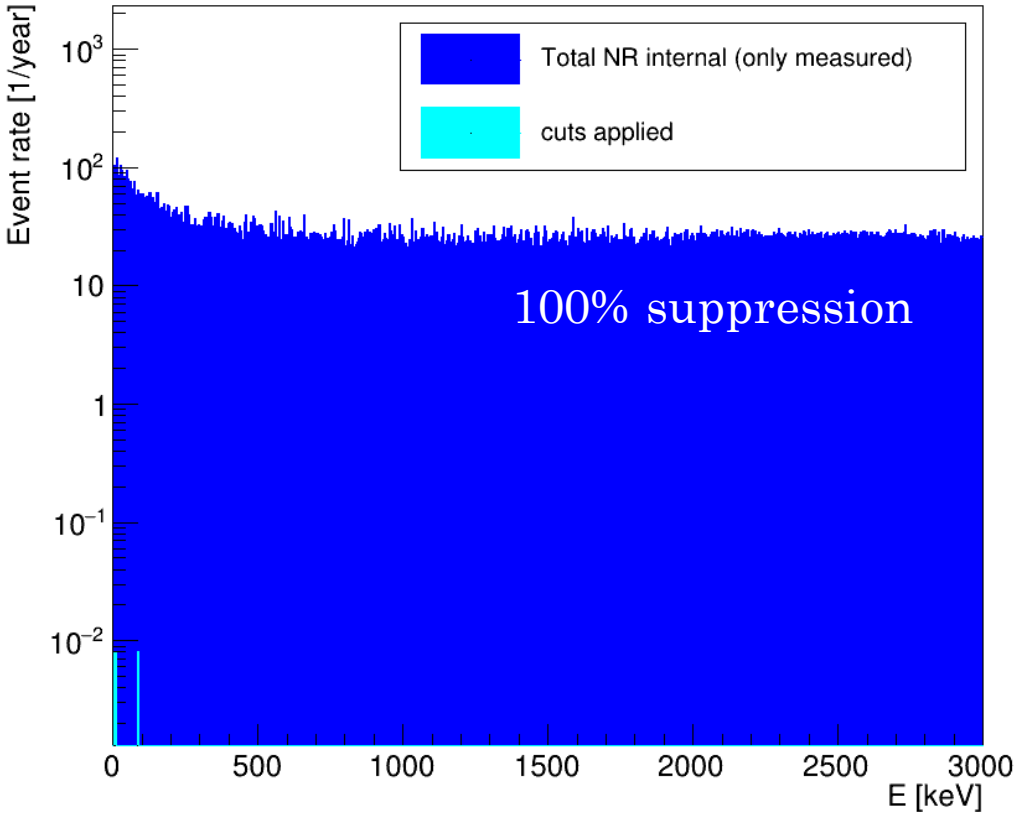


Only NR, cuts applied



Background reduction (only measured)





Conclusions

- Total internal background rate is in the range **(2.2 - 7.4)×10^6 events/yr**
  - Of which the NR rate is **(1.8 - 6.1)×10^4 events/year**
- I applied some fiducial cuts (reduction of sensitive volume of ~23%)
  - Total rate is reduced by a factor between 89% and 96% (~100% for NR)
- The most radioactive components are the resistors and the field rings (and the cathode)
- The radioactivity from the copper shielding was not included in this study – I will do a more accurate simulation with the new geometry of the shielding