SUMMER NEWS ON SENSITIVITY STUDY CYGNO

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NEW ADDITIONS

- During August two more pieces were added to the frequentist approach sensitivity study

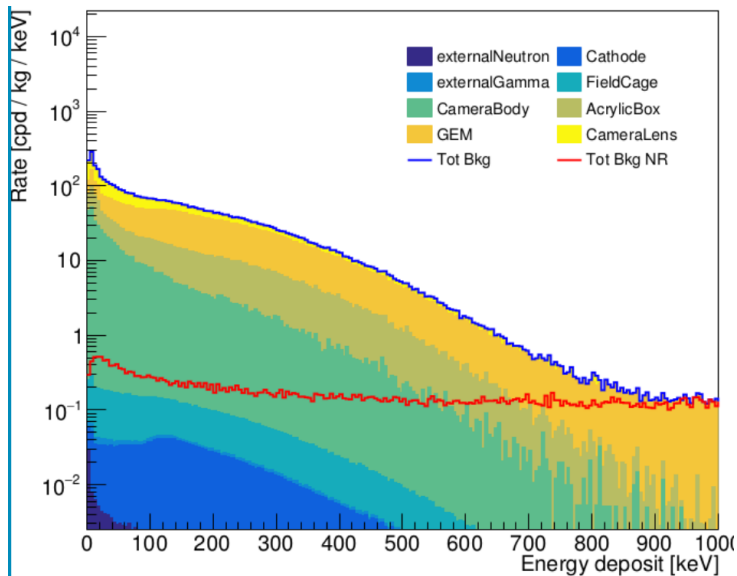**Quenching factor effect**

Added in the spectra calculation

Number of events of background

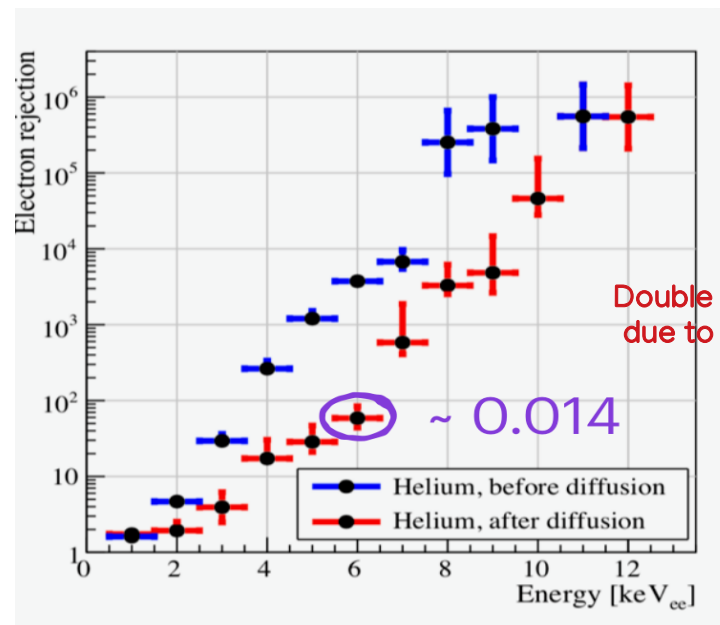Evaluation based on the results of the simulation

- These were applied to different time of exposure and volumes.

- Other than the usual 10, 100, 1000, 10000 events of background, Giulia exploited the rejection factor from Sven's plot and obtained from simulation the expected value for CHINOTTO and CYGNO

Double the rejection factor due to our measurements

~ 0.014

CHINOTTO 1.4×10^4 evt/y

CYGNO 6.8×10^4 evt/y
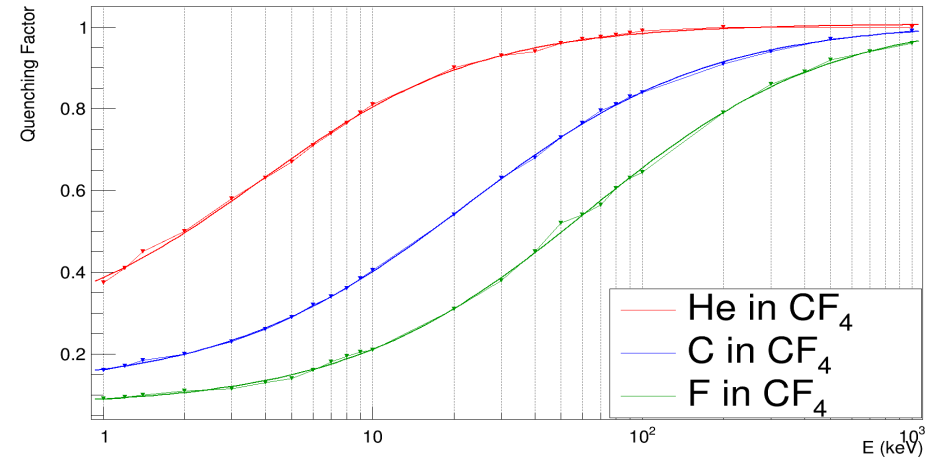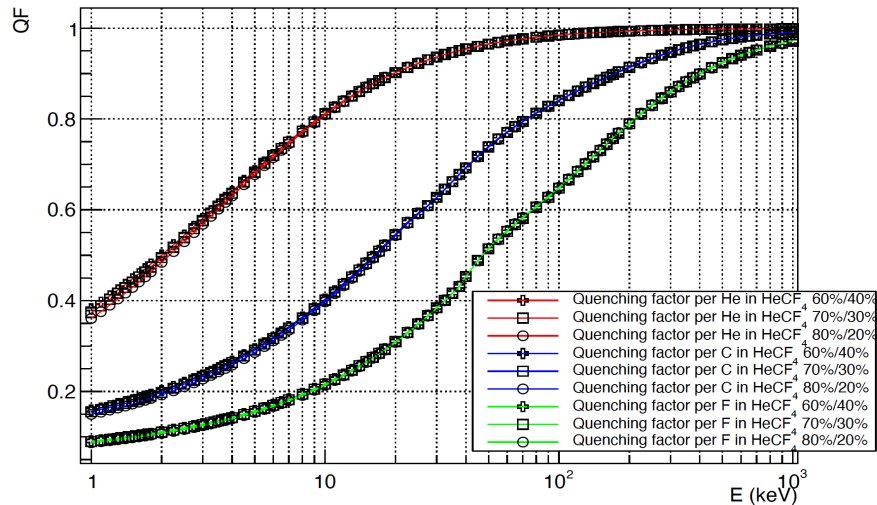
- The quenching factor links the original energy of the nucleus E, to the measurable energy E'

$$E' = E \cdot q_f(E)$$

- Given the measurements of the quenching factors I parametrised them for each element as a function of the original and measurable energy

$$q_f(E) = a + \frac{b}{1 + \left(\frac{c}{E}\right)^d}$$

- The quenching factor would require to change the differencial cross section

$$\frac{dR}{dcos\ \gamma\ dE} \rightarrow \frac{dR}{dcos\ \gamma\ dE\,'}$$

- However, being at the moment interested only in the angular spectrum, the energy is integrated on, which makes it easier
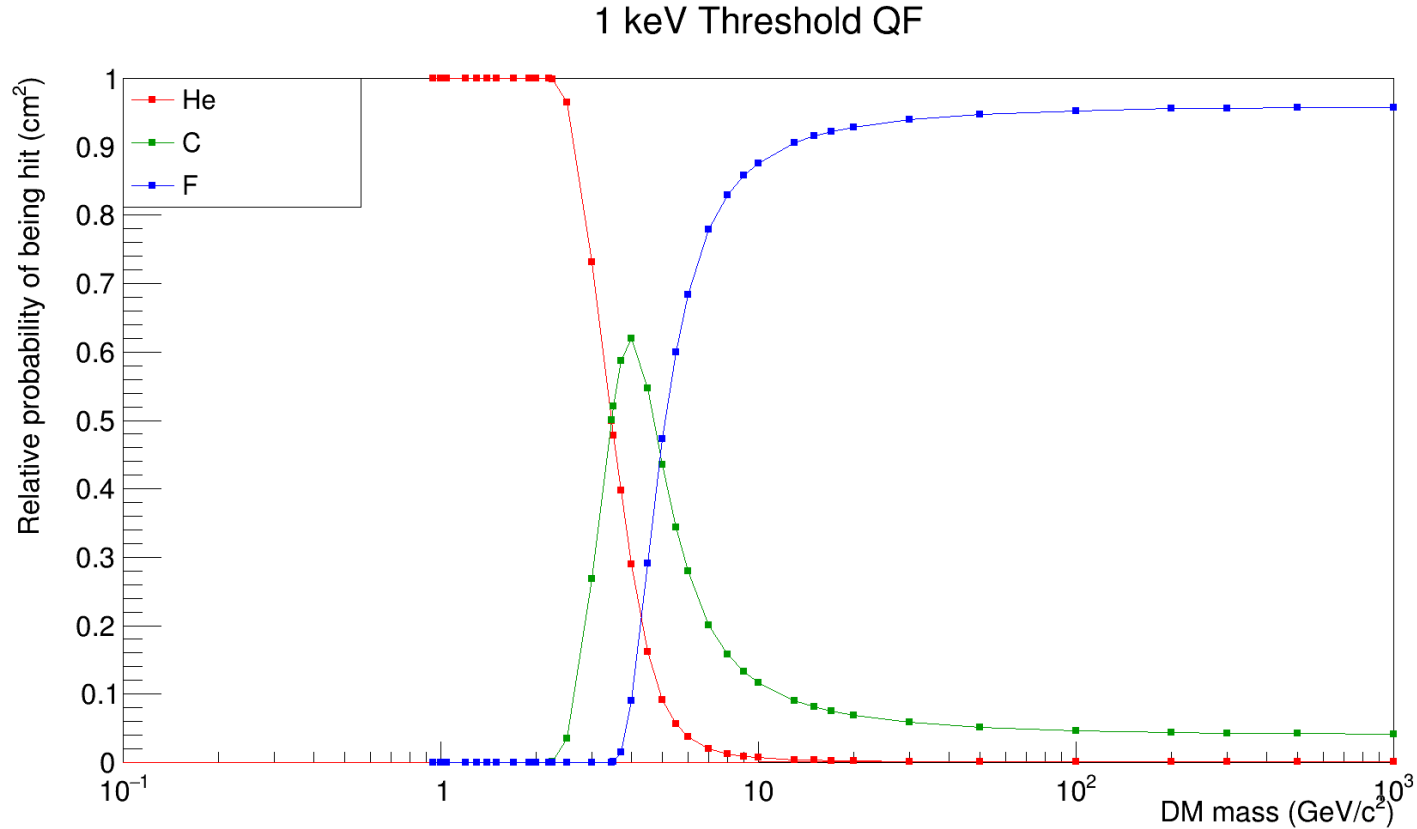
$$\frac{dR}{dcos\ \gamma} = \int_{E_{thr}}^{\frac{1}{2} m_\chi r (v_E \cos \gamma + v_{esc})^2} \left(e^{-\frac{(v_{min} - v_E \cos \gamma)^2}{v_0^2}} - e^{-\frac{v_{esc}^2}{v_0^2}} \right) dE_R$$

This is no more 1 keV, but the original energy of recoil of the element if 1 keV is the threshold of what we can measure

The q_f acts changing the threshold of the integral differently for each element
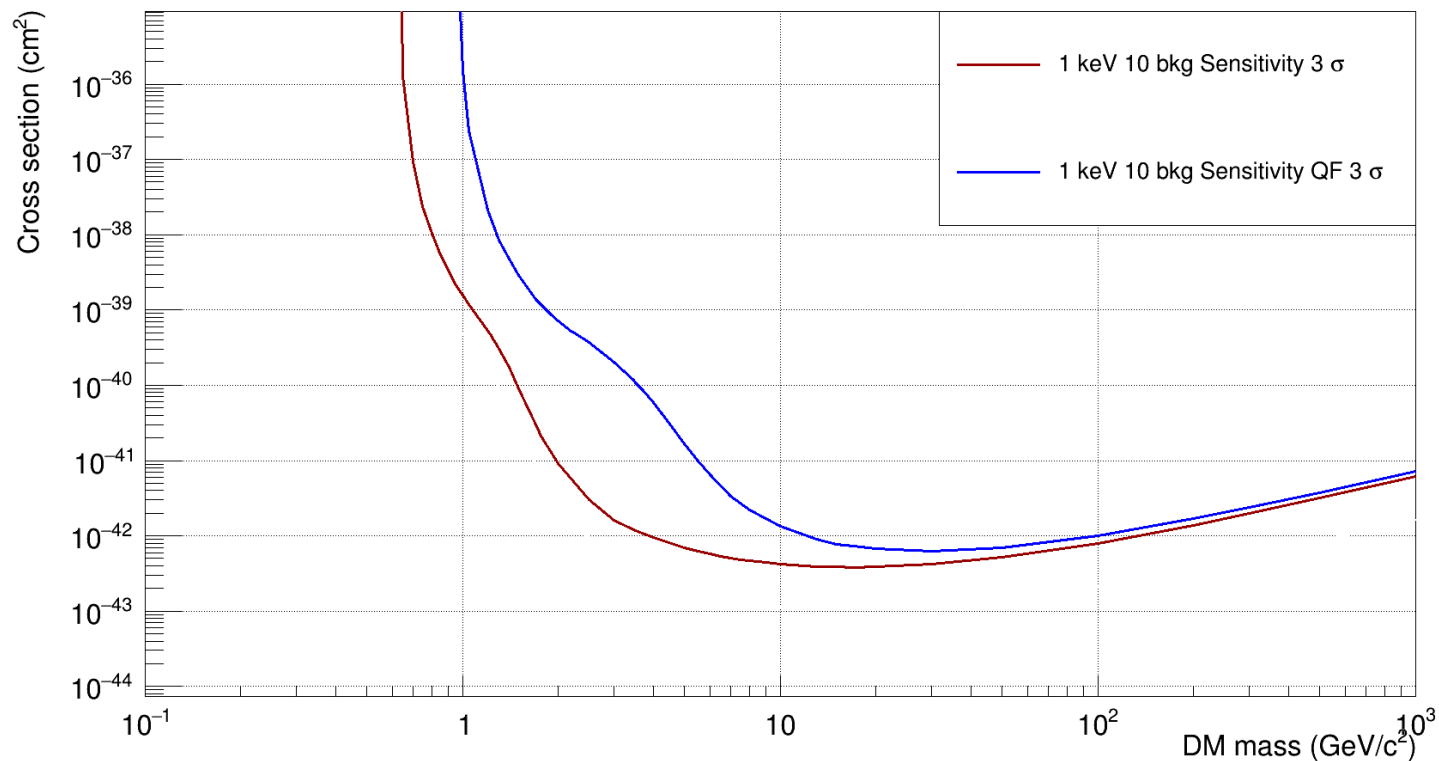
- This change has an effect also on the relative probability of each element of being detected

1 keV Threshold QF

• The same statistical procedure for the sensitivity studies was performed

1 m³ 1 year exposure

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1 m^3 1 year exposure

New energy threshold on the helium reflects on the minimum mass visible

Cross section (cm^2)

1 keV 10 bkg Sensitivity 3 σ

1 keV 10 bkg Sensitivity QF 3 σ

DM mass (GeV/c^2)

- The same statistical procedure for the sensitivity studies was performed
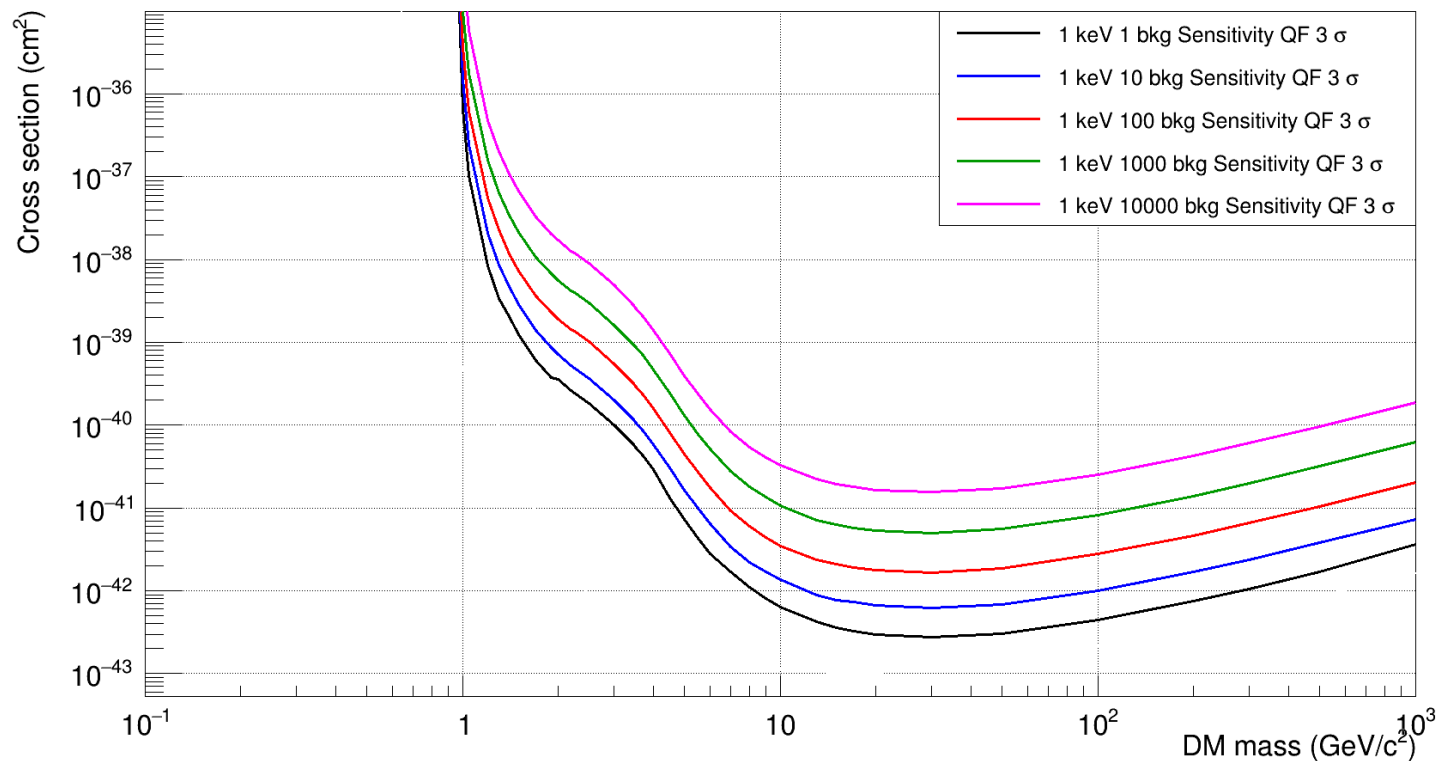
1 m³ 1 year exposure

New energy threshold on the helium reflects on the minimum mass visible

The shape of the curve changes because the q_f of the elements are different

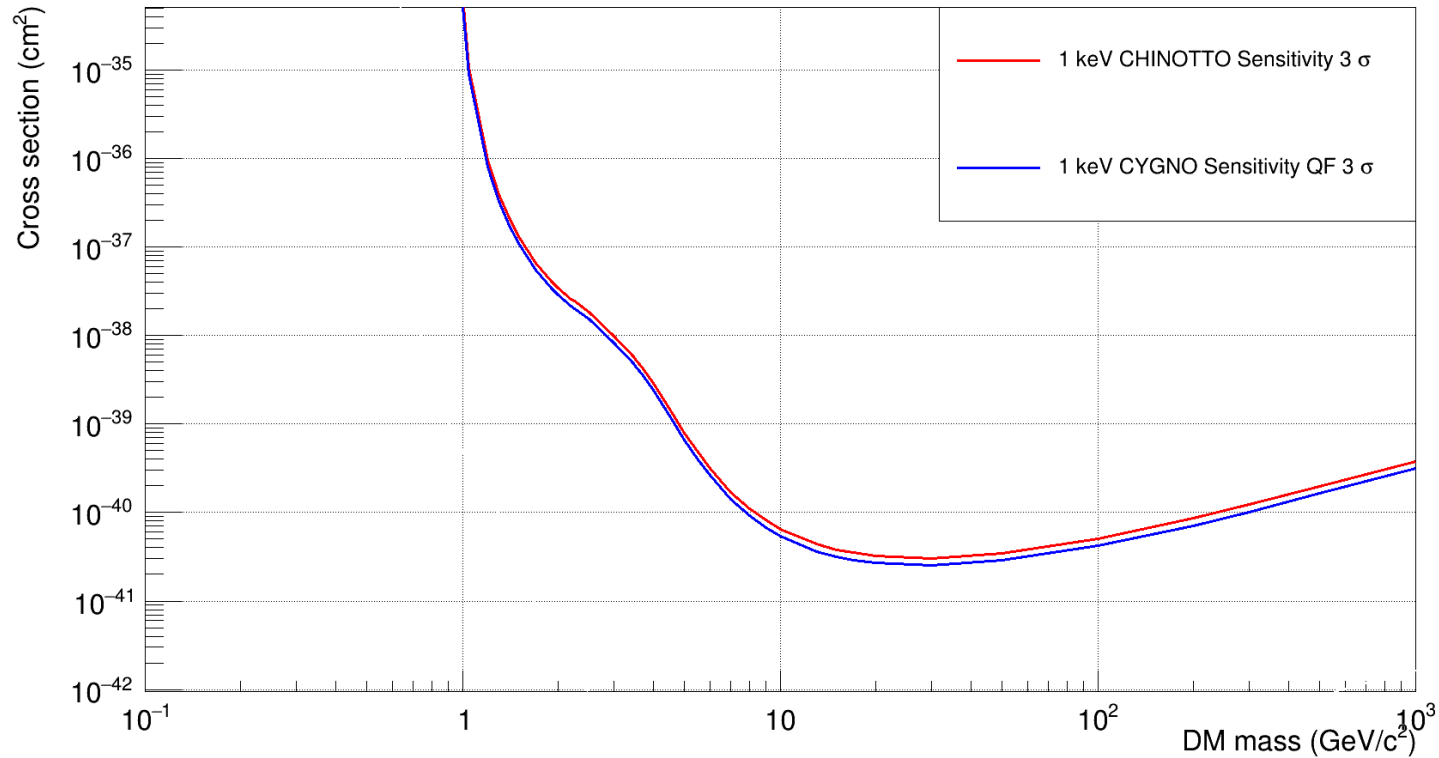• Including the quenching factor and different values of background events

1 m³ 1 year exposure

- Using the different volumes and the expected background

1 year exposure

- Different exposures were also tried scaling linearly the background events both for the volume and the time. Also the CL 90% is quoted but it highly approximated by simply dividing by a factor 2, just to have an idea (will be correct once the bayesian approach will beconsistently used)
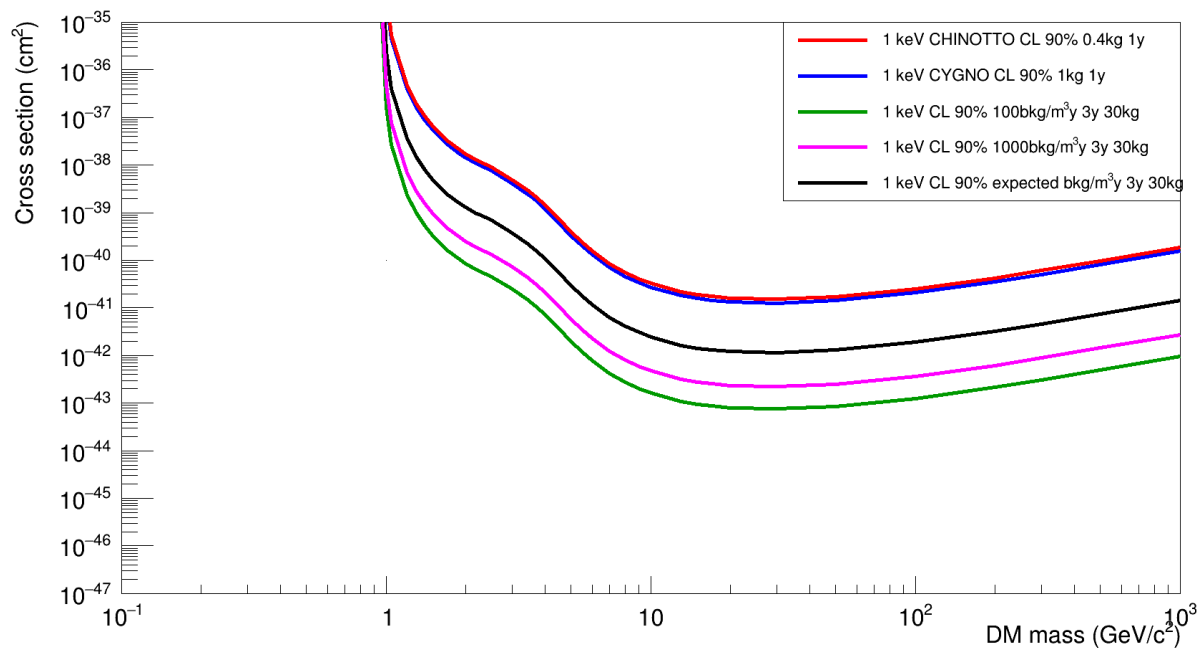
• With a threshold of 1 keV on the detectable energy this corresponds

Helium	2.02 keV
Carbon	3.9 keV
Fluorine	6.18 keV