Detecting Solar Neutrinos with Directional Gas TPCs

Chiara Lisotti on behalf of the CYGNUS-Oz collaboration

Dark Matter

In our Universe, there is about 5 times more Dark Matter than there is visible matter!

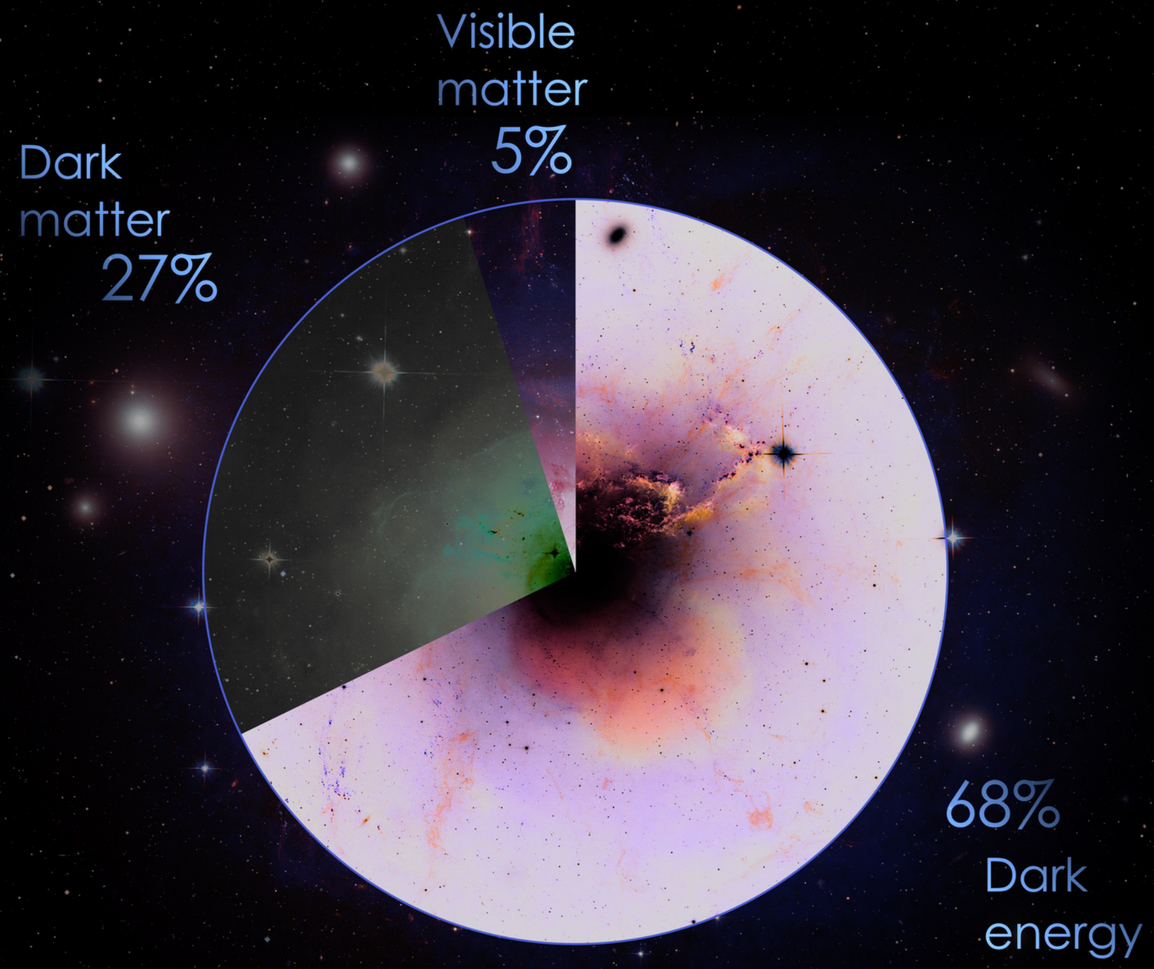

Photo by NASA's Goddard Space Flight Center

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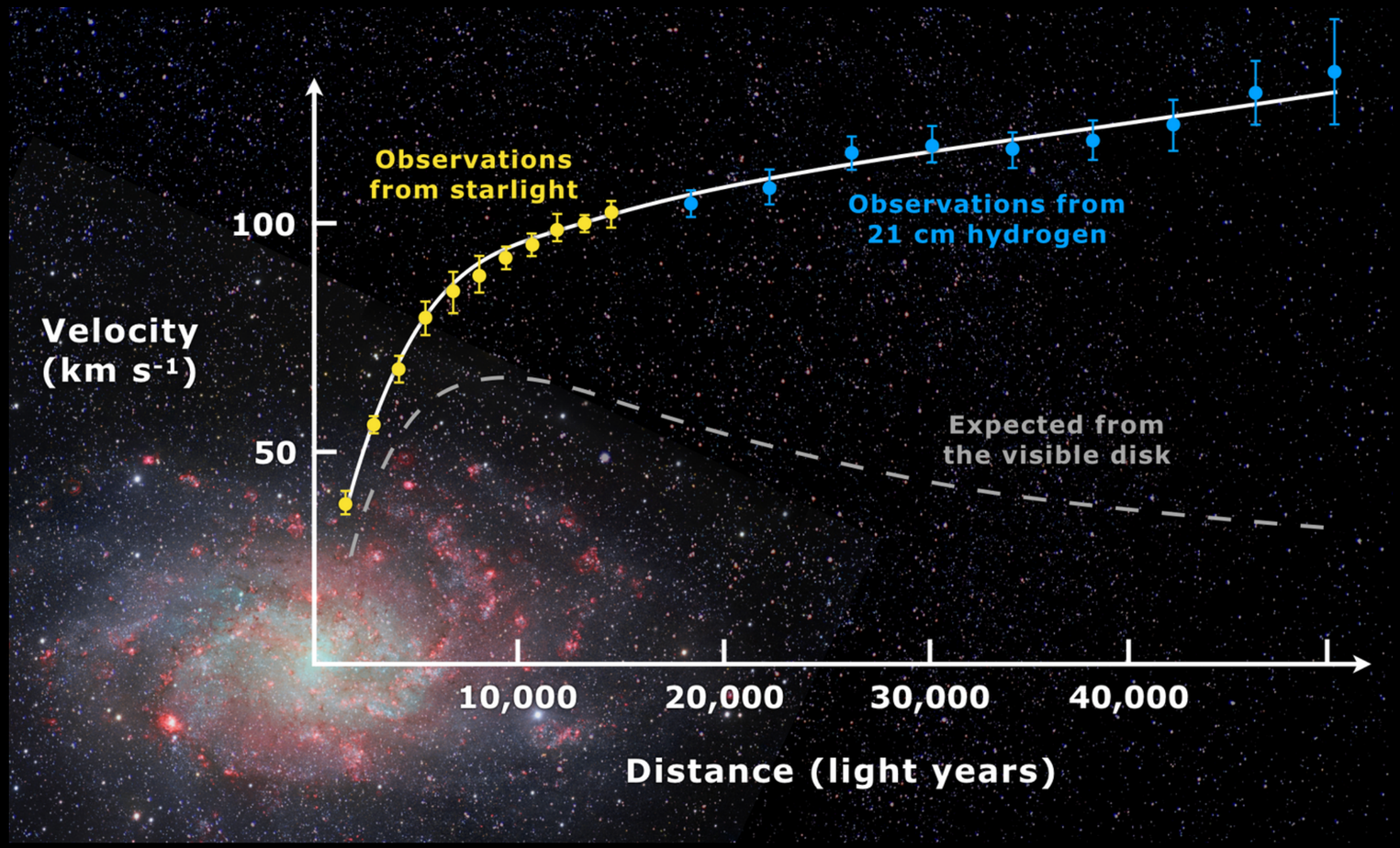
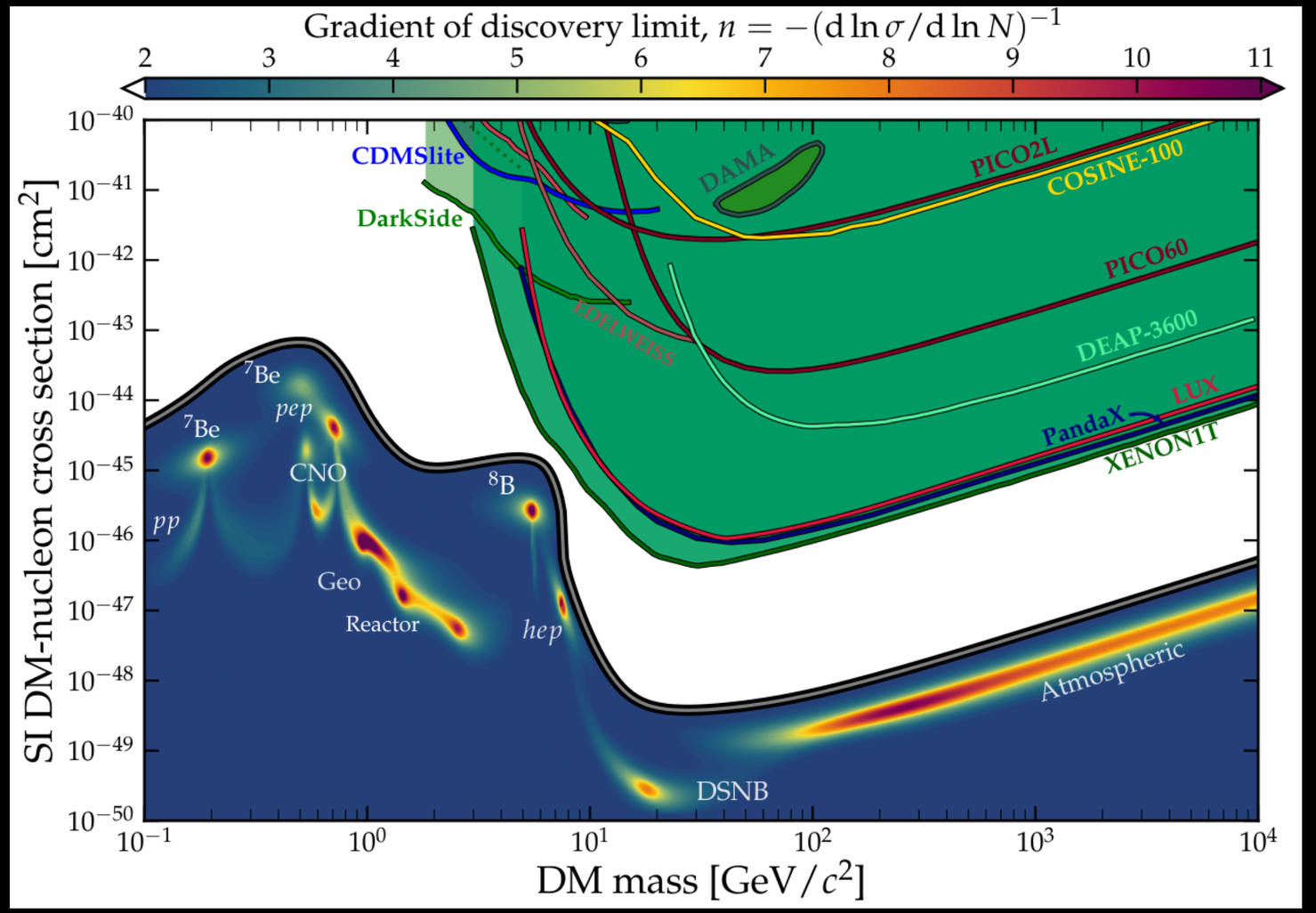


Photo by M. De Leo

Direct Detection

Direct detection of DM has mainly focused on weakly interacting massive particles (WIMPs)



O'Hare et al. [2203.05914]

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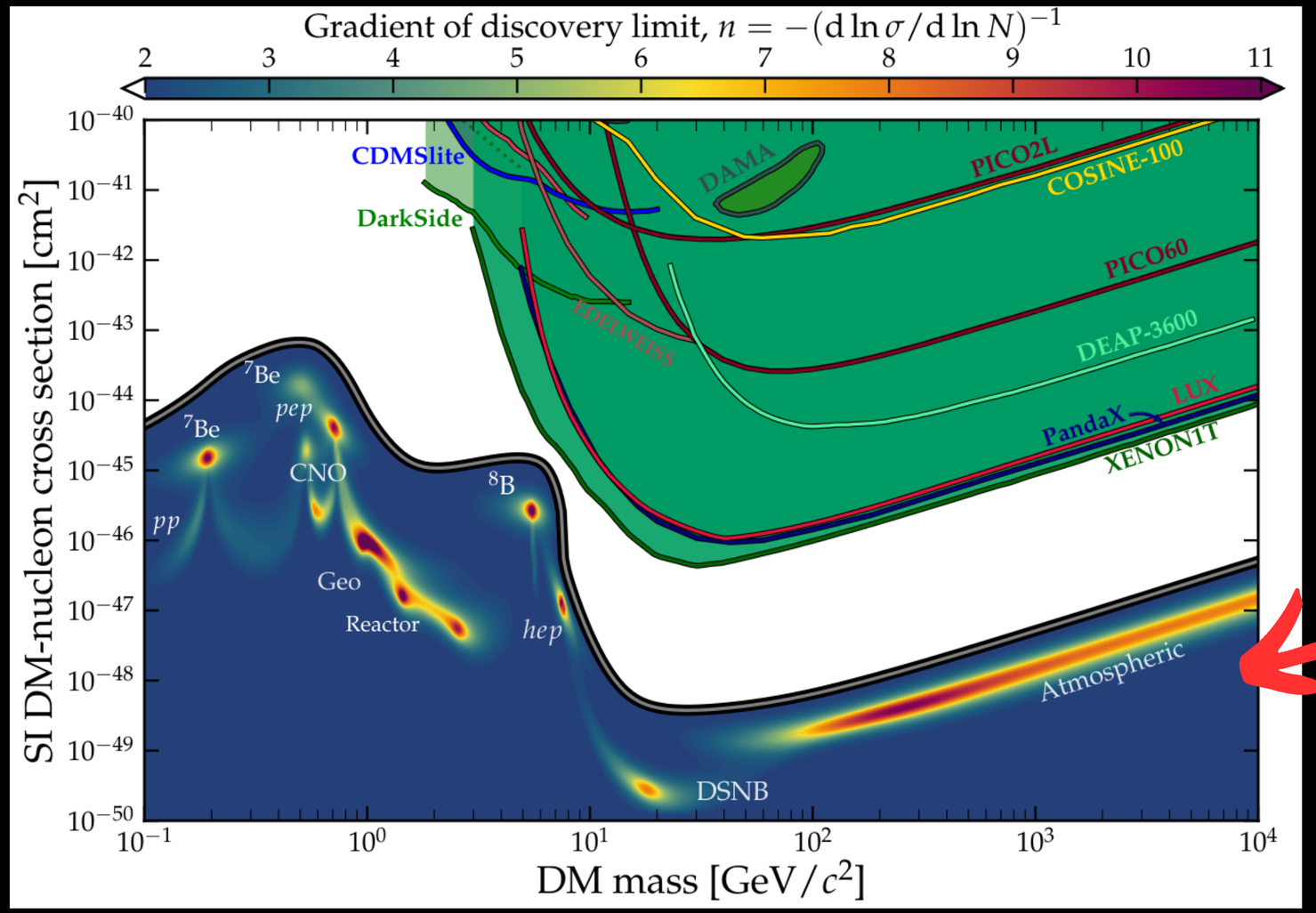

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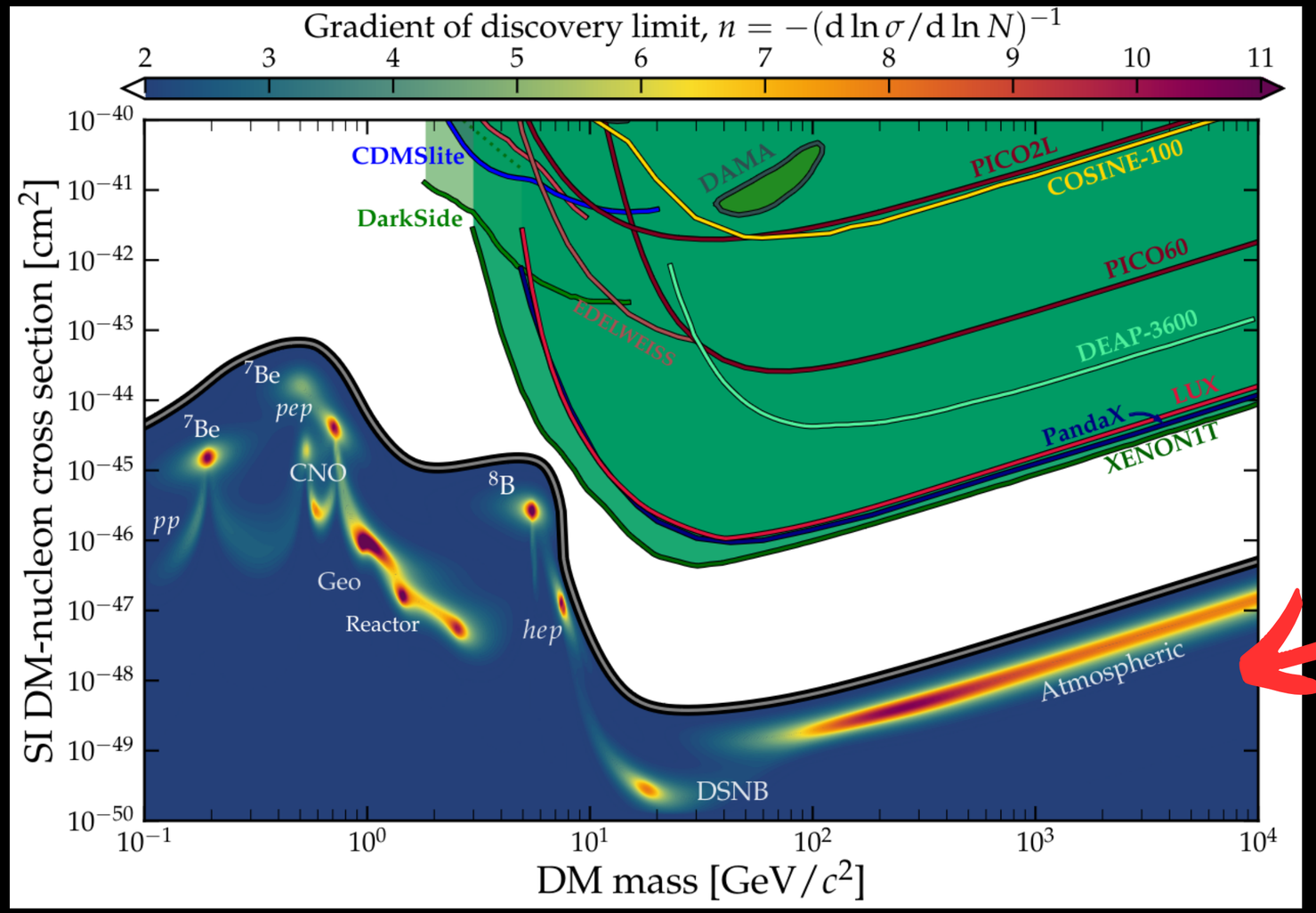

neutrino fog!

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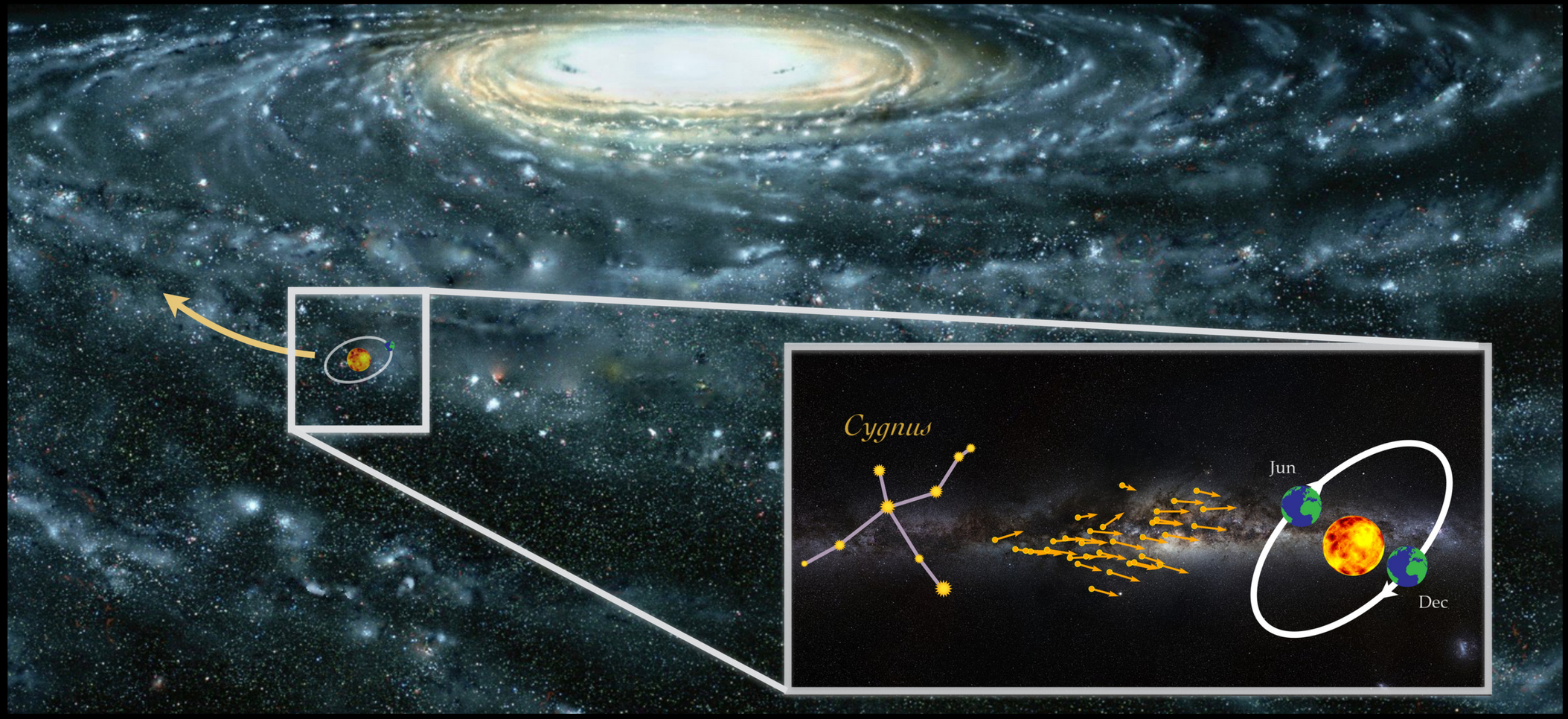
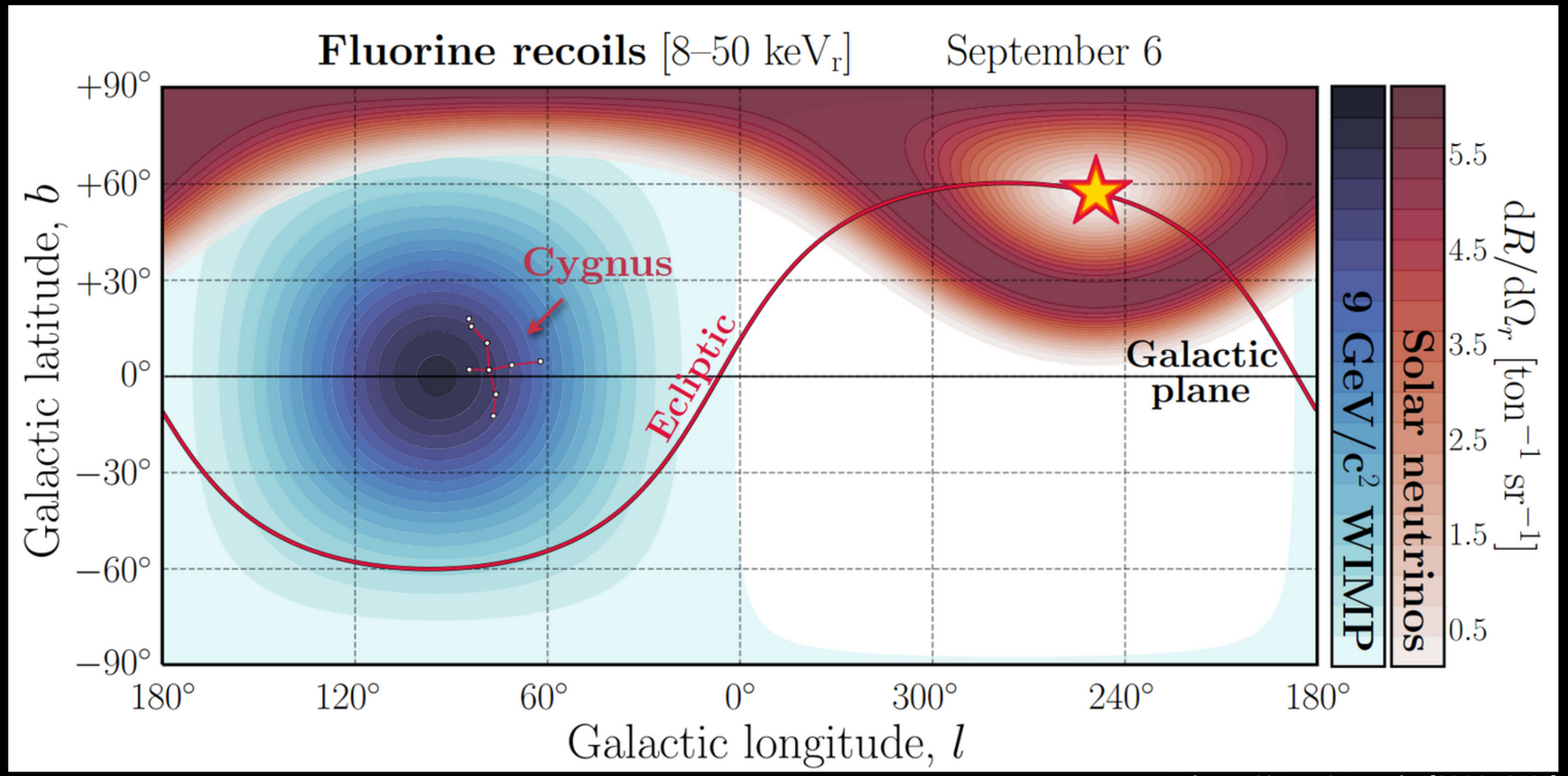


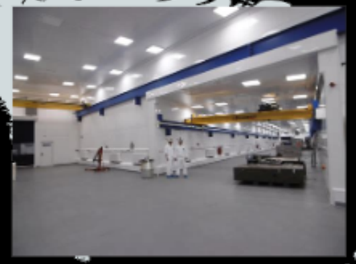
O’Hare

Directional Signature



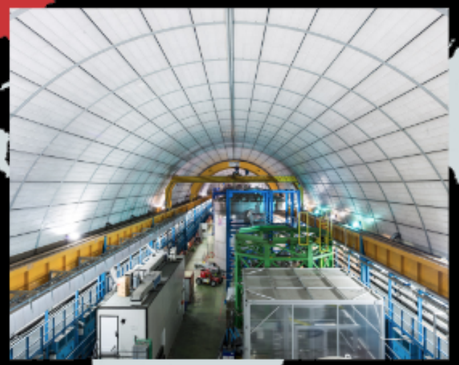
Vahsen, O'Hare & Loomba [2008.12587]

CYGNUS consortium



CYGNUS-10
Boulby, UK

CYGNUS-HD10
Lead, USA



CYGNO
Gran Sasso, Italy

CYGNUS-KM
Kamioka, Japan

CYGNUS-Oz
Stawell, Aus

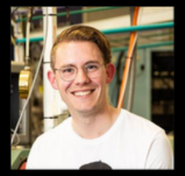
CYGNUS-Oz

Australian National University





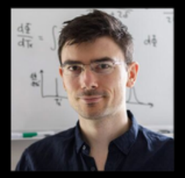





THE UNIVERSITY OF SYDNEY



THE UNIVERSITY OF MELBOURNE

THE UNIVERSITY of ADELAIDE







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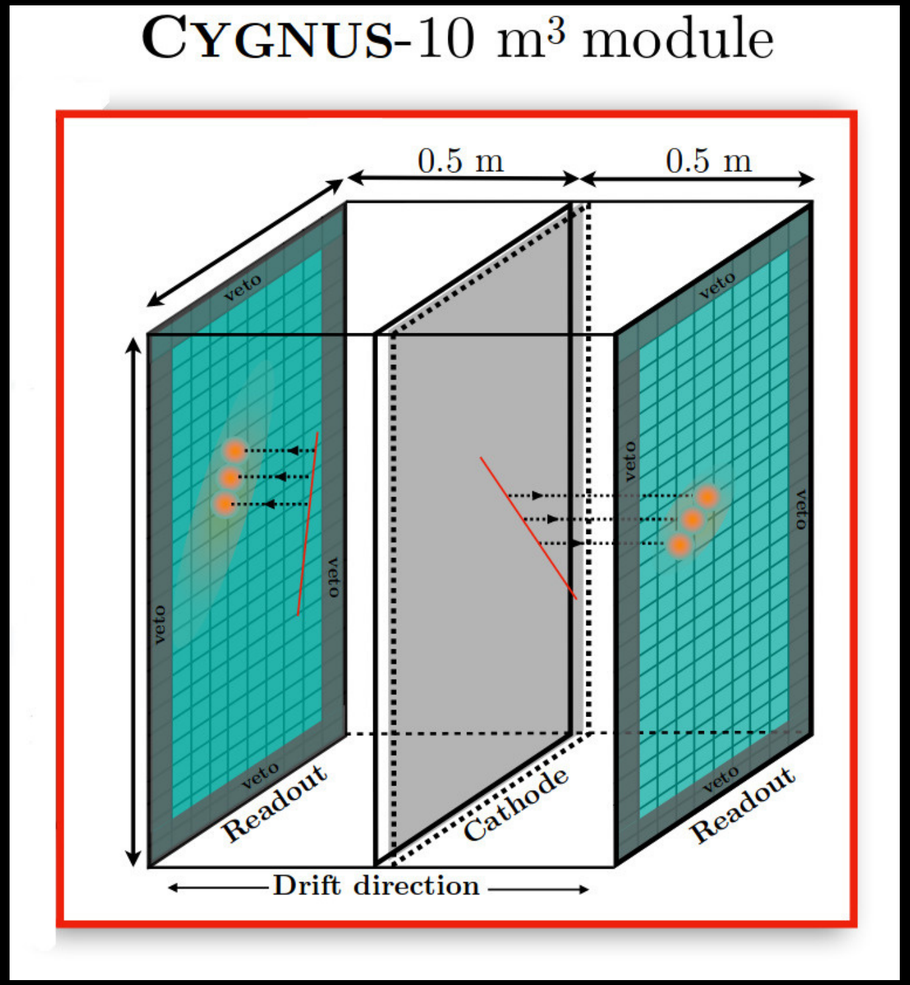
Paul Jackson (Adelaide)


Greg Lane (ANU)


Nicole Bell (Melbourne)


Ciaran O’Hare (Sydney)

Gas Time Projection Chamber



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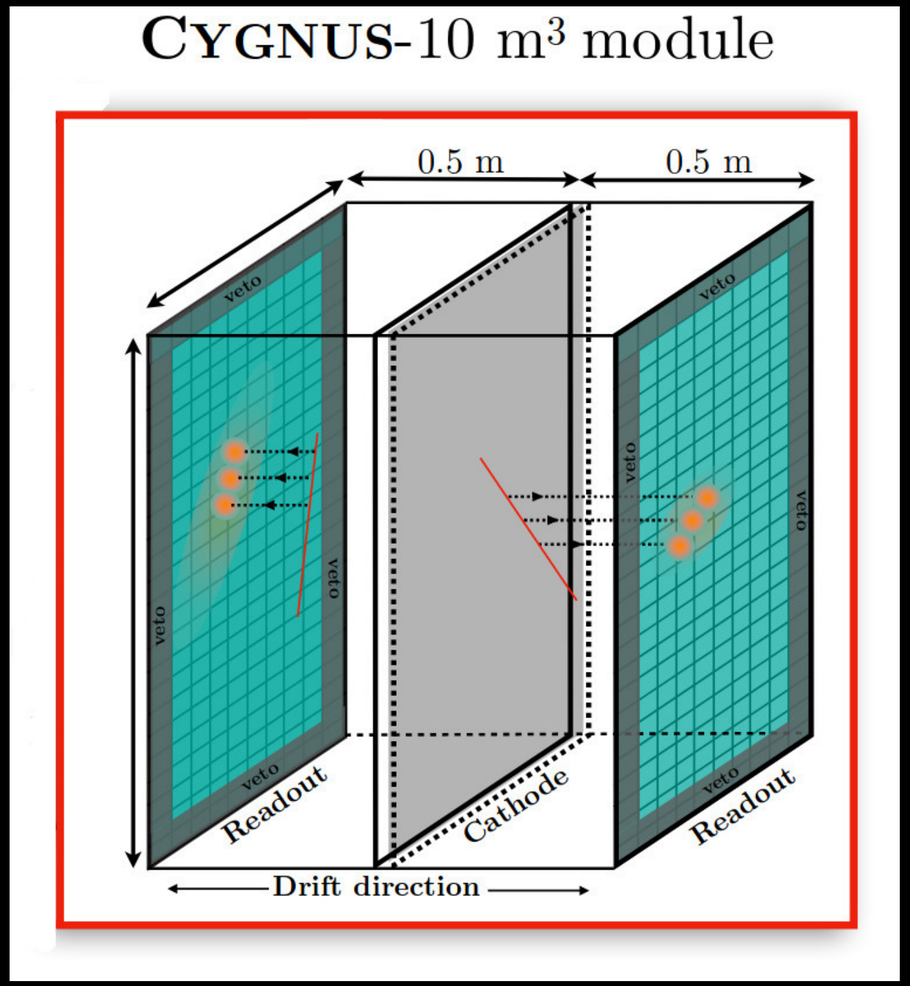
Recoils caused by WIMPs or neutrinos generate an ionisation track in the gas



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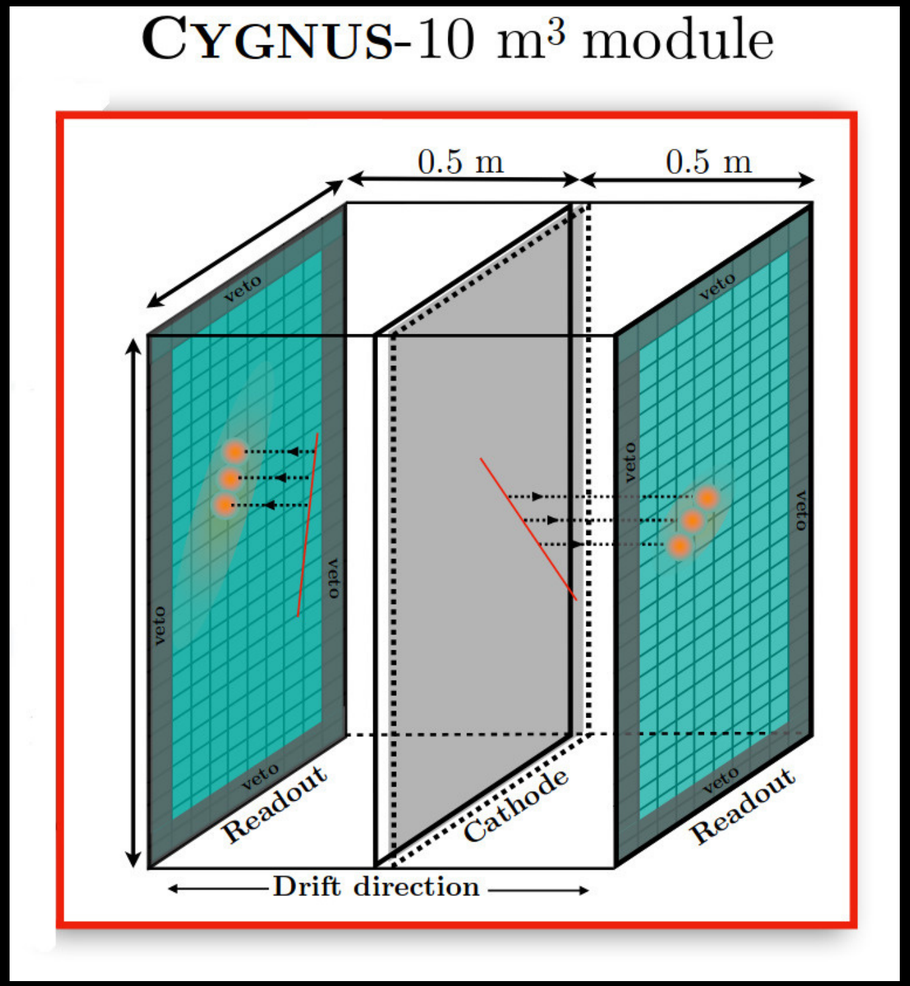

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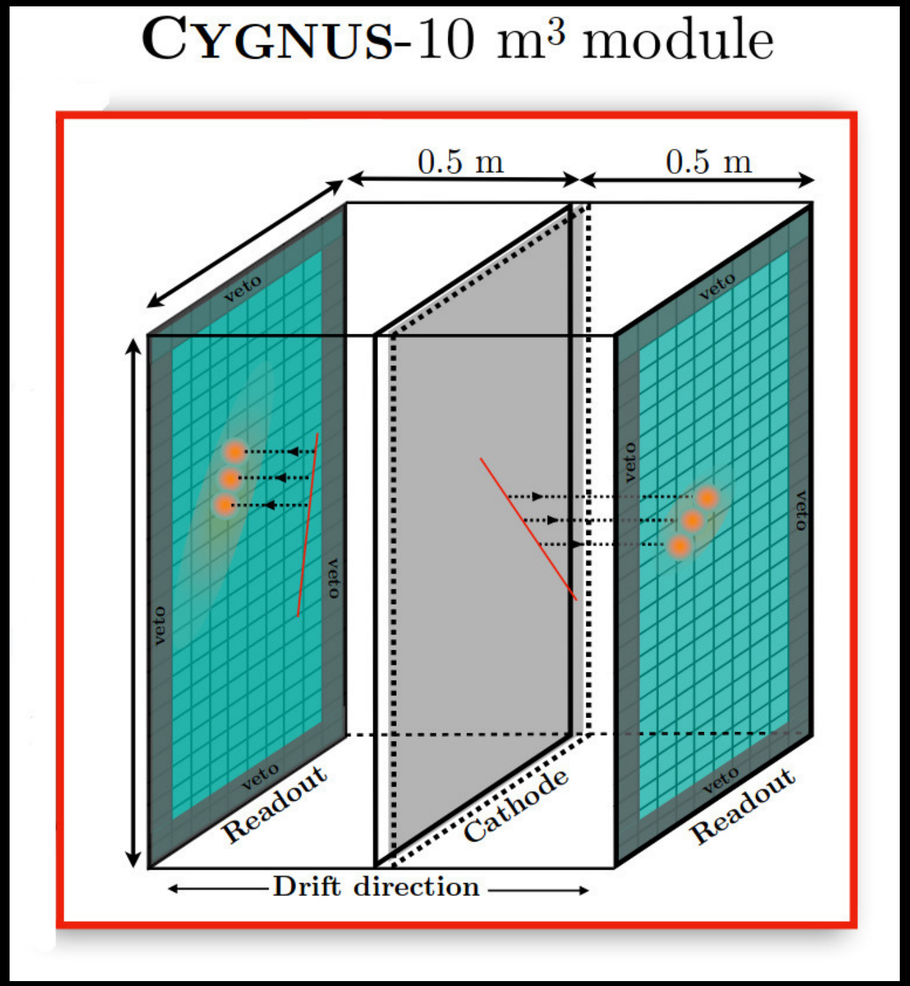

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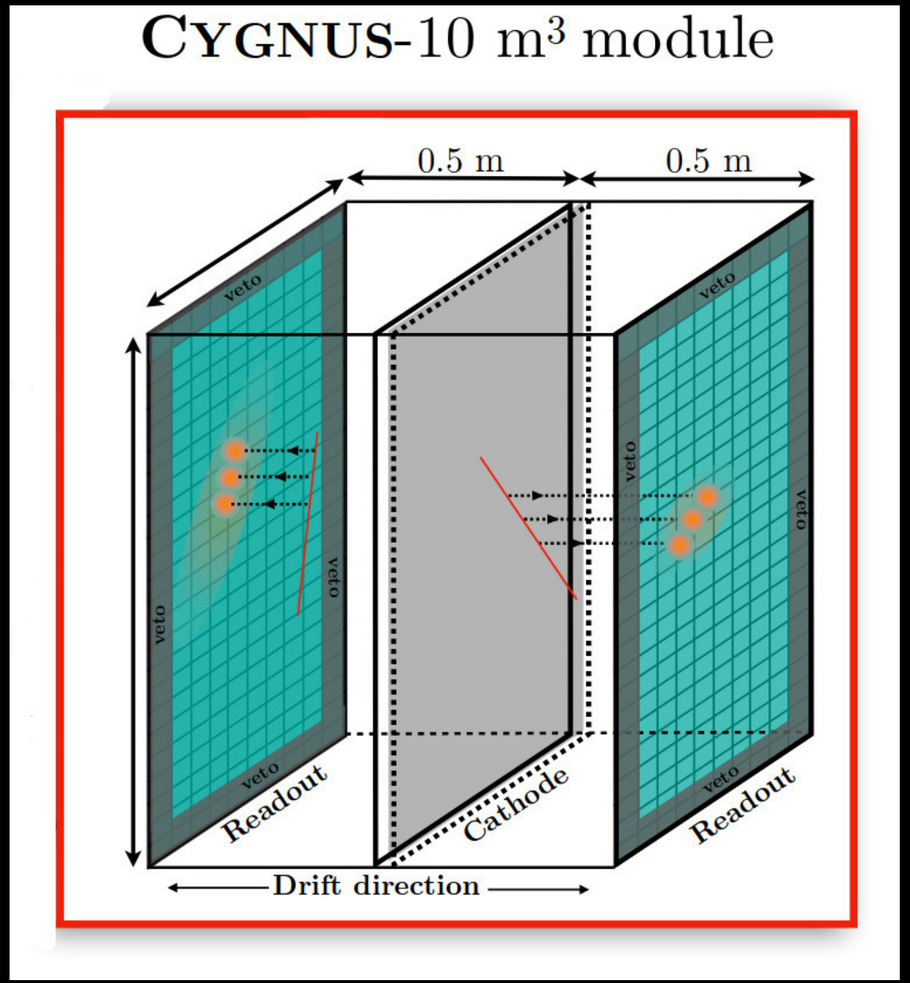
Experiment is placed underground to avoid cosmic ray background



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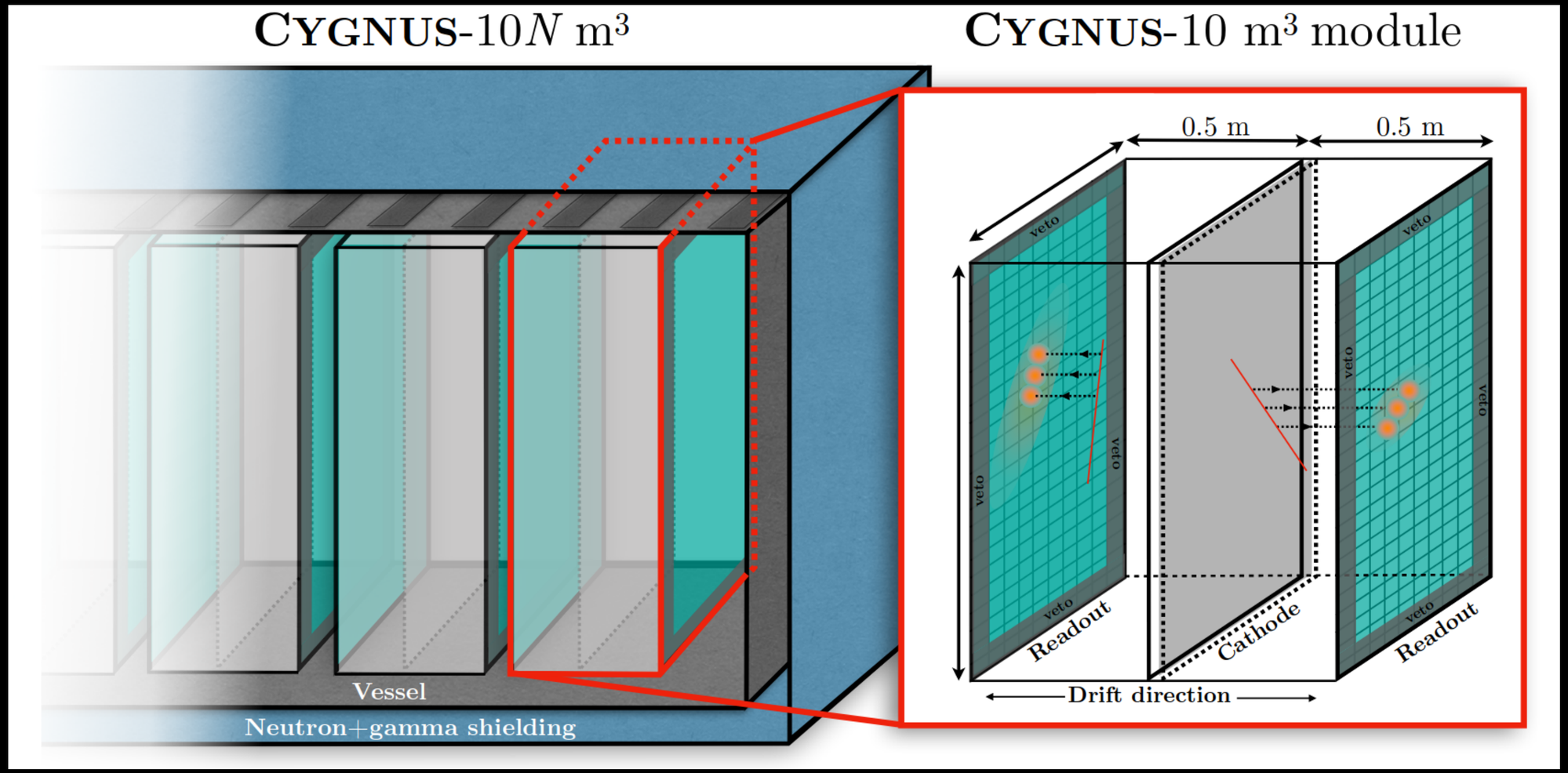
Gas Time Projection Chamber

Will be made modular: allows larger total volume while keeping drift length small



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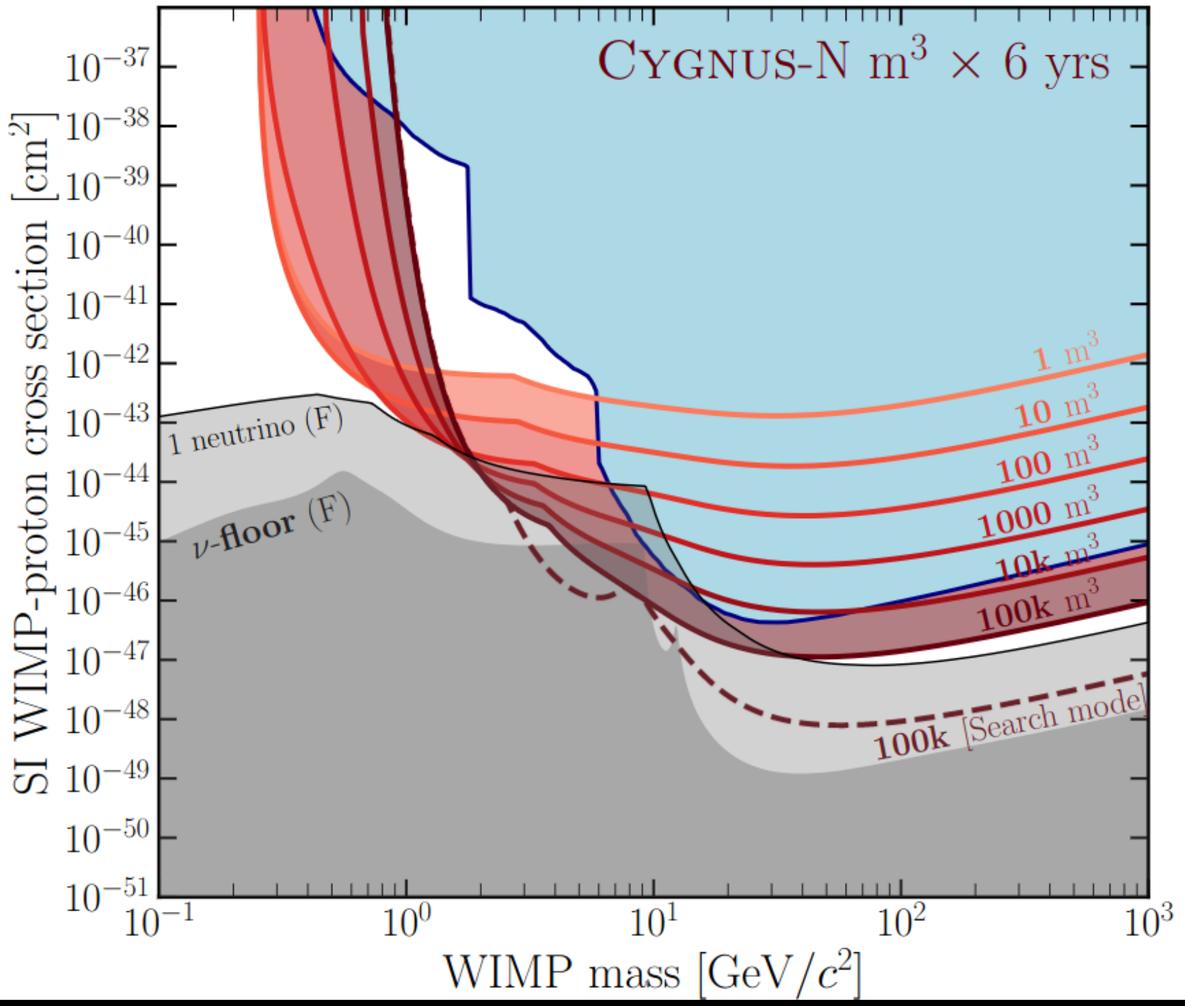
Expected Sensitivity



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Measure geoneutrinos

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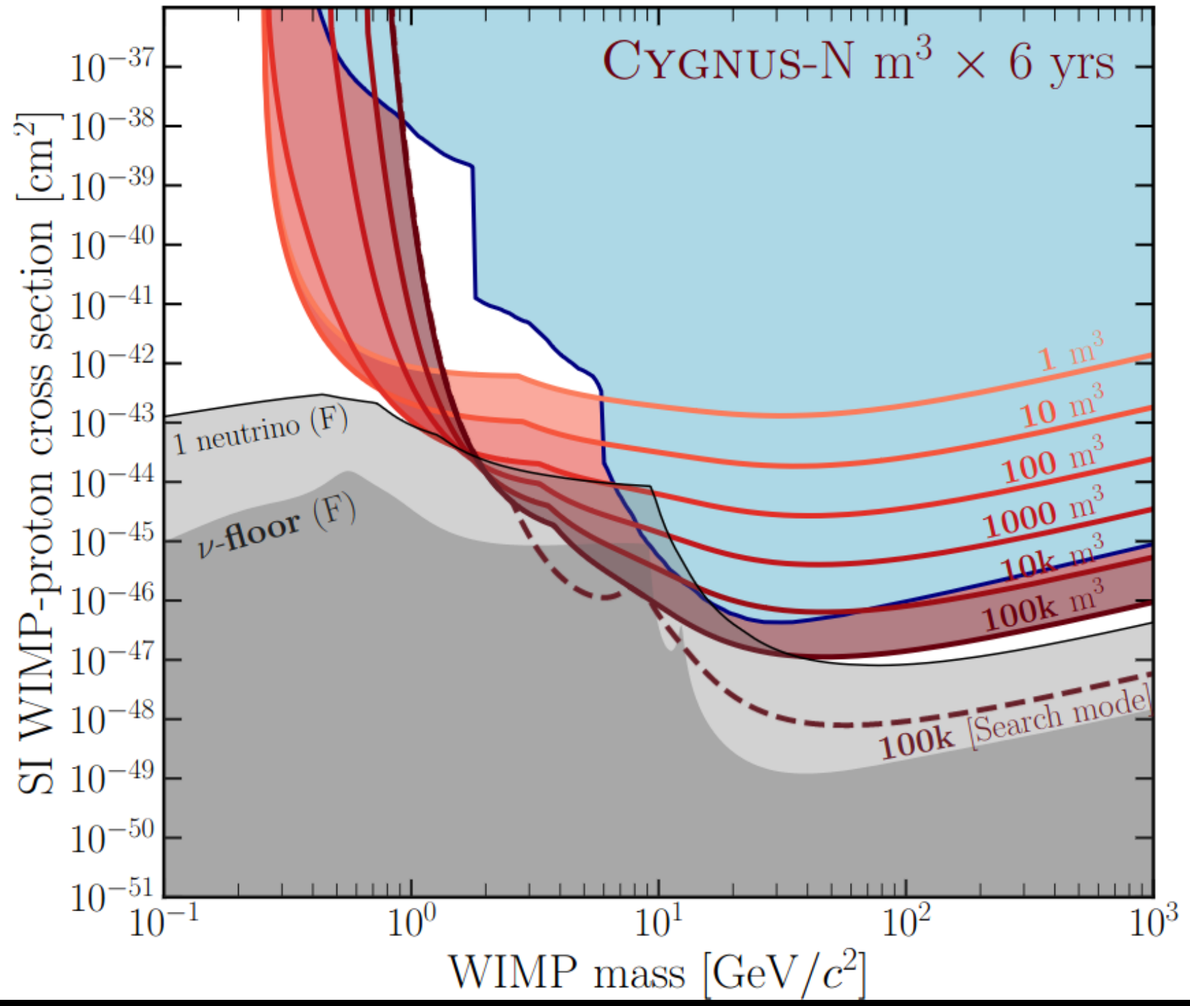

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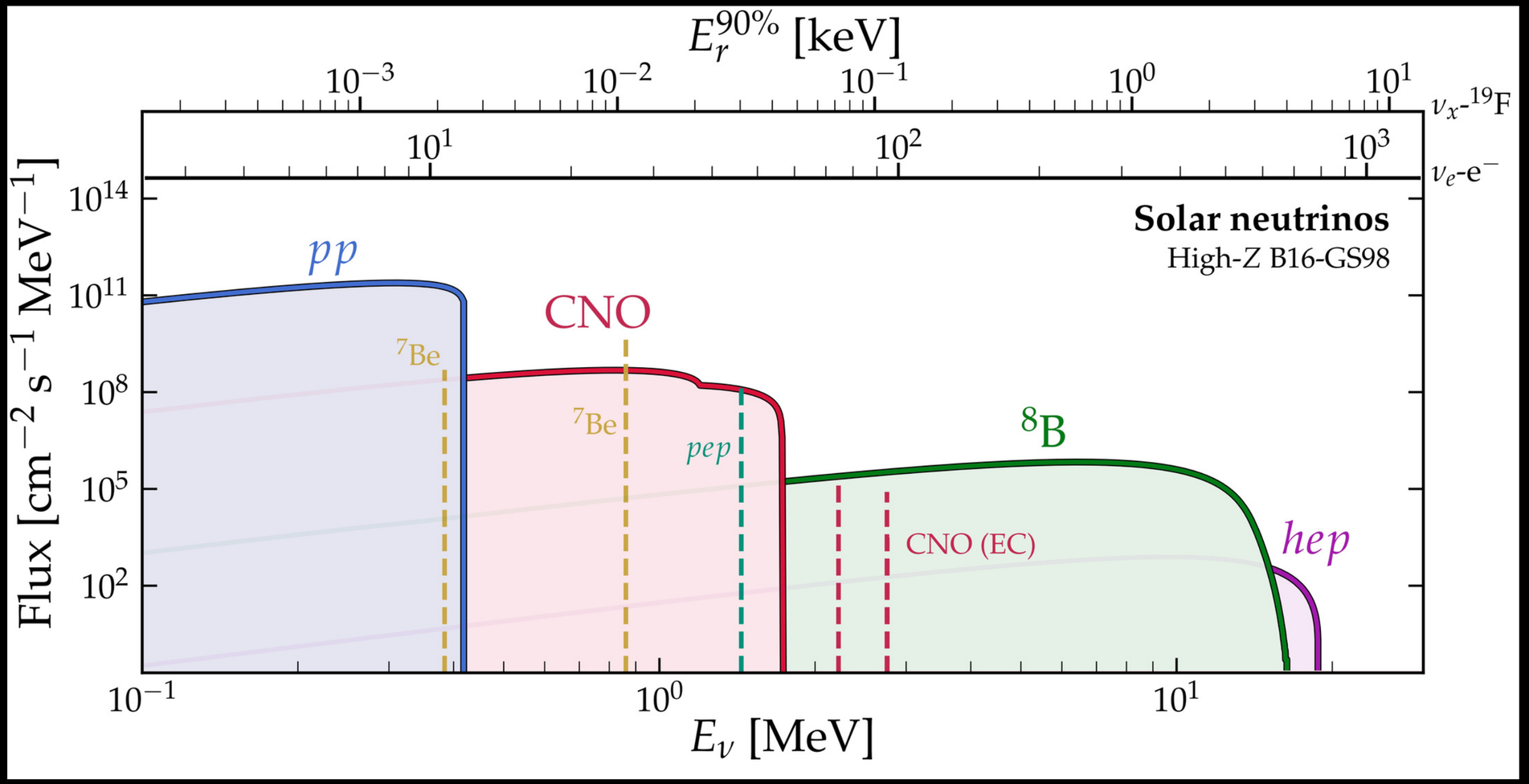

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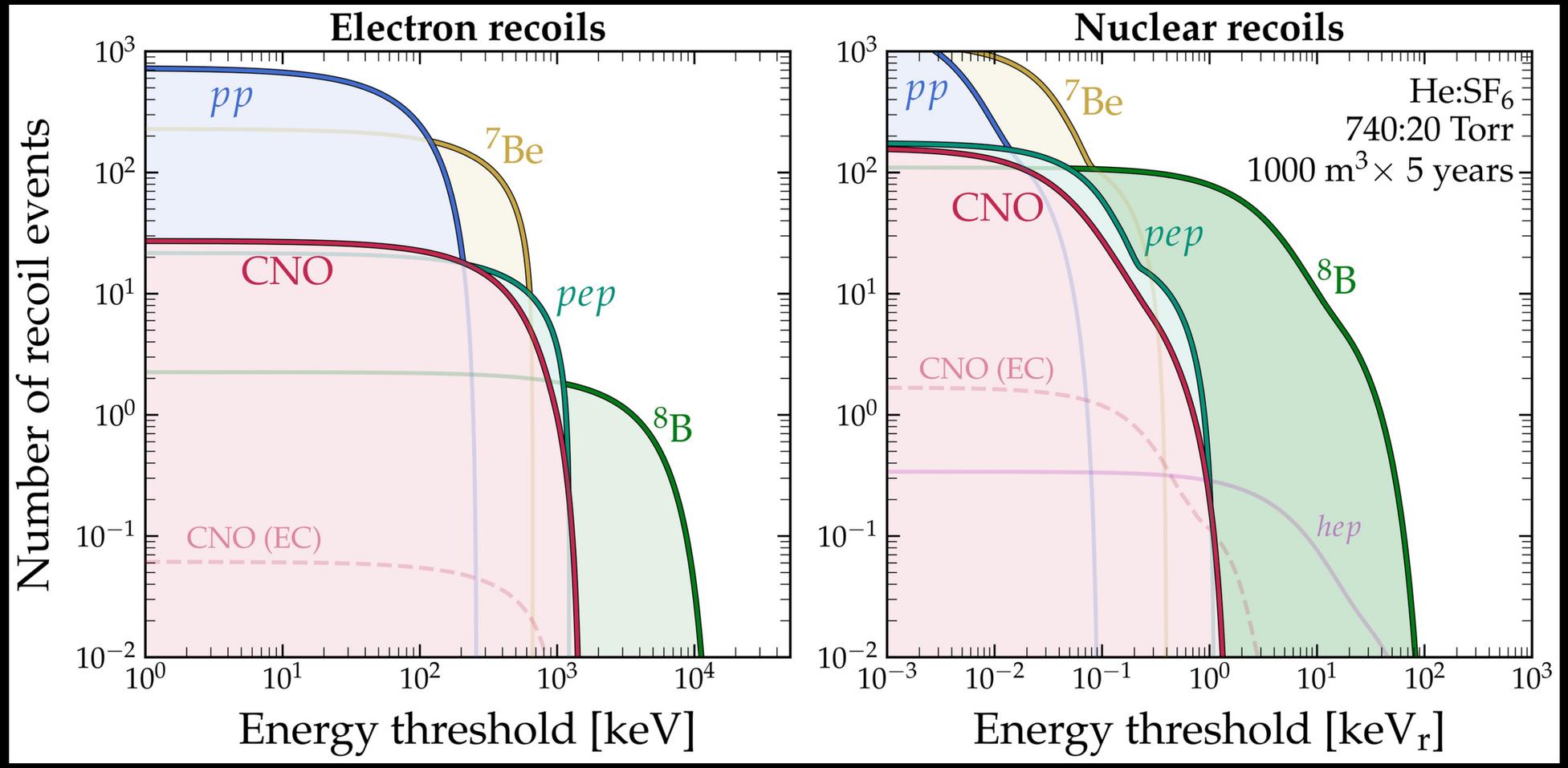

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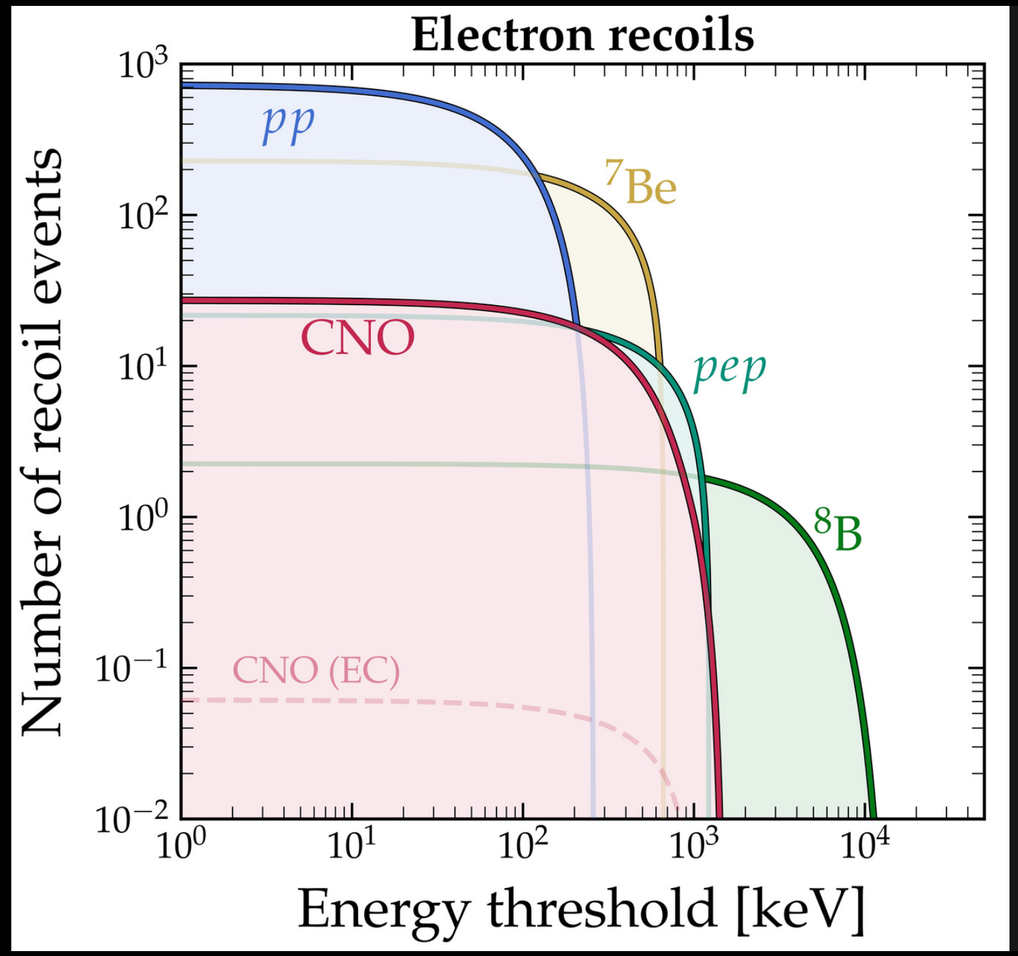
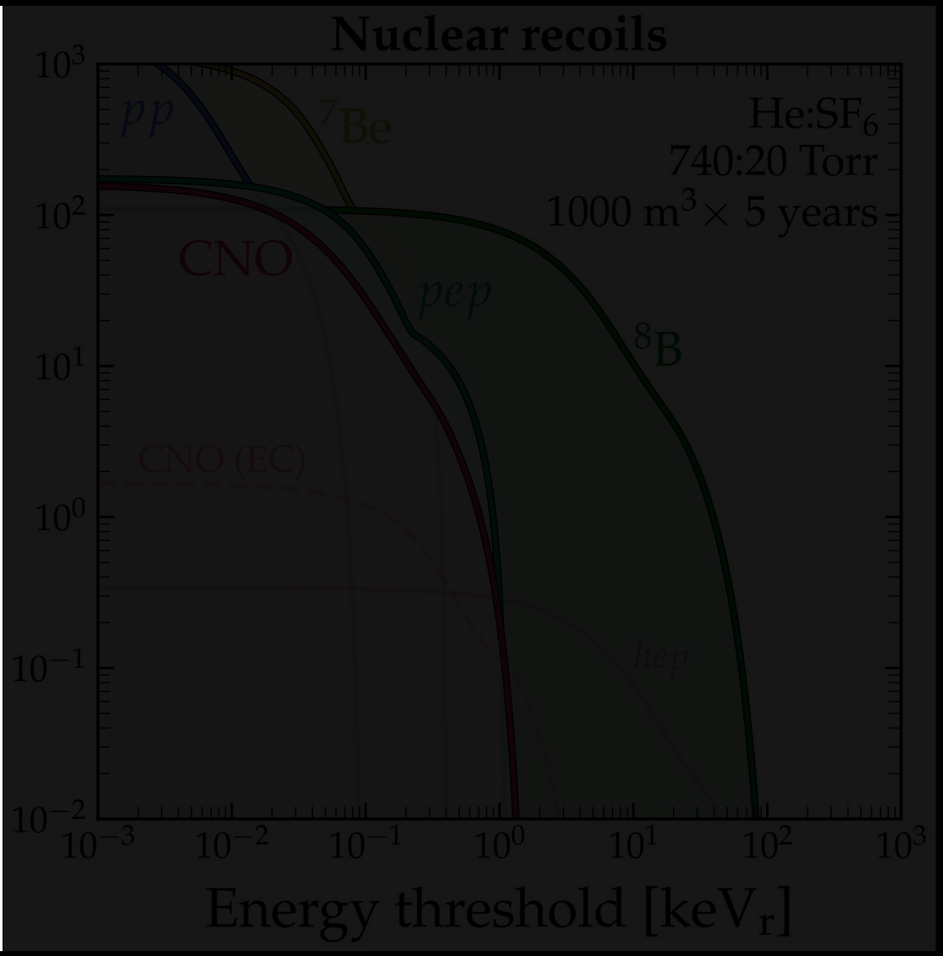
Let us focus on electron recoils





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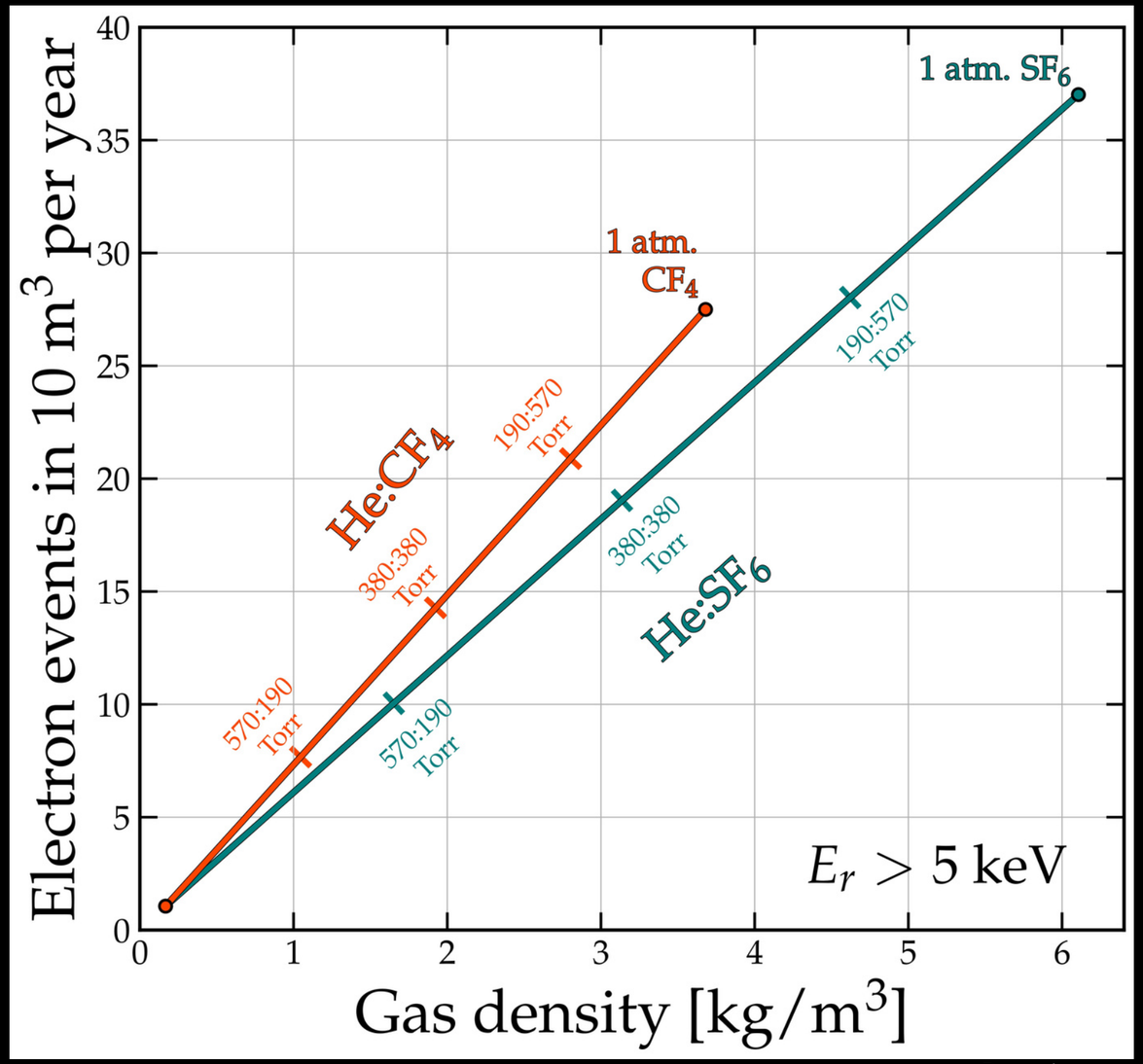
Solar Neutrino-Electron Scattering



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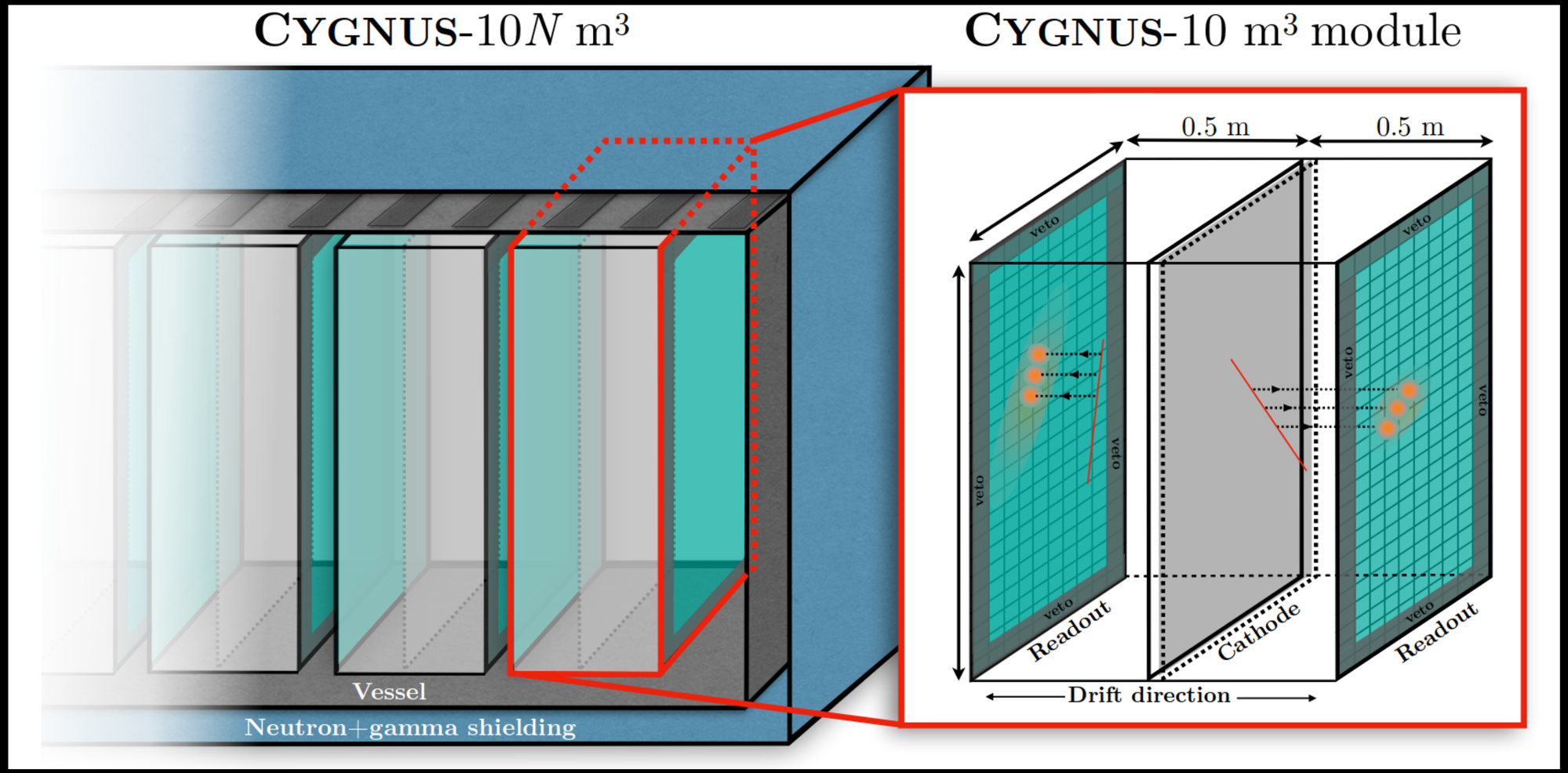
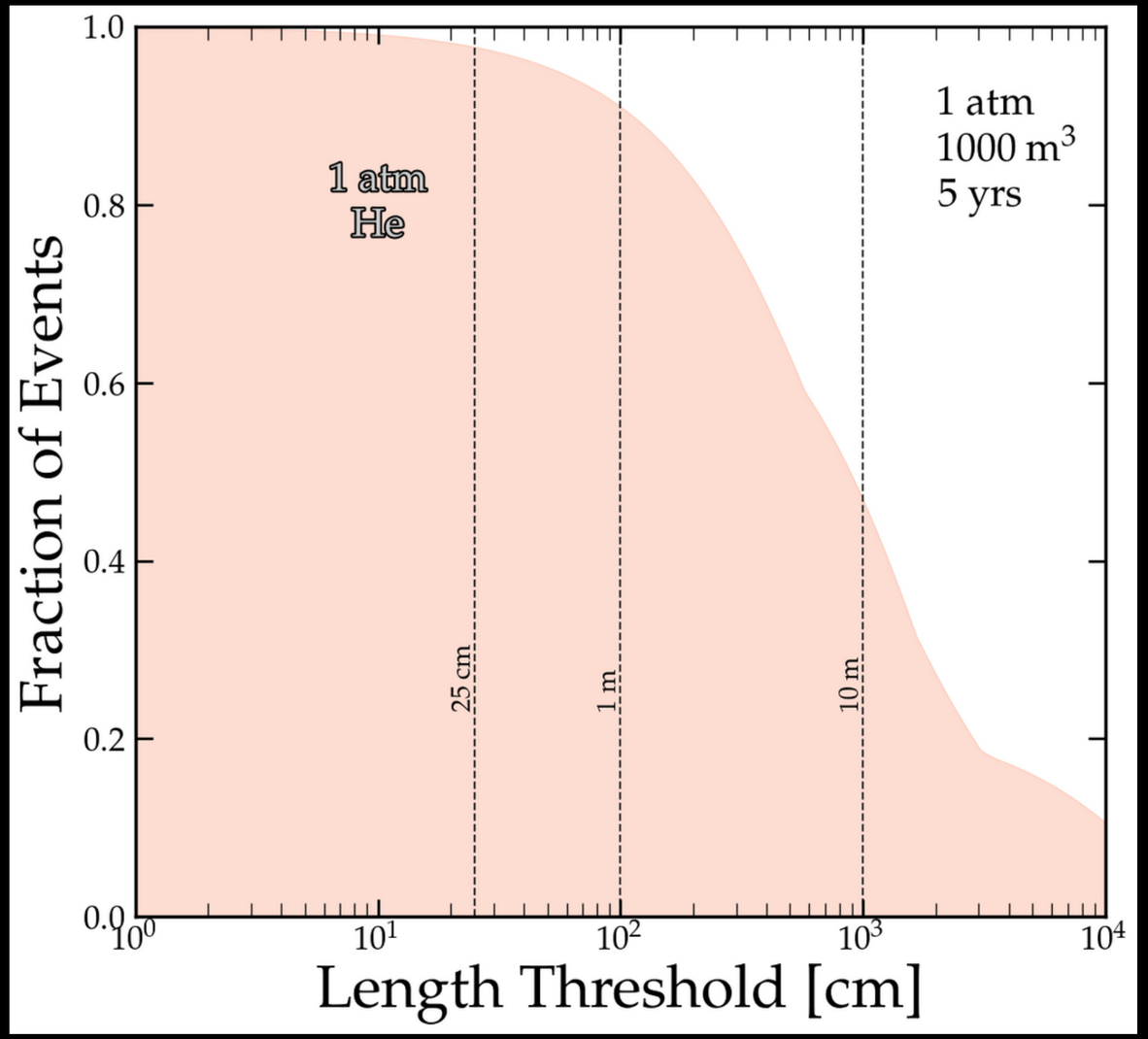
Gas Time Projection Chamber

Let us consider CYGNUS-1000 m^3



Vahsen, O'Hare & Loomba [2008.12587]

Fraction of Recoils vs Track Length



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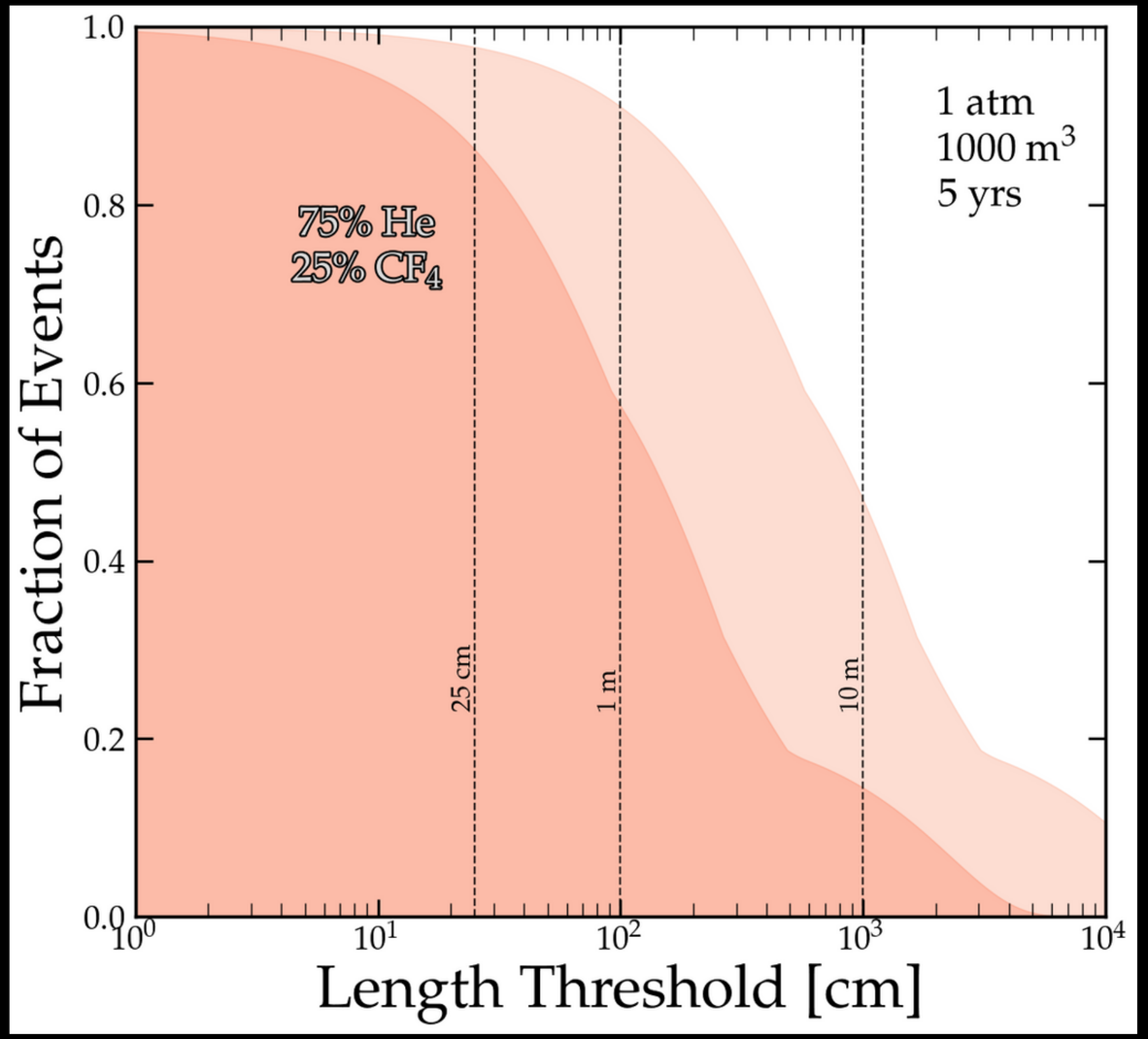

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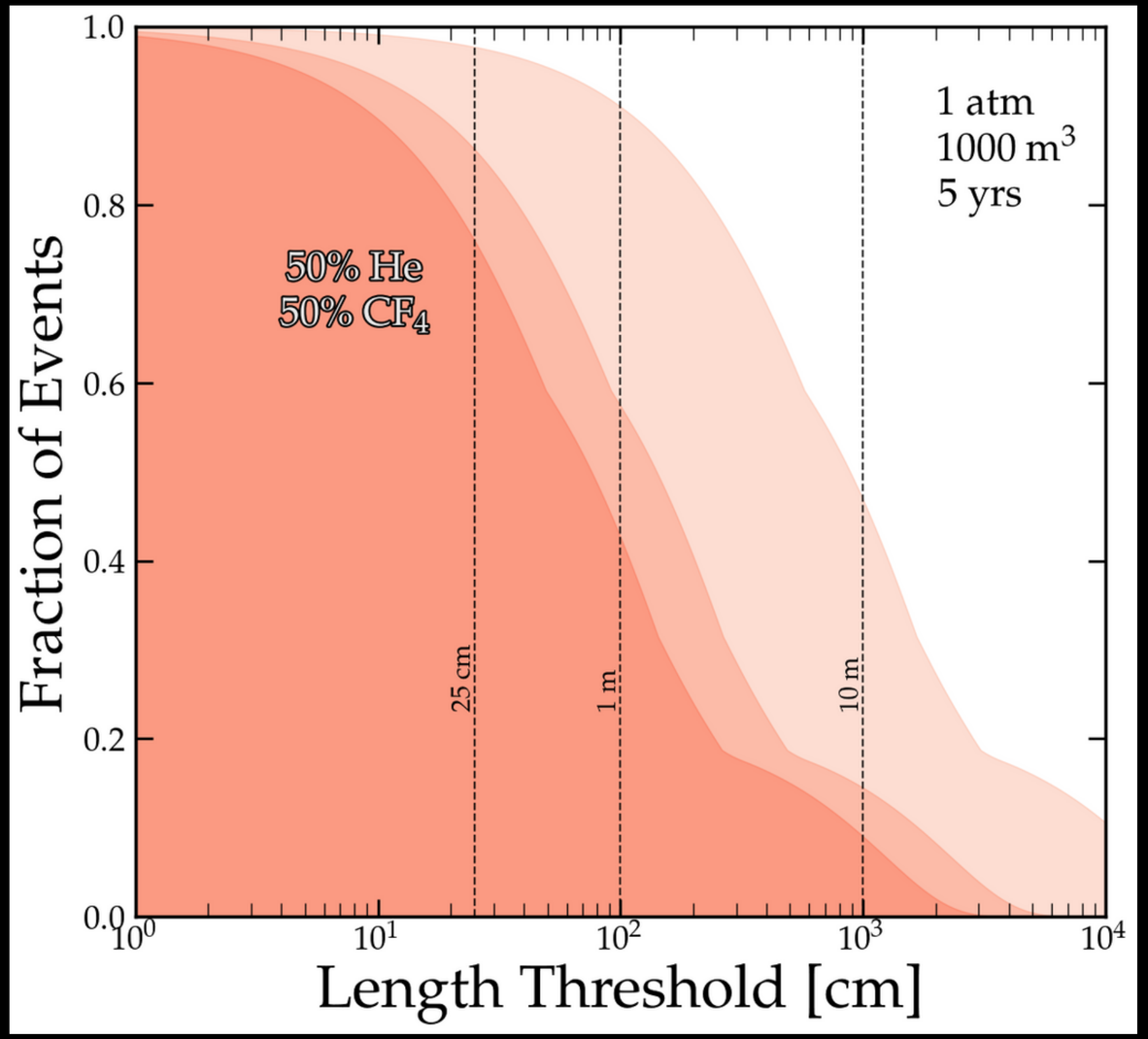

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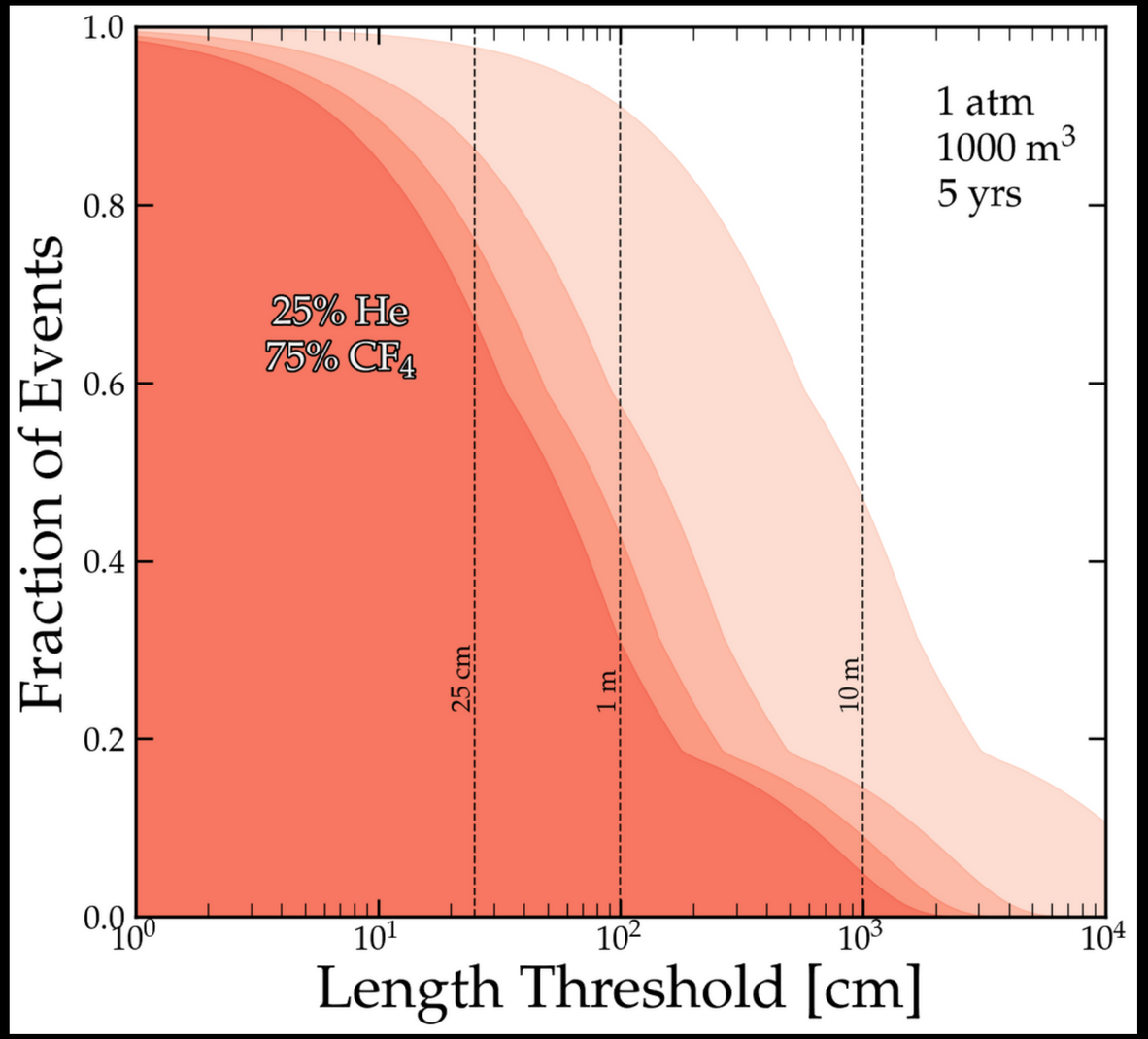

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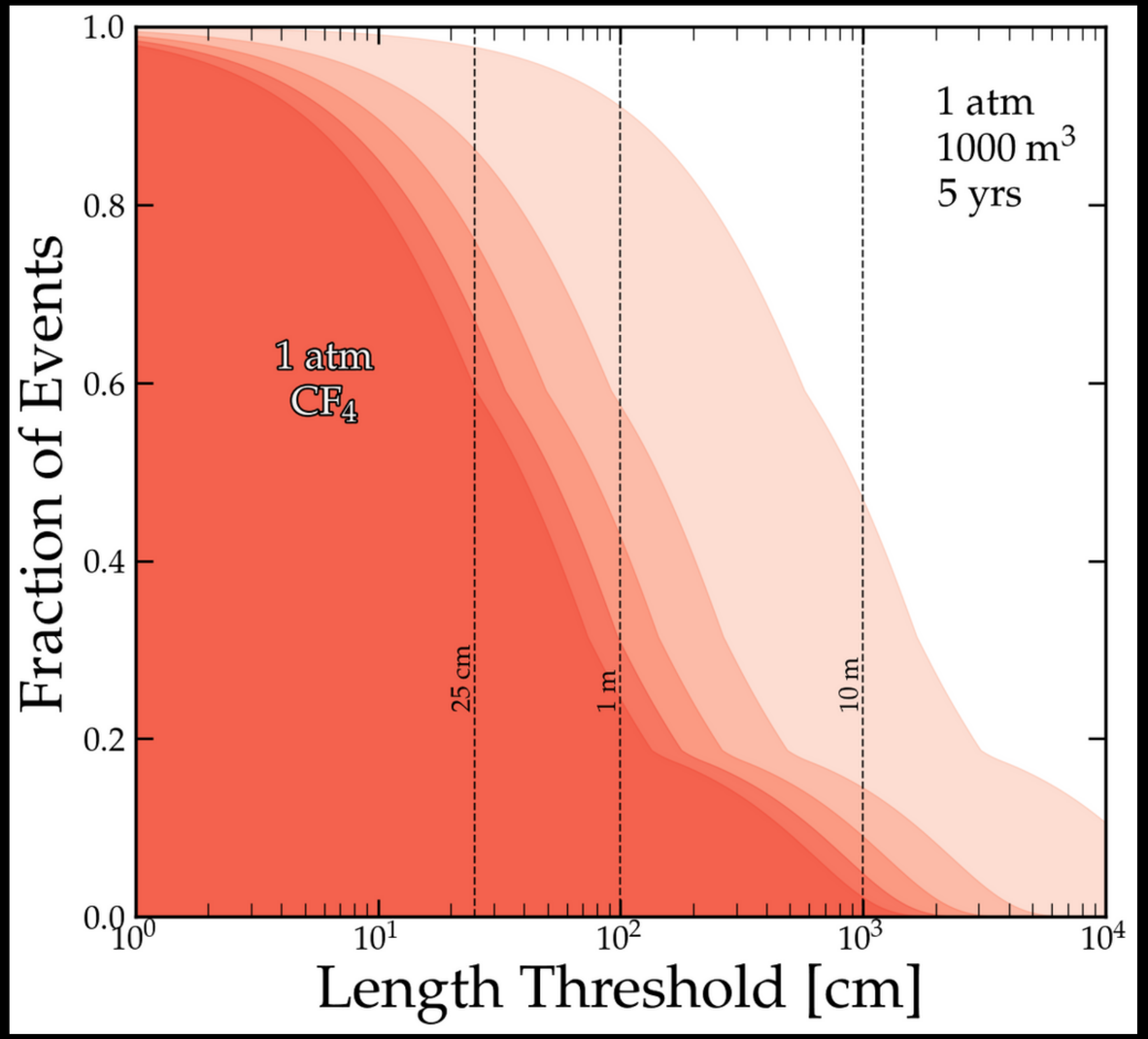
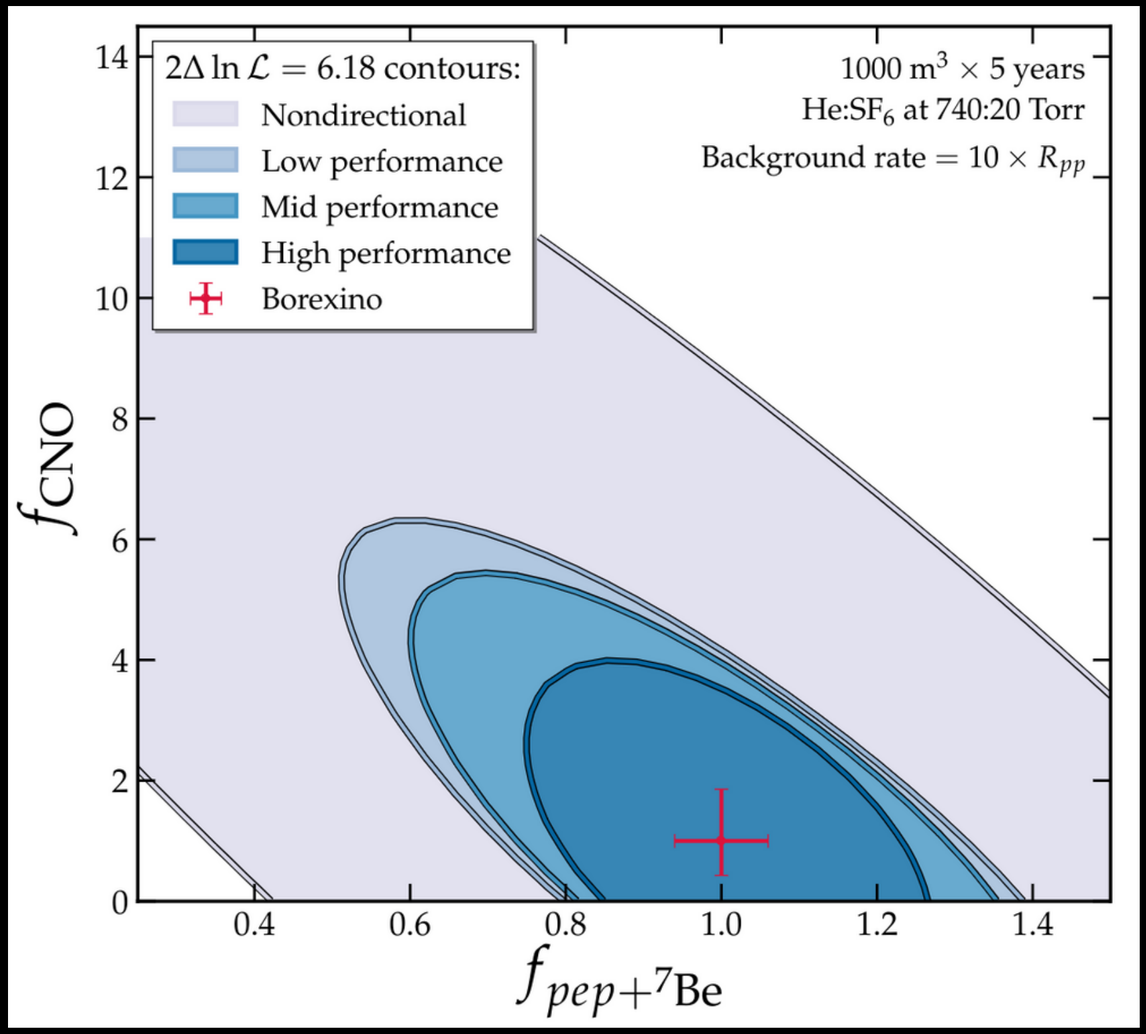


Expected Results



O'Hare et al. [2203.05914]

Conclusions

The proposed CYGNUS experiment aims to use directionality to reach beyond the neutrino fog

The same experiment could be used to study the neutrino background itself!

In this case, directionality would make it possible to measure and distinguish between the different solar neutrino fluxes