Dark matter: then and now

Christopher McCabe

IPPP 2011 - 2014

IPPP, Durham, 25 August 2025

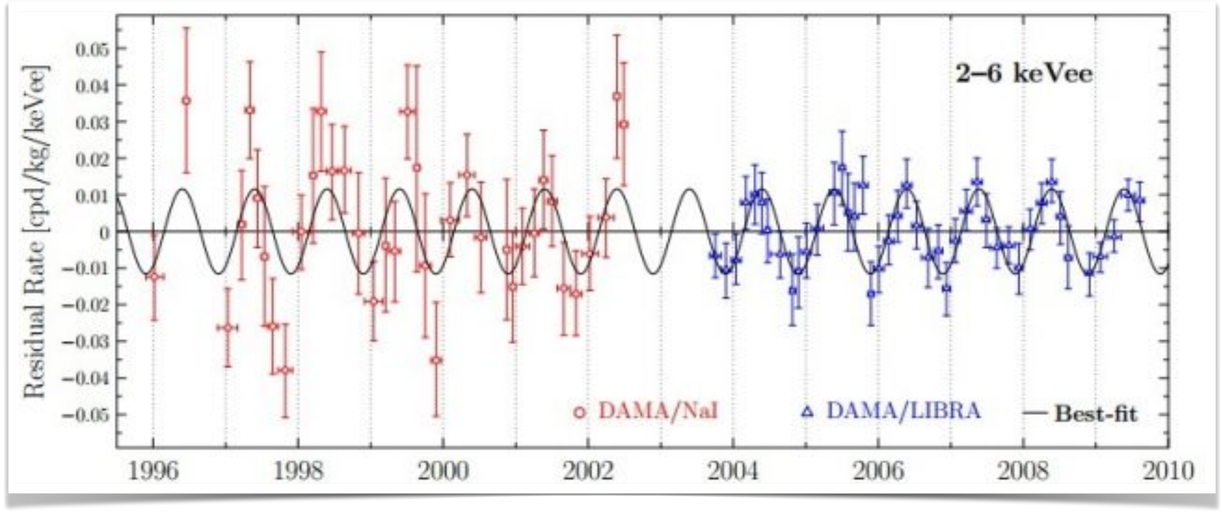
Then: circa 2011 - 2014


July 2012

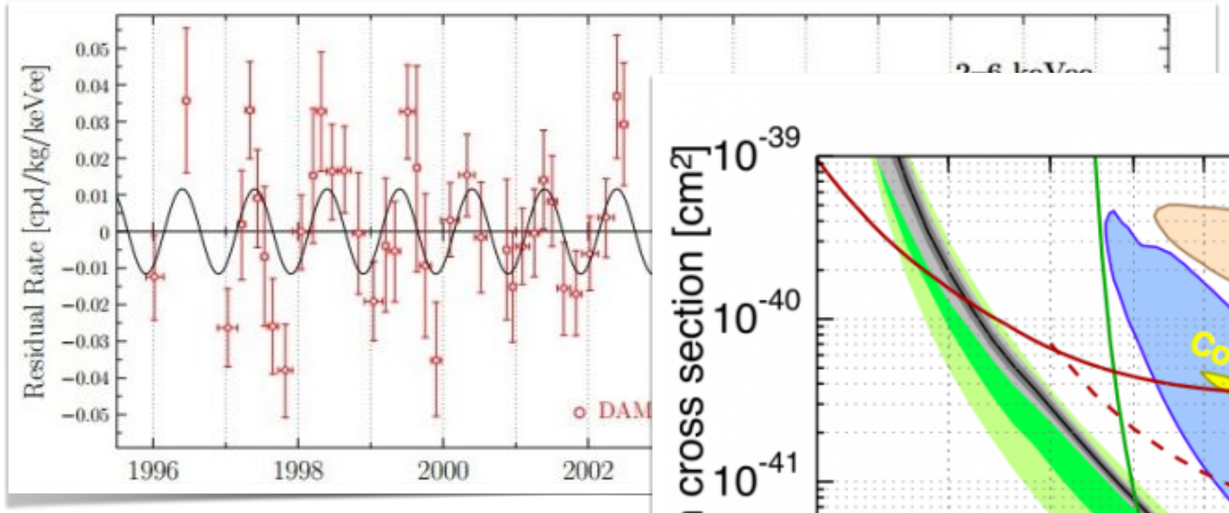

Status of Standard Model Higgs searches in ATLAS
Using the full datasets recorded in 2011 at √s= 7 TeV and 2012 at √s=8 TeV: up to 10.7 fb-1
Fabiola Gianotti (CERN), representing the ATLAS Collaboration
July 2012

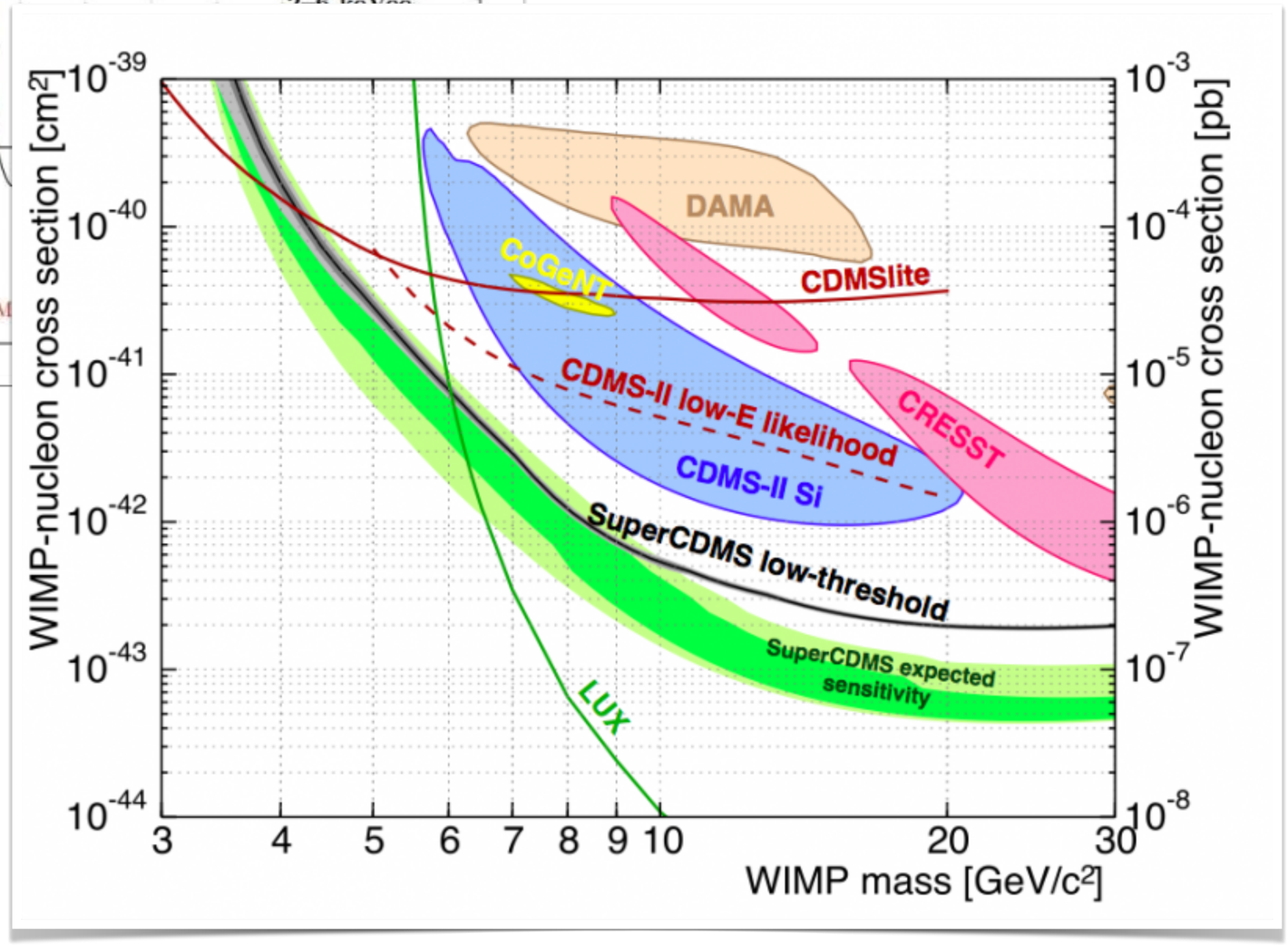

Chasing dark
matter signals

Direct detection anomalies

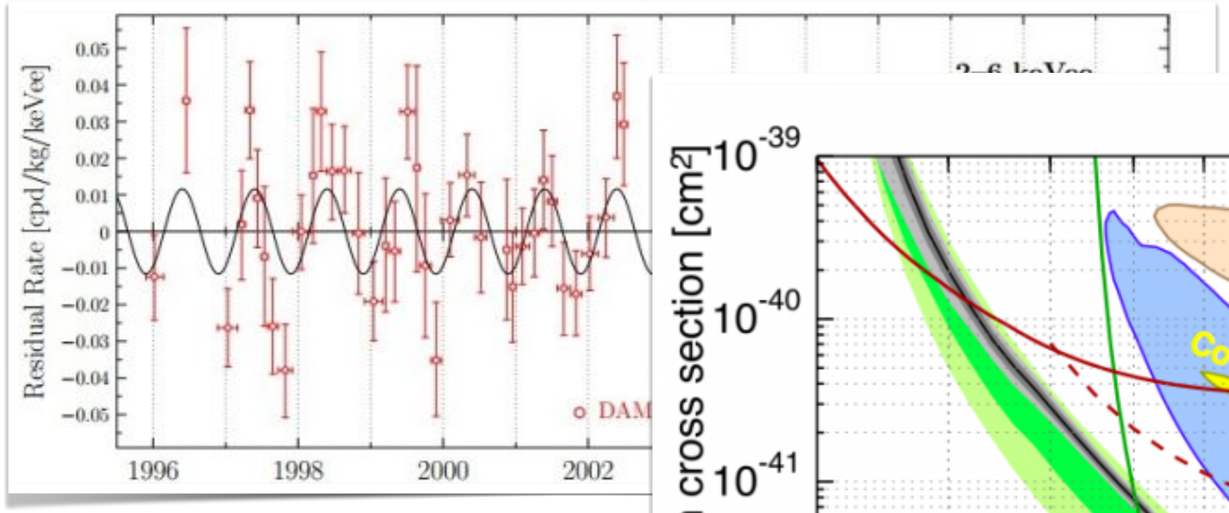


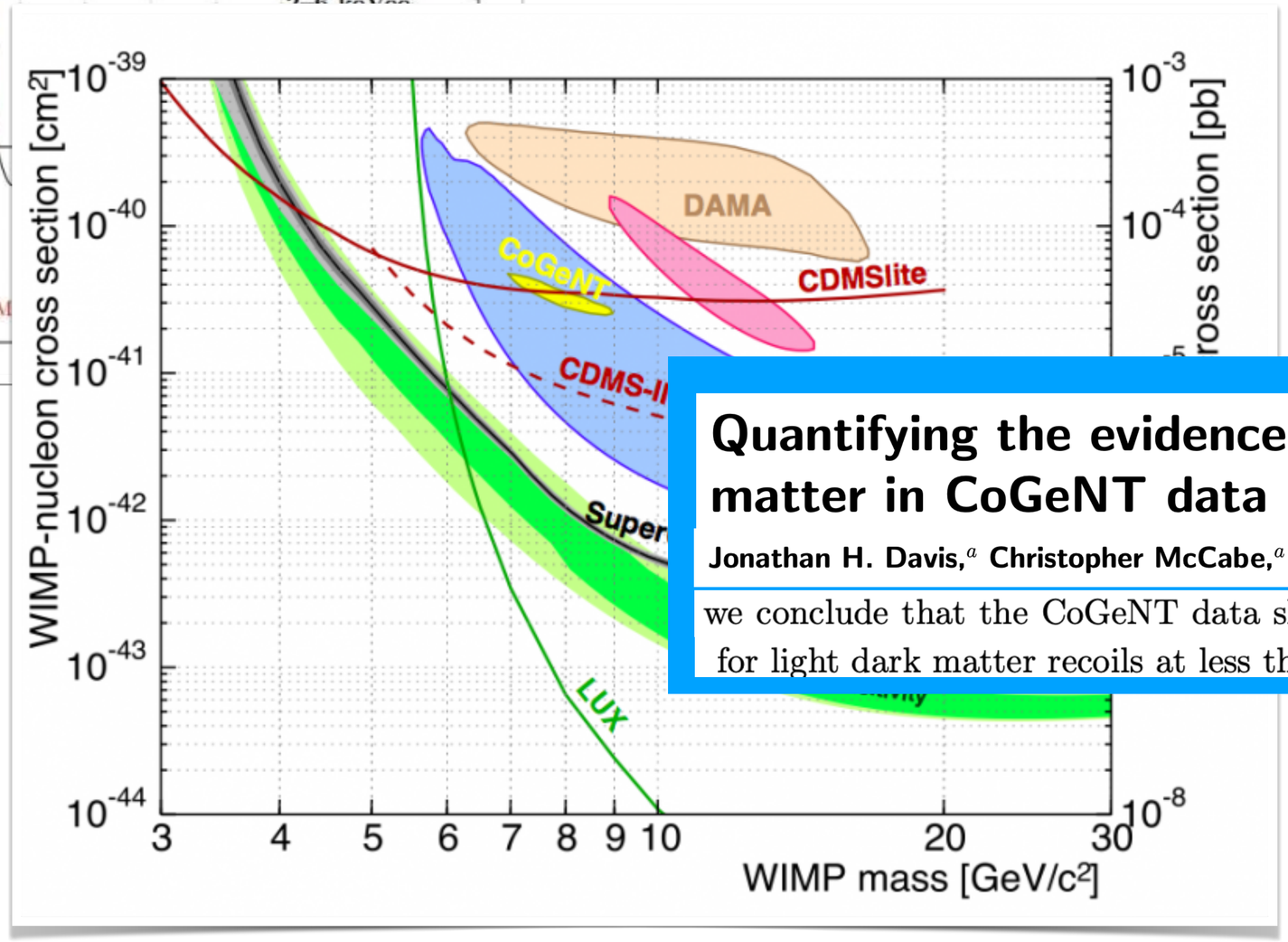
Direct detection anomalies





Direct detection anomalies





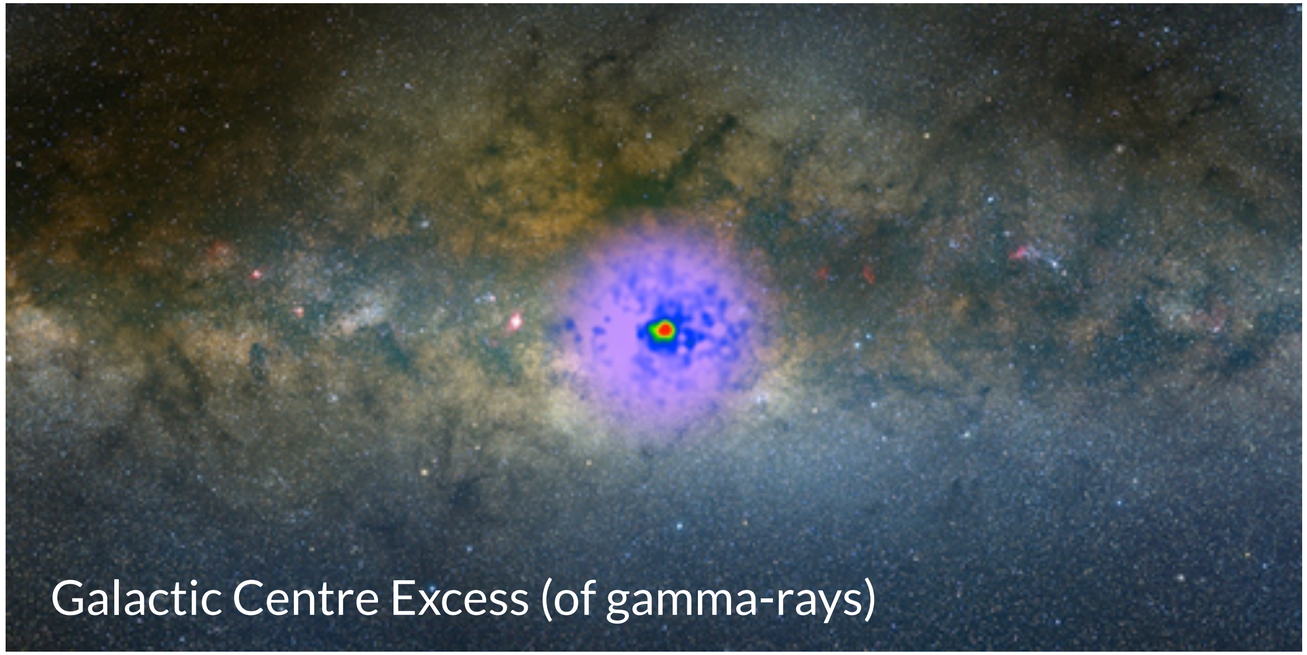
Quantifying the evidence for dark matter in CoGeNT data

Jonathan H. Davis,[a] Christopher McCabe,[a] and Céline Bœhm[a,b]

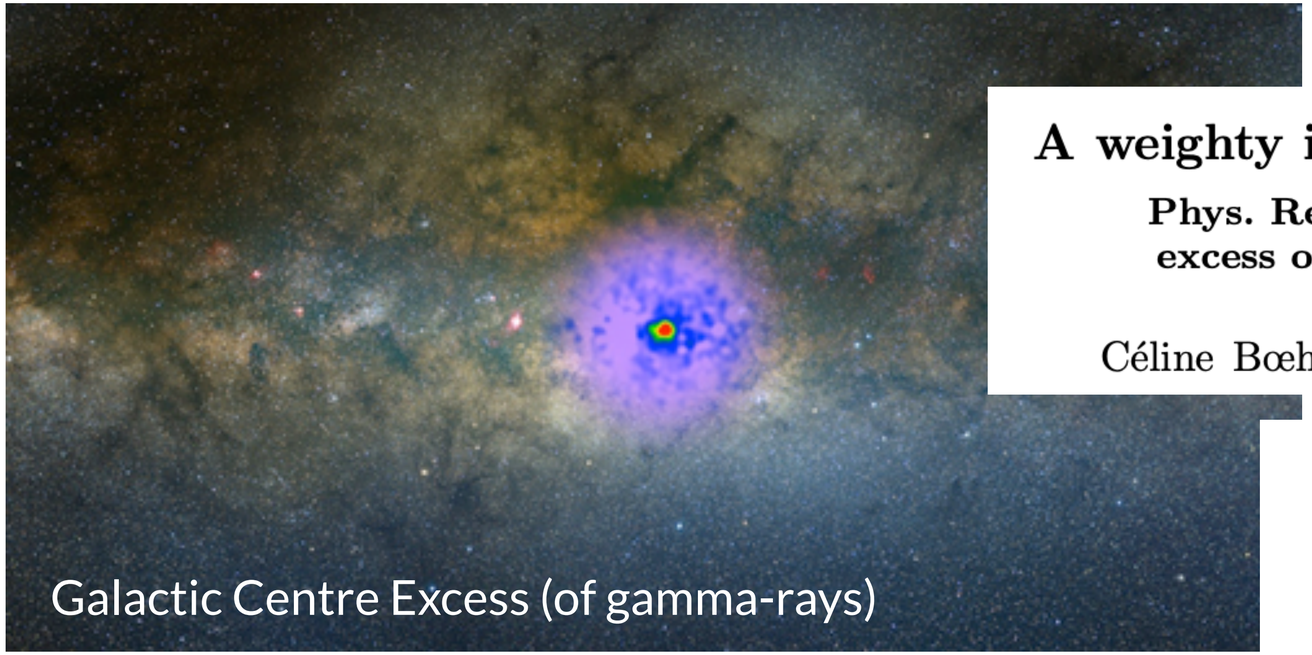
we conclude that the CoGeNT data show a preference for light dark matter recoils at less than 1σ.

arXiv: 1405.0495
JCAP

Indirect detection anomalies



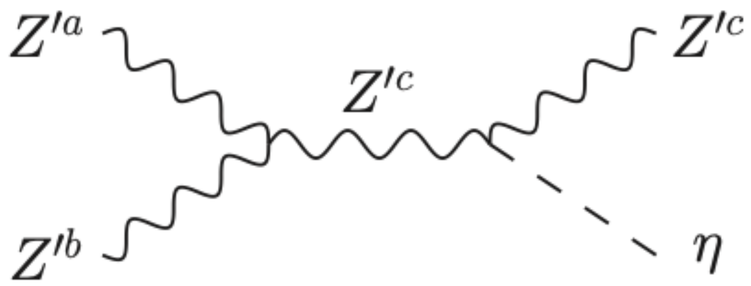
Indirect detection anomalies



A weighty interpretation of the Galactic Centre excess

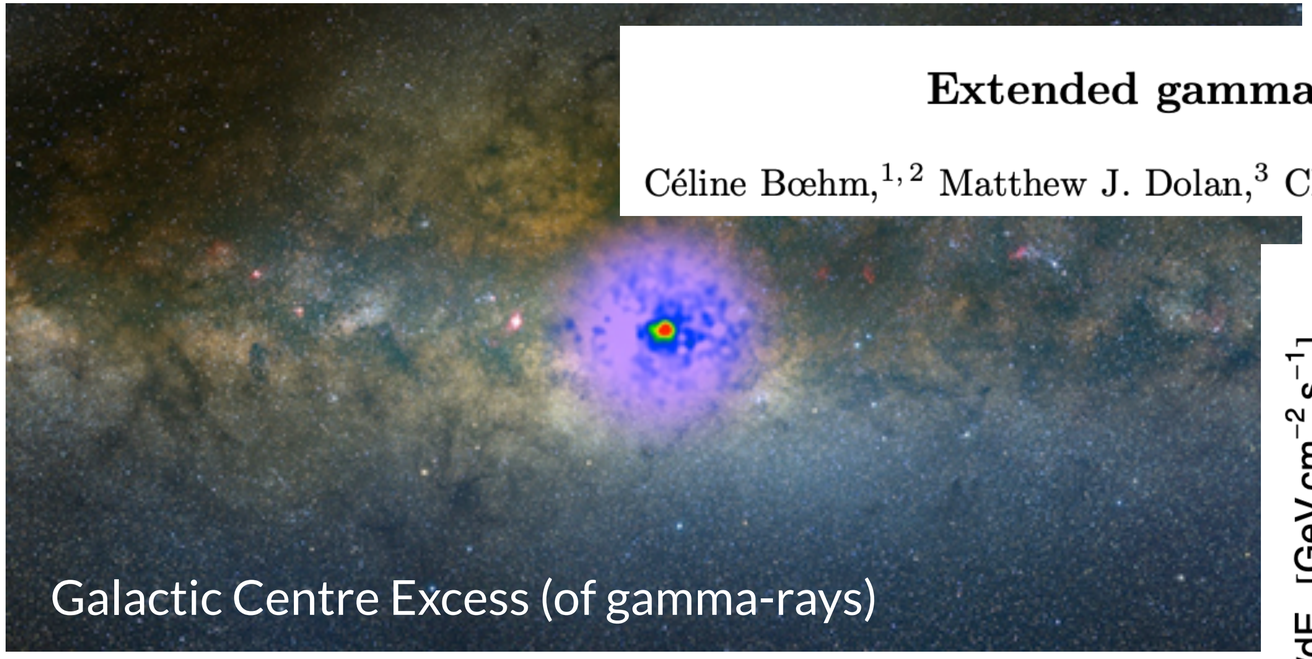
Phys. ReV. D title: Interpretation of the Galactic Center excess of gamma rays with heavier dark matter particles

Céline Bœhm,[1,2] Matthew J. Dolan,[3] and Christopher McCabe[1]



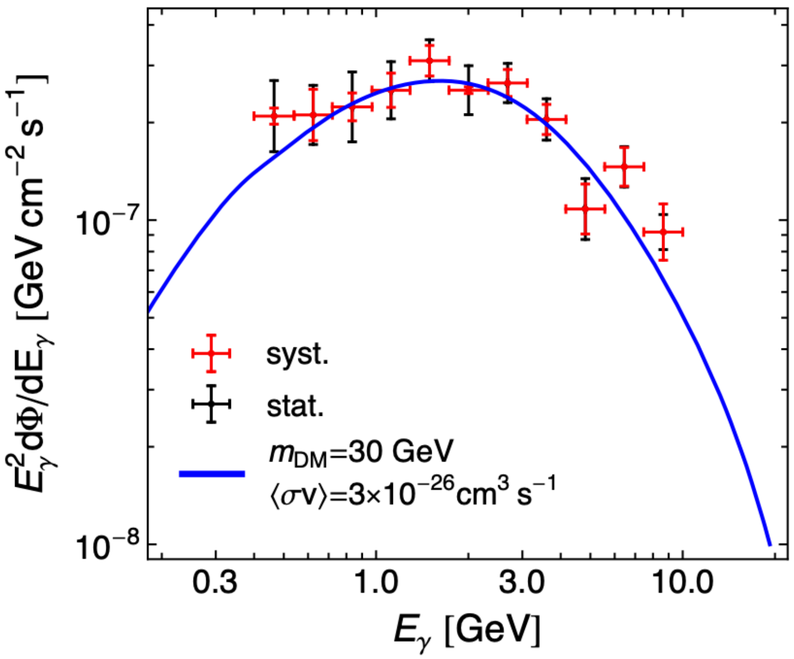
arXiv: 1404.4977, PRD

Indirect detection anomalies



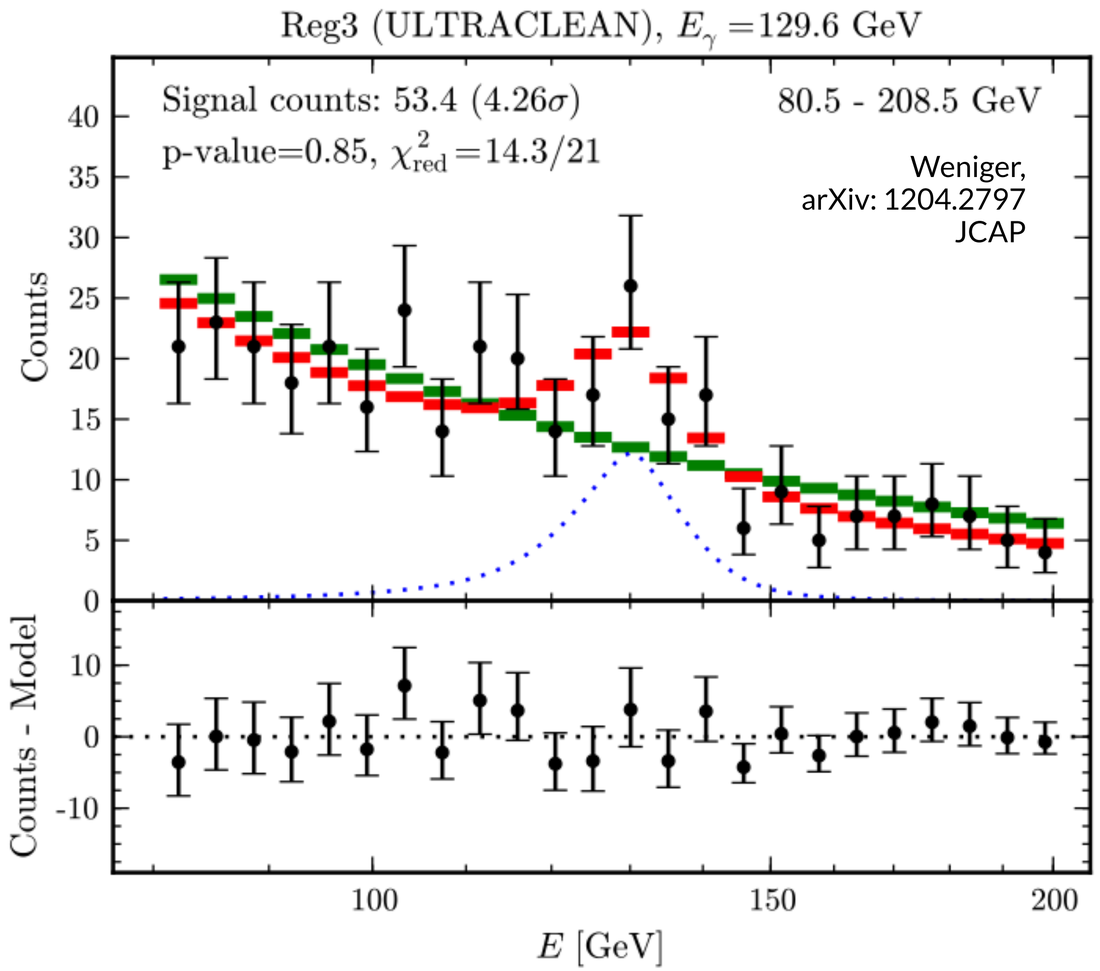
Extended gamma-ray emission from Coy Dark Matter

Céline Bœhm,[1,2] Matthew J. Dolan,[3] Christopher McCabe,[1] Michael Spannowsky,[1] and Chris J. Wallace[1]



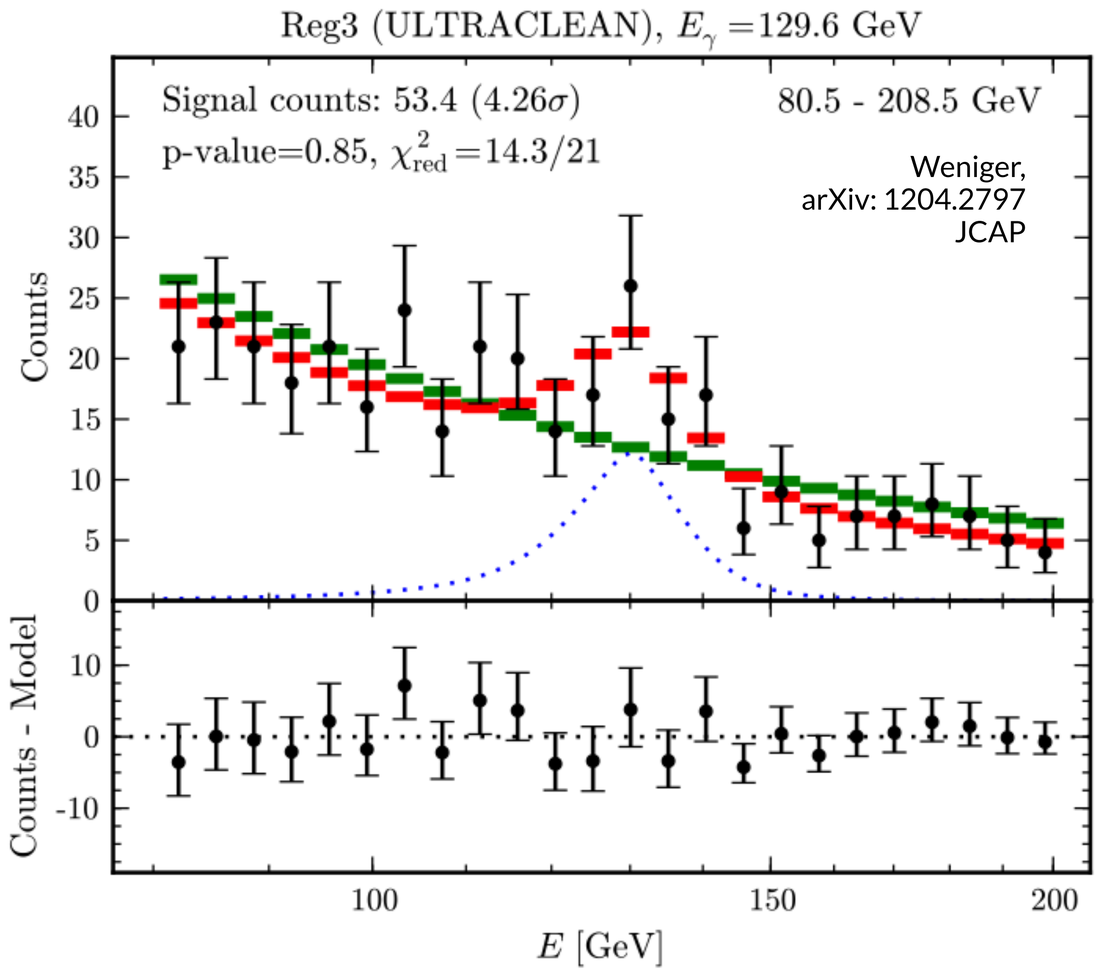
arXiv: 1401.6458, PRD

Indirect detection anomalies



Weniger,
arXiv: 1204.2797
JCAP

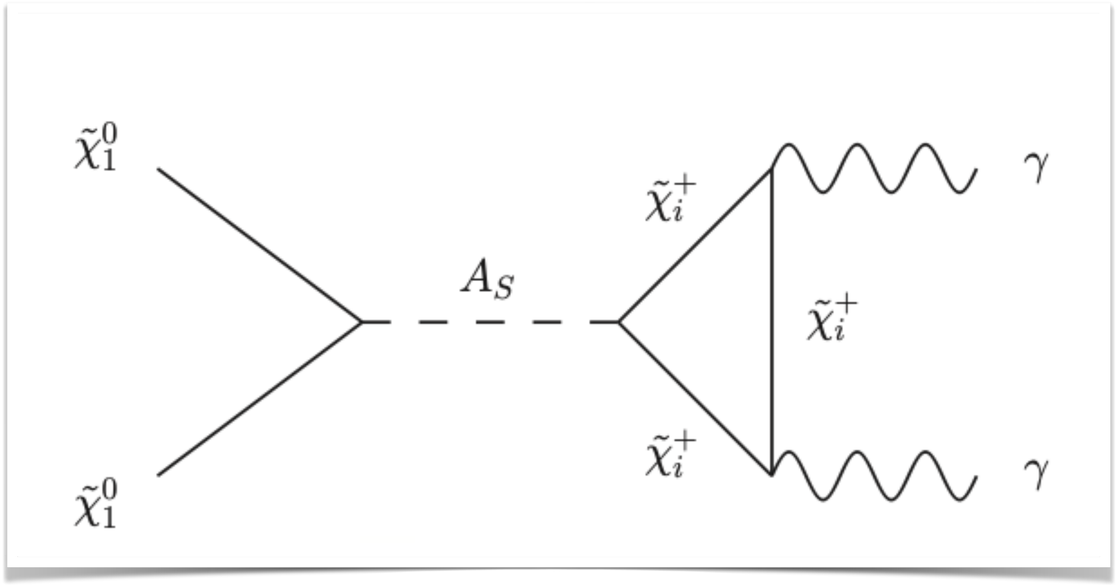
Indirect detection anomalies



Weniger,
arXiv: 1204.2797
JCAP

Neutralino dark matter and the Fermi gamma-ray lines

Guillaume Chalons,[1,*] Matthew J. Dolan,[2,†] and Christopher McCabe[2,‡]



arXiv: 1211.5154, JCAP

Now

Chasing dark matter signals: old and new frontiers

Cosmic Frontier's recommendation

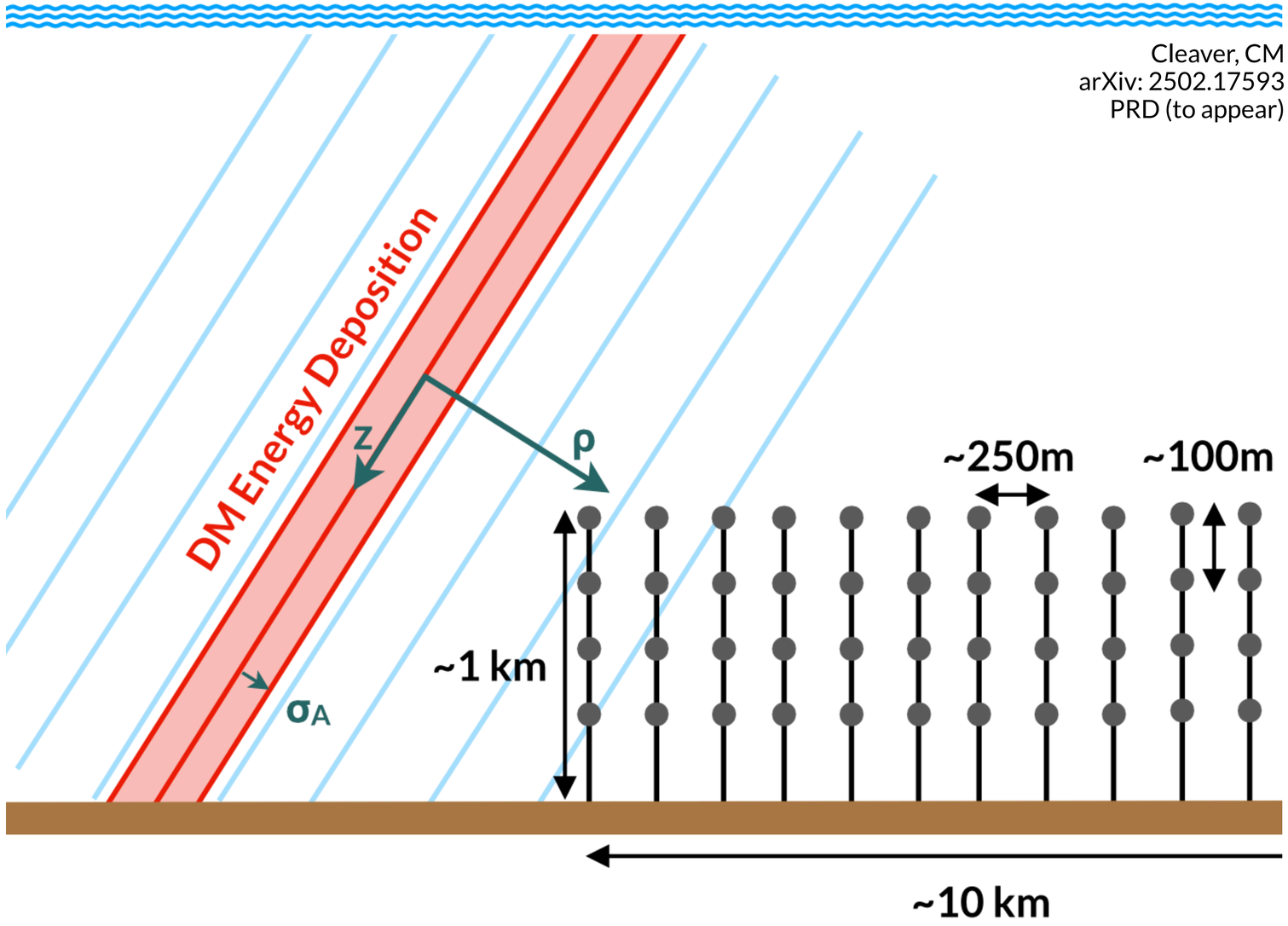
Delve deep (cover high priority targets e.g., WIMPs)

Search wide (explore as much DM parameter space as possible)

Cooley et al,
arXiv:2209.07426

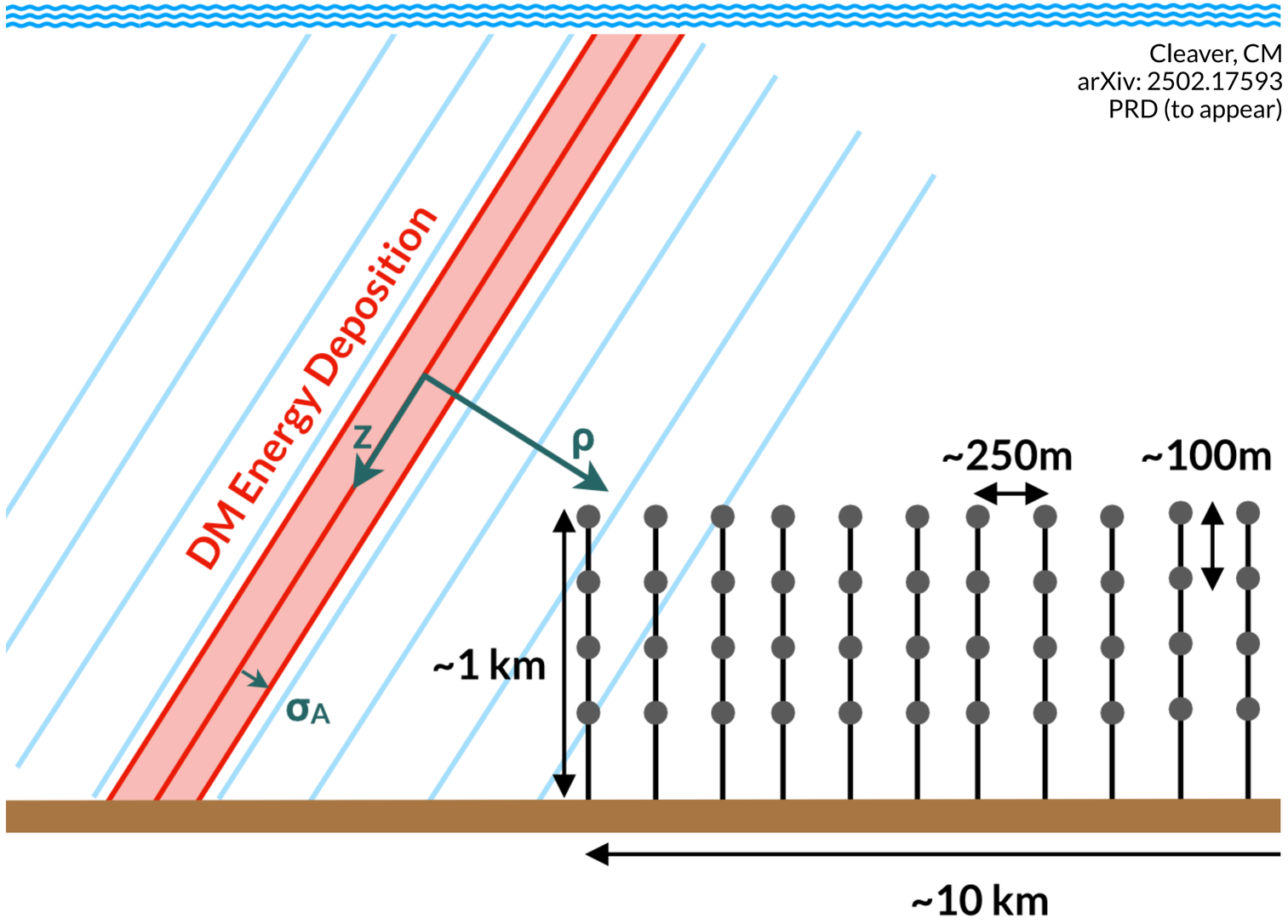
Bertone, Tait, Nature 2019

Dark matter: Macroscopic masses and cross-sections



Dark matter: Macroscopic masses and cross-sections

Lesson from IPPP:
Quantifying backgrounds is an important as quantifying the signal



AMBIENT NOISE IN THE SEA

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

NAVAL SEA SYSTEMS COMMAND

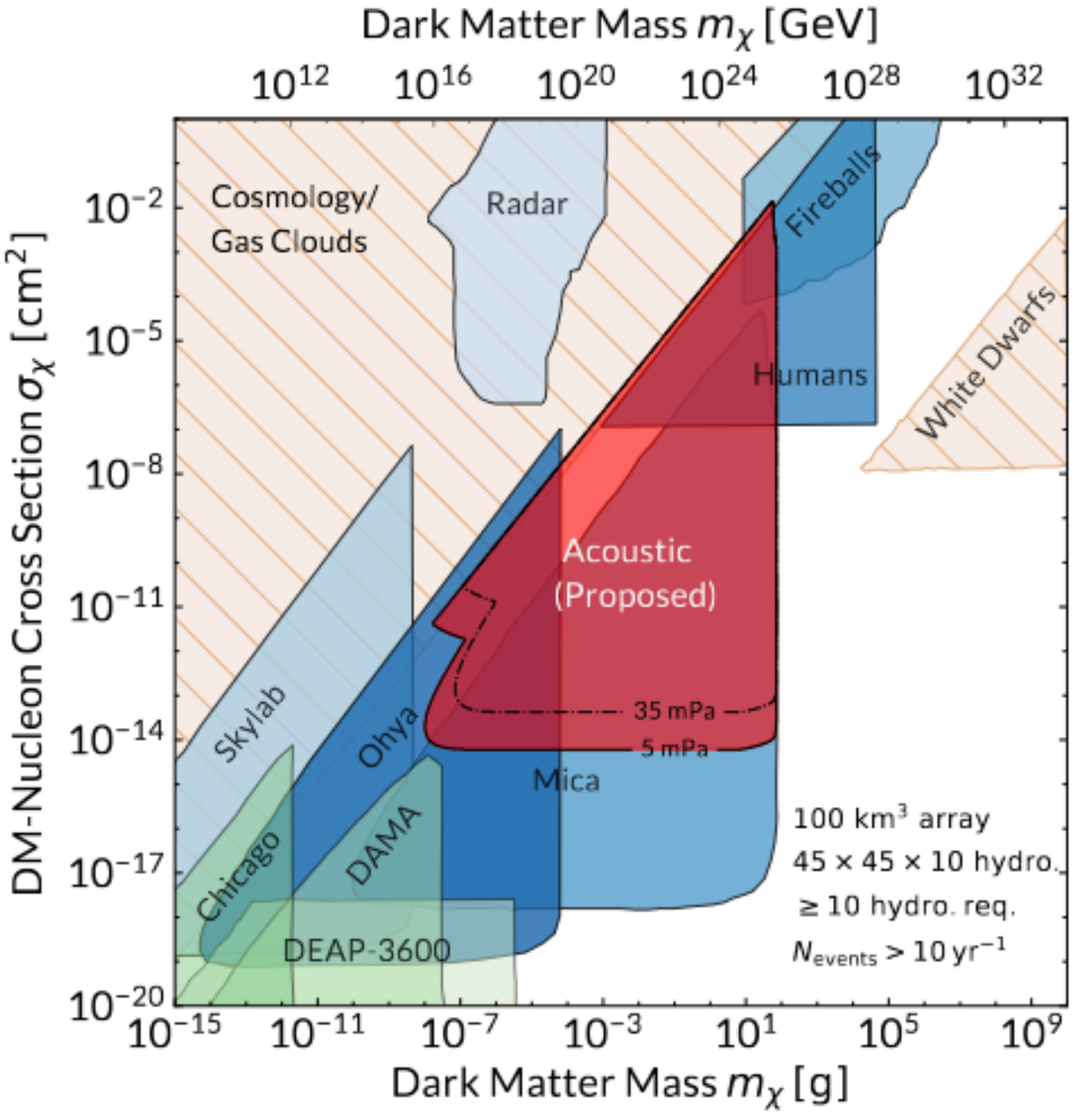
UNCLASSIFIED UNLIMITED
QinetiQ Proprietary

QinetiQ

SEA 7 Technical report:
Underwater ambient noise
(Non-technical summary)

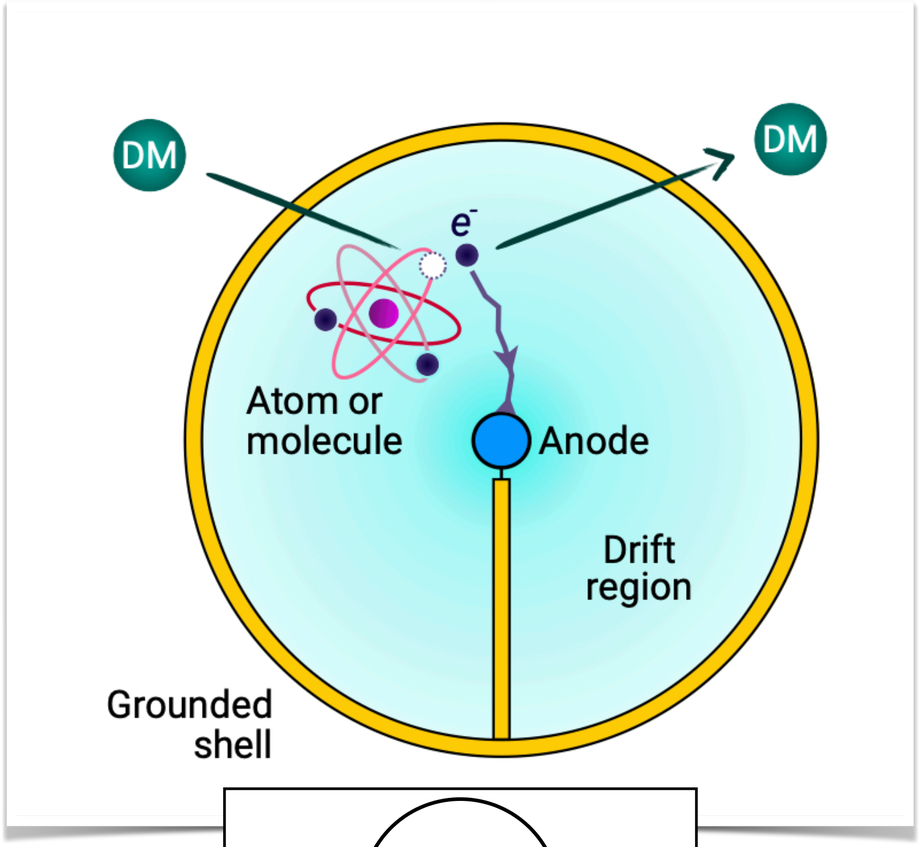
Eavesdropping on whales

The acoustic detection of ultra high energy neutrinos in the Mediterranean Sea



Cleaver, CM
arXiv: 2502.17593
PRD (to appear)

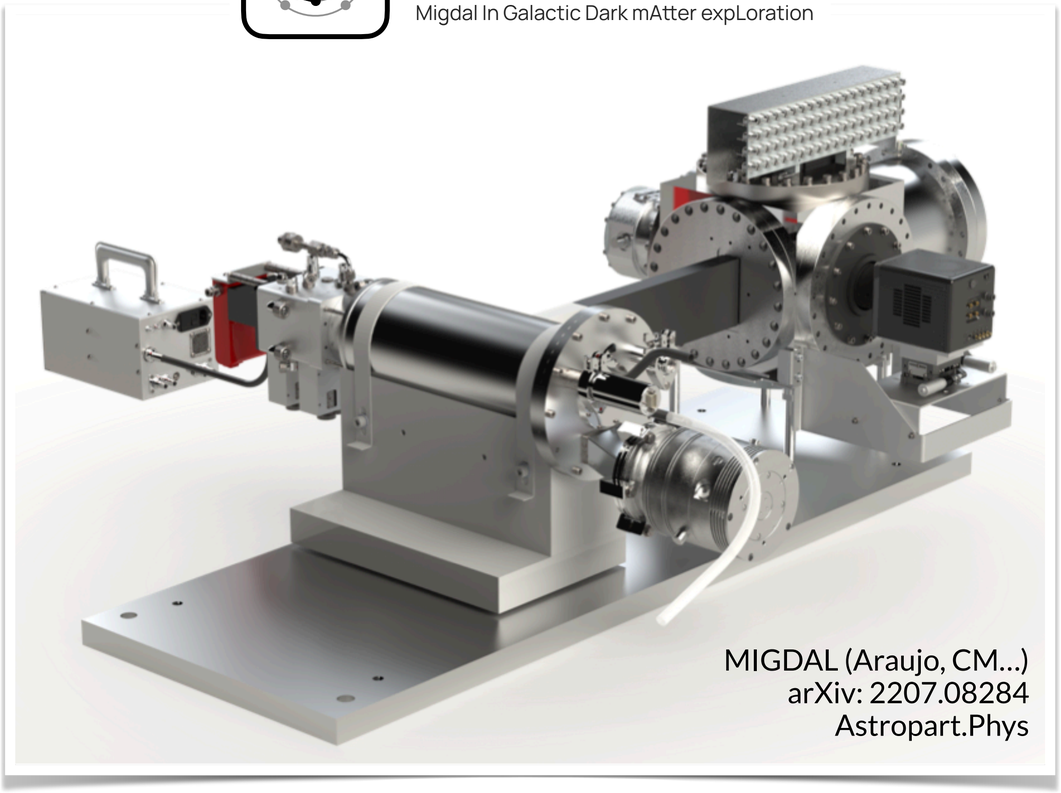
Dark matter: MeV - GeV scale



DarkSPHERE
NEWS-G@Boulby

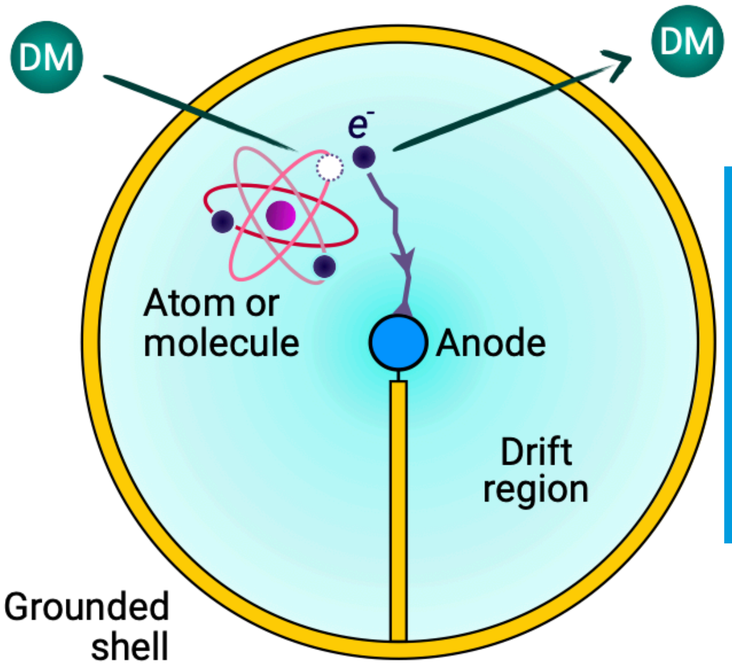
DarkSPHERE (Balogh, Hamaide, CM…)
arXiv: 2301.05183, PRD

MIGDAL
Migdal In Galactic Dark mAtter expLoration



MIGDAL (Araujo, CM…)
arXiv: 2207.08284
Astropart.Phys

Dark matter: MeV - GeV scale



DarkSPHERE
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DarkSPHERE (Balogh, CM…)
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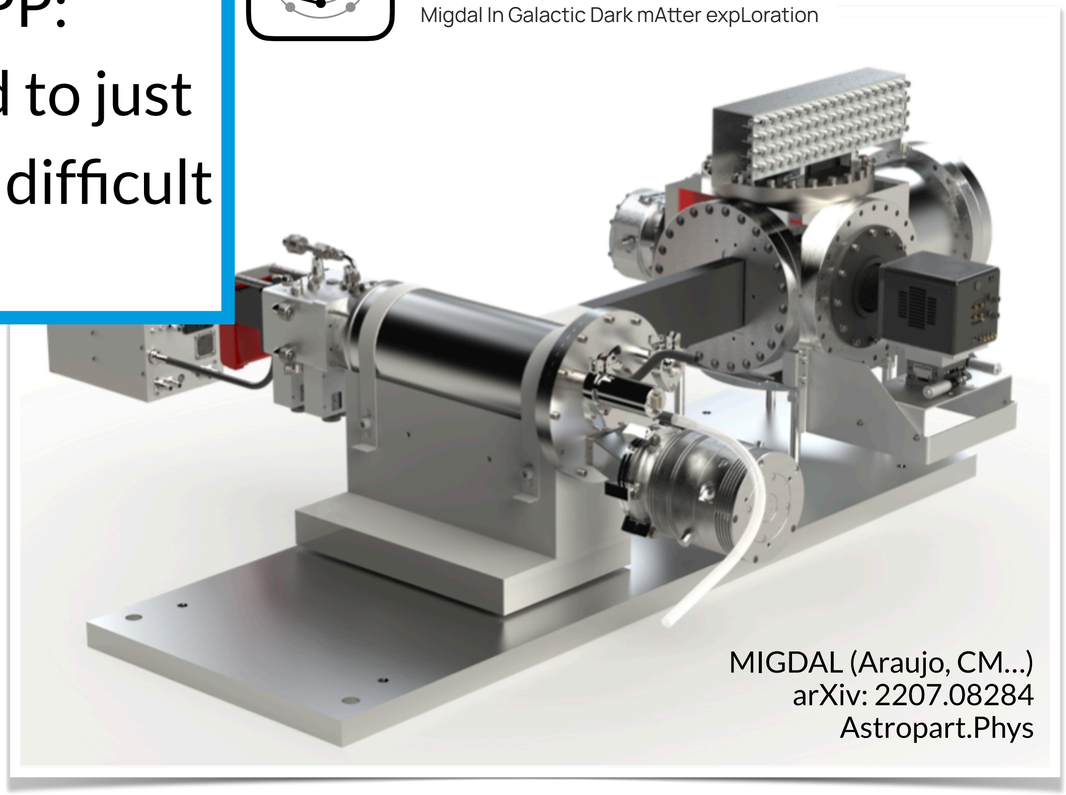
Lesson from IPPP:
Sometimes you need to just get on and tackle the difficult calculations

MIGDAL
Migdal In Galactic Dark mAtter expLoration



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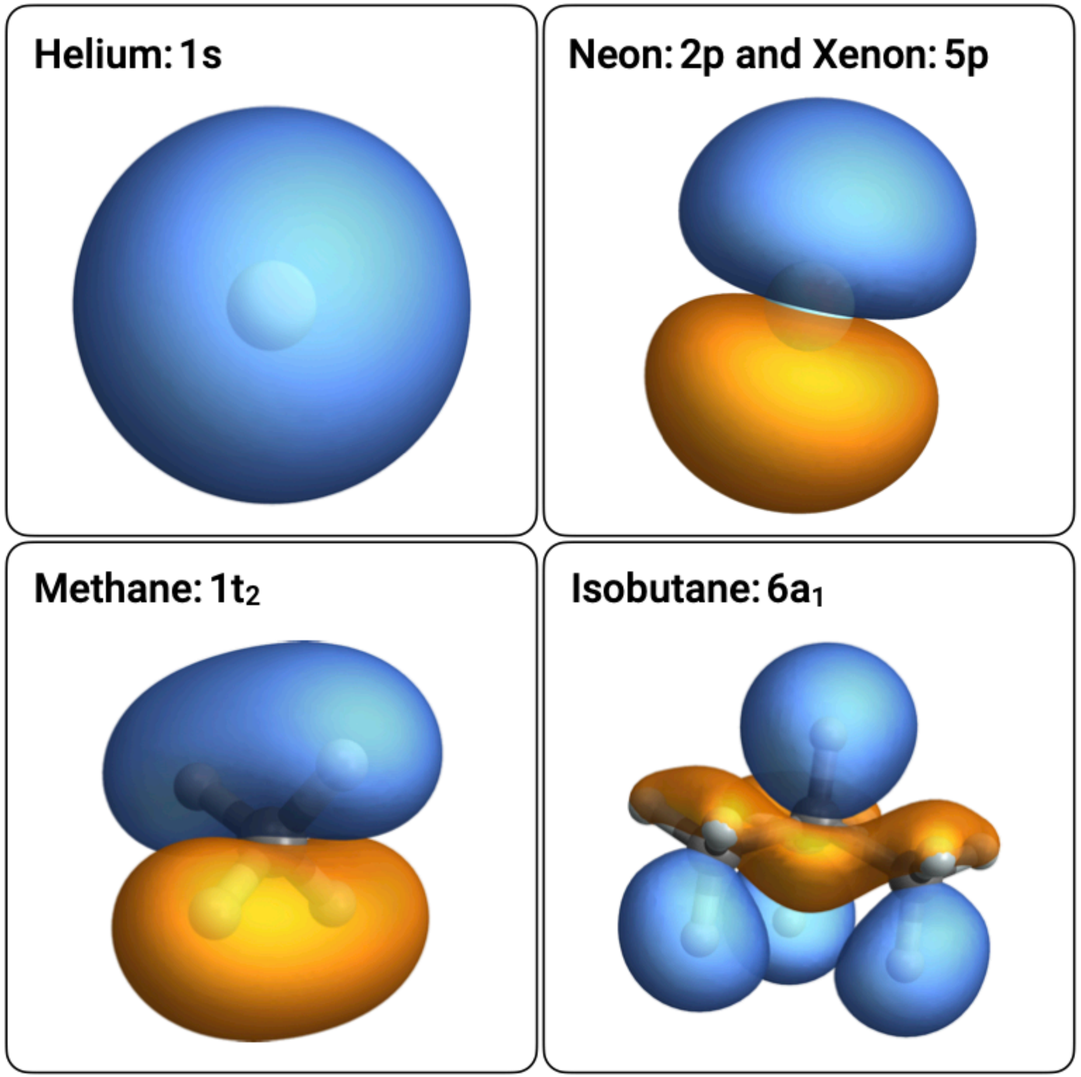
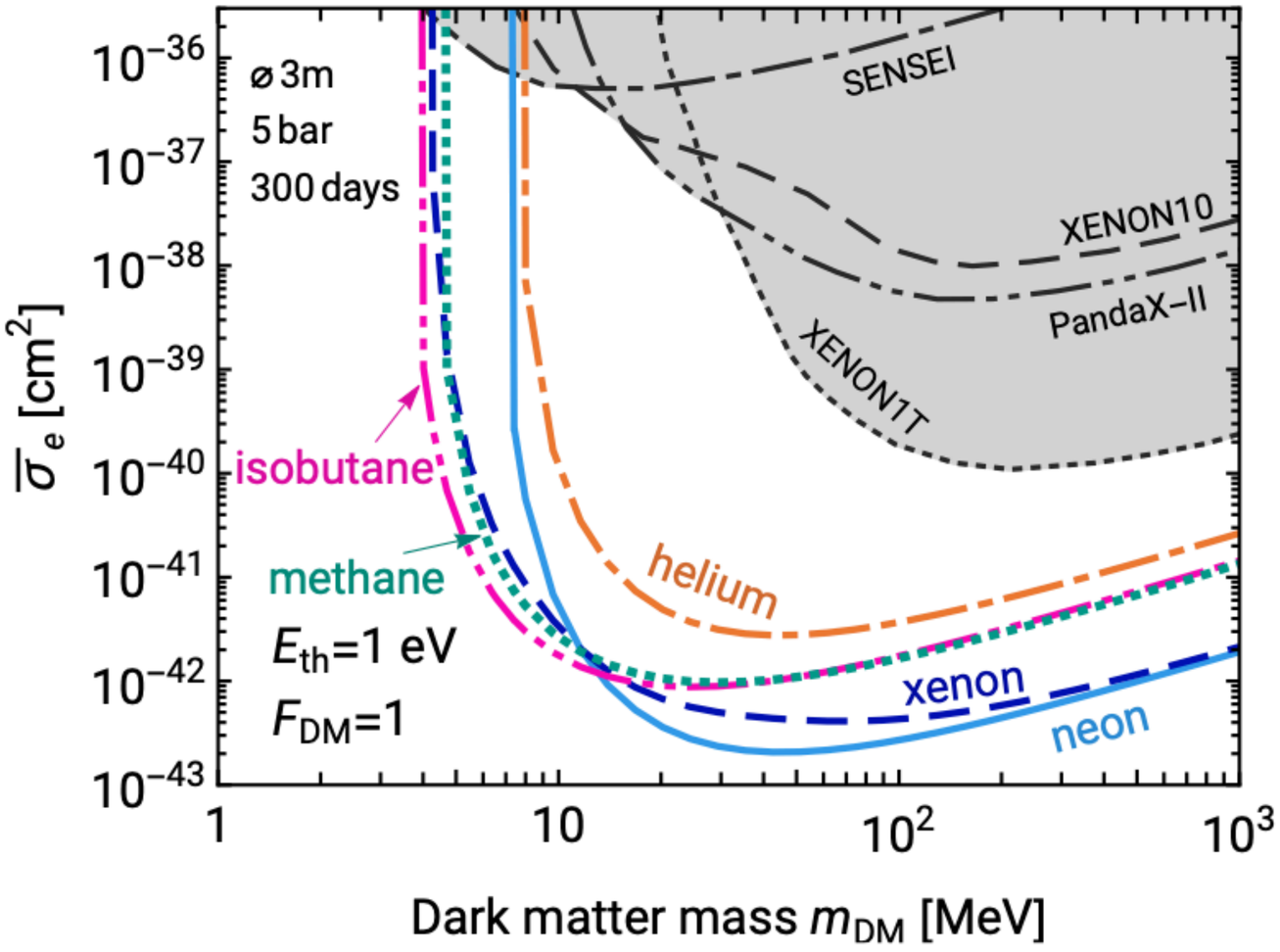
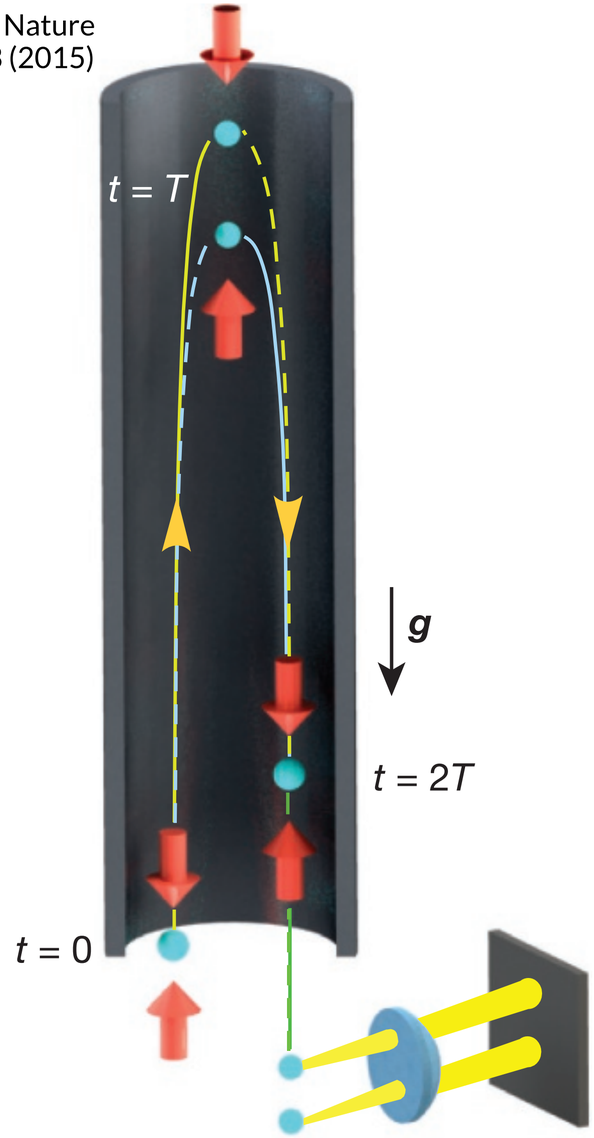




Hamaide, CM
arXiv: 2110.02985, PRD

New frontiers with atom interferometry: neV scale

Kovachy et al, Nature
528, 530–533 (2015)



AION

AION (Badurina, CM, et al)
arXiv: 1911.11755, JCAP
arXiv: 2504.09158
arXiv: 2508.03491

Initial puzzle: what should we do with curves below 1 Hz?

Simply cut-off the lines?
Almost certainly too conservative

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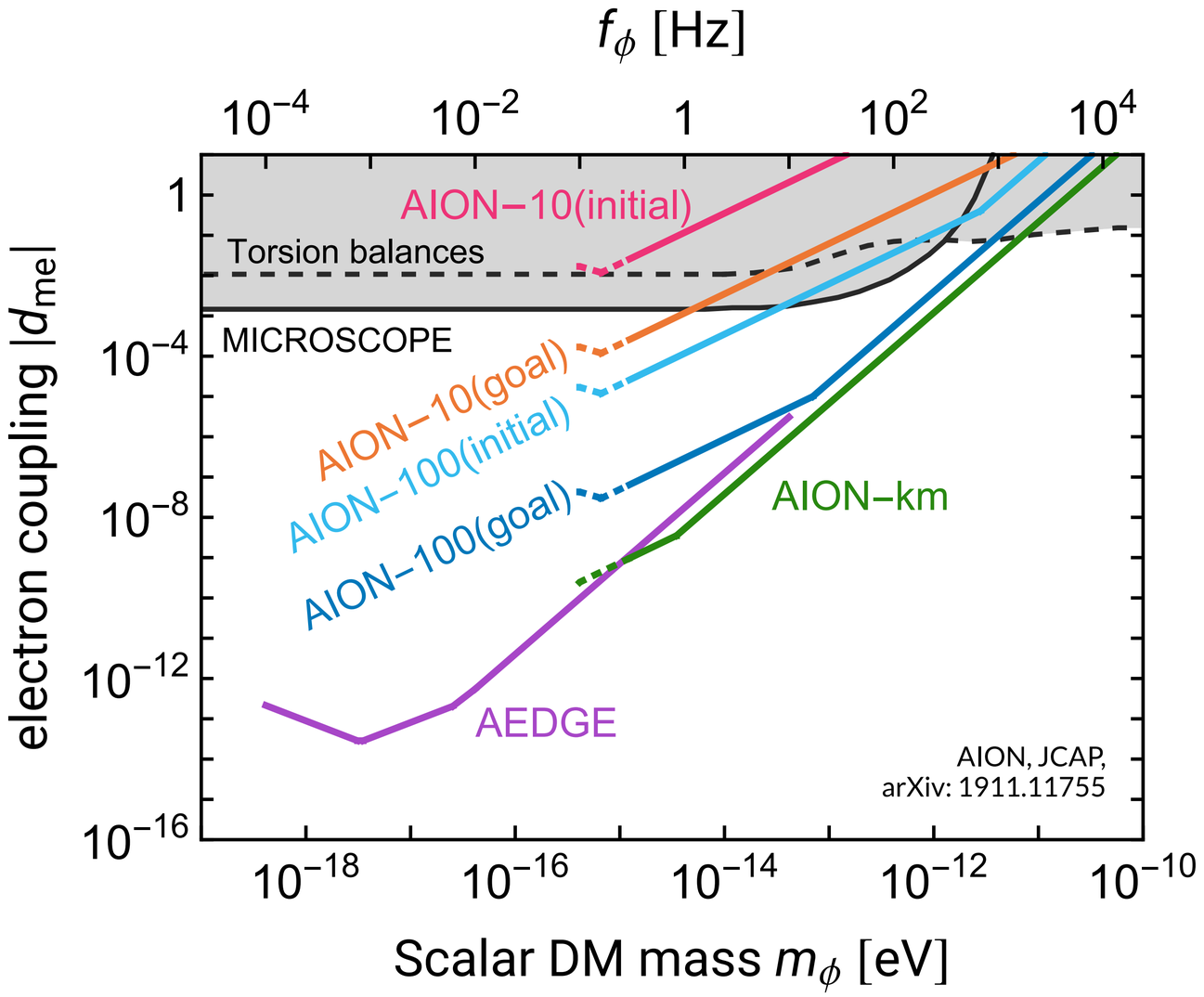
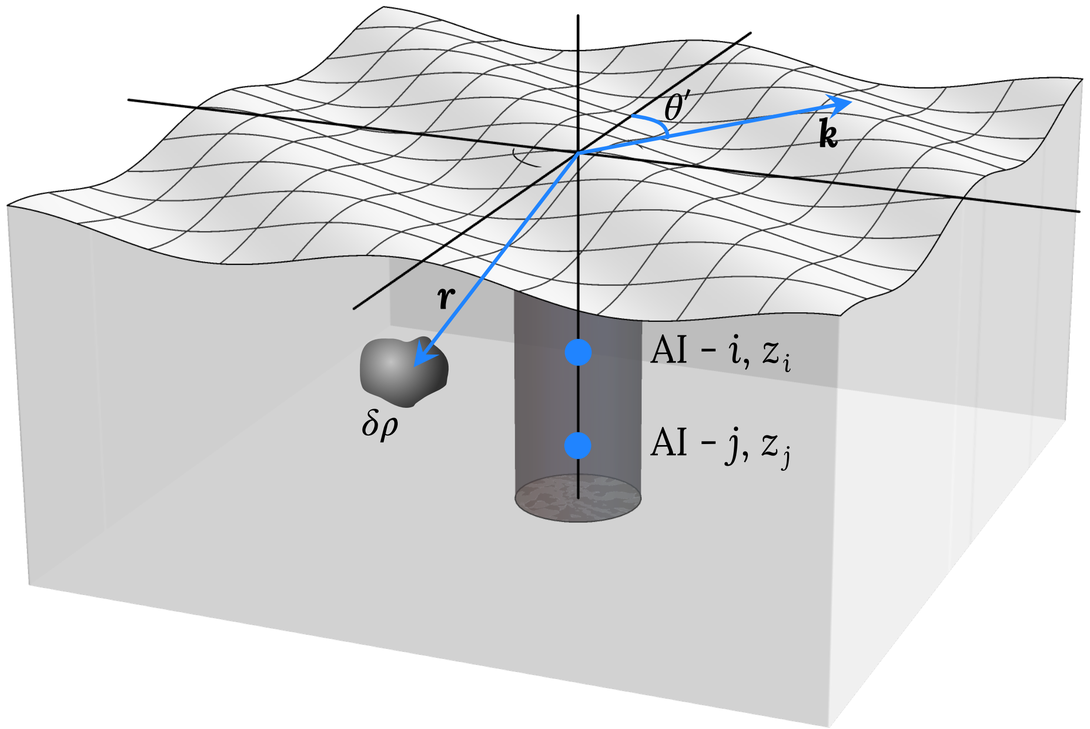
Lesson from IPPP:
Sometimes you need to just get on and tackle the difficult calculations



Factors that could limit sub-Hz regime

Seismic effects

surface waves, body waves, …



Factors that could limit sub-Hz regime

Seismic effects
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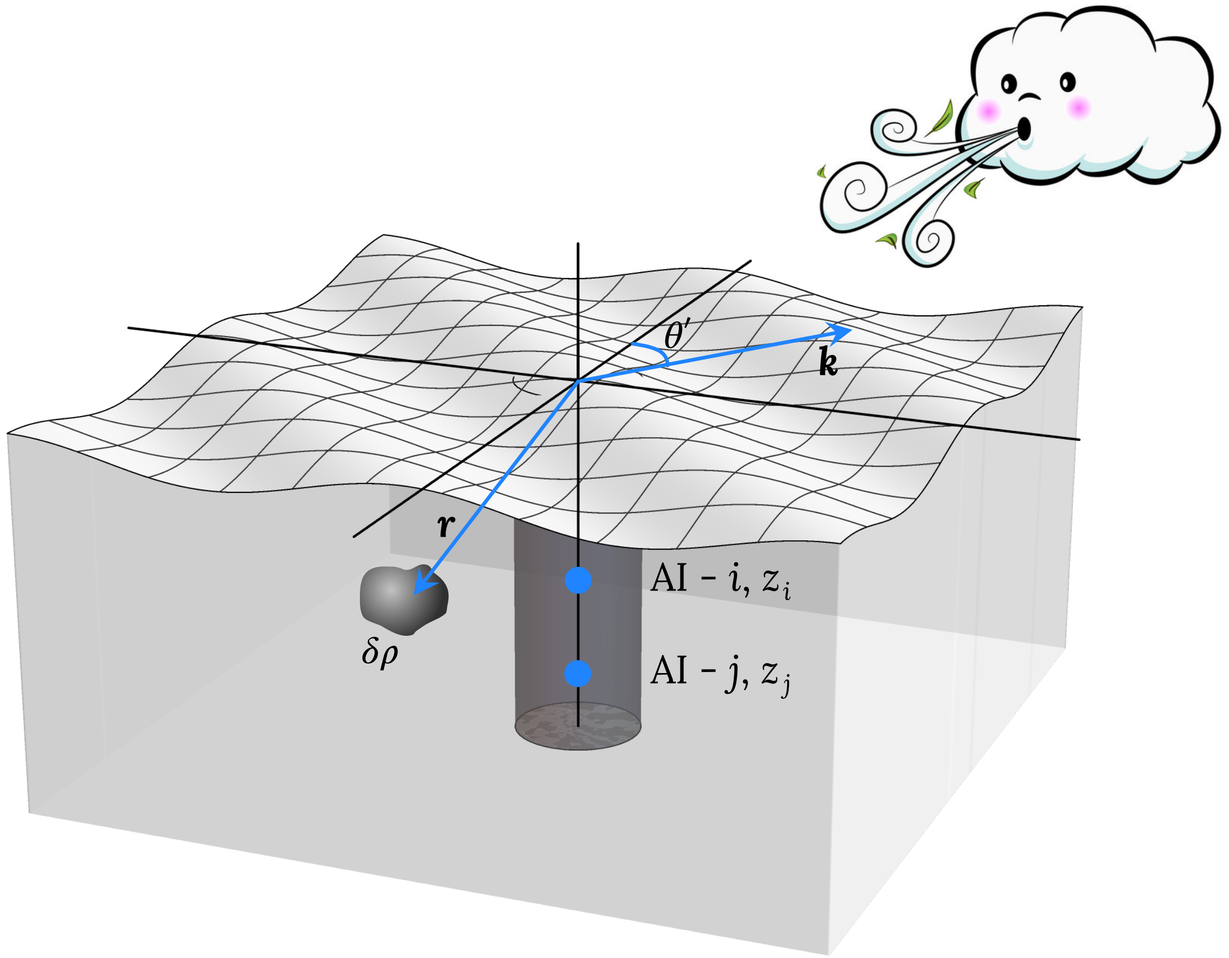
Atmospheric effects
temperature, pressure, …



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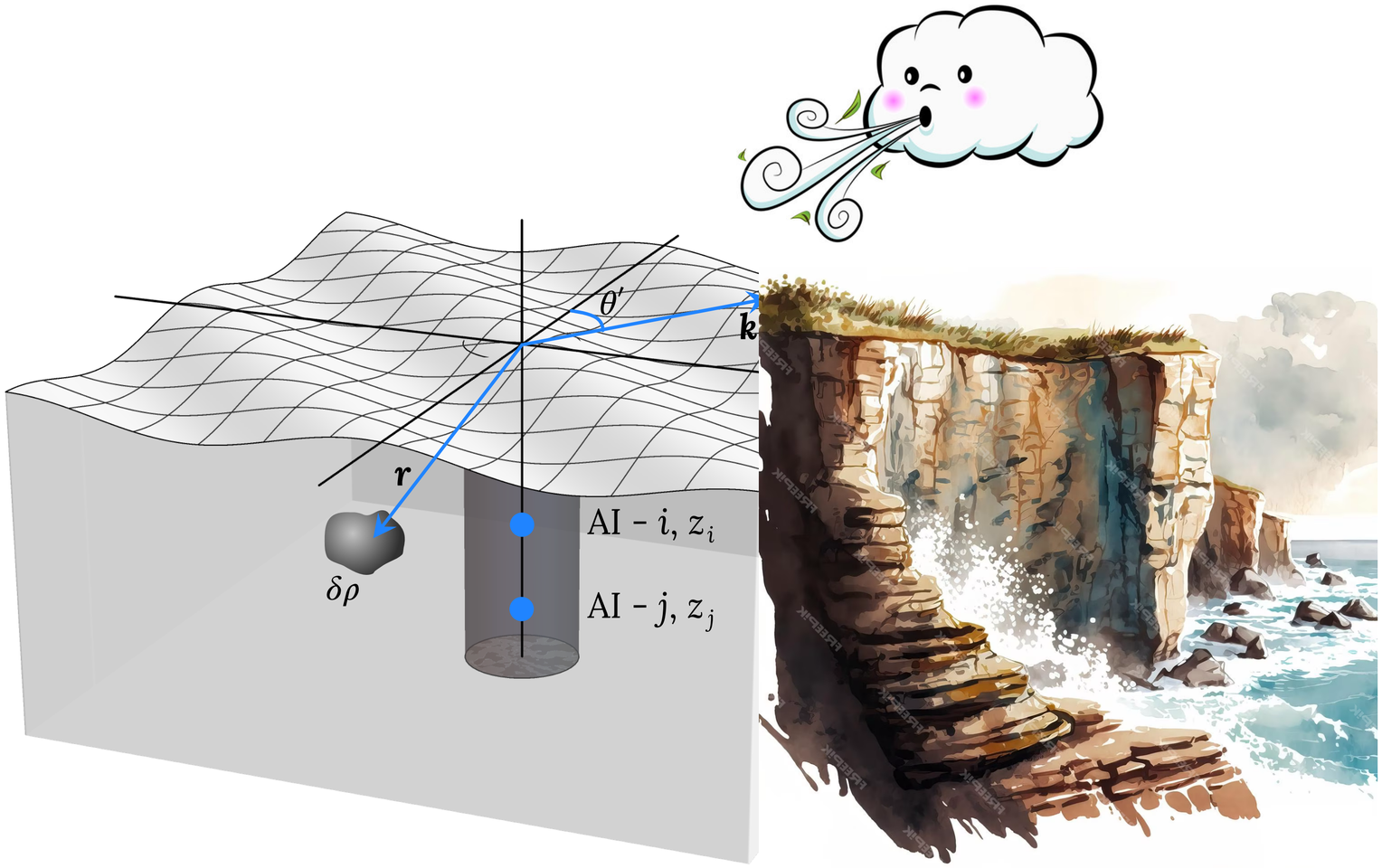
e.g. if hosted at Boubly



Factors that could limit sub-Hz regime

Seismic effects
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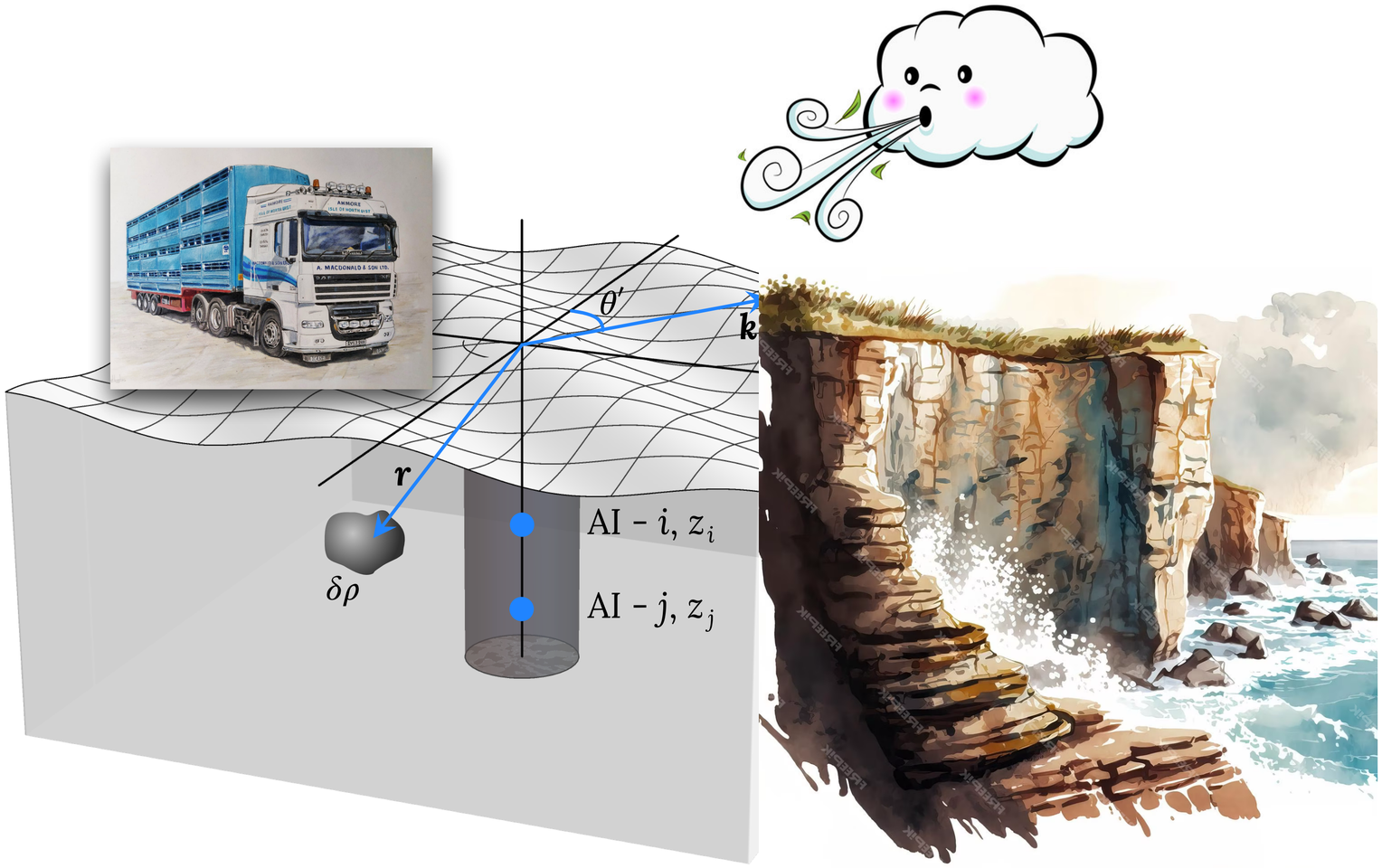
Local moving objects
vehicles, etc



Factors that could limit sub-Hz regime

Seismic effects

surface waves, body waves, …

Badurina, CM, et al, arXiv:2211.01854 (PRD)

Atmospheric effects

temperature, pressure, …

Carlton, CM, et al, arXiv:2412.05379 (PRD)

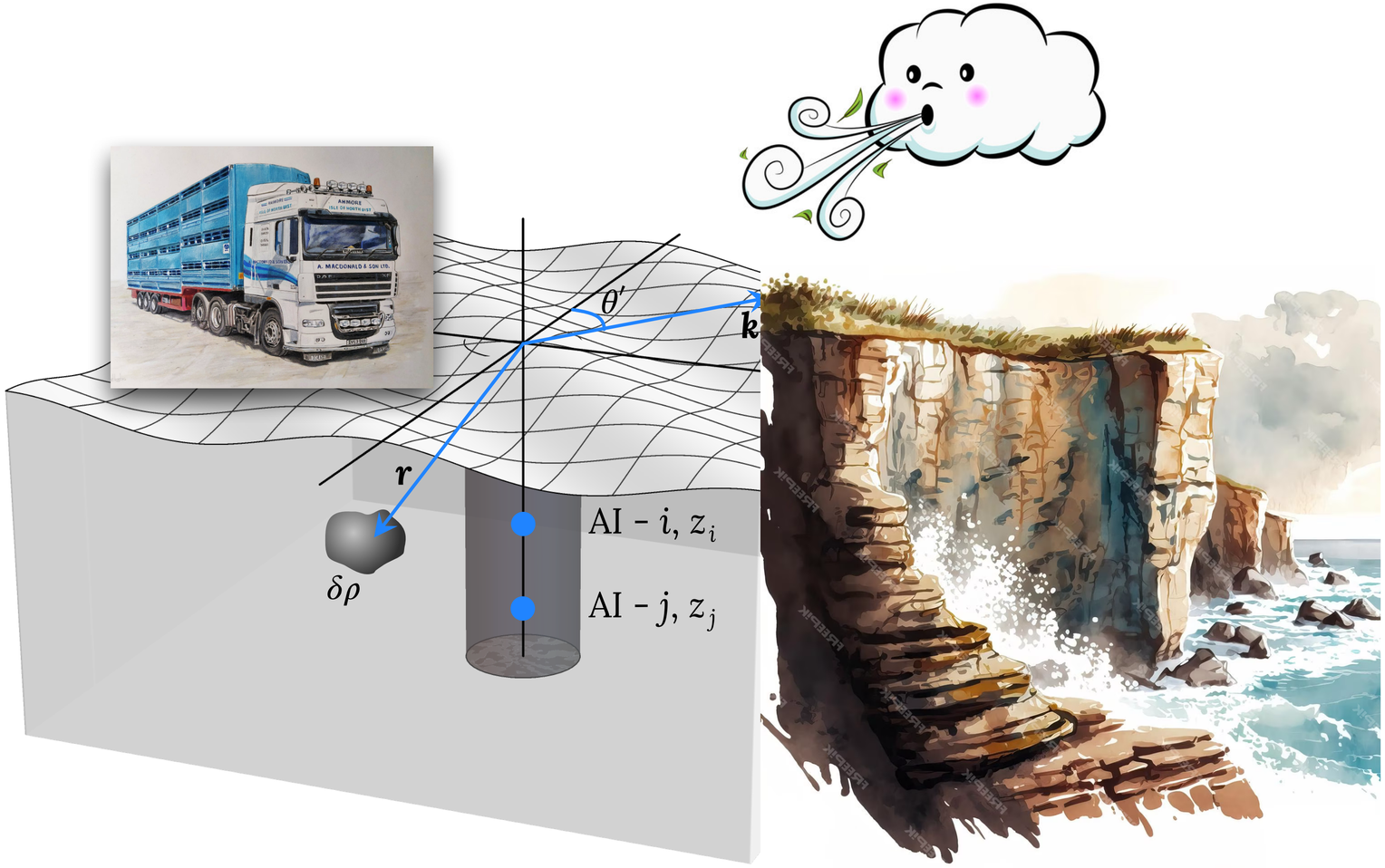
Ocean/sea effects

e.g. if hosted at Boubly

Local moving objects

vehicles, etc

Carlton, CM, arXiv:2308.10731 (PRD)



Happy Birthday IPPP: in a short time, you had a huge impact on how I approach dark matter research

still collaborating with contacts made at that time

still following the lessons learnt from observing others here