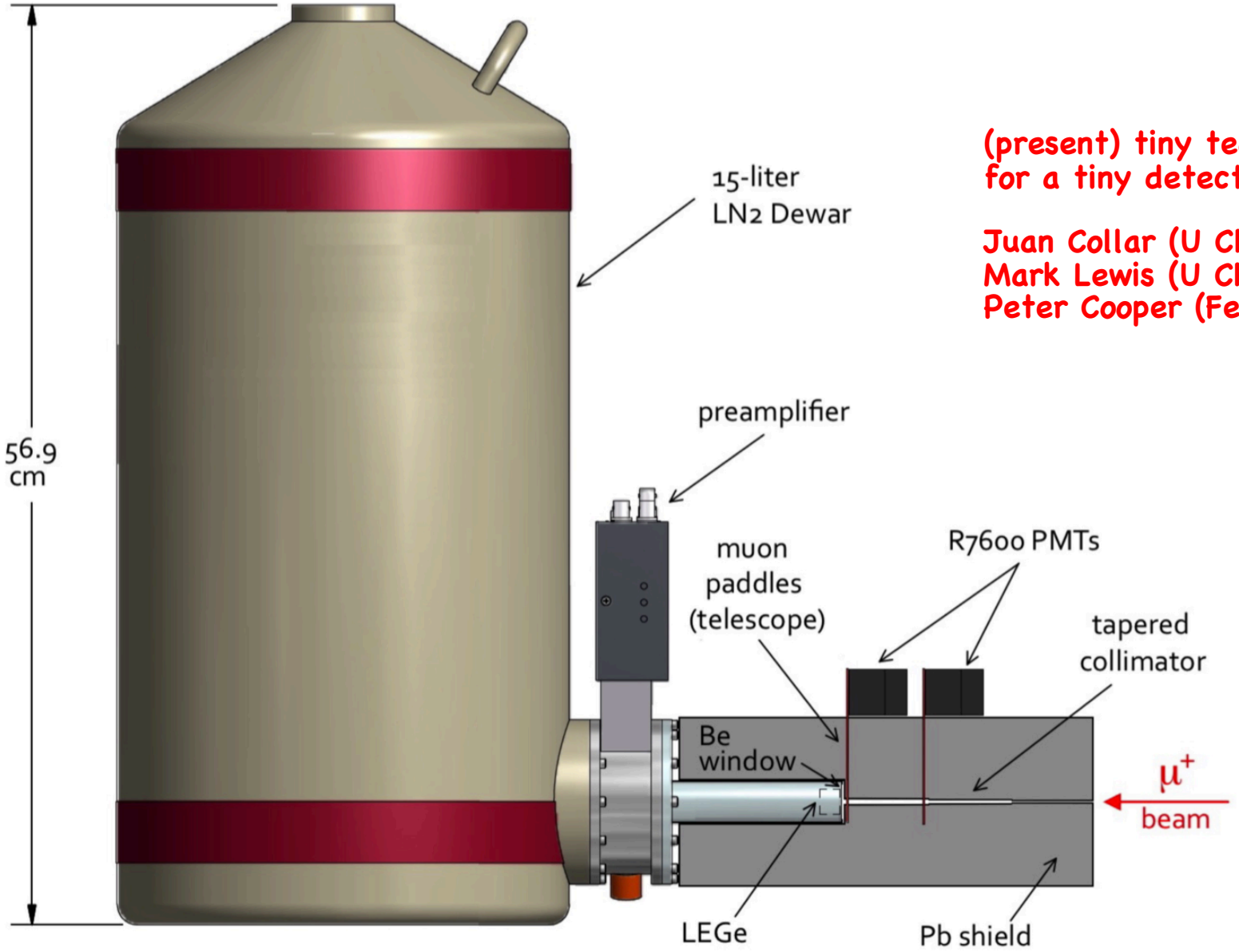
TRIUMF proposal S2129

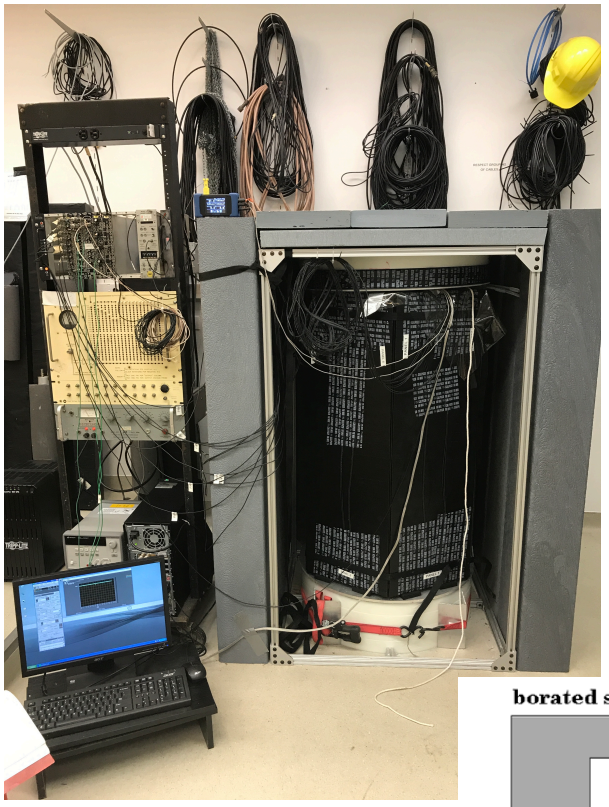
Search for a cosmologically-relevant boson in muon decay



(present) tiny team
for a tiny detector:

Juan Collar (U Chicago)
Mark Lewis (U Chicago)
Peter Cooper (Fermilab)

one thing leading to another...

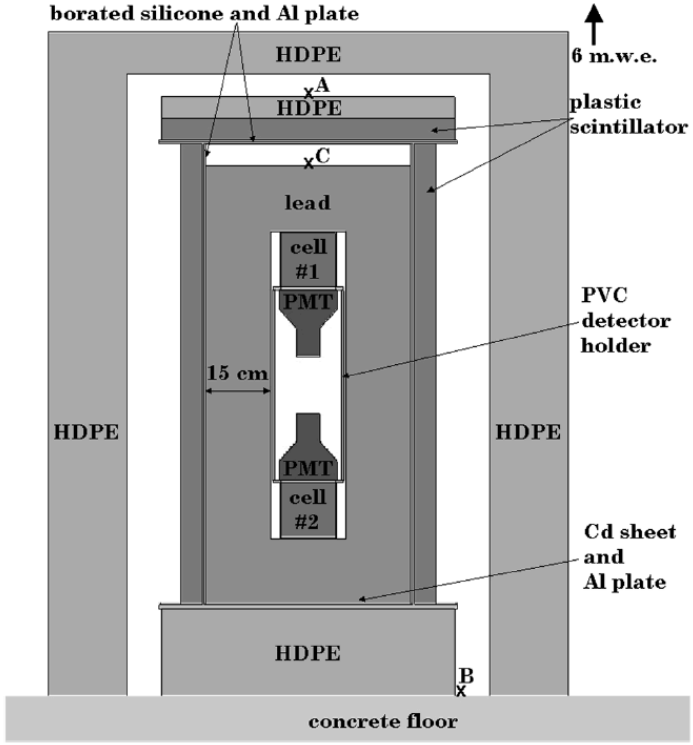


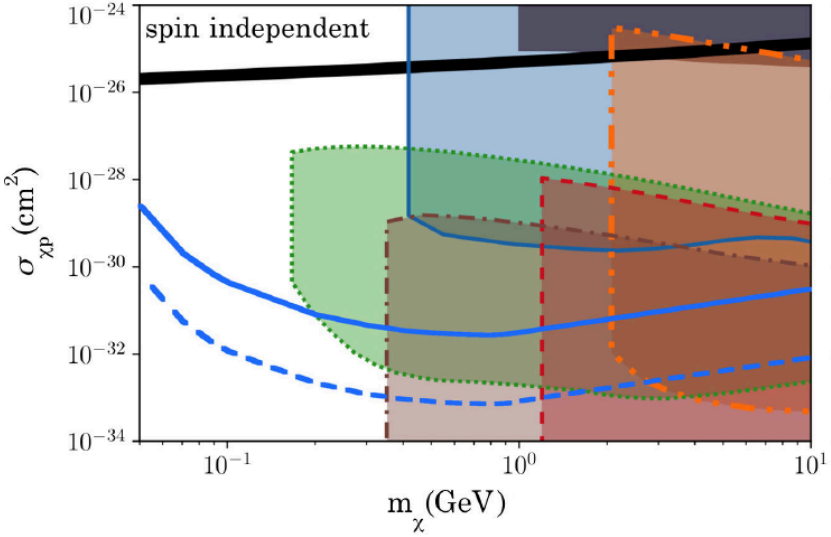
junk recycling...

PHYSICAL REVIEW D **98,** 023005 (2018)

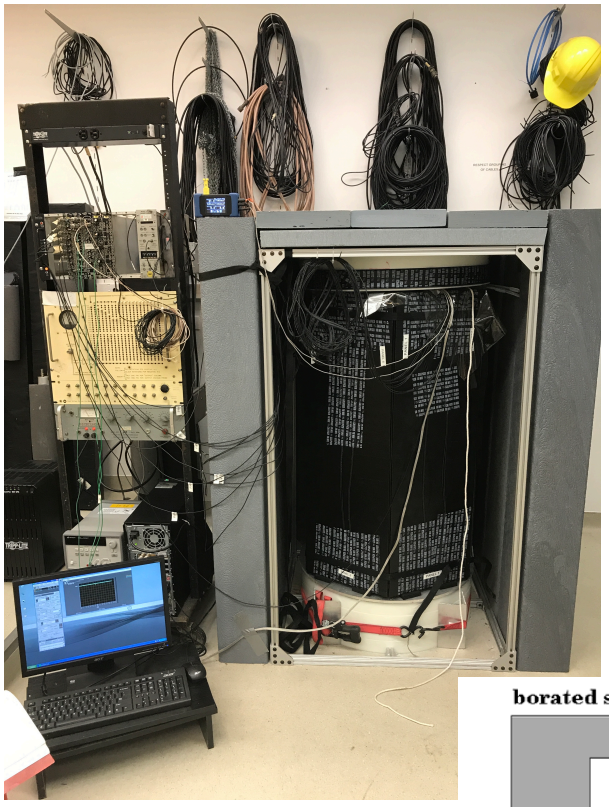
Search for a nonrelativistic component in the spectrum of cosmic rays at Earth

J. I. Collar*





one thing leading to another...



junk recycling...

PHYSICAL REVIEW D **98,** 023005 (2018)

Search for a nonrelativistic component in the spectrum of cosmic rays at Earth

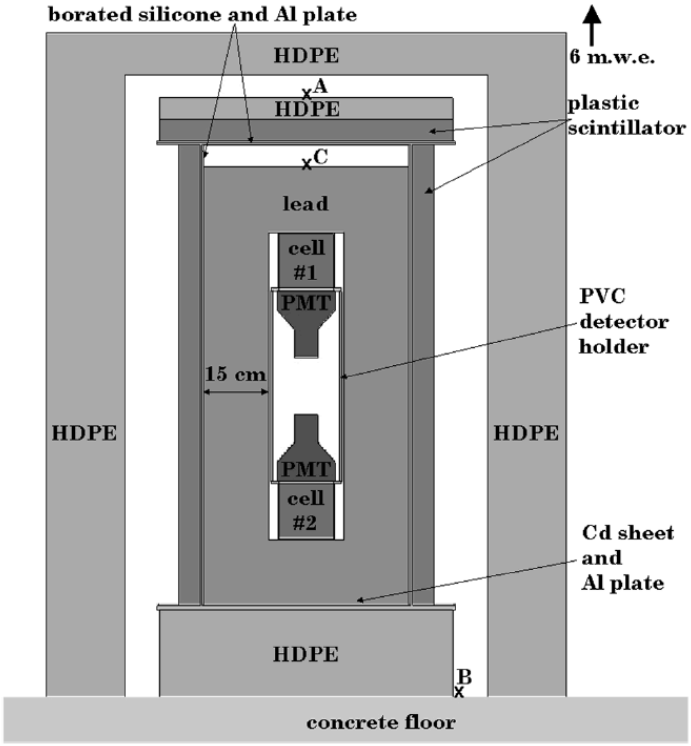
J. I. Collar*

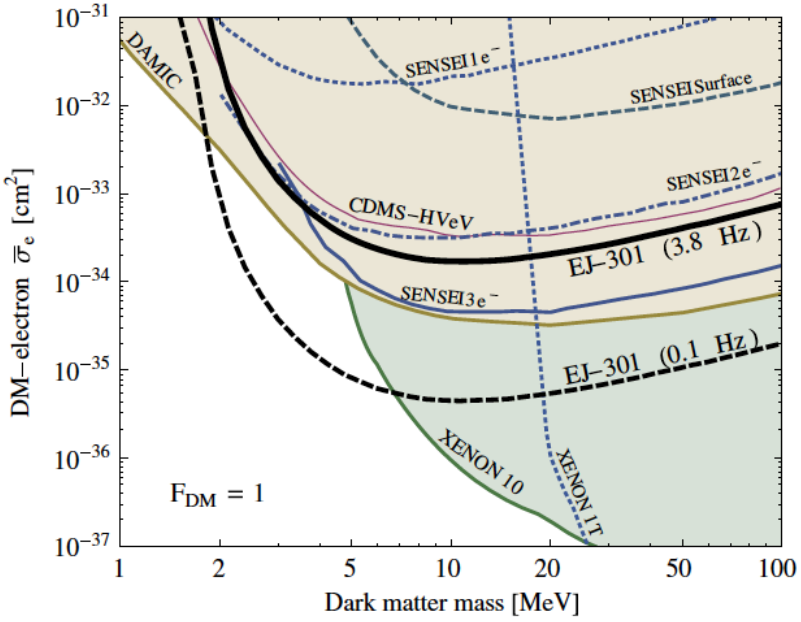
low-mass DM limits...

PHYSICAL REVIEW D **101,** 056001 (2020)

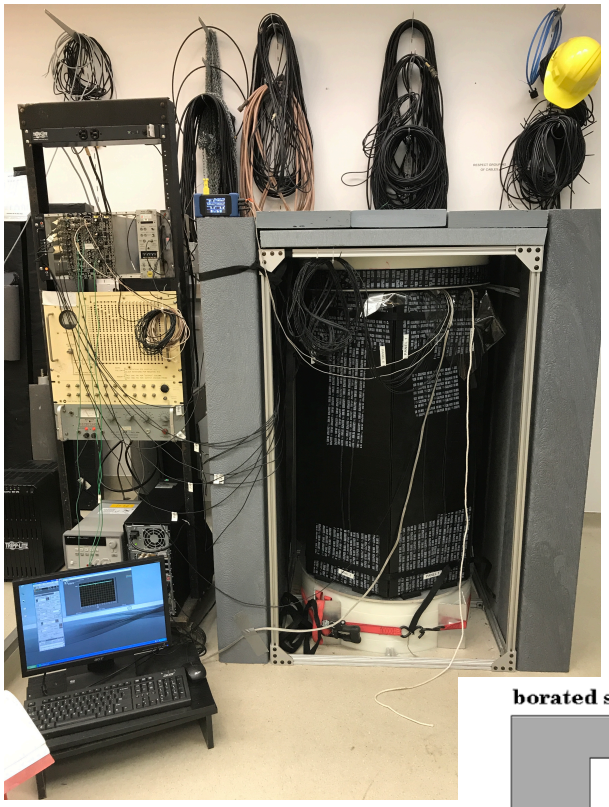
Dark matter-electron scattering from aromatic organic targets

Carlos Blanco,[1,2,*] J. I. Collar,[1,2,†] Yonatan Kahn,[3,‡] and Benjamin Lillard[3,§]





one thing leading to another...



junk recycling...

PHYSICAL REVIEW D **98,** 023005 (2018)

Search for a nonrelativistic component in the spectrum of cosmic rays at Earth

J. I. Collar*

high-mass DM limits...

PHYSICAL REVIEW D **103,** 023019 (2021)

New experimental constraints in a new landscape for composite dark matter

Christopher V. Cappiello[1,2,*] J. I. Collar[3,†] and John F. Beacom[1,2,4,‡]

low-mass DM limits...

PHYSICAL REVIEW D **101,** 056001 (2020)

Dark matter-electron scattering from aromatic organic targets

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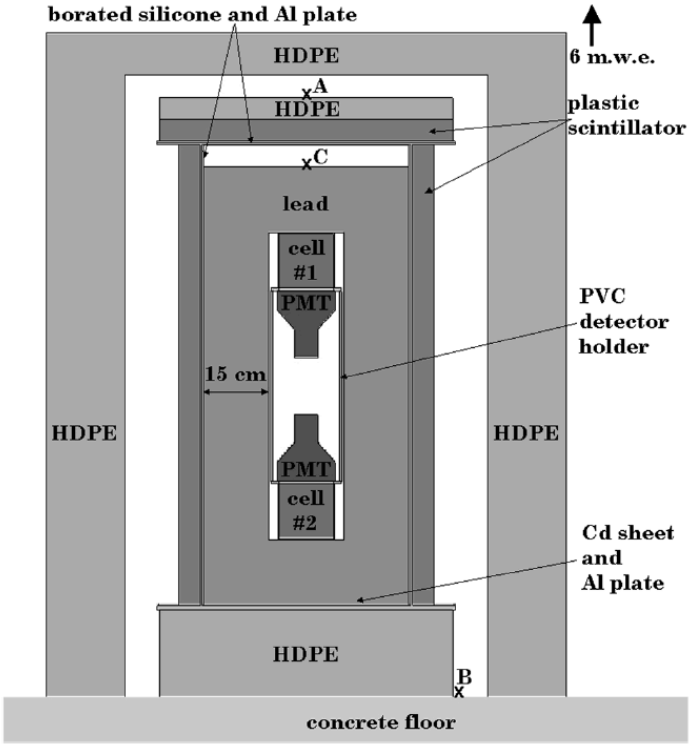
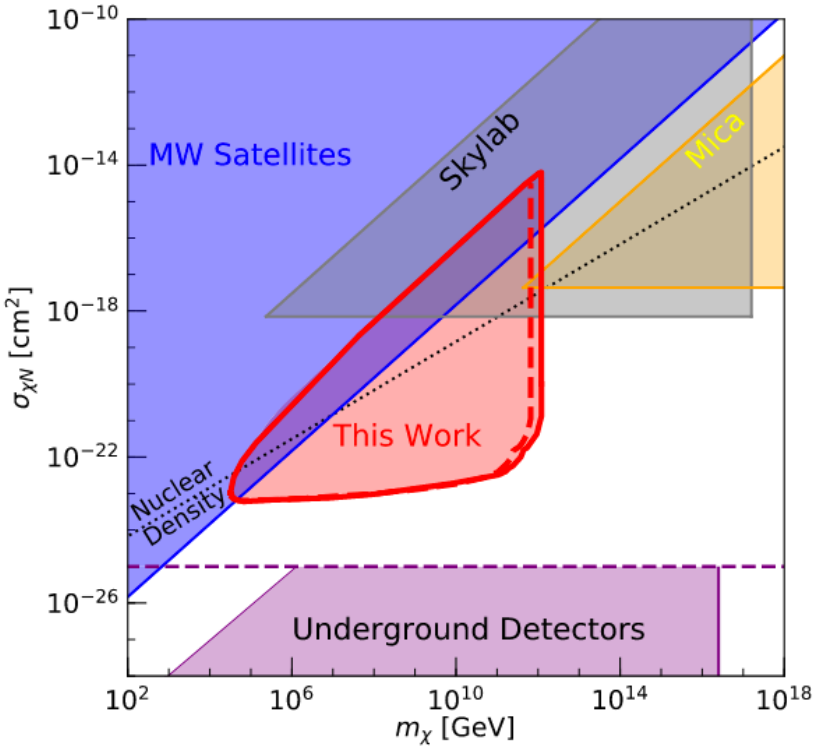
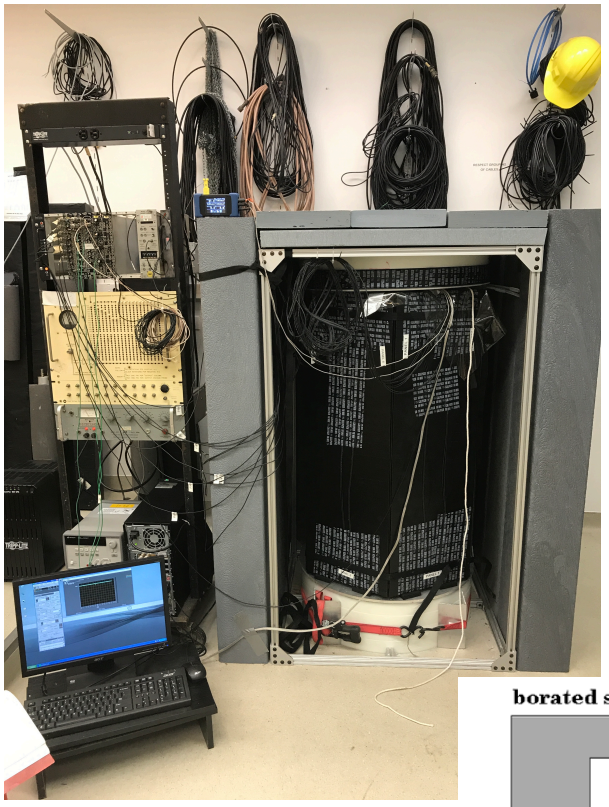




one thing leading to another...



junk recycling...

PHYSICAL REVIEW D **98,** 023005 (2018)

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J. I. Collar*

high-mass DM limits...

PHYSICAL REVIEW D **103,** 023019 (2021)

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PHYSICAL REVIEW D **101,** 056001 (2020)

Dark matter-electron scattering from aromatic organic targets

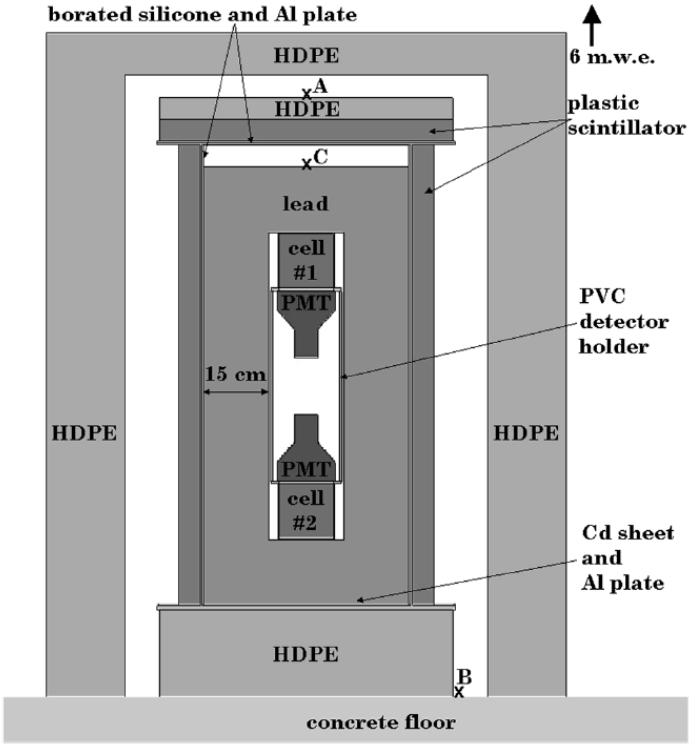
Carlos Blanco,[1,2,*] J. I. Collar,[1,2,†] Yonatan Kahn,[3,‡] and Benjamin Lillard[3,§]

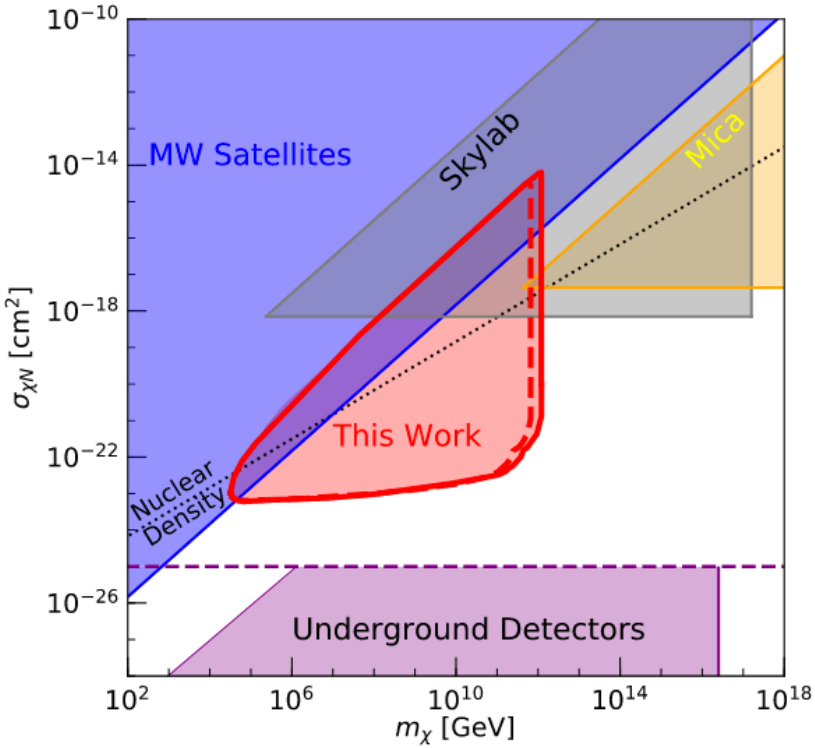
ruminations on muon backgrounds...

PHYSICAL REVIEW D **103,** 052007 (2021)

Search for a cosmologically relevant boson in muon decay

J. I. Collar*





one thing leading to another...

Physics Letters B 348 (1995) 19–28

Anomaly in the time distribution of neutrinos from a pulsed beam stop source

KARMEN Collaboration

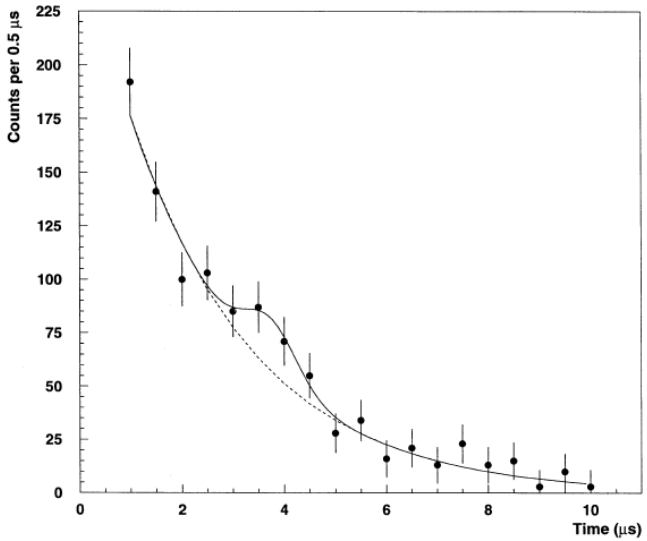


Fig. 1. Time distribution of events in the KARMEN calorimeter after the subtraction of the cosmic background.[3] The data are fitted to an exponential with the 2.2 μs decay constant on which is superimposed a Gaussian signal centered at 3.7 μs. The fit procedure results in χ^2 of 9.8 for 14 degrees of freedom.

arXiv:hep-ex/0008073v1 30 Aug 2000

Does the KARMEN time anomaly originate from a beam-correlated background?

F. Atchison, M. Daum*, P.-R. Kettle, C. Wigger

(womp-womp)

one thing leading to another…

Physics Letters B 348 (1995) 19–28

Anomaly in the time distribution of neutrinos from a pulsed beam stop source

KARMEN Collaboration

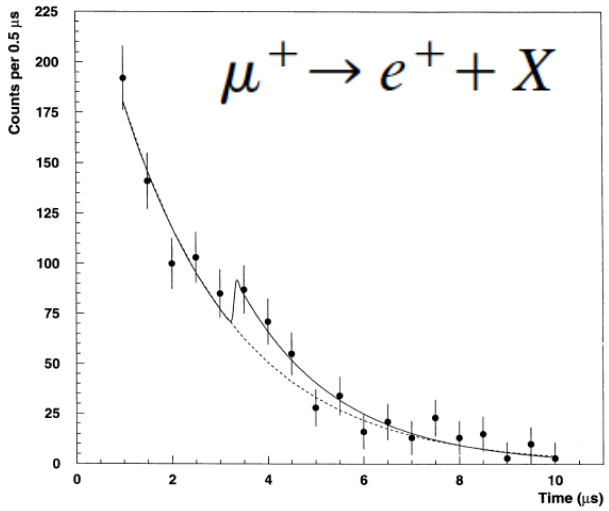


Fig. 2. Time distribution of events in the KARMEN calorimeter after the subtraction of the cosmic background.[3] The solid curves are a fit to the points by a sum of two exponentials. The first exponential describes the time distribution in the region from 1.0 to 3.3 μs and the other in the region from 3.3 to 10 μs with time constants of $(2.29 \pm 0.34)\mu s$ and $(2.1 \pm 0.6)\mu s$, respectively. The broken line corresponds to the extrapolation of the first exponential. The fit procedure results in χ^2 of 9.7 for 15 degrees of freedom.

Does the KARMEN time anomaly originate from a beam-correlated background?

F. Atchison, M. Daum*, P.-R. Kettle, C. Wigger

(womp-womp)

Physics Letters B 434 (1998) 163–168

Exotic muon decays and the KARMEN anomaly

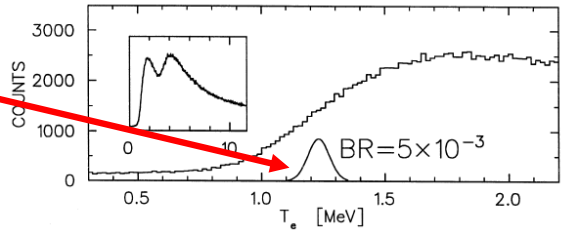
S.N. Gninenko [1], N.V. Krasnikov [2]

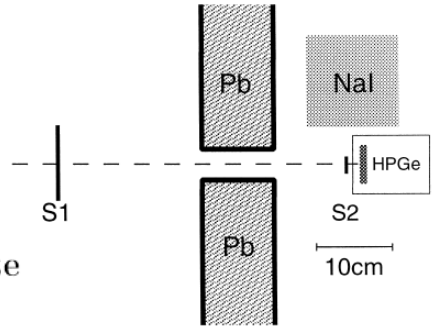
Physics Letters B 446 (1999) 363–367

Search for exotic muon decays [1]

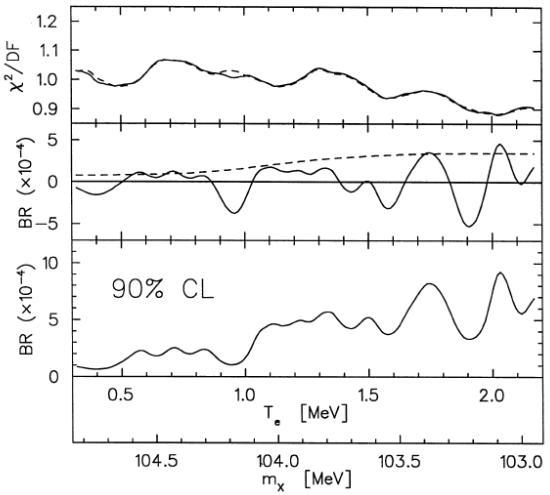
R. Bilger [a,2], K. Föhl [b], H. Clement [a], M. Cröni [a], A. Erhardt [a], R. Meier [a], J. Pätzold [a], G.J. Wagner [a]

THIS
(but much skinnier!)



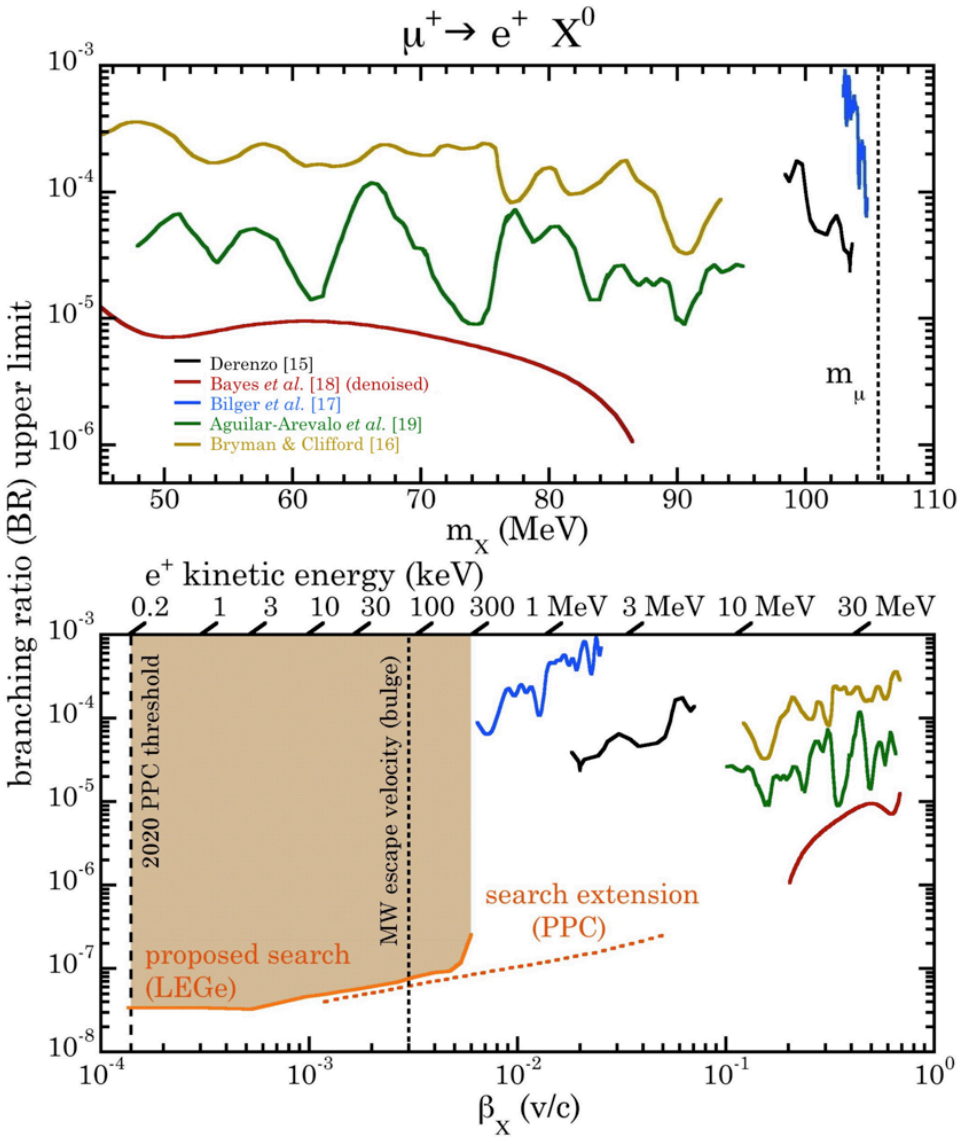


"Germanium beam-dump"



"motivation"

(isn't CLFV enough?)

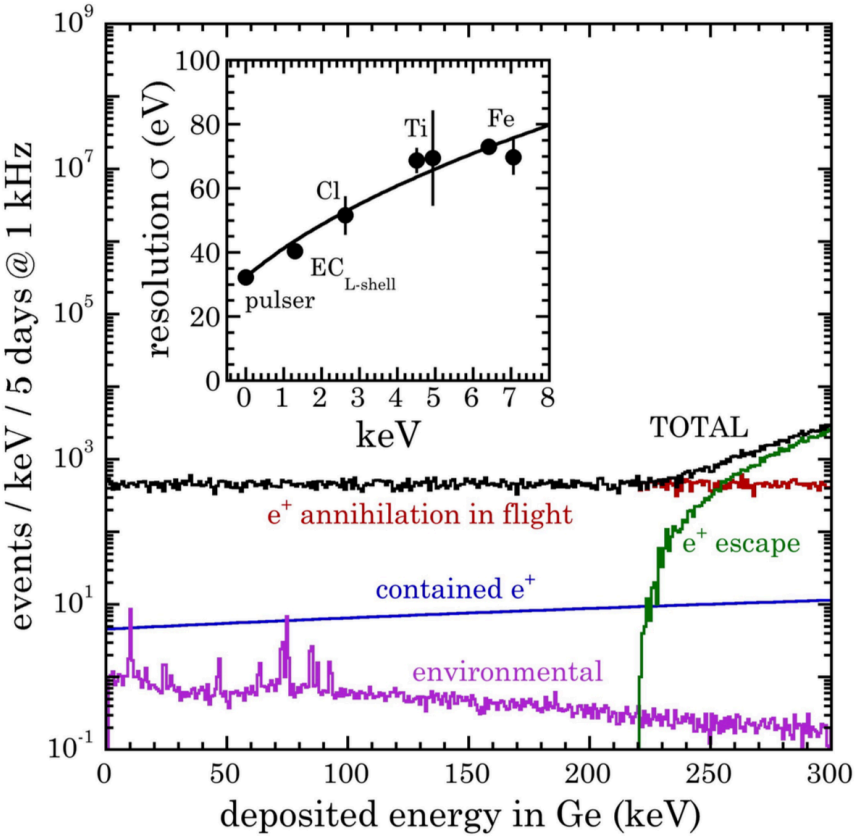


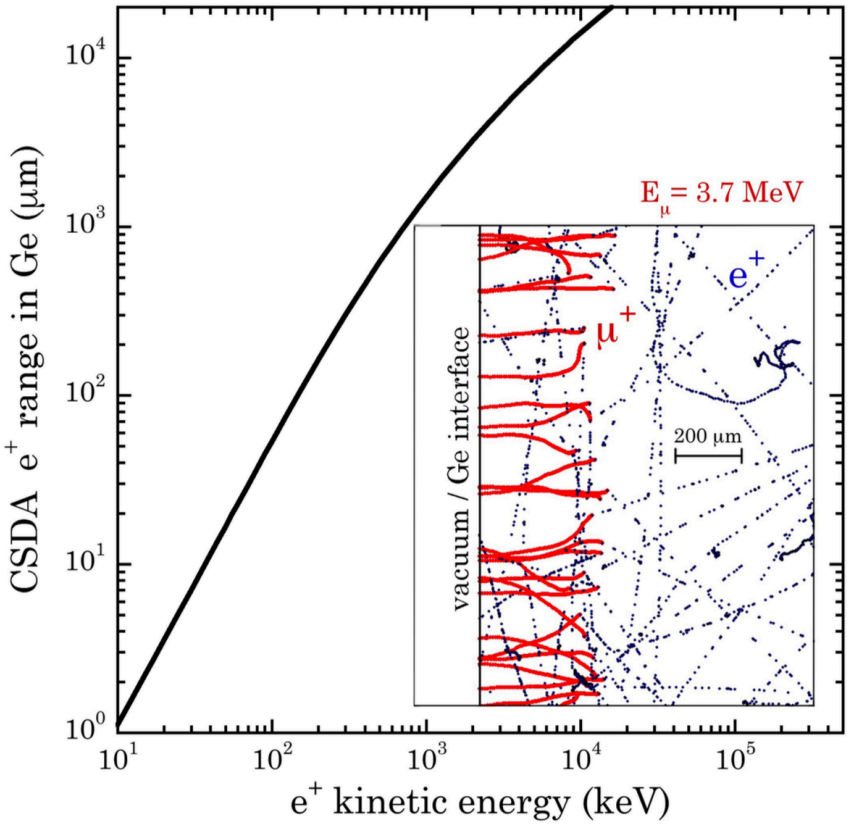
conventional

avant-garde

(some not-totally-stupid possible cosmological roles for this X^0 beast)

Preparation: simulation

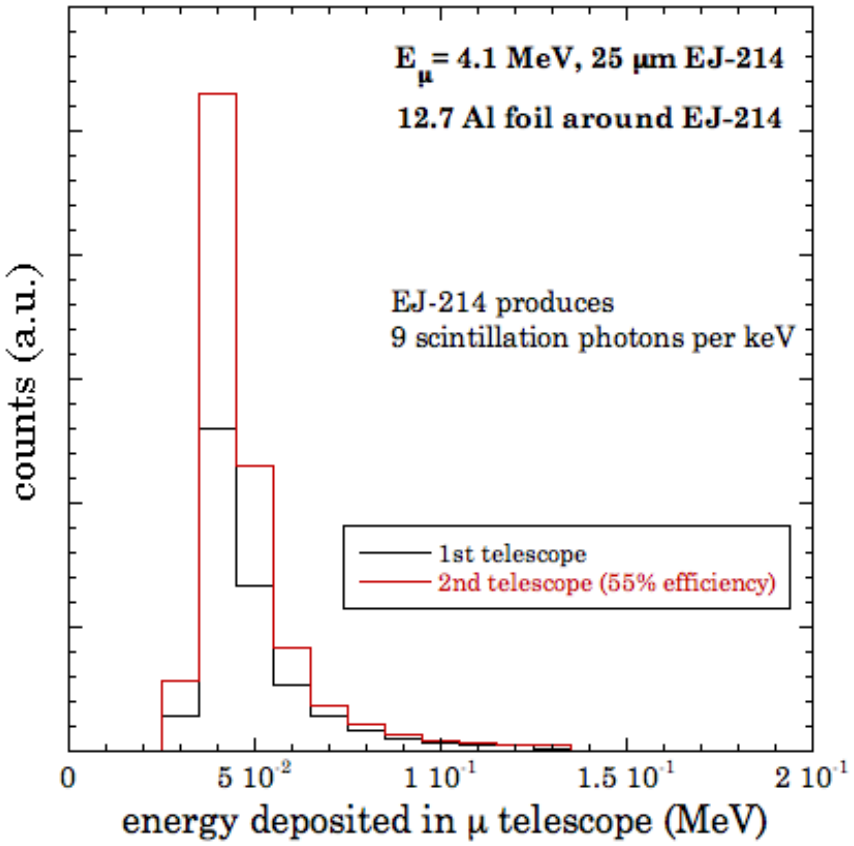


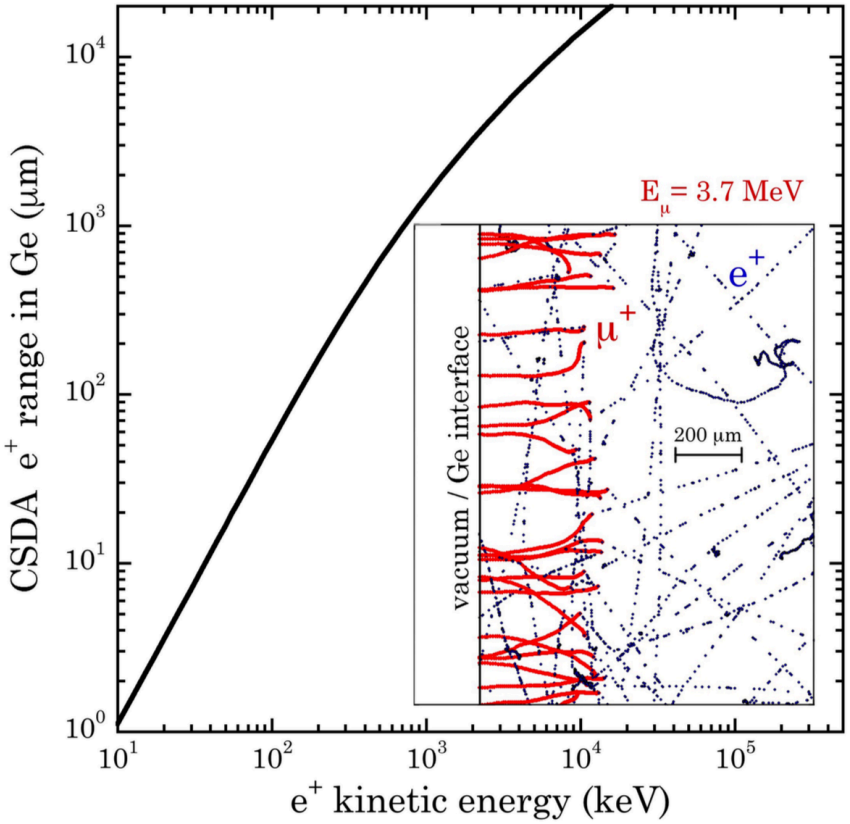


Excellent BR sensitivity from:

1) low-mass detector (2g)
2) Small fraction of Michel β+ at low-energy
3) Superb detector energy resolution

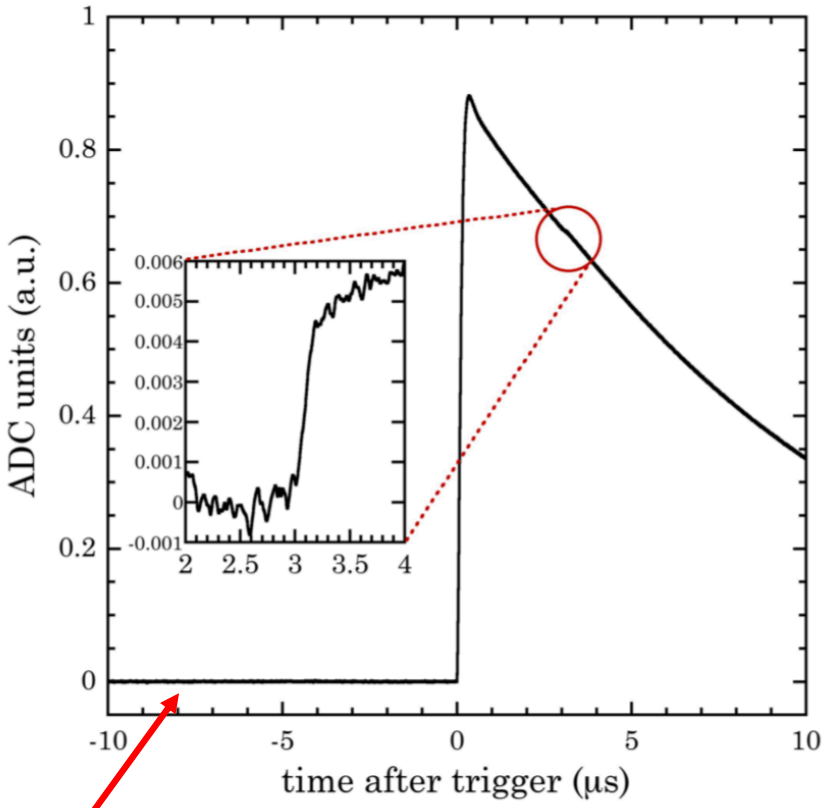
Preparation: simulation

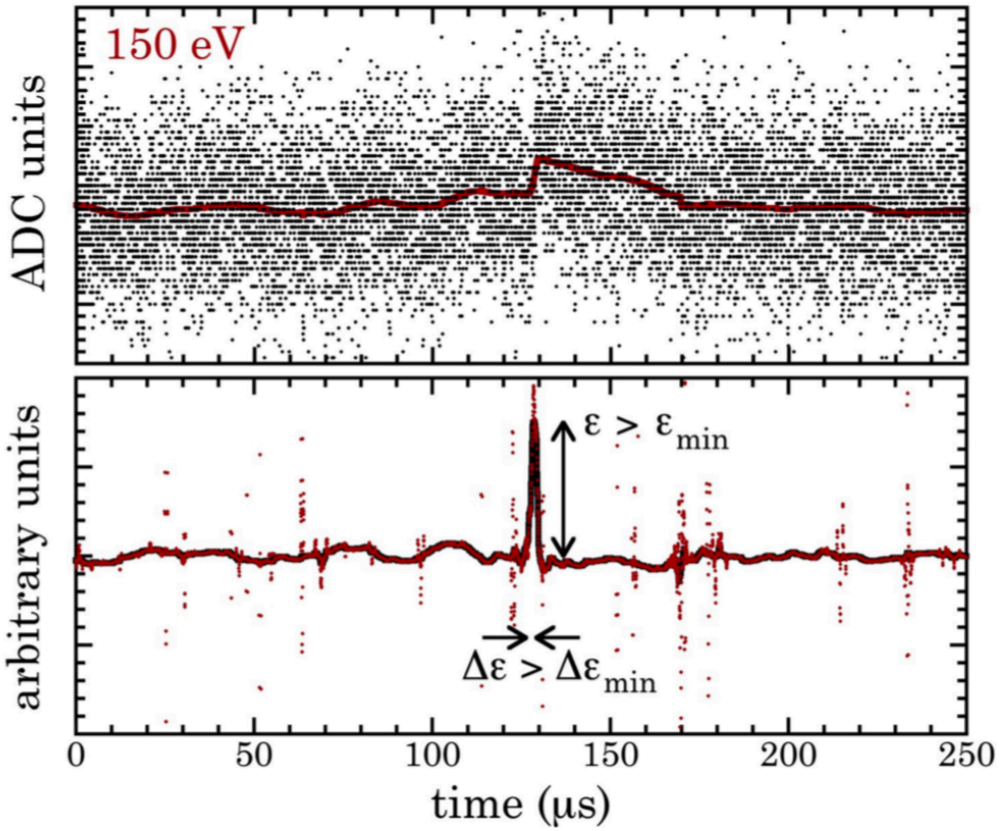




beam bckg discrimination possible
(but probably unnecessary)

Preparation: DAQ & analysis tools

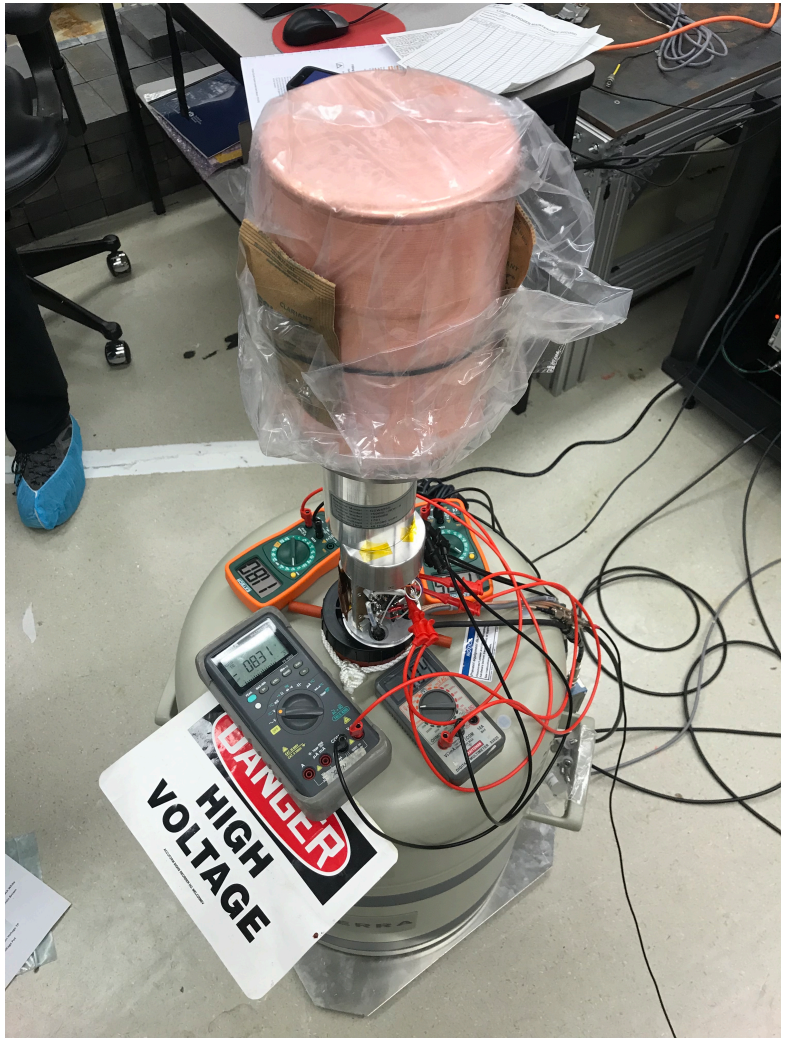


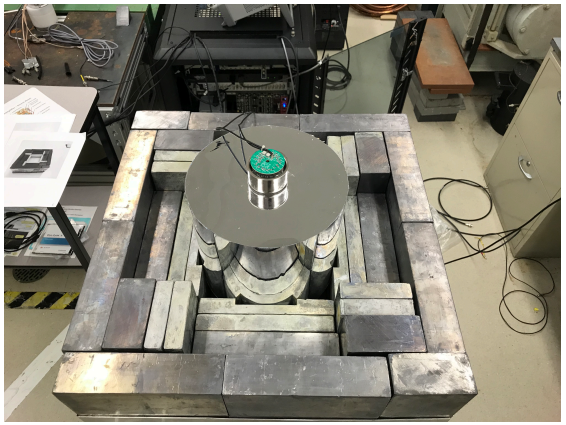


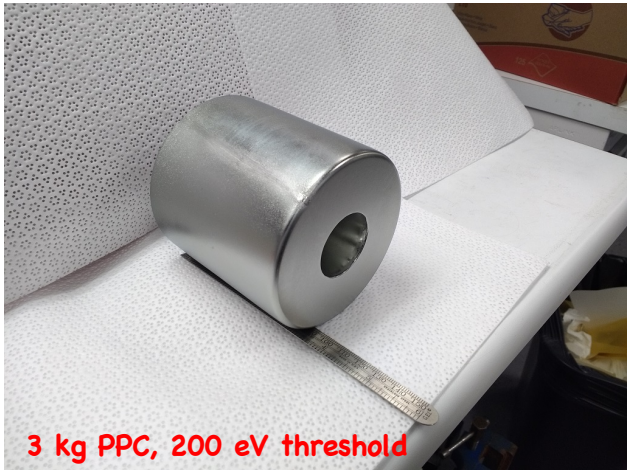
Modern approach: digitize and you shall conquer
(avoid analog electronics, move fancy analysis offline)

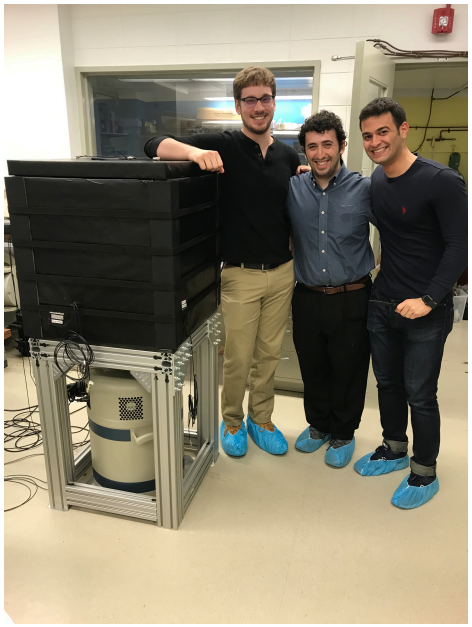
BONUS: study steady-state backgrounds in pre-trigger trace.

Synergy: not our first germanium low-noise rodeo

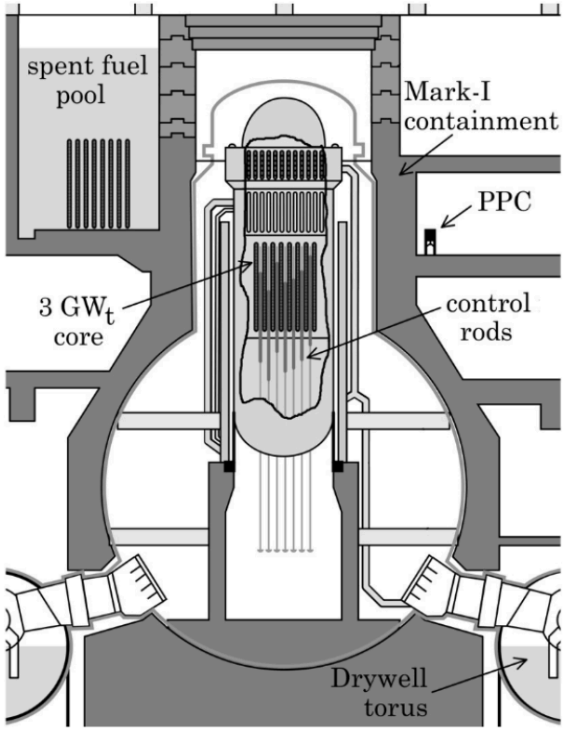






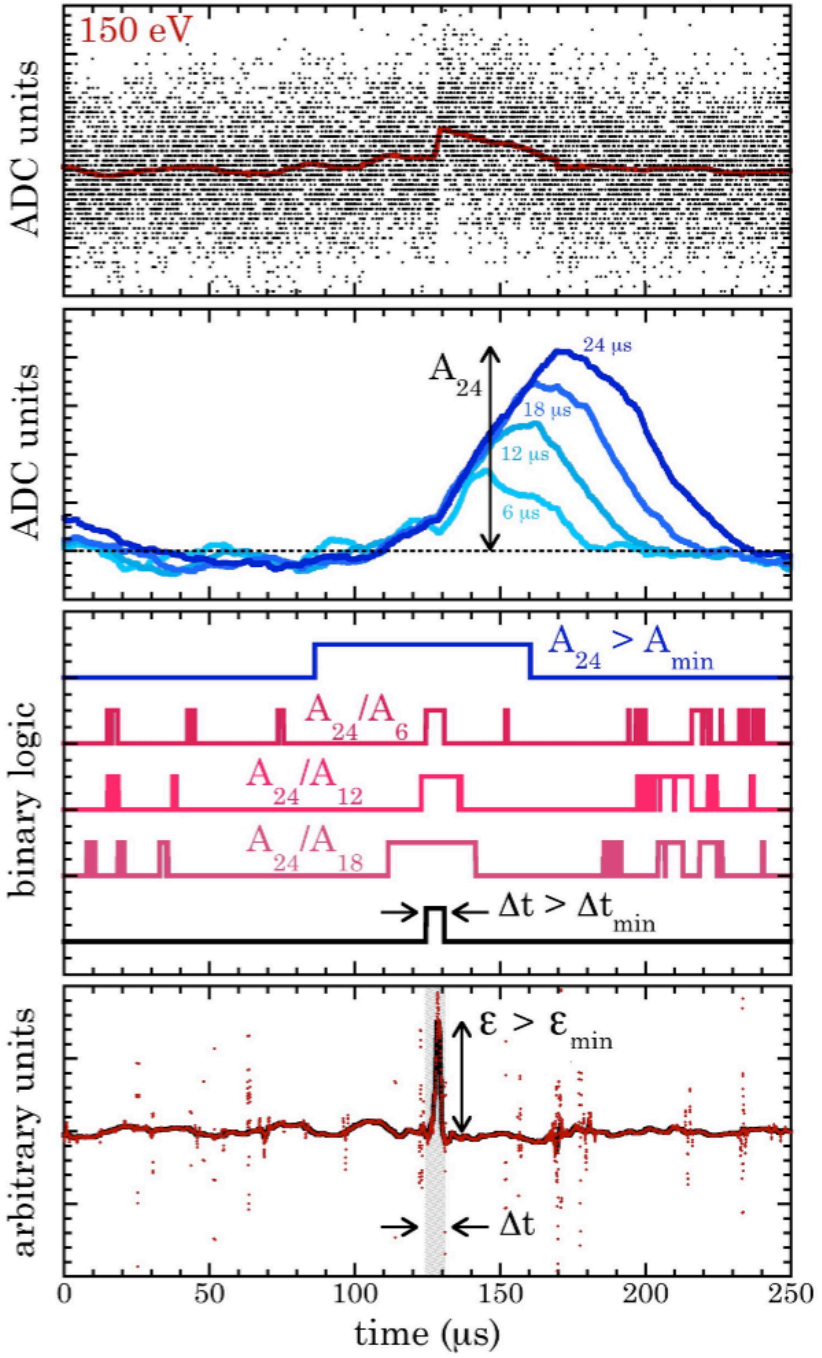


Synergy: not our first germanium low-noise rodeo

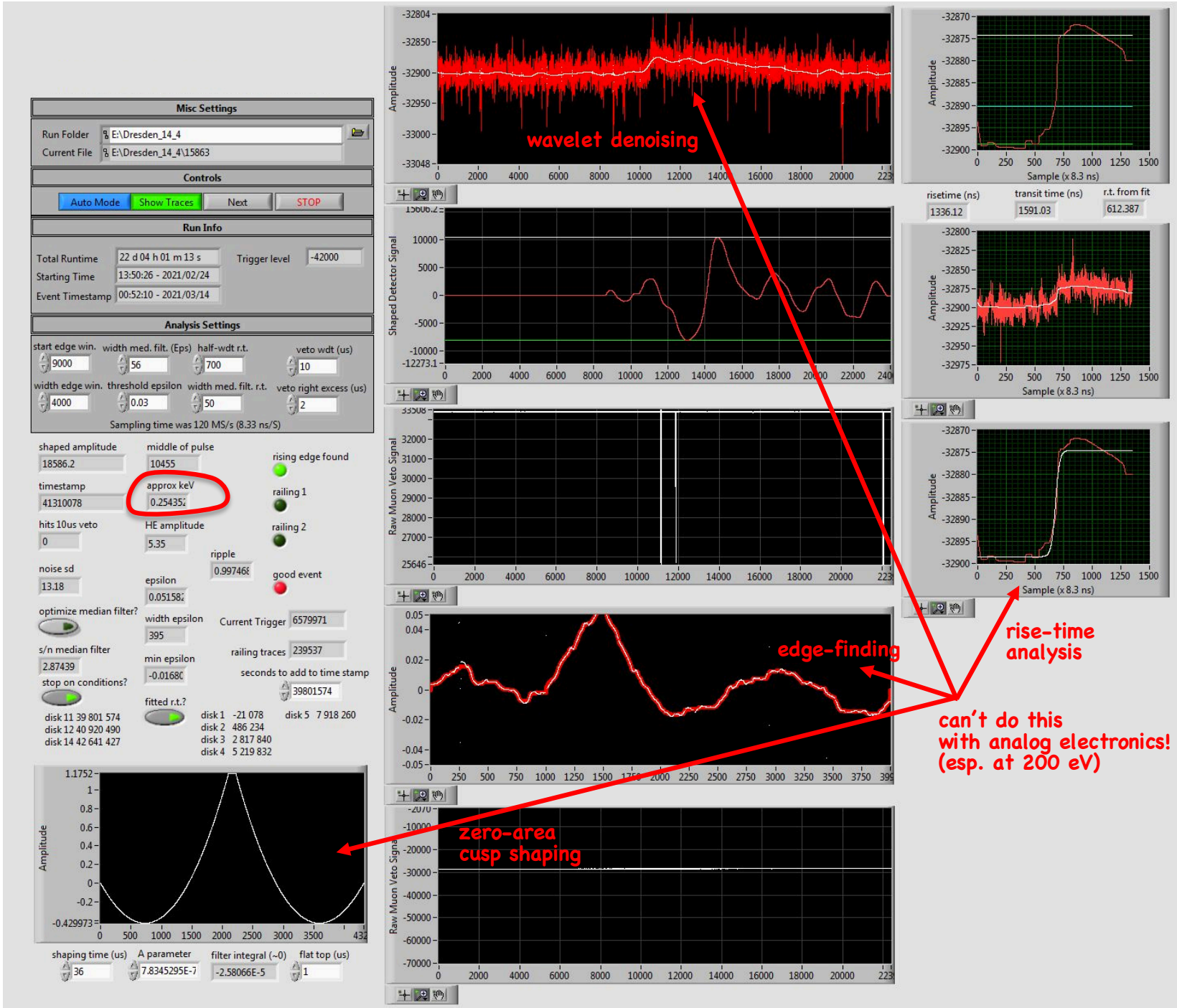


Synergy: not our first germanium low-noise rodeo

(obligatory selfie)



Synergy: not our first germanium low-noise rodeo

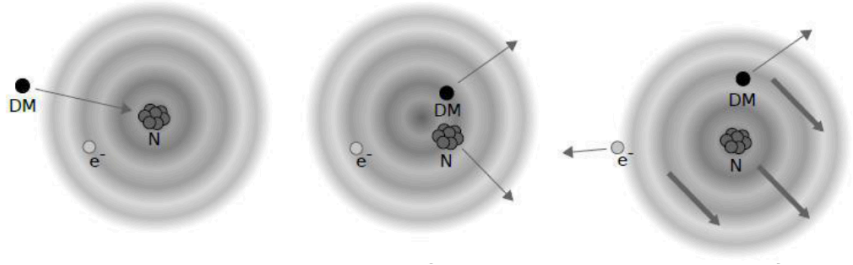


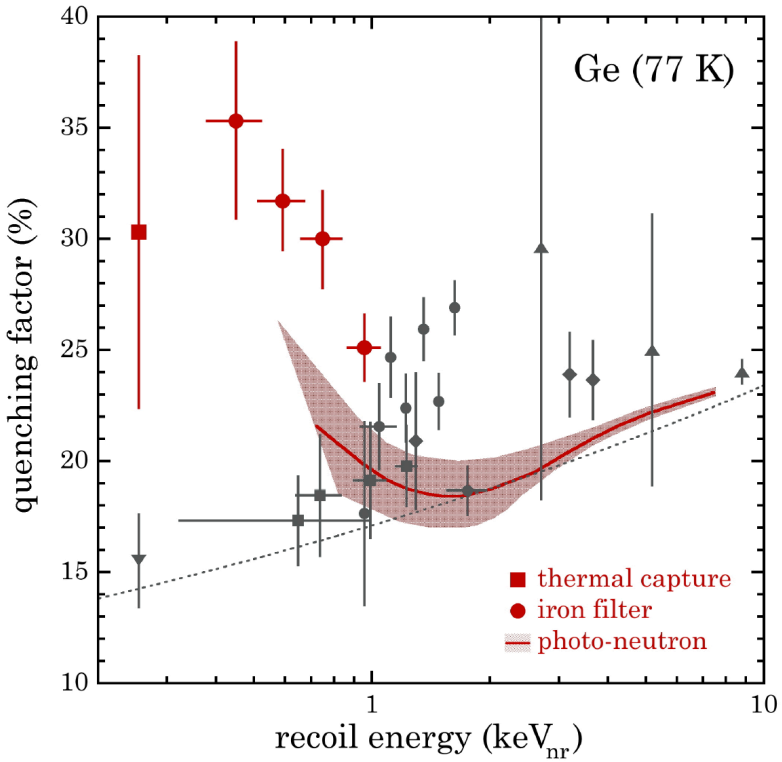
Synergy: not our first germanium low-noise rodeo

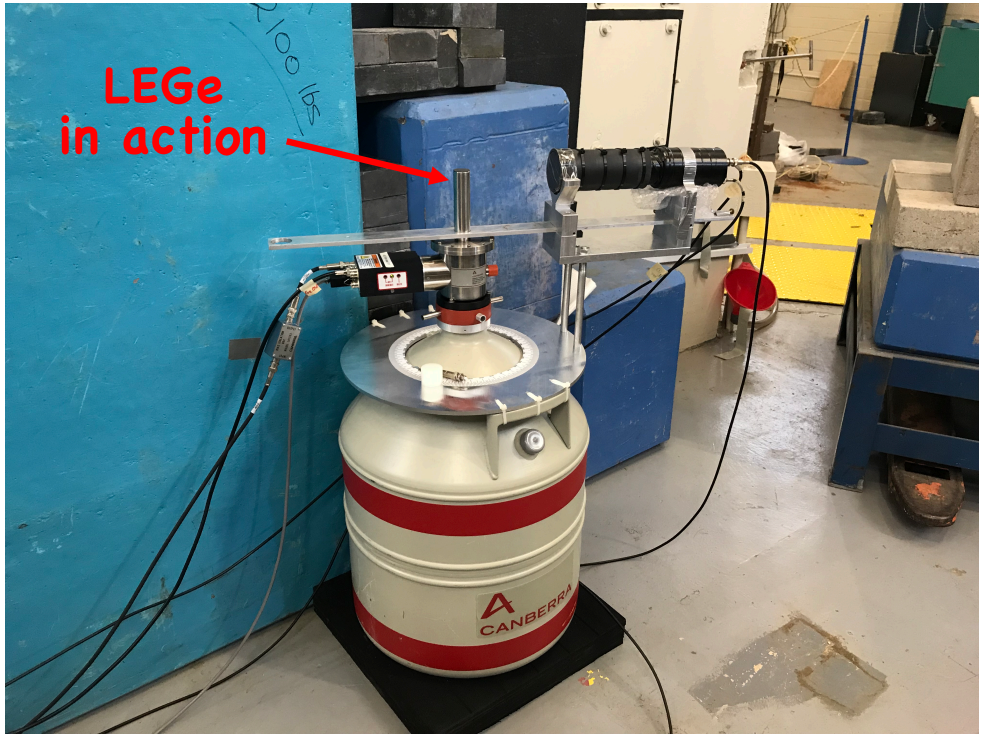
Germanium response to sub-keV nuclear recoils: A multipronged experimental characterization

J. I. Collar,* A. R. L. Kavner, and C. M. Lewis
Enrico Fermi Institute, Kavli Institute for Cosmological Physics, and Department of Physics, University of Chicago, Chicago, Illinois 60637, USA

(Received 3 March 2021; accepted 7 April 2021)







Ready when you are

- First detector seed-funded by KICP (expected to arrive last week…). Adjustable gain for maximum S/N.
- Pending NSF proposal for search extension (larger, more expensive PPC).
- One week (17x 8-hour shifts requested) for expected sensitivity. Beam alignment expertise at TRIUMF?
- Ready on our end as early as summer of 2021.
- Hopefully more collaborators soon!