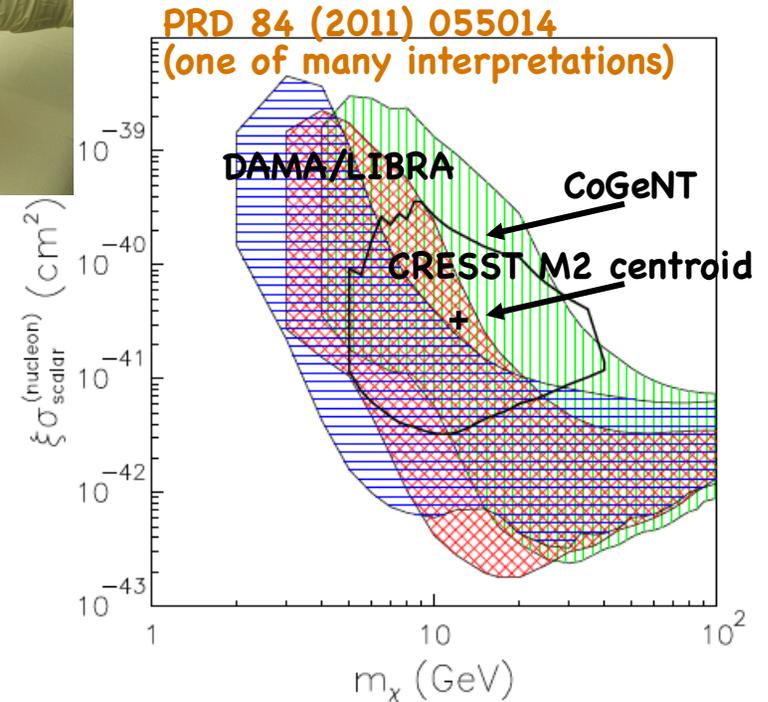
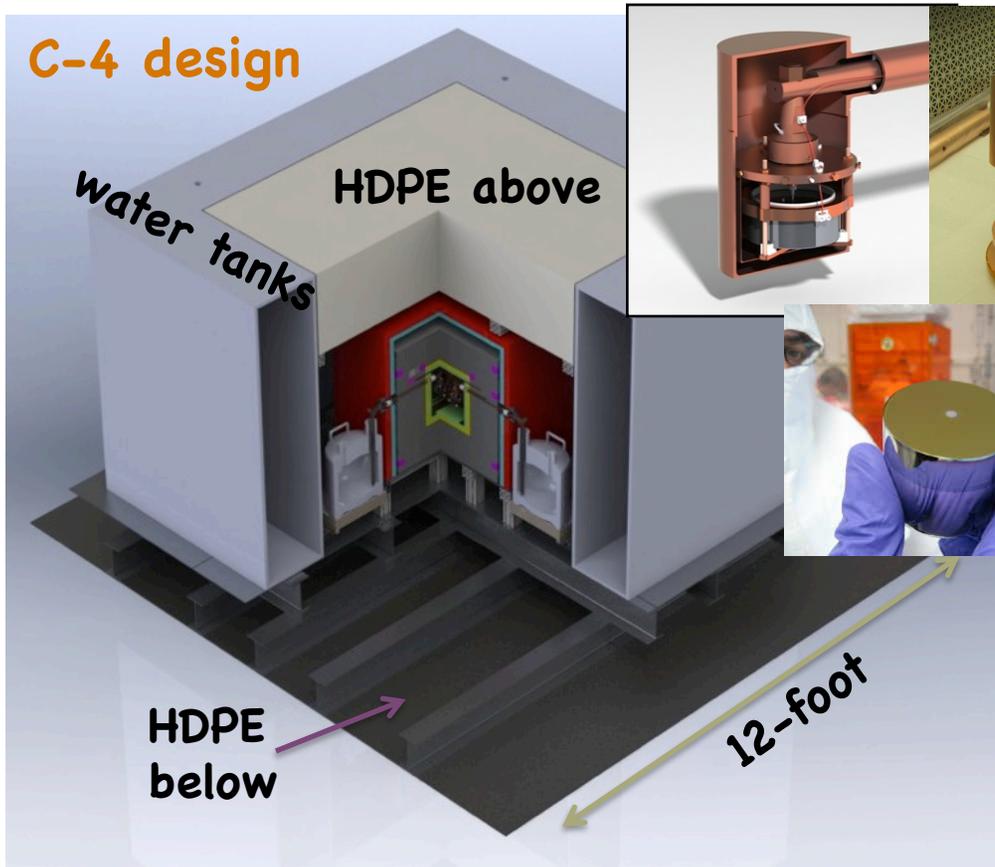
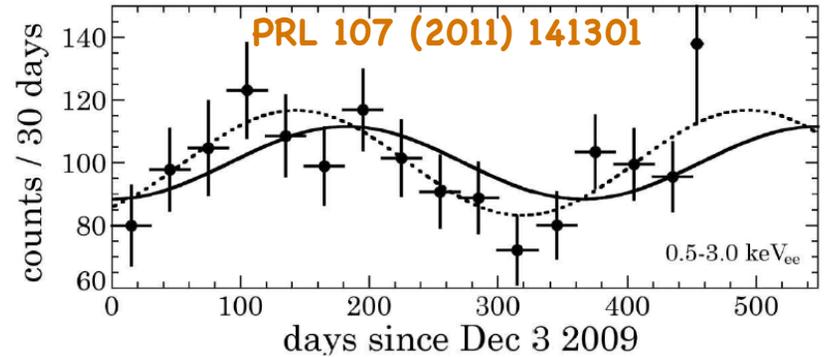


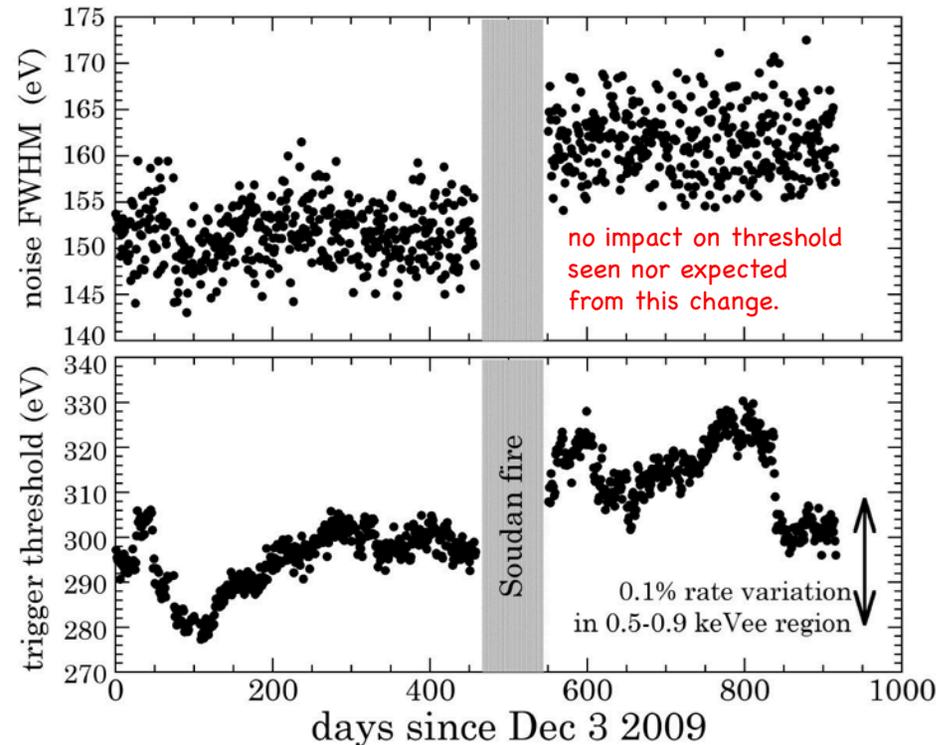
CoGeNT: a dedicated search for low-mass WIMPs

- An excellent example of synergy with industry: Canberra's PPCs around since early 80's.
- Remarkably simple commercial technology leads to applications in double-beta decay (MAJORANA, GERDA) and astroparticle physics (CoGeNT).
- Searches for an annual modulation require exquisite instrumental stability. But how much is enough?
- PNNL/UC/Canberra C-4 expansion (x10 mass, lower bckgs and threshold) will make it, or break it.



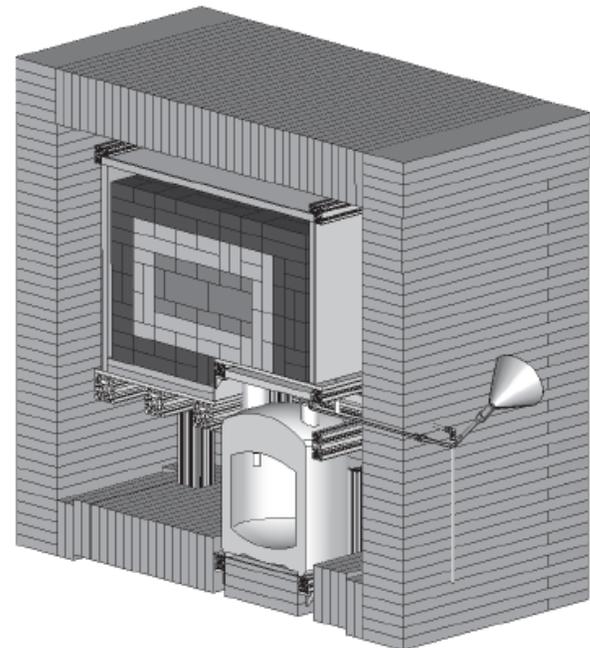
News from the CoGeNT front:

- Long (and overdue) paper to appear soon, simultaneous with C-4 design paper.
- Detector is alive and well, post-Soudan fire. Approaching an additional 150 kg-day of *uninterrupted* data-taking. Three years at end of 2012.
- Sneak-preview of new data today (analysis only recently started). Should be considered very preliminary.
- Plan to release time-stamped bulk *and* surface events, from two independent analysis pipelines (allowing to study effect of choice of cuts). Long paper doubles as a “manual” for use of these data.
- Previous experiment in data sharing has been very rewarding (hint-hint).
- First C-4 detector in production.



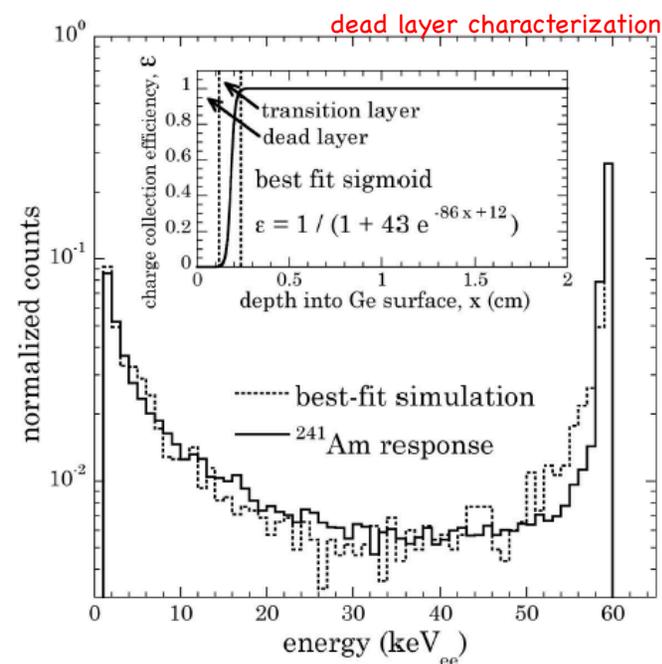
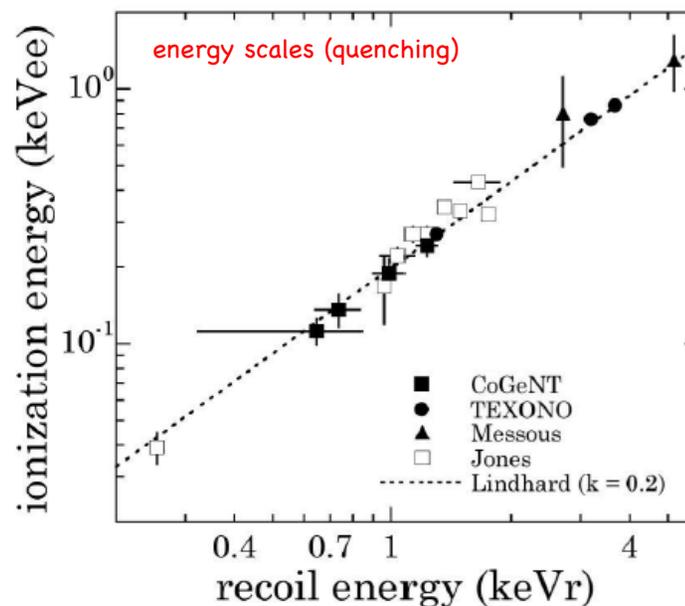
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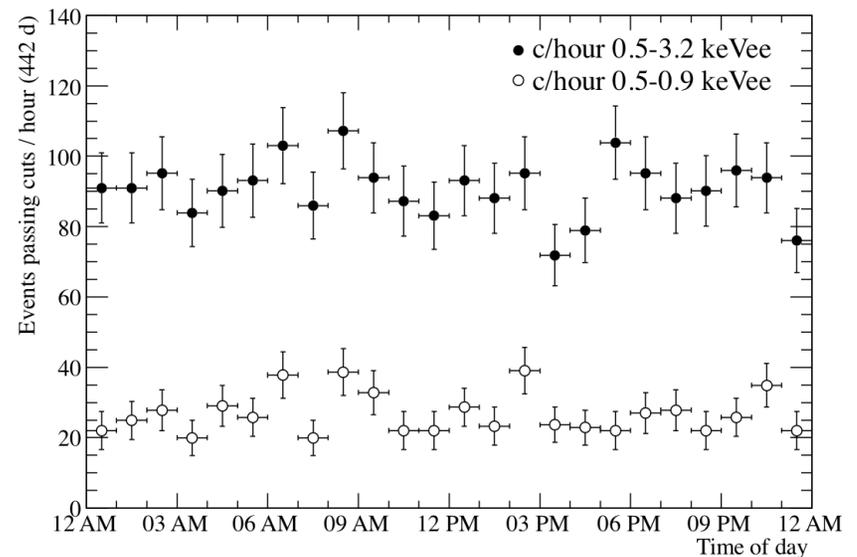
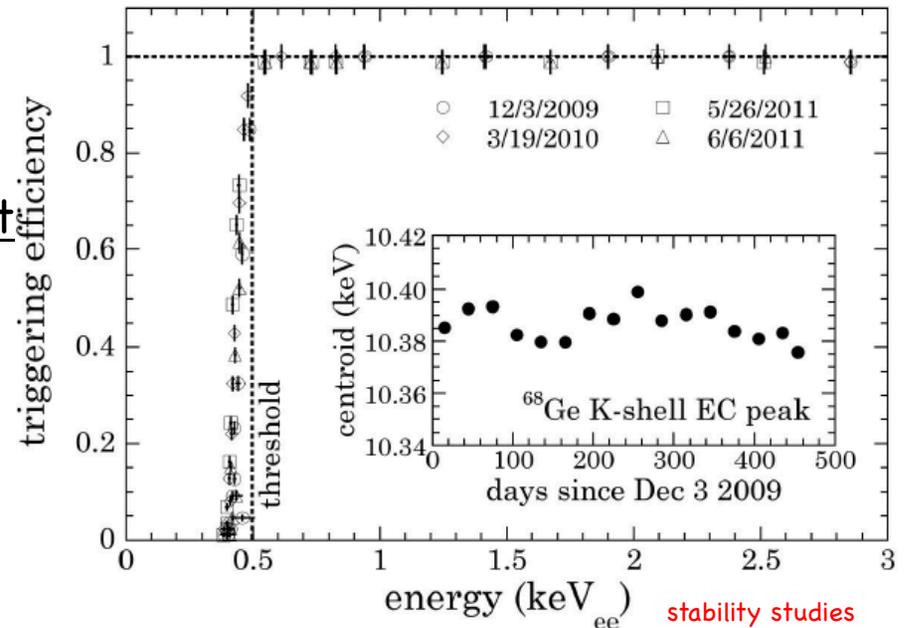
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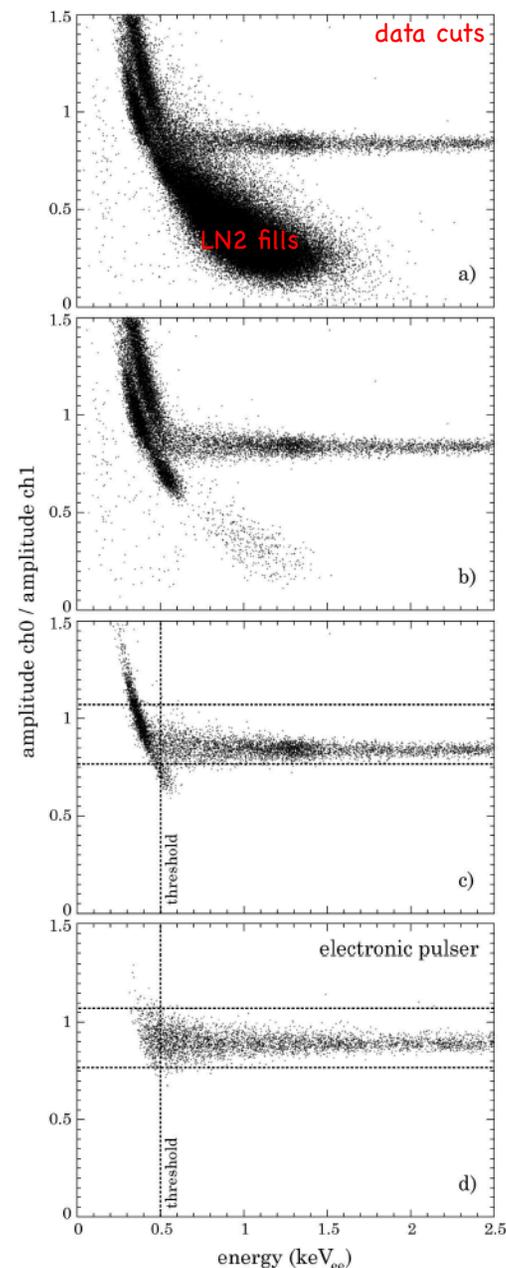
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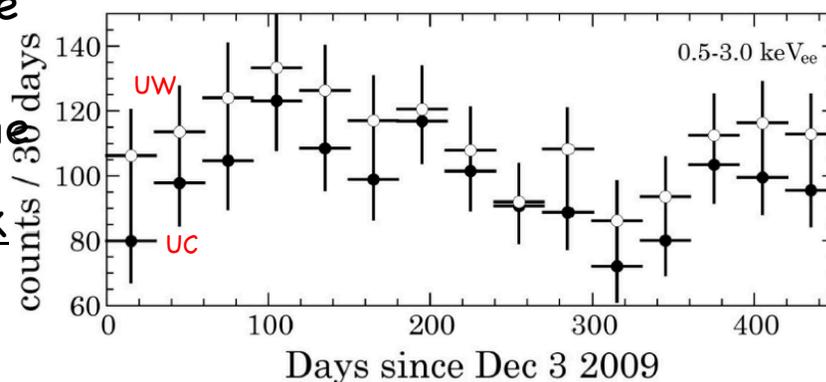
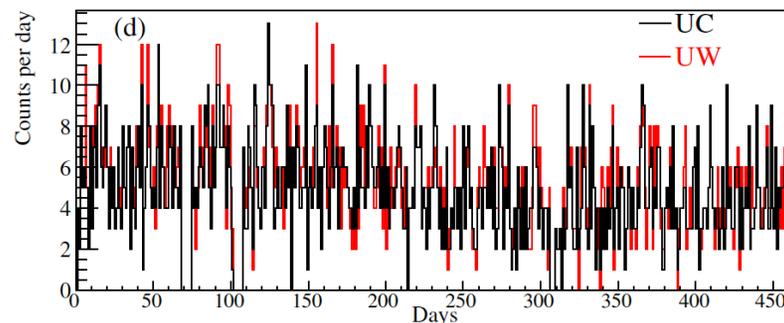
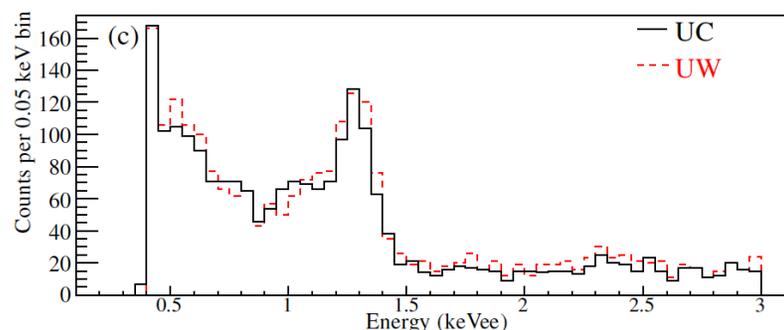
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Many mostly redundant cuts:
the only thing that can be said about the origin of CoGeNT's low-E excess with any confidence is that these are not electronic noise events.

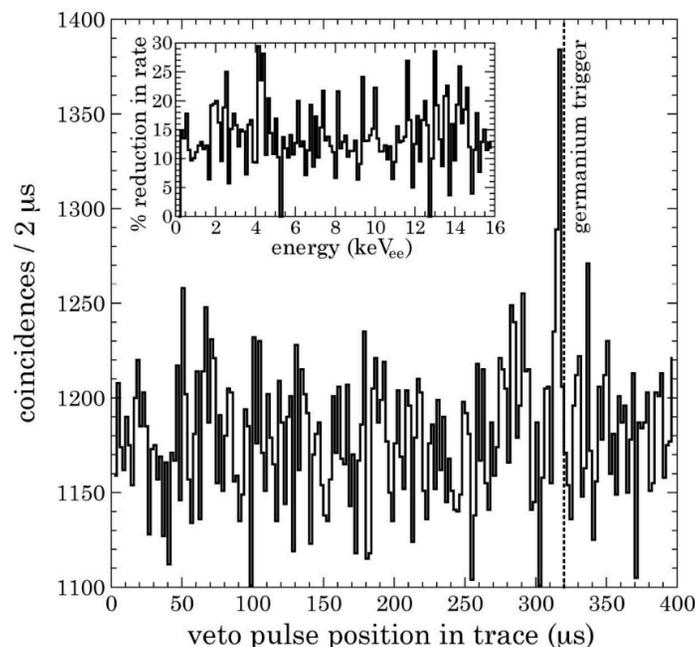
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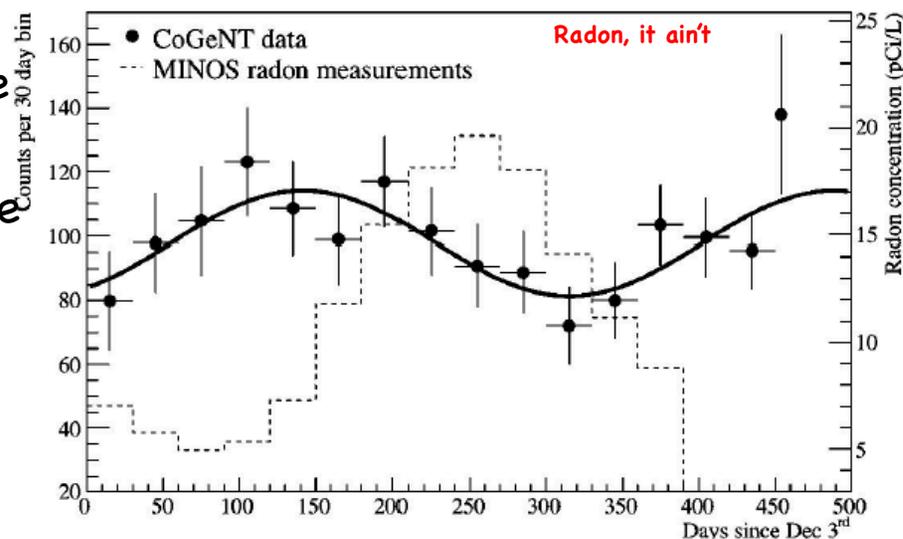


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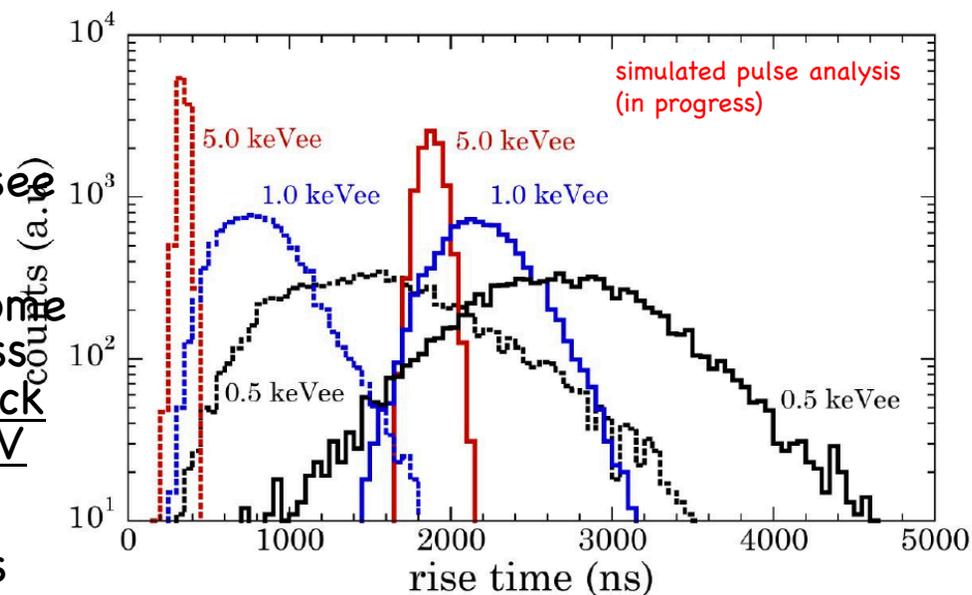
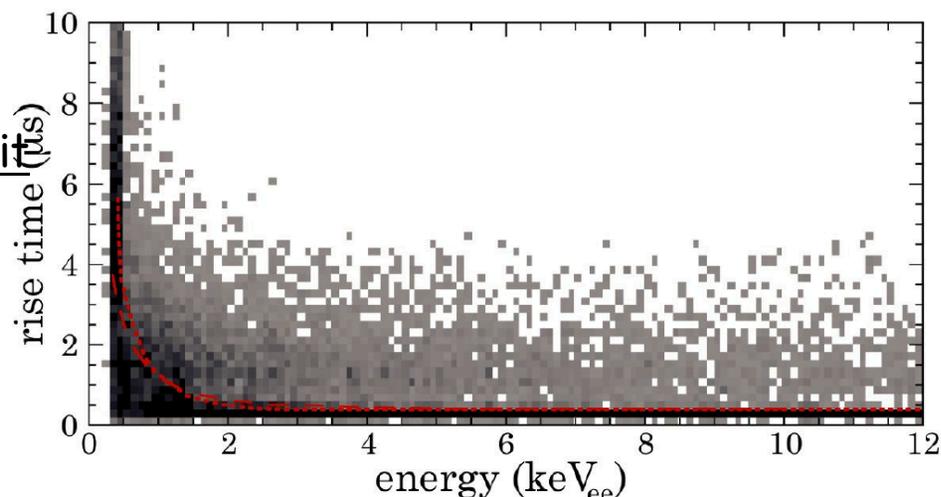


Excellent agreement between observed muon veto rate and predictions from MCNP-Polimi and GEANT



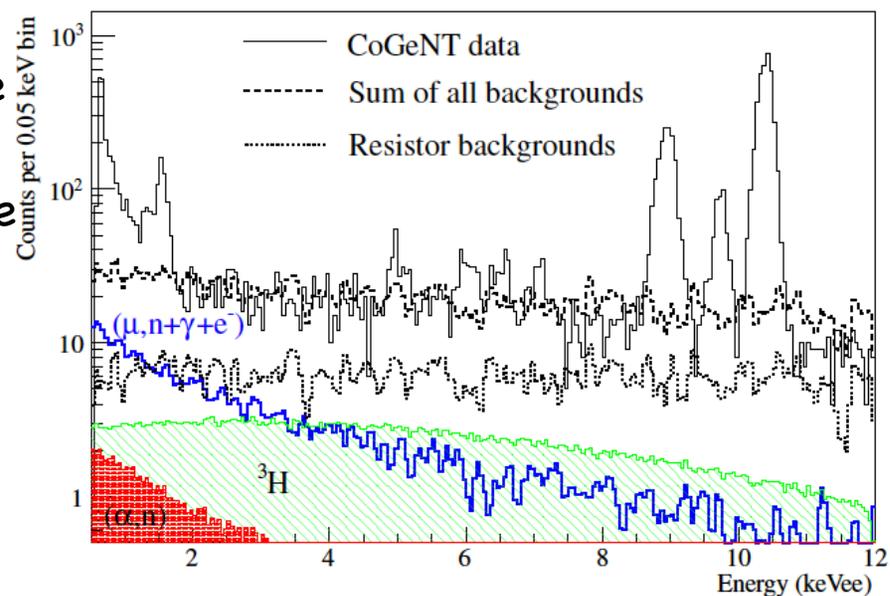
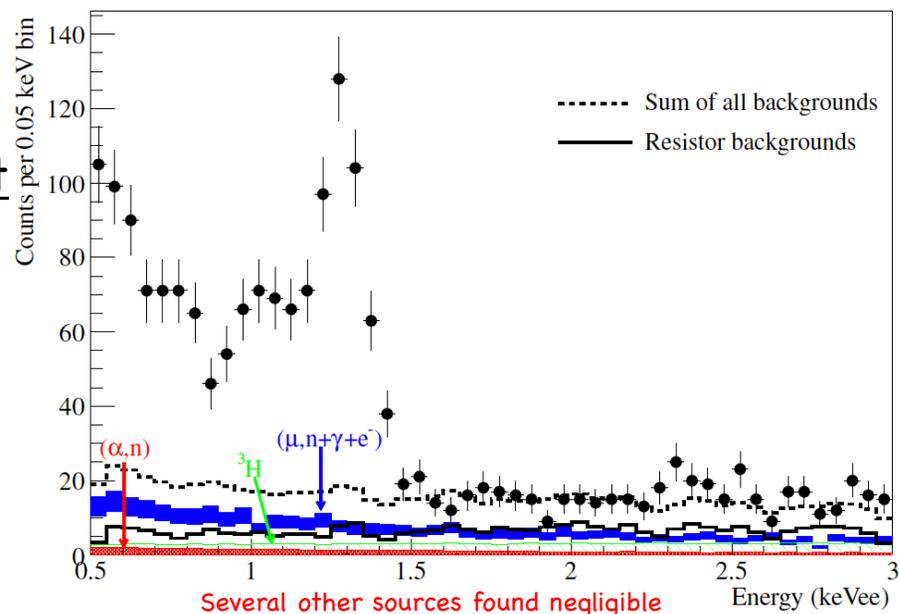
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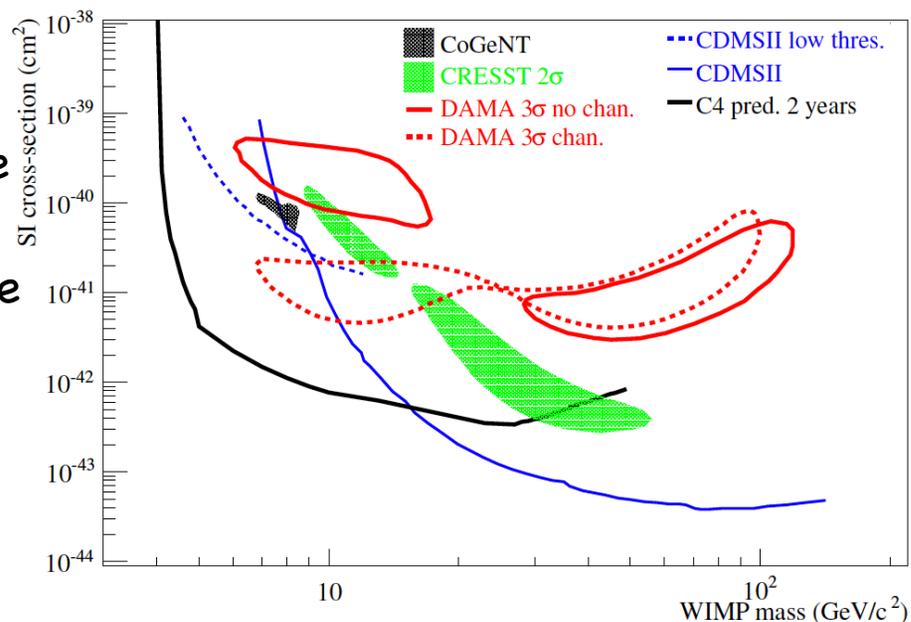
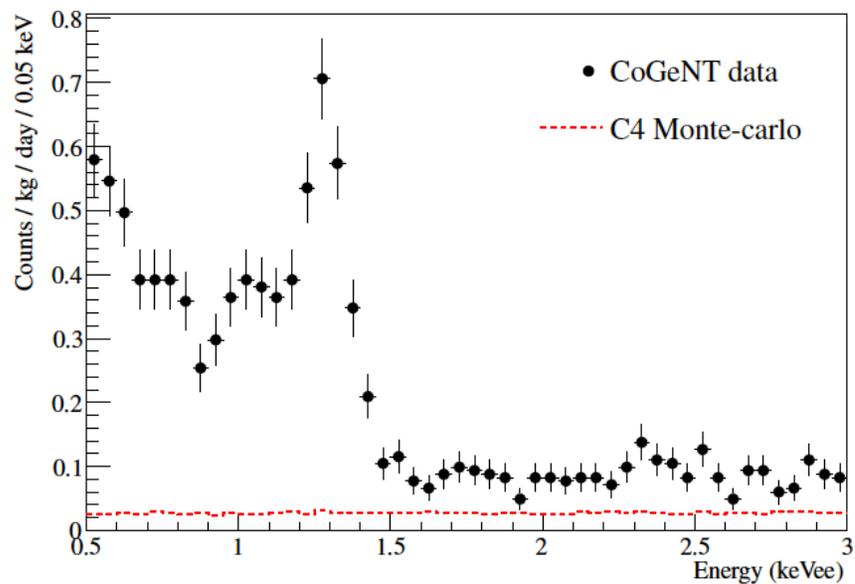
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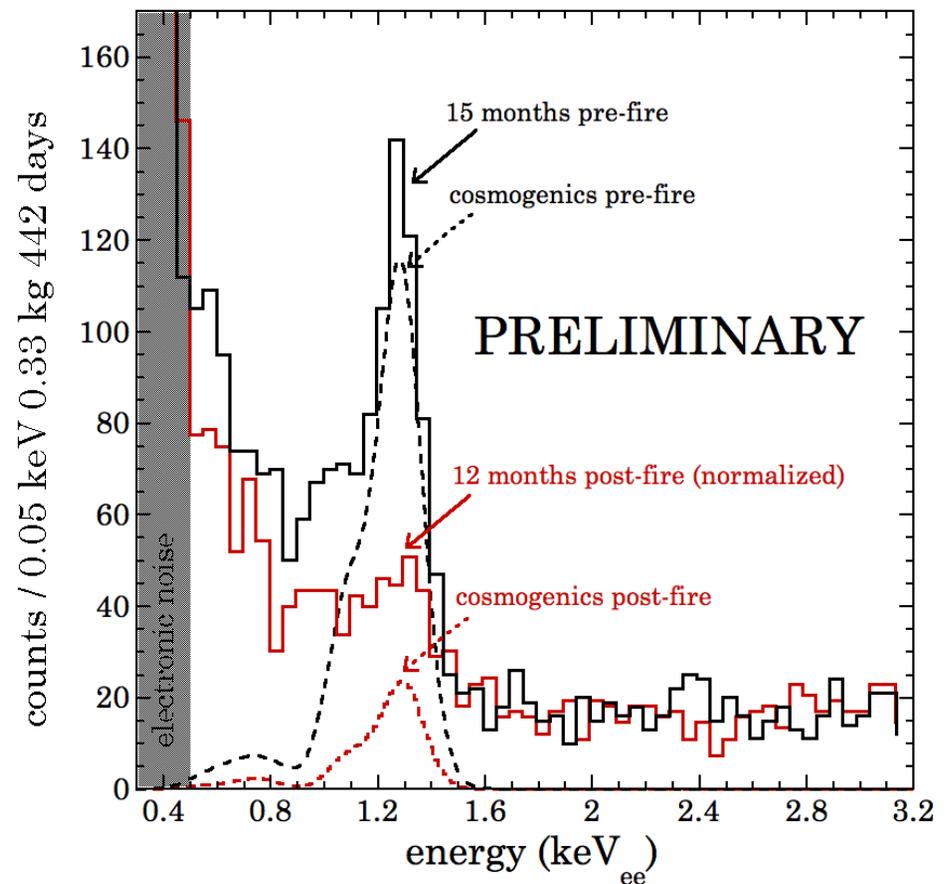
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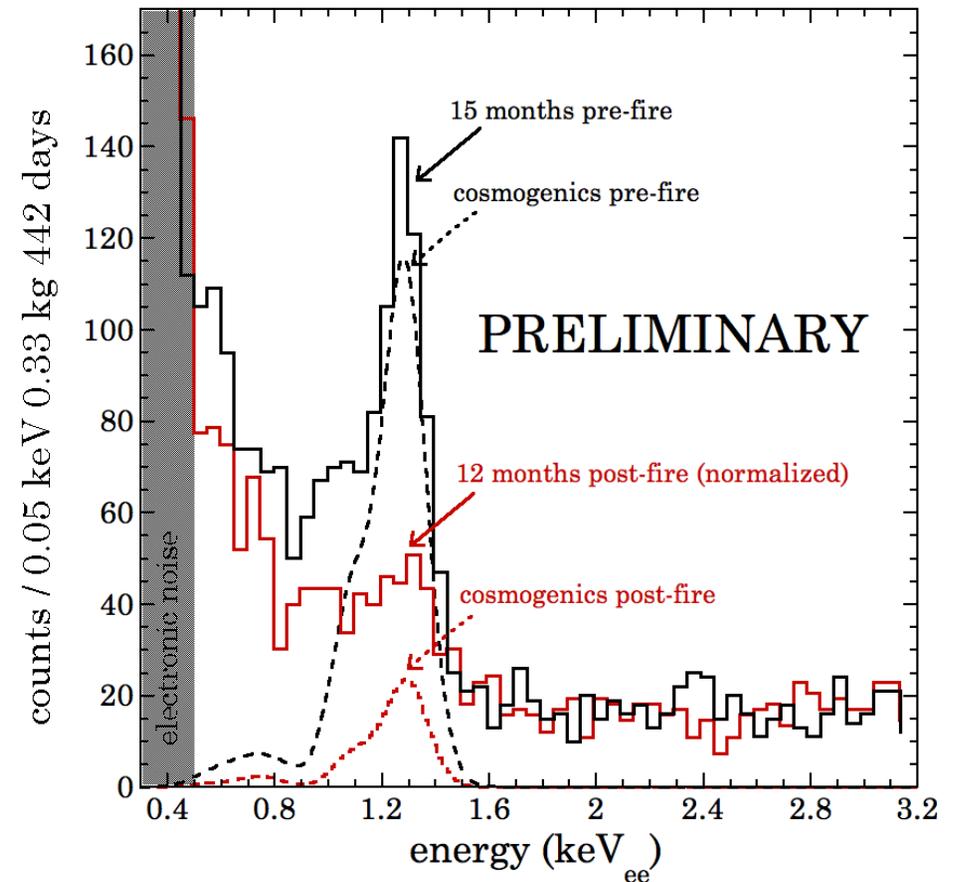
New data: sneak preview (very preliminary)

- Checking that all parameters employed in cuts have remained stable following the 3 mo. thermal cycle post-fire (we want to continue with no changes to those -cuts have been frozen from the beginning, a *de facto* blind analysis-)
- Low-energy excess still there.
- Rates look flatter on second year.
Optimist: to be expected, the modulation was too large.
Pessimist: to be expected, the modulation was a fluke.
- Cosmogenics nicely getting out of the way: the region 0.5-0.7 keV may have decayed an additional ~15% beyond what expected from these. Needs just a few more months to distinguish between a very long-lived decay there ($T_{1/2} \sim 6$ years (!?)) or initial short decay from unrejected surface events. All this can affect modulation phase a tad.
- How to treat all this new info: we are performing a sophisticated 2D (energy-time) analysis in collaboration with Matt Bellis and Chris Kelso, able to test several halo model features.

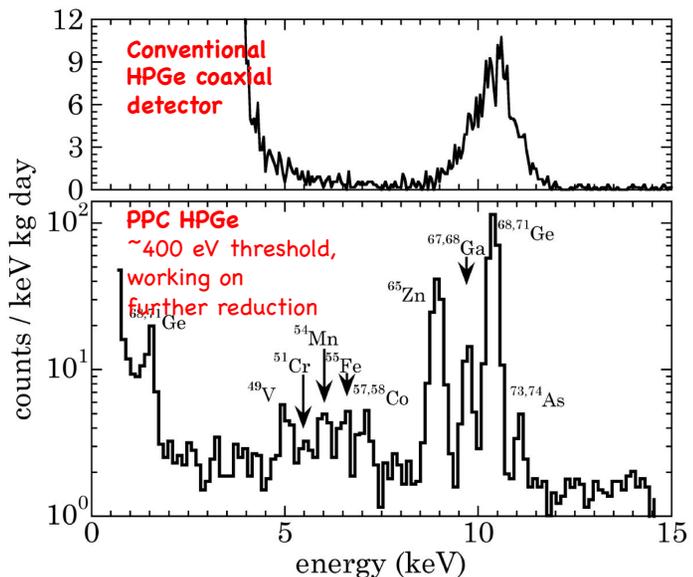


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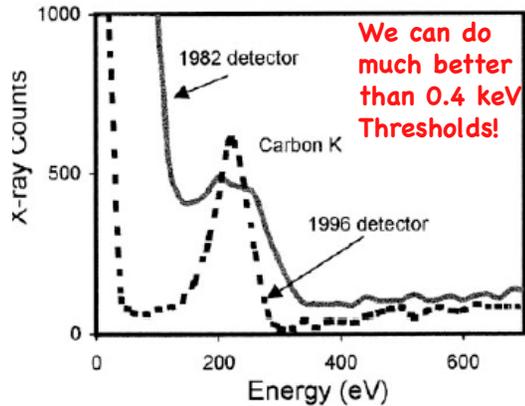
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Clear need for C-4 x10 mass,
reduced threshold and backgrounds,
if we are ever to stop chasing our tails.



State-of-the-art for ~1 pF detectors:



We can do much better than 0.4 keV Thresholds!

Present PPCs dominated by parallel-f noise:



Noise identification detective work (approximately ~2 years of cracking detectors open):

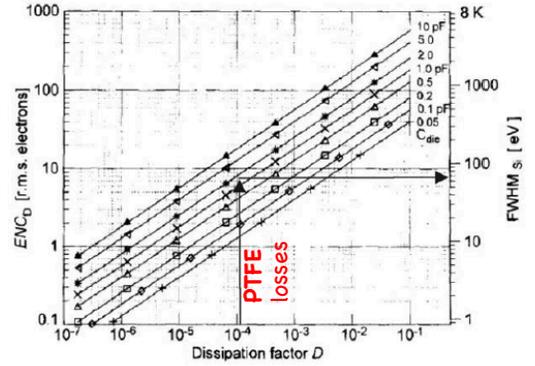
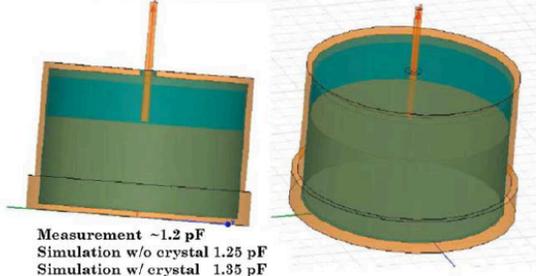
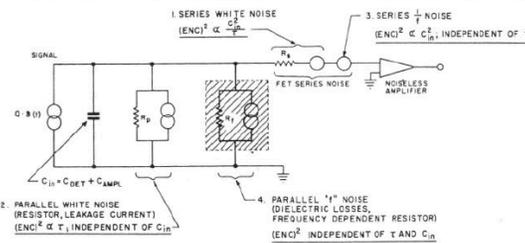
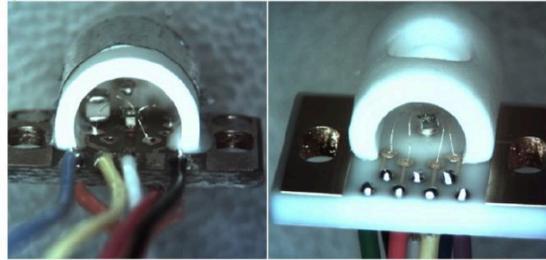
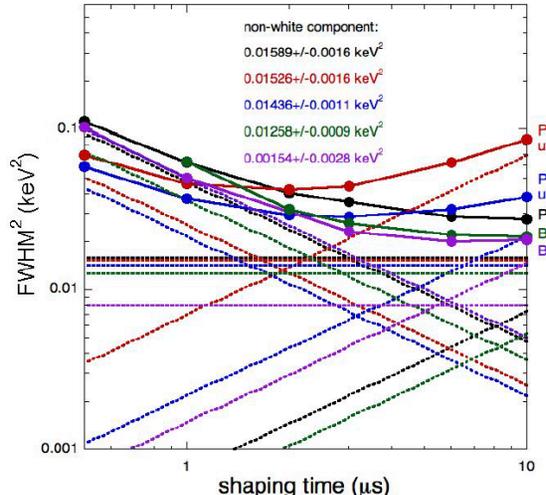
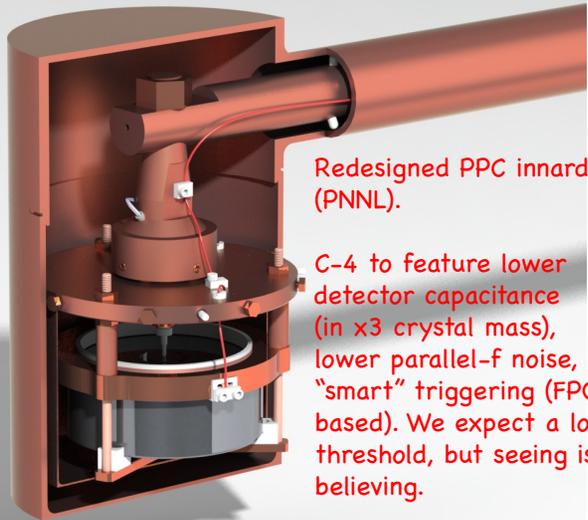


Fig. 4. Equivalent noise charge contribution due to the lossy dielectrics.

Noise abatement not dissimilar to background reduction: one layer of crap hides the next one (noise terms add in quadrature!).

FIG. 2: *Left*: Electronic noise contributions measured with a pulser, for a number of PPC detectors and their upgrades. The (flat) non-white component remained invariable up to the last attempt (BEGe-II, see text). *Right*: Top left, commercial FET package employing a sub-optimal boron nitride and PCB package, and a surface-mount feedback capacitor. The improved package on the right uses a vacuum feedback capacitor, PTFE as the single dielectric, and improved mounting of the heating resistor. This package features not only the best available measures against non-white electronic noise, but is also constructed out of radioclean materials. Bottom: schematic illustrating the origin and characteristics of several sources of electronic noise in detector systems, with “parallel-f” highlighted [12].

(all of this noise mumbo-jumbo actually checks)



Redesigned PPC innards (PNNL).

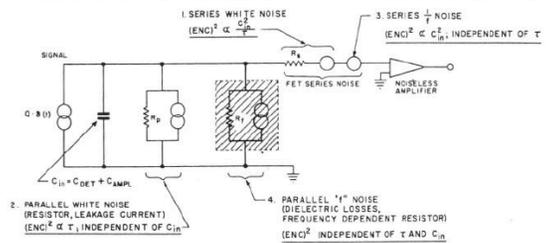
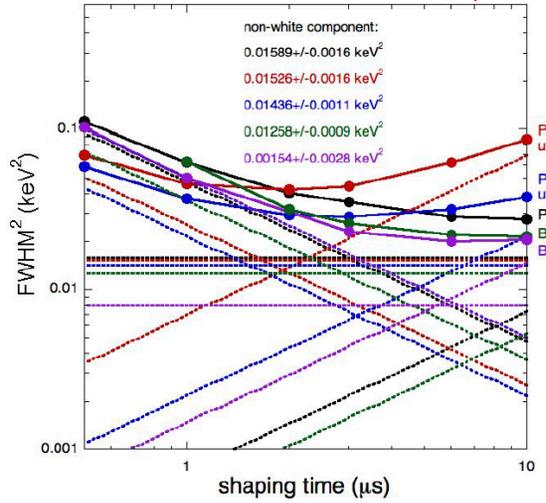
C-4 to feature lower detector capacitance (in x3 crystal mass), lower parallel-f noise, "smart" triggering (FPGA based). We expect a lower threshold, but seeing is believing.

Starting new electronics & DAQ from scratch: a must to confirm a modulation, for all experiments.



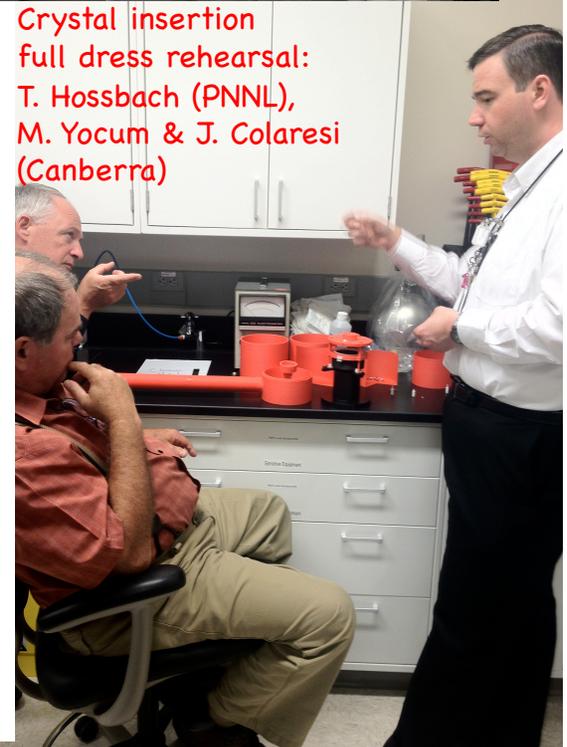
Tourist #1
Tourist #2

Taking shape:
First C-4 cryostat at PNNL



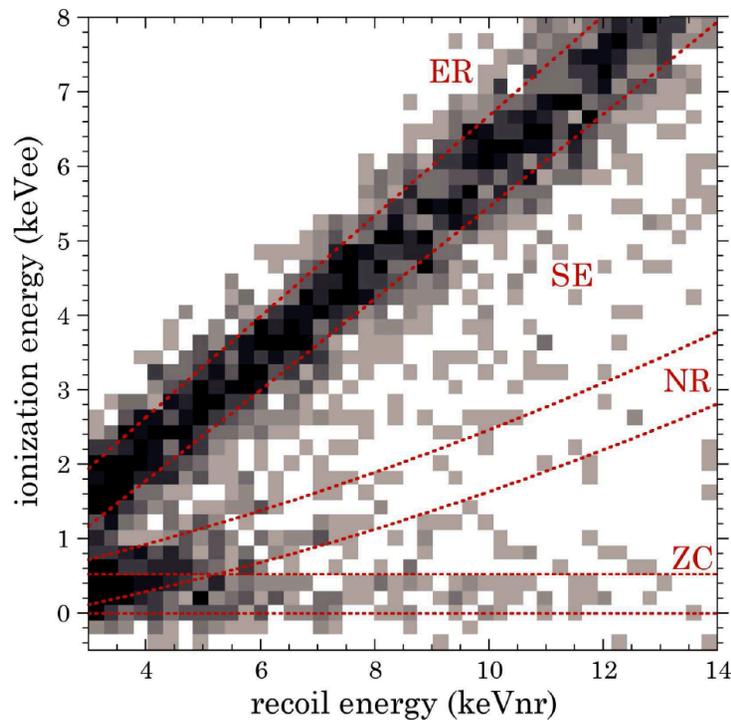
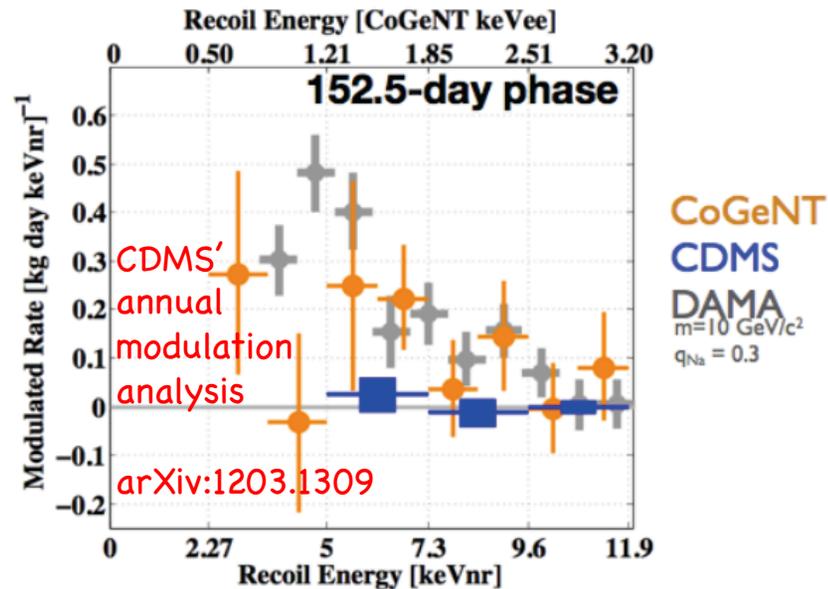
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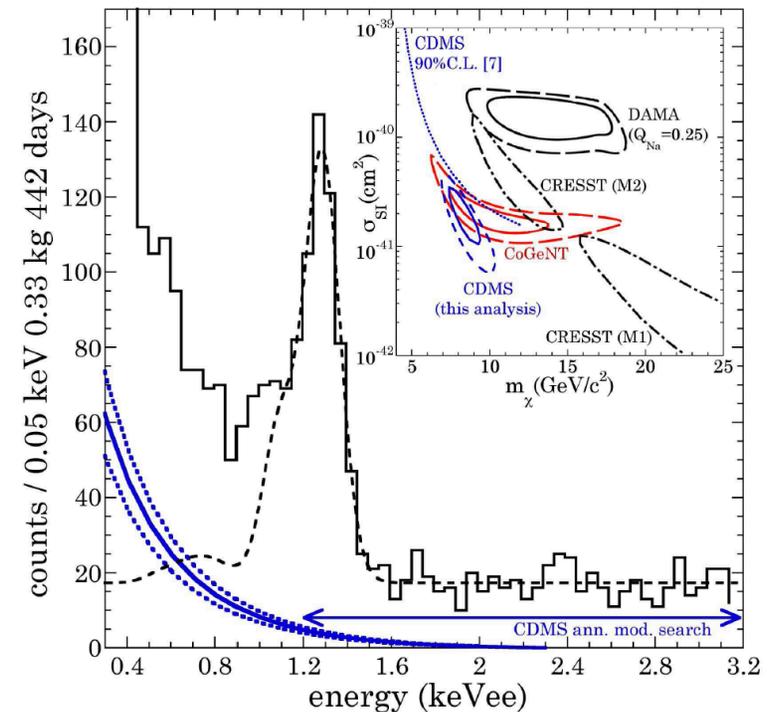
Crystal insertion full dress rehearsal: T. Hossbach (PNNL), M. Yocum & J. Colaresi (Canberra)

The light-WIMP front is not getting any less confusing

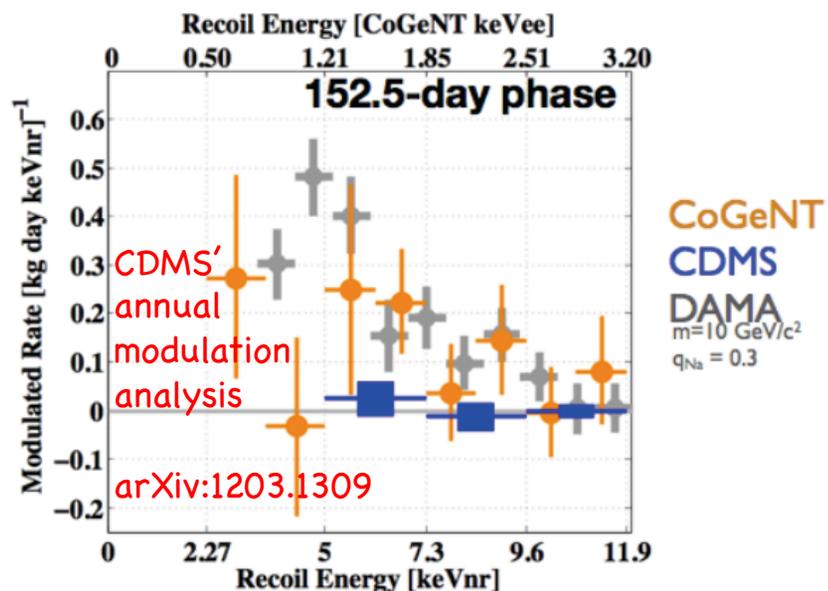


An alternative look at the same data reveals a 5.7σ excess in the NR band, beyond the reach of CDMS' ann. mod. analysis, in surprising agreement with CoGeNT.

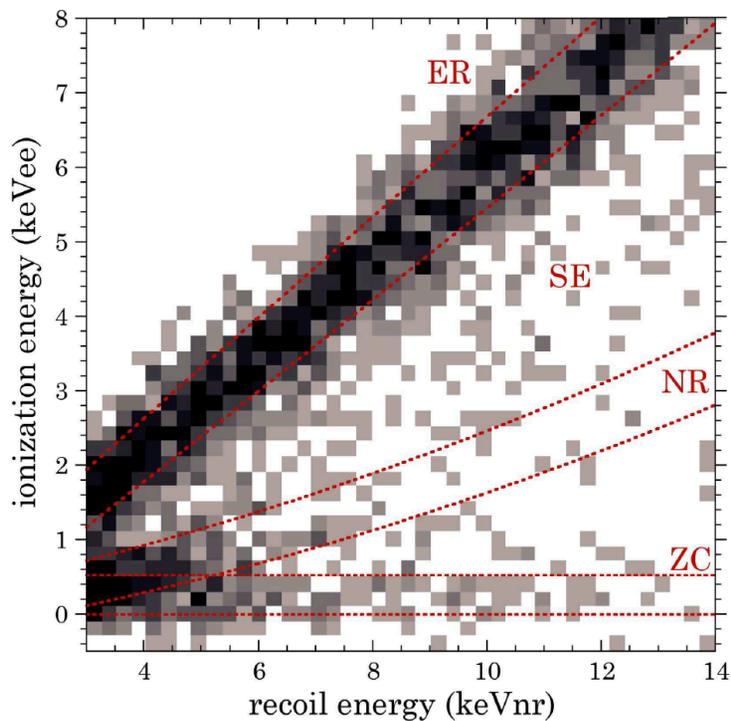
arXiv:1204.3559 (see N. Fields talk yesterday)



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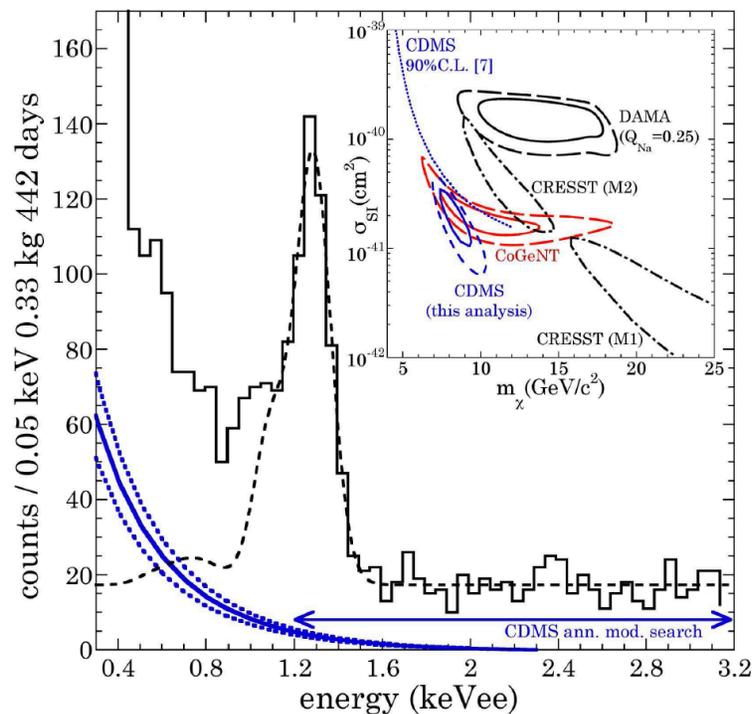


Just when I thought I was out...they pull me back in.



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arXiv:1204.3559
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“À la guerre comme à la guerre”

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CDMS Q&A, yesterday's afternoon funfest:

- “No, we never looked at the data from the eight detectors overlapped”
- “No, we never performed an annual modulation search at lower energy”

(Third time I get the same replies, from different CDMS speakers)

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> Subject: Radon variation at Soudan

Orthogonal axis:

> As I mentioned at the meeting yesterday, Radon concentrations also vary seasonally (and also daily) at Soudan. Our own measurements (figure attached) use a well-calibrated sensitive instrument (Rad7), but our sampling has not been thorough enough to pin down the phase accurately. MINOS has been using a less precise instrument, but they have kept it automatically sampling every hour since Nov 2007 (only partly overlapping our data sets). It is clear that the Radon seasonal variation has a phase that drifts somewhat between early August and early September, and that the curve is not purely sinusoidal. If this is the cause of the variation [REDACTED] sees in our low threshold NR region, it should show up more clearly when we look at ER's. Both we and Cogent do have Radon purges, but it is possible that neither is quite good enough.

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“All is fair in love and war”

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- “No, we never performed an annual modulation search at lower energy”

(Third time I get the same replies, from different CDMS speakers)

> From: [REDACTED]
> Date: Thu, 12 May 2011 10:14:04 -0500
> To: [REDACTED]
> Cc: CDMS Analysis <cdms_analysis@fnal.gov>
> Subject: Radon variation at Soudan

Orthogonal axis:

> As I mentioned at the meeting yesterday, Radon concentrations also vary seasonally (and also daily) at Soudan. Our own measurements (figure attached) use a well-calibrated sensitive instrument (Rad7), but our sampling has not been thorough enough to pin down the phase accurately. MINOS has been using a less precise instrument, but they have kept it automatically sampling every hour since Nov 2007 (only partly overlapping our data sets). It is clear that the Radon seasonal variation has a phase that drifts somewhat between early August and early September, and that the curve is not purely sinusoidal. If this is the cause of the variation [REDACTED] sees in our low threshold NR region, it should show up more clearly when we look at ER's. Both we and Cogent do have Radon purges, but it is possible that neither is quite good enough.

That is a remarkably taut ship, but I worry about the values we are instilling in our students, and the general (mental) health of this field.

“All is fair in love and war”

“À la guerre comme à la guerre”

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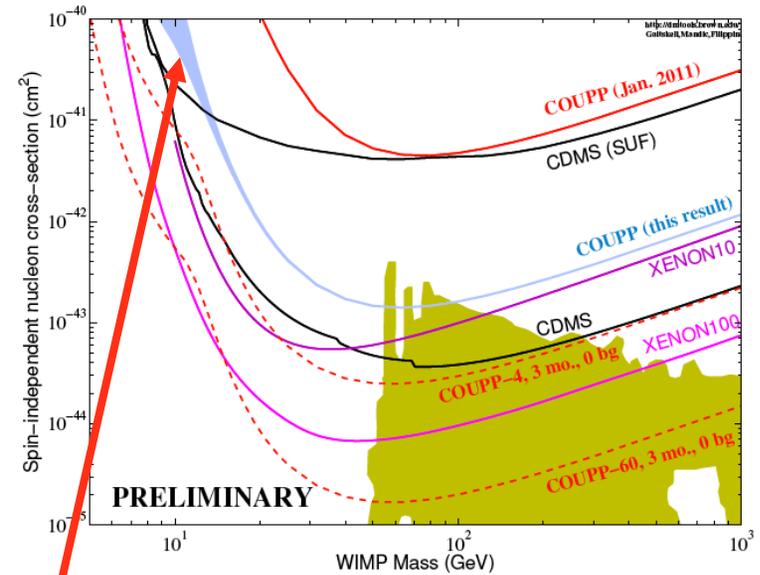
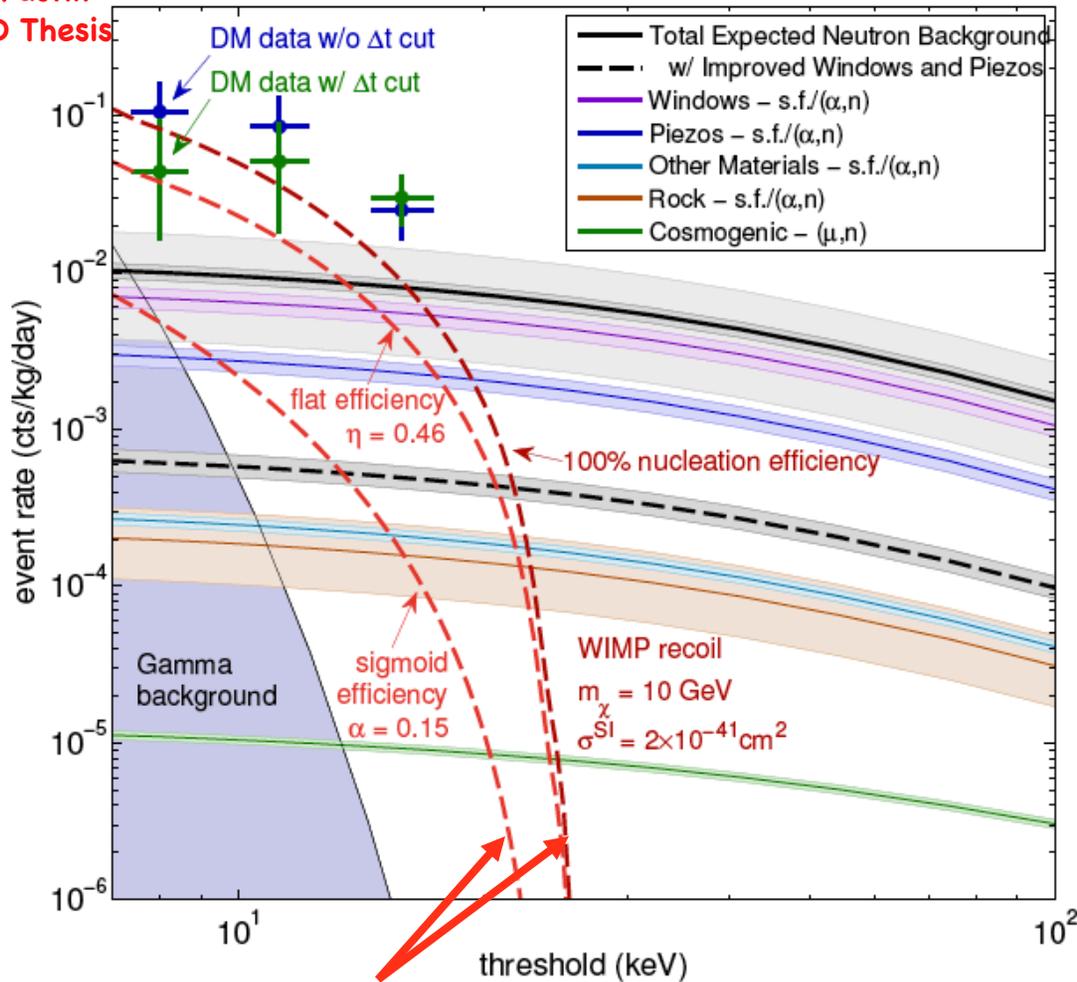
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Experimentalists should strive to reduce uncertainties (as opposed to living off of them)

D. Fustin
PhD Thesis

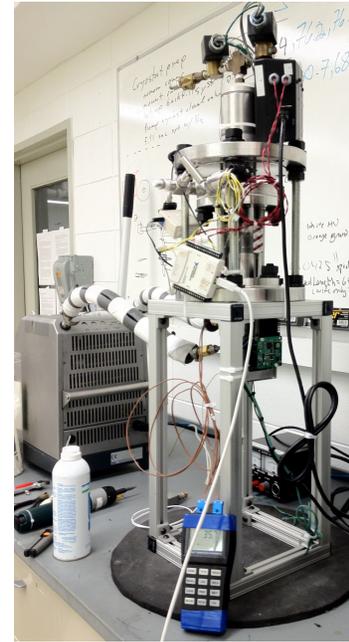
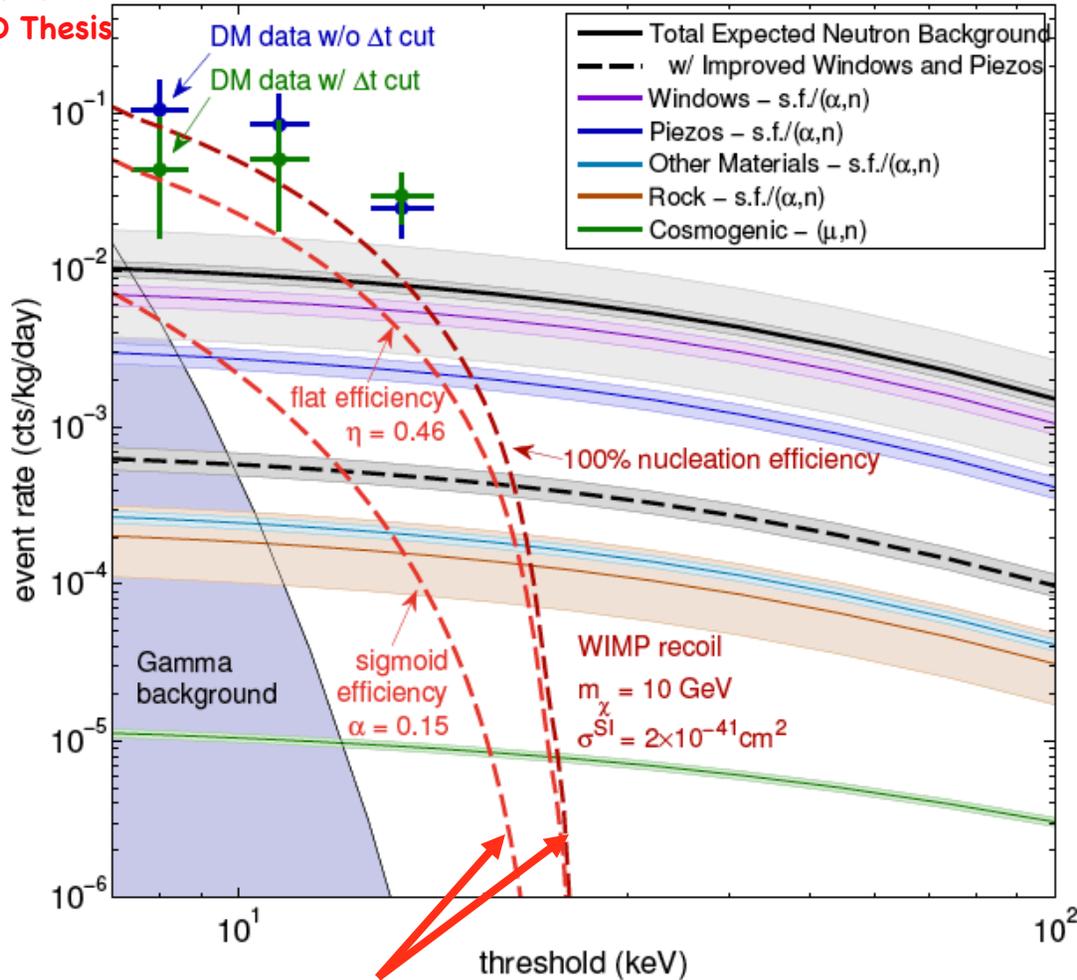


Six months ago we could not distinguish between these three possibilities (for low-E recoils, within COUPP).

Rational solution: design a relevant calibration. In the mean time, account for uncertainty.

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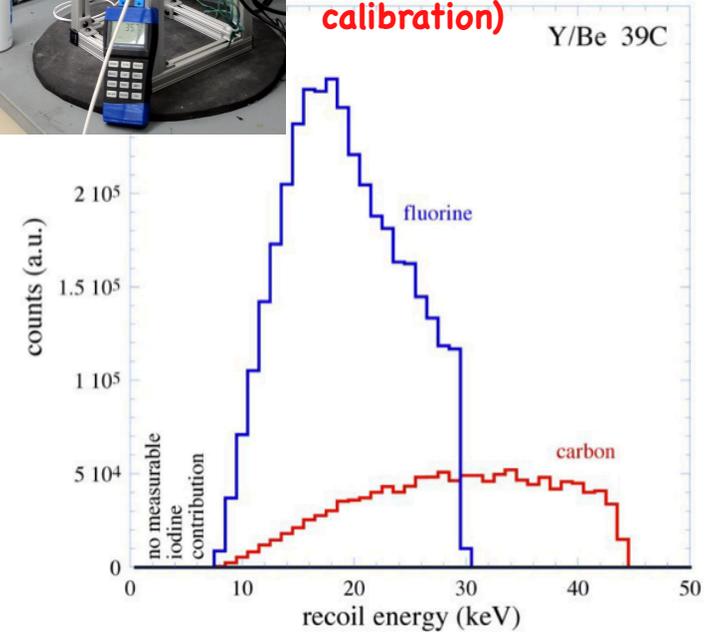
D. Fustin
PhD Thesis



Y-88/Be
breaks the impasse.

Now we know which
curve is correct.

See COUPP talk
by A. Robinson
(also H. Lippincott's on
additional CIRTE
calibration)



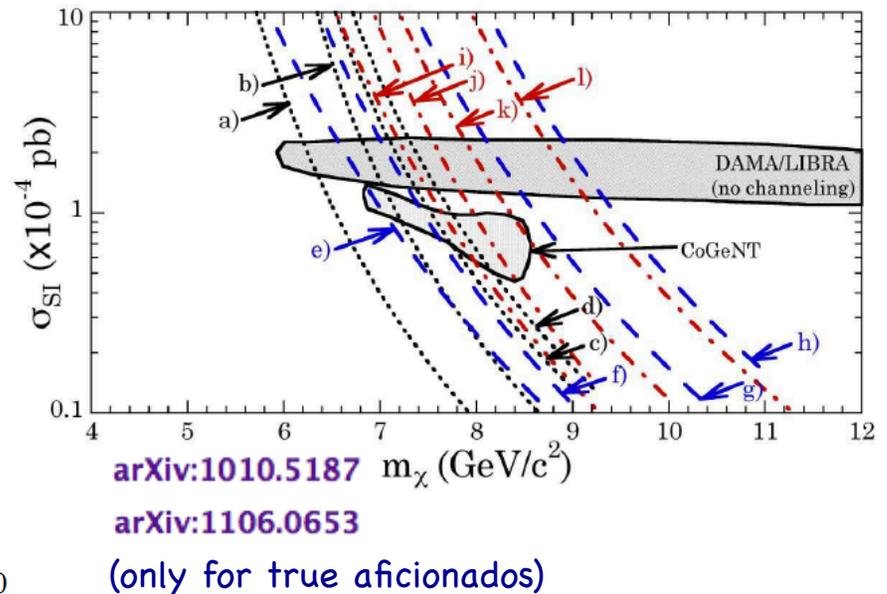
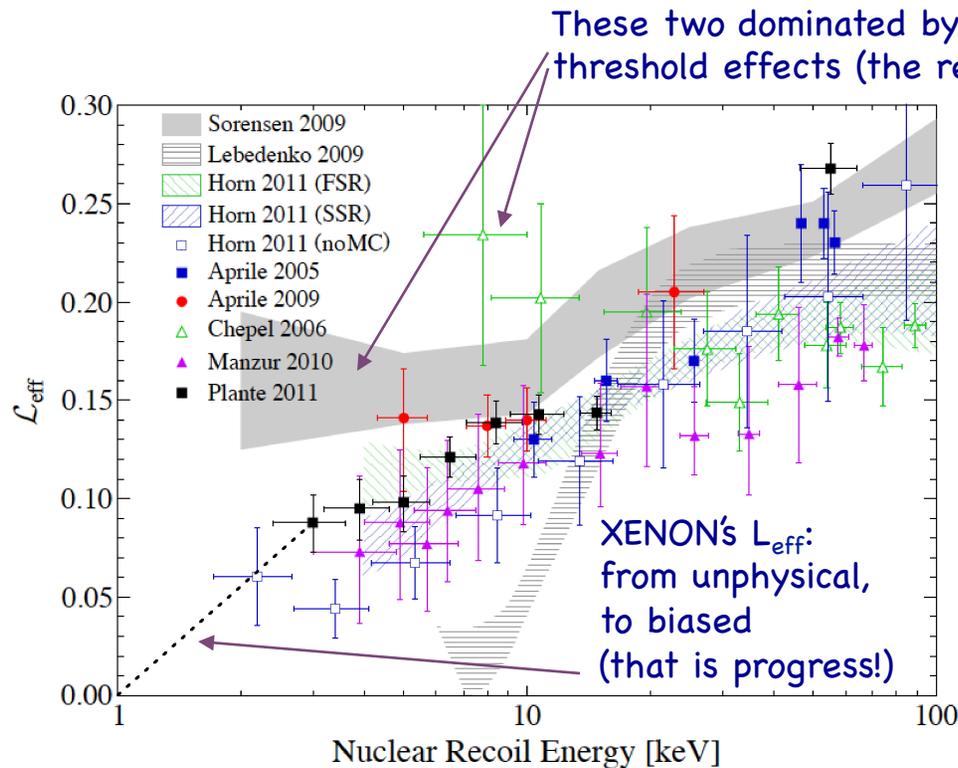
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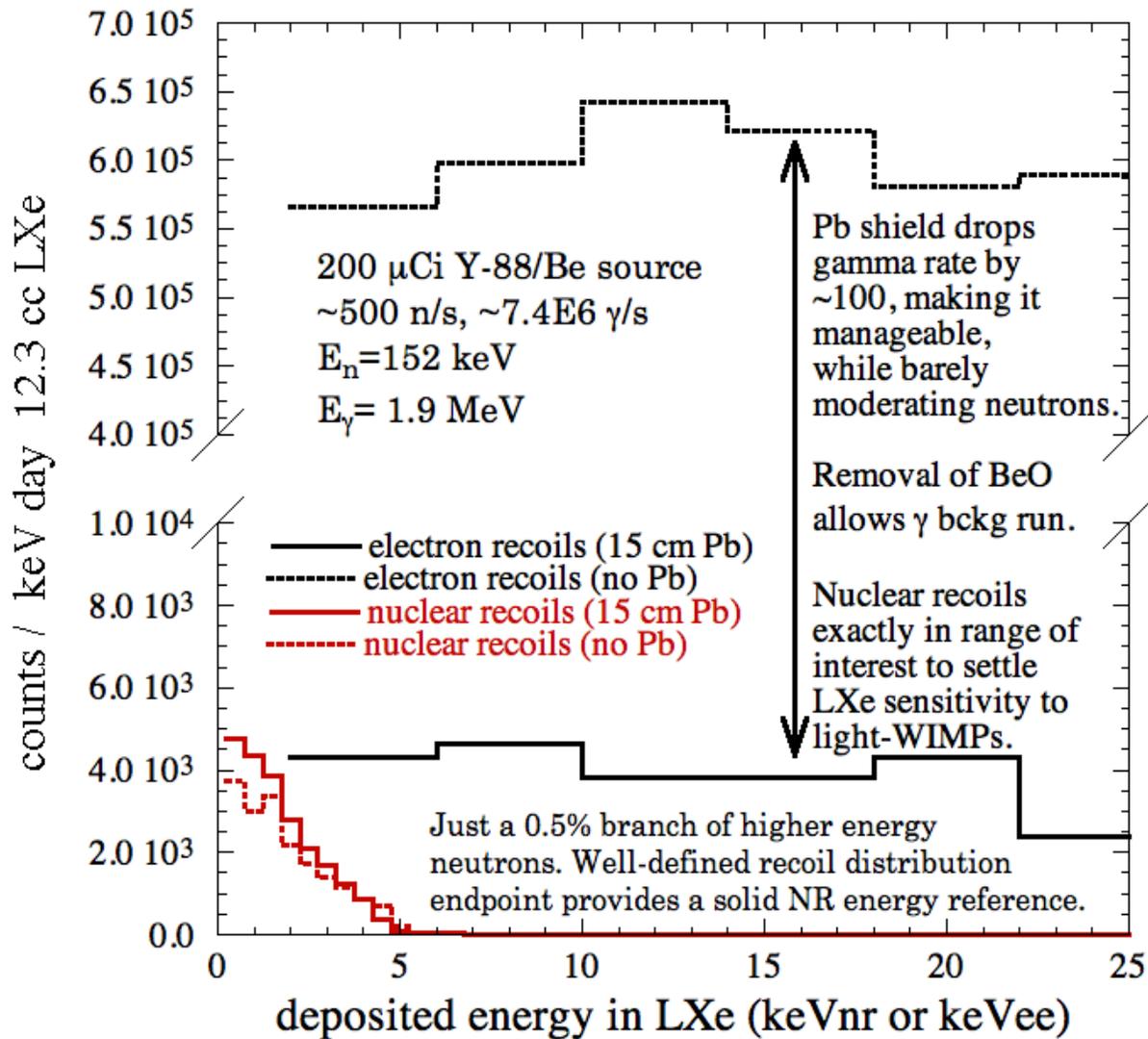
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Two groups in this room:

- Those who take XENON100 low-mass limits at face value.
 - Those who are aware of the assumptions and choices made to arrive at them (and notice what those two events right at threshold may mean within that context).
- NB: NR and ER separation actually *improves* in LXe at low-E.



A challenge to XENON-100:

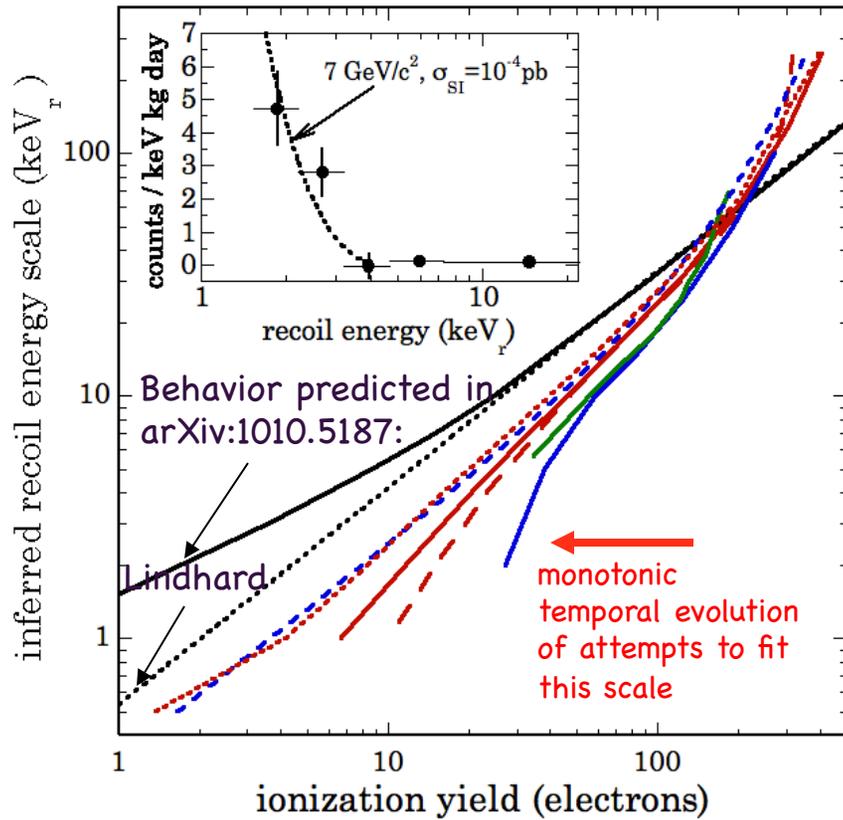


Perform a (shielded) Y-88/Be calibration *in situ* and tell us what you see (or don't see)

(notice differences with a bubble chamber, where P and T are the only instrumental effects that can affect response, allowing use of a small calibration device)

Let's settle this question once for all.

It won't be for a lack of ways to calibrate LXe at low energy:

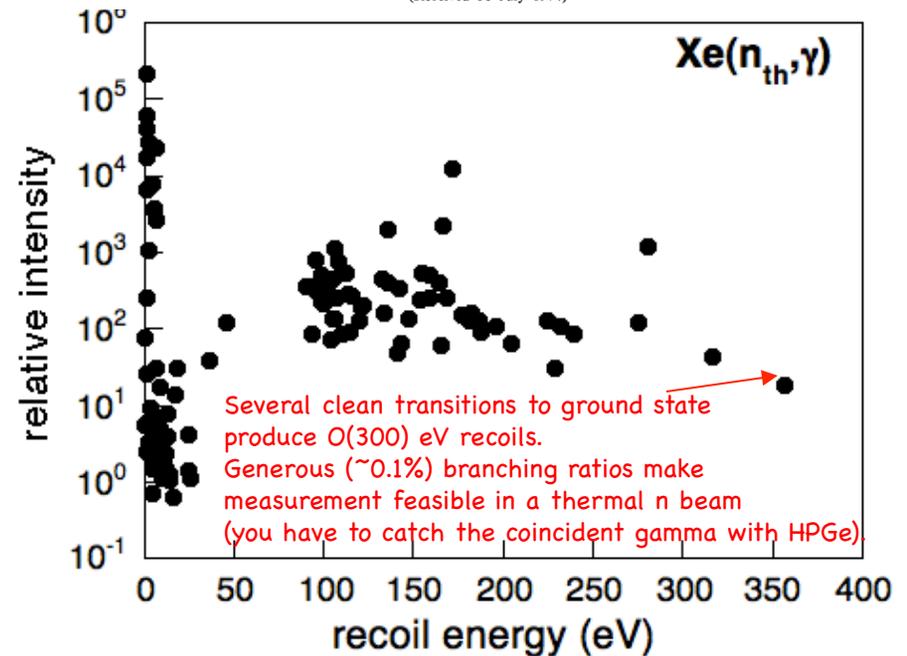


Xenon is one of the few targets favorable to use of an old calibration method, ideal to measure low-E trend of S2 scale:

PHYSICAL REVIEW A VOLUME 11, NUMBER 4 APRIL 1975

Energy lost to ionization by 254-eV ^{73}Ge atoms stopping in Ge^\dagger

K. W. Jones and H. W. Kraner
Brookhaven National Laboratory, Upton, New York 11973
(Received 30 July 1974)



XENON10 S2 conundrum: an additional ~ 1 keV shift in E scale turns a “robust exclusion” into “evidence” for a light-WIMP.

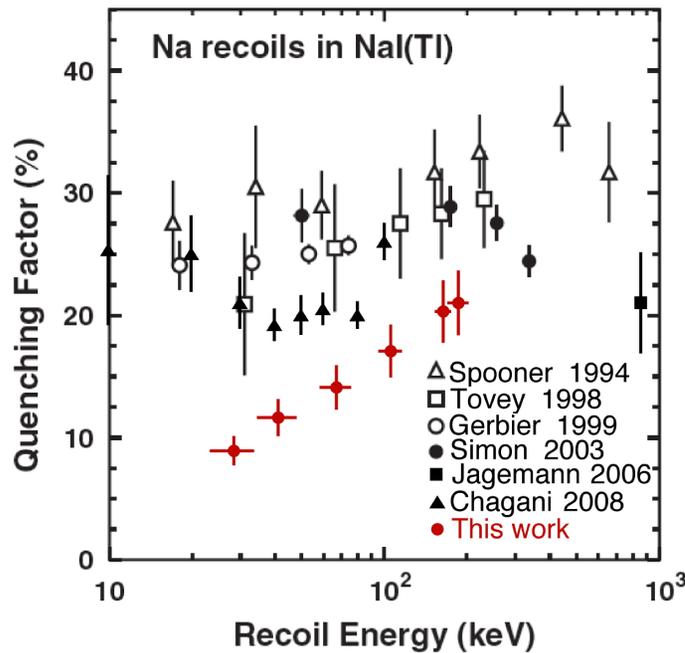
Similar approach generates CDMS’ deviant quenching factor (isolated in that respect for Ge, see N. Field’s talk)... an indicator of its reliability.

To finalize:

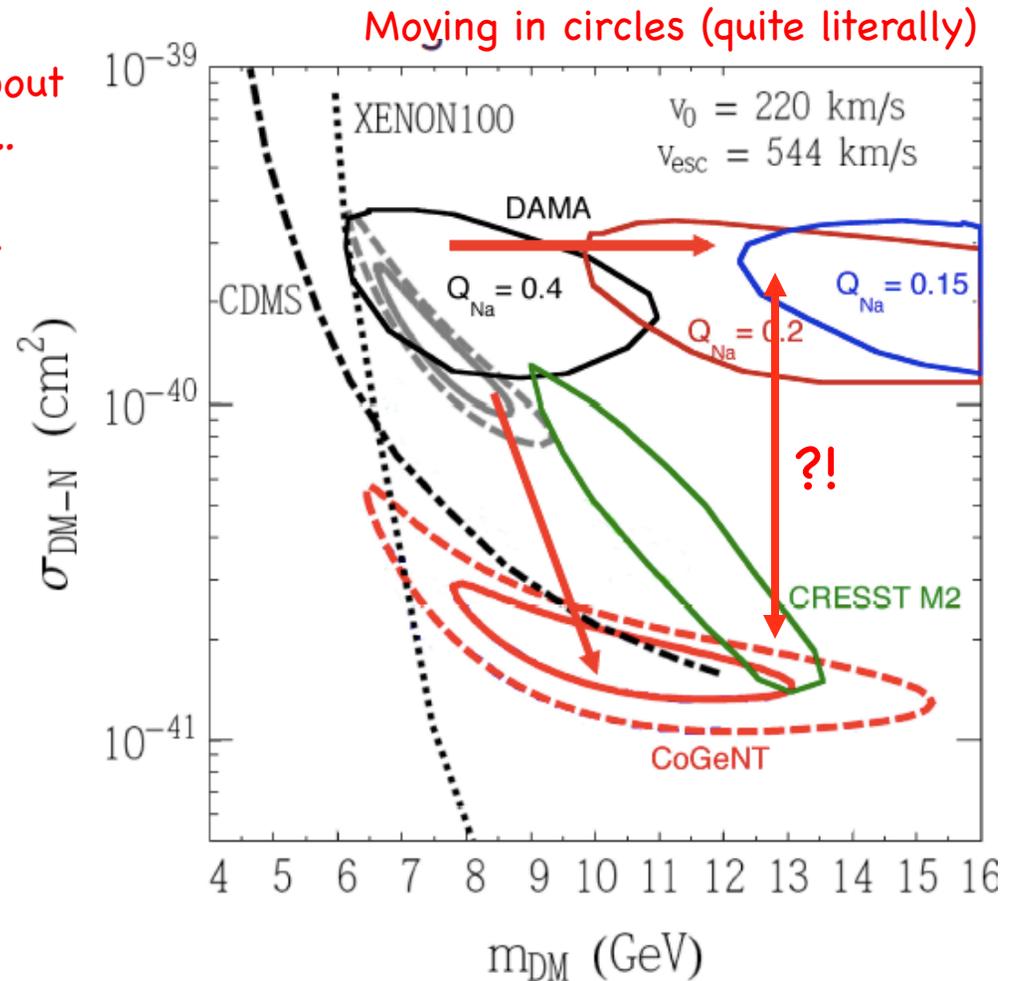
Strictly from the point of view of radiation detection, this speaker does not know how to reconcile DAMA, CoGeNT and CRESST:

Either we are to learn something subtle about the halo, couplings, or detector effects, or...

their observations have nothing in common.



Finally, in preparation
(also absence of channeling)



May we know *something* with
any certainty by IDM2014

(& let us play fair
in the mean time)