DAMIC: Dark Matter Search using thick CCDs

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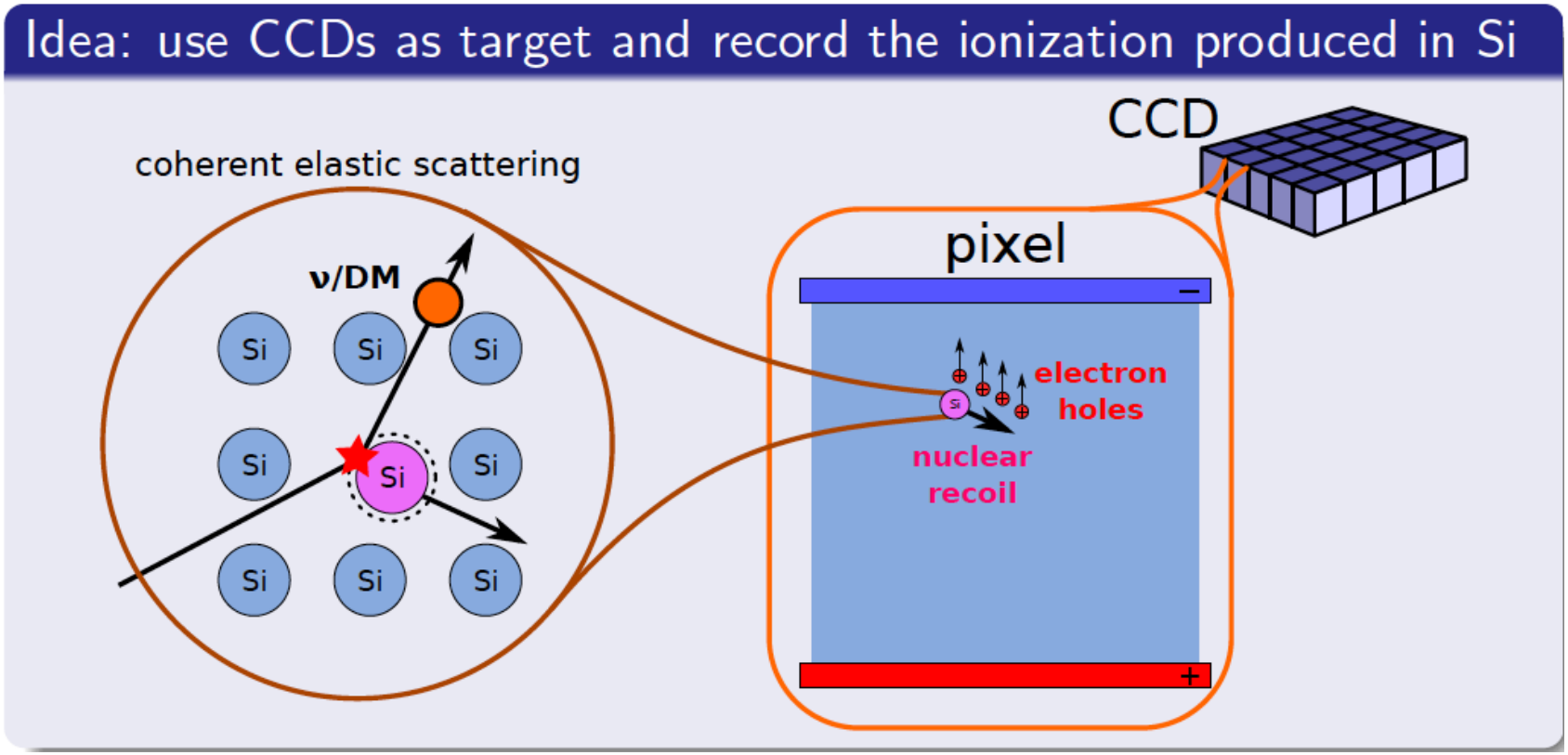
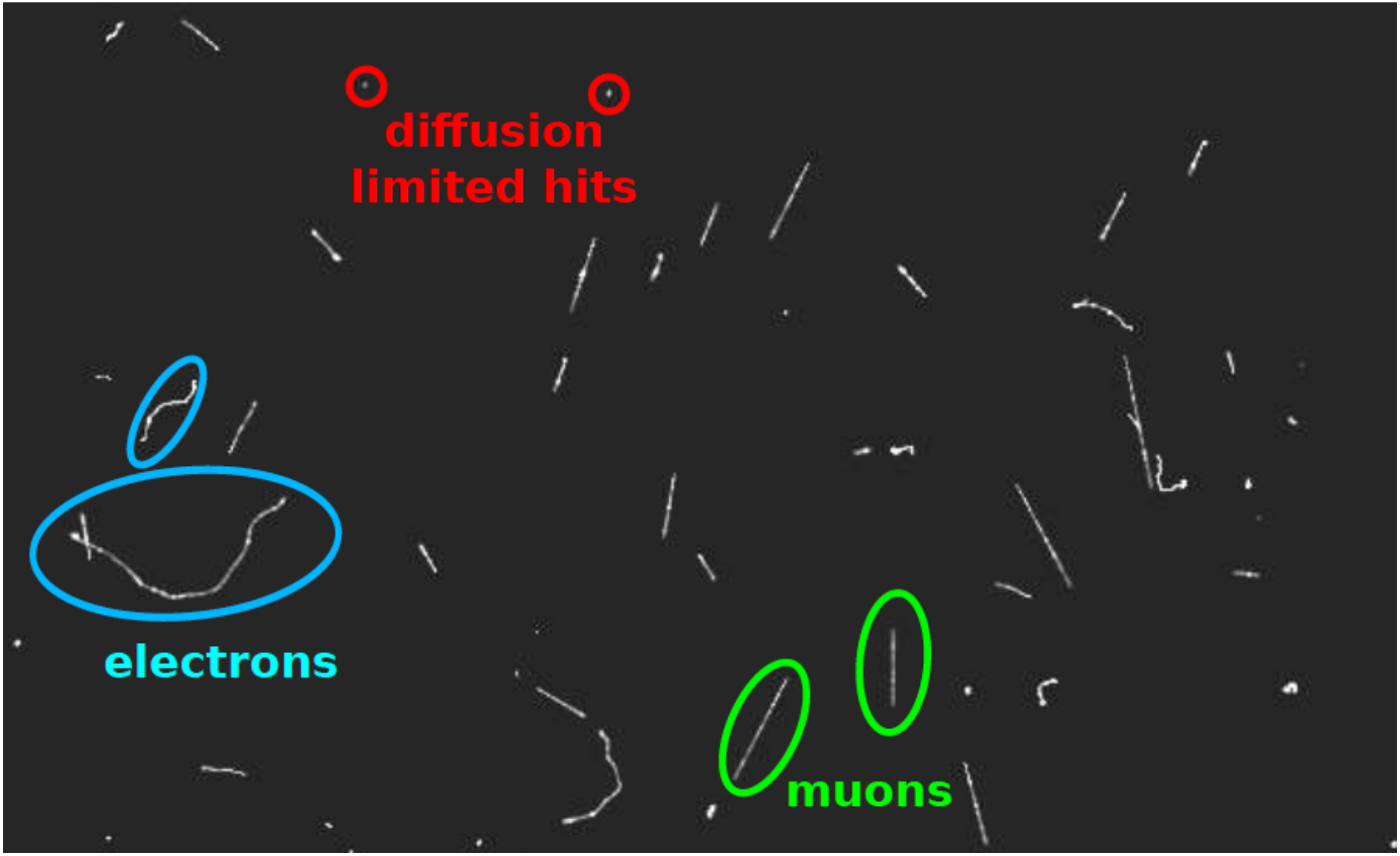
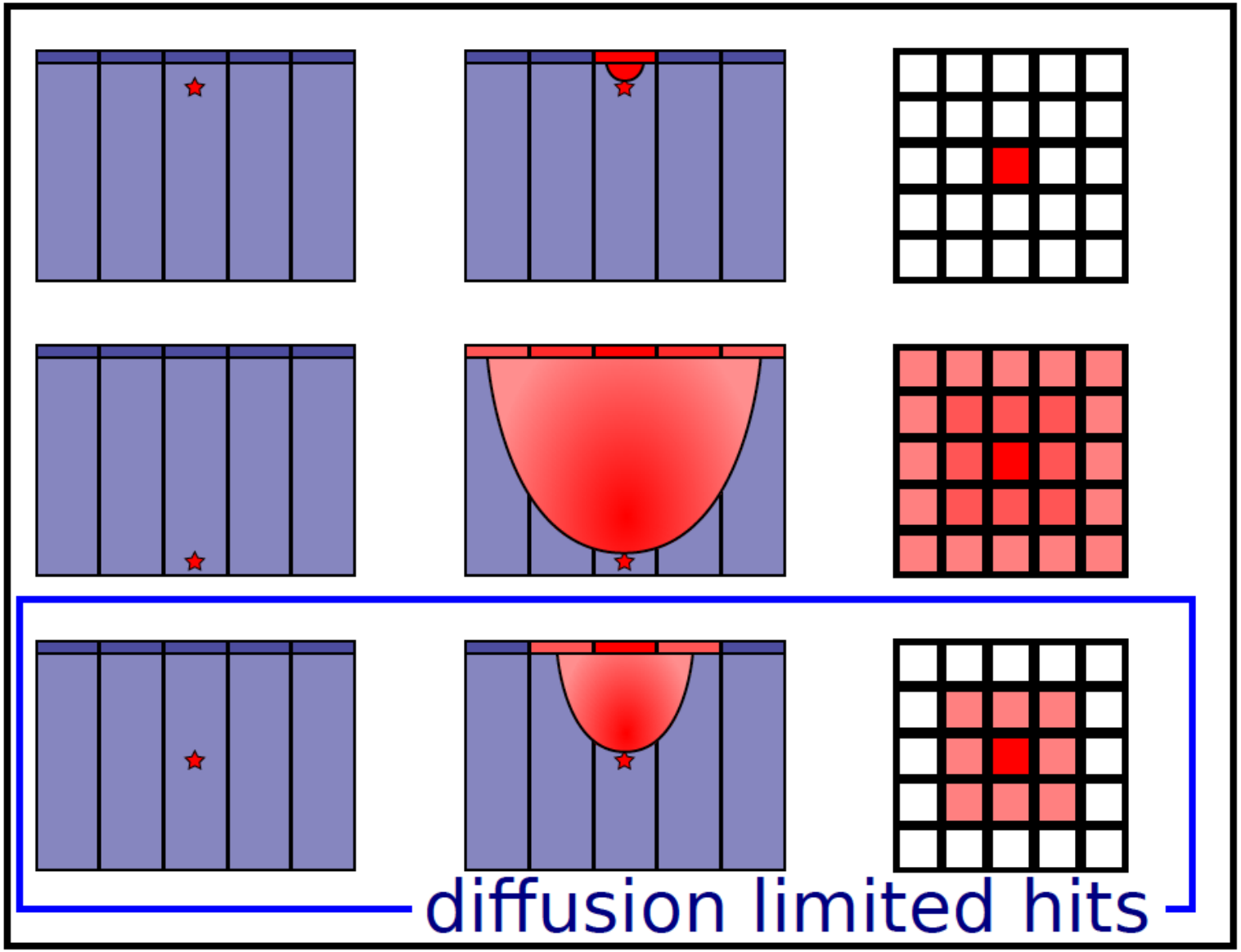
For the DAMIC Collaboration





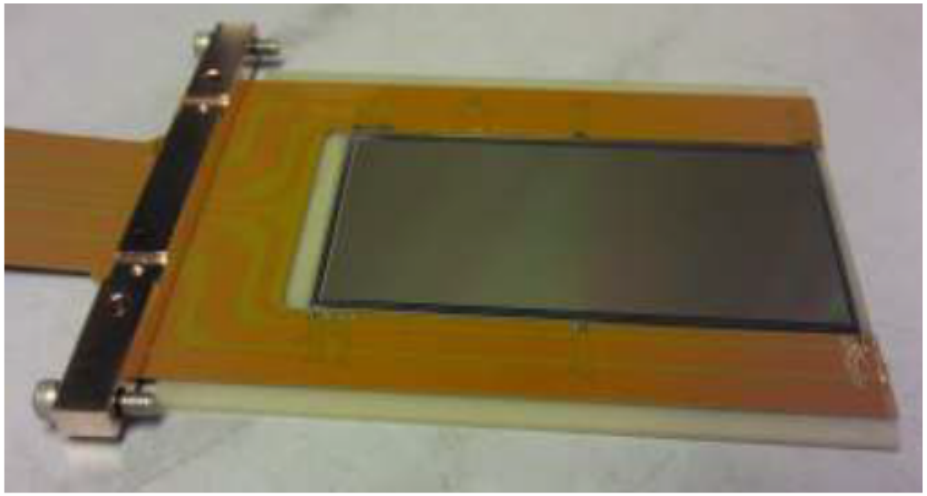
Particle ID in CCDs

Self shielding: X-ray look like nuclear recoils (small), but they are on the edge of the detector.



We use scientific CCDs from DECam

- 10x thicker than most CCDs (250 μm)
  - $\sim$1 gr per CCD
  - allows selection of limited diffusion events: *self-shielding*
- pixel size of 15 μm
- CCDs cooled to -150 C to achieve RMS of 2 e^-
- Threshold of 40 eVee

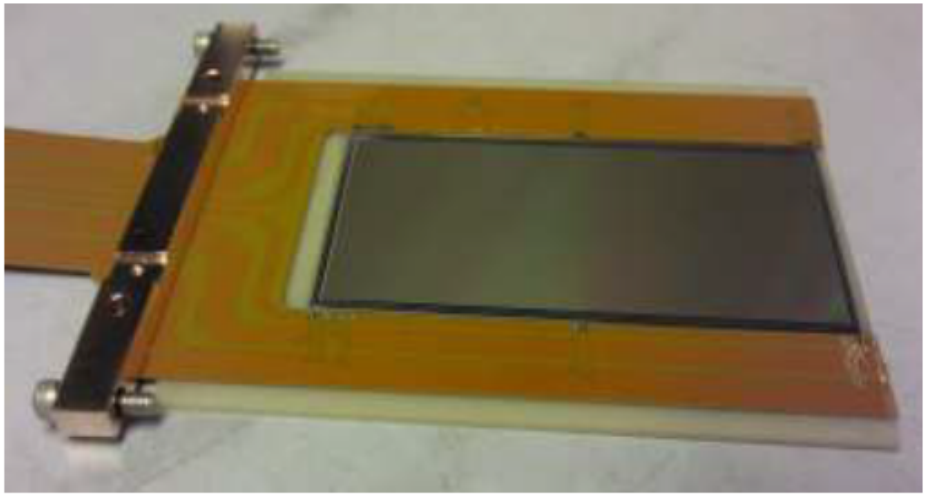


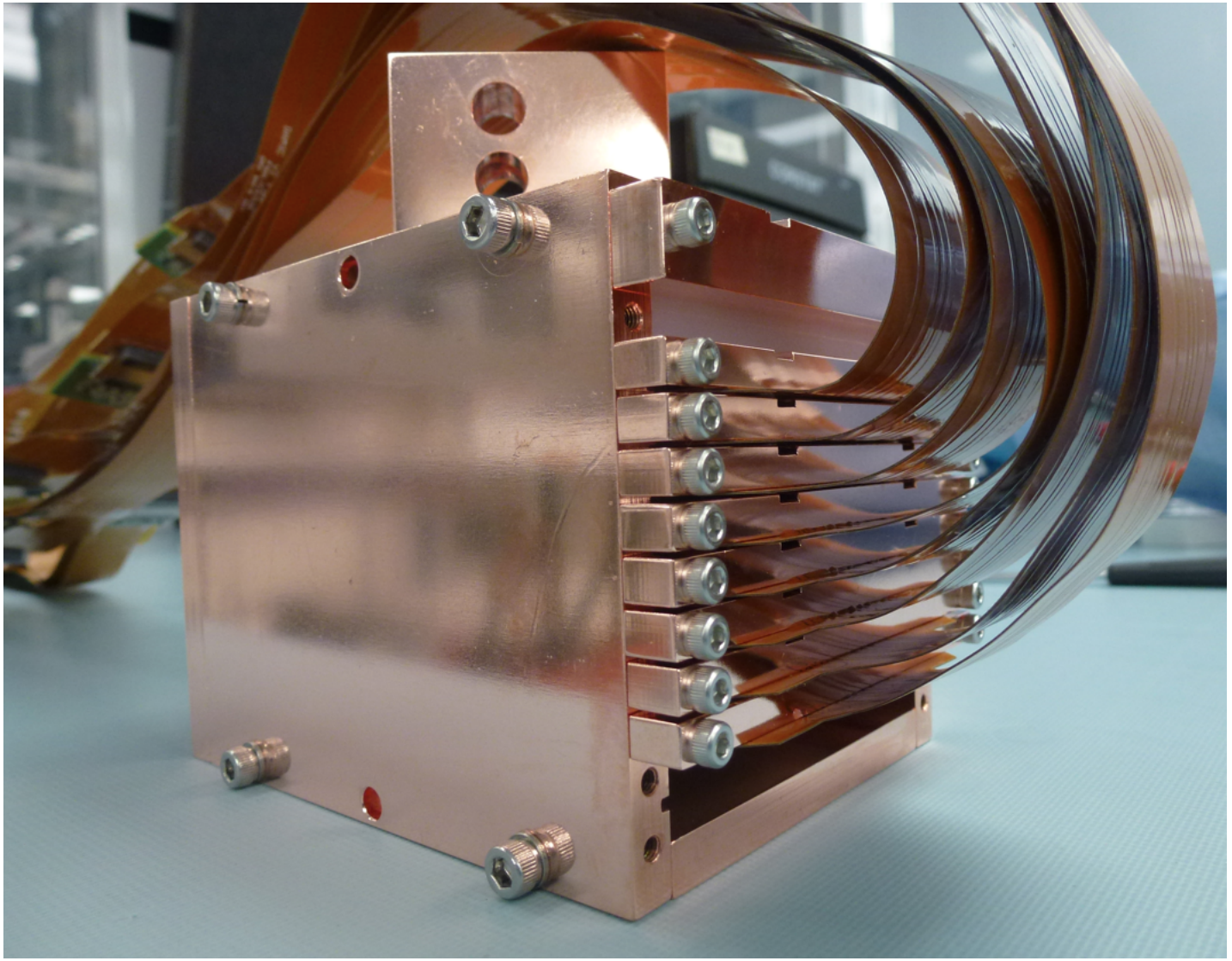
Detectors developed by LBNL CCD group!

will

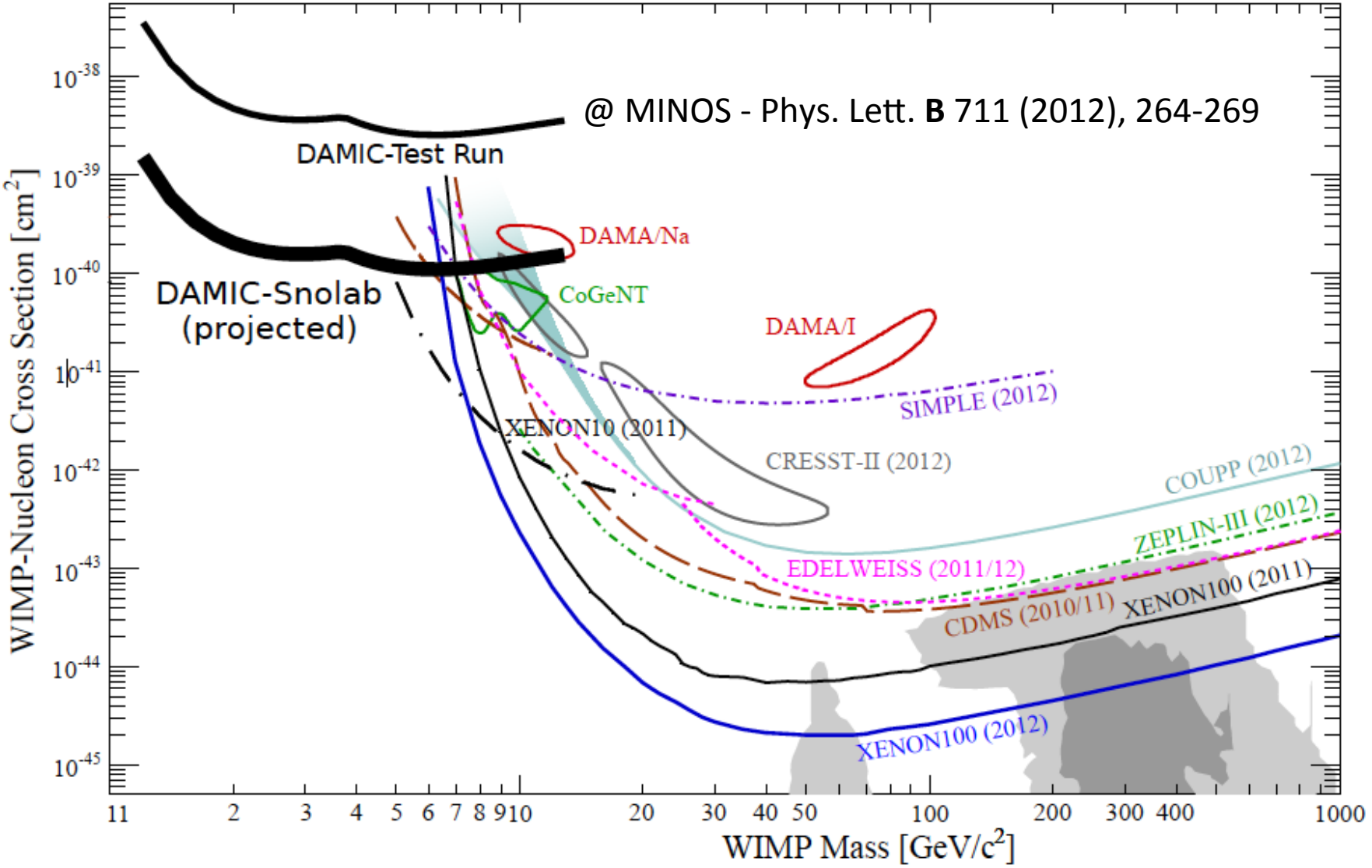
We use scientific CCDs designed for DAMIC

- 10x thicker than most CCDs (250 μm)
  - 20g per CCD
  - allows selection of limited diffusion events: *self-shielding*
- pixel size of 15 μm
- CCDs cooled to -150 C to achieve RMS 0.2e-
- Threshold of 4eV : single e-





~10g array installed at SNOLAB in December 2012.
Operating with threshold of 40eV.



J.Tiffenberg (FNAL)

Nov12 **Completed installation at Snolab**

- Lead and Polyethylene shields fully assembled
- Nitrogen purge installed and running

Dec12-Jan13 **Running parameters optimization**

- physics backgrounds measurements
- electronic noise measurements and minimization

Dec12-Feb13 **Inner components activity measurements**

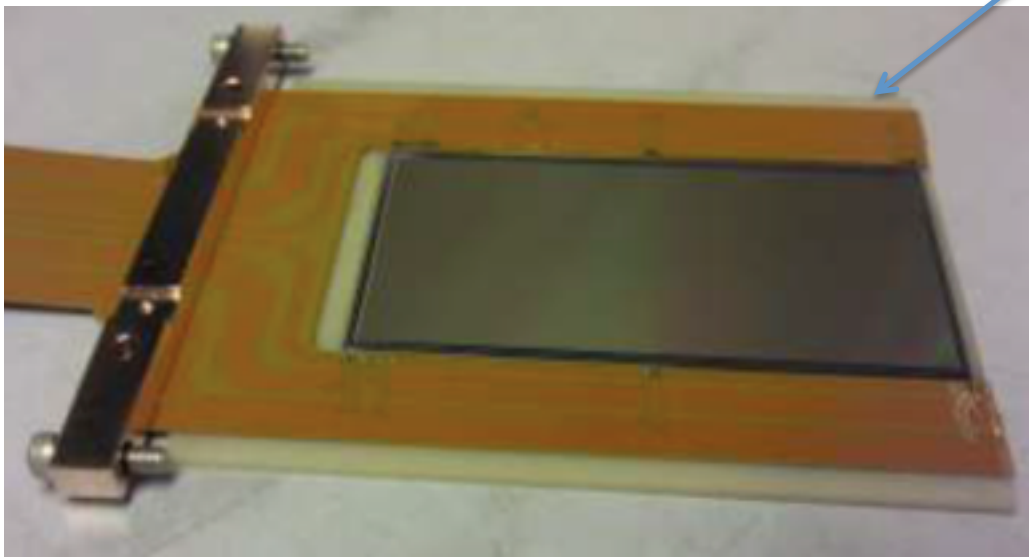
- Snolab underground counting facility.
- and at the University of Chicago.

Feb13-.. **First Physics run**

- stable run, setup taking data with no unexpected dead-time.
- all support systems (vacuum pump, cryocooler, DAQ) working as expected.
- better understanding of backgrounds

Thanks to the SNOLAB staff for the tremendous support that allowed us to get this experiment working in 2 weeks. Thanks also for supporting the operation and support with the counting facility!

^{238}U 5 Bq/kg
^{235}U 0.16 Bq/kg
^{232}Th 0.2 Bq/kg

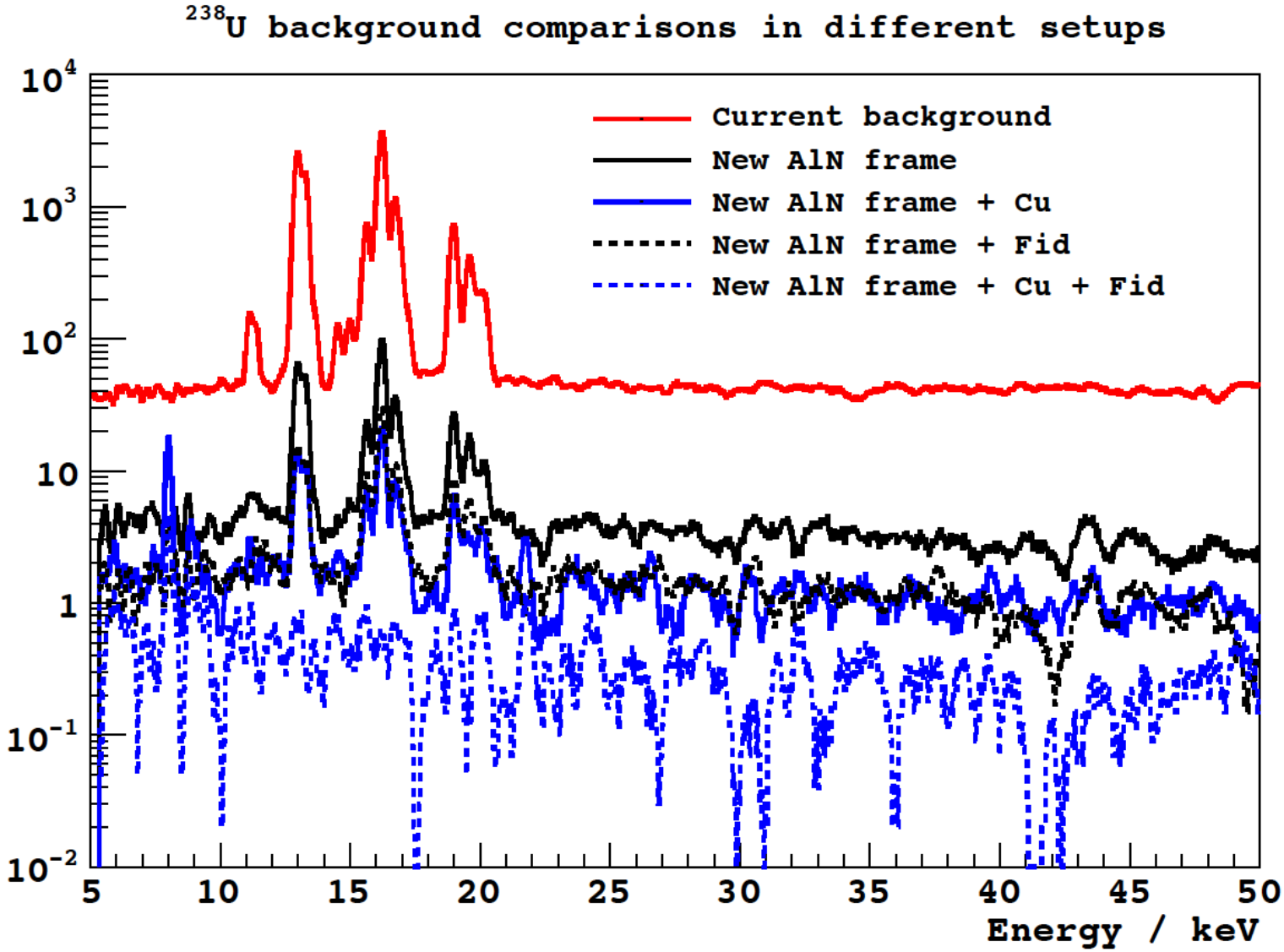


Ugly surprise:

The ceramic piece we attached to the CCD has high background. This was originally measured for a different batch to be low background.

This means that we did not get the improvement expected from moving to SNOLAB. The good thing is that know where the problem is, and we know how to solve it. As a first step we will build a package with only a frame of ceramic.

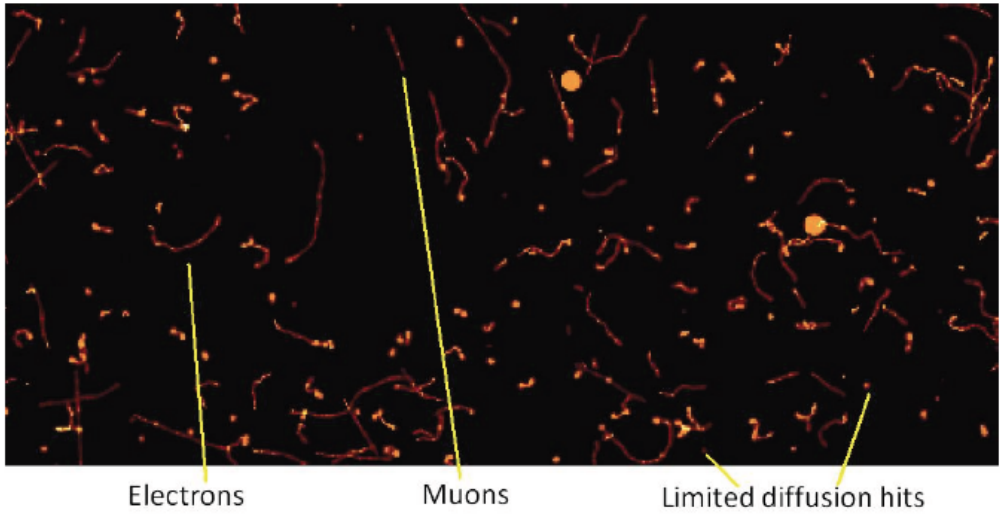
This will be completely eliminated on future packages…



A.Chavarria (U.Chicago)

Good news:

Alphas are very clearly distinguished in CCDs.



In ~20 days of running @ snolab we saw 13 alphas. The average alpha rate is 2.7 uBq / CCD. The detector purity is not the limitation yet.

A.Chavarria, J. Tiffenberg

Other related activities:

1) Installing a copy of DAMIC this summer at a reactor in Brazil to look for coherent scattering of neutrinos.

2) Low energy calibration of nuclear recoils:

- Scattering experiment using neutron beam at Notredame.
- Neutron capture in Silicon at Indiana.

3) DAMIC-sur : a copy of DAMIC installed in a copper mine in Chile. Collaboration with Mexico, Argentina, Chile and Brazil.

Next steps

- Replace packages to remove hot AlN.
- Currently using 1g CCDs. The LBNL group thinks it is possible to build up to 20g CCDs, this means that 100g is easy, 1kg possible.
- Submitted a proposal to try increase the mass of the experiment to 100g.