Progress in the Analysis of CDMS I Results

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CDMS I results PRL 2000

CDMS strategy

Improvements

Systematics: Efficiencies
Silicon data
Monte Carlo: double/single

Relaxation of fiducial cut: shared events

Basic story maintained

Conclusions

CDMS Collaboration

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(Feb00 ALS)

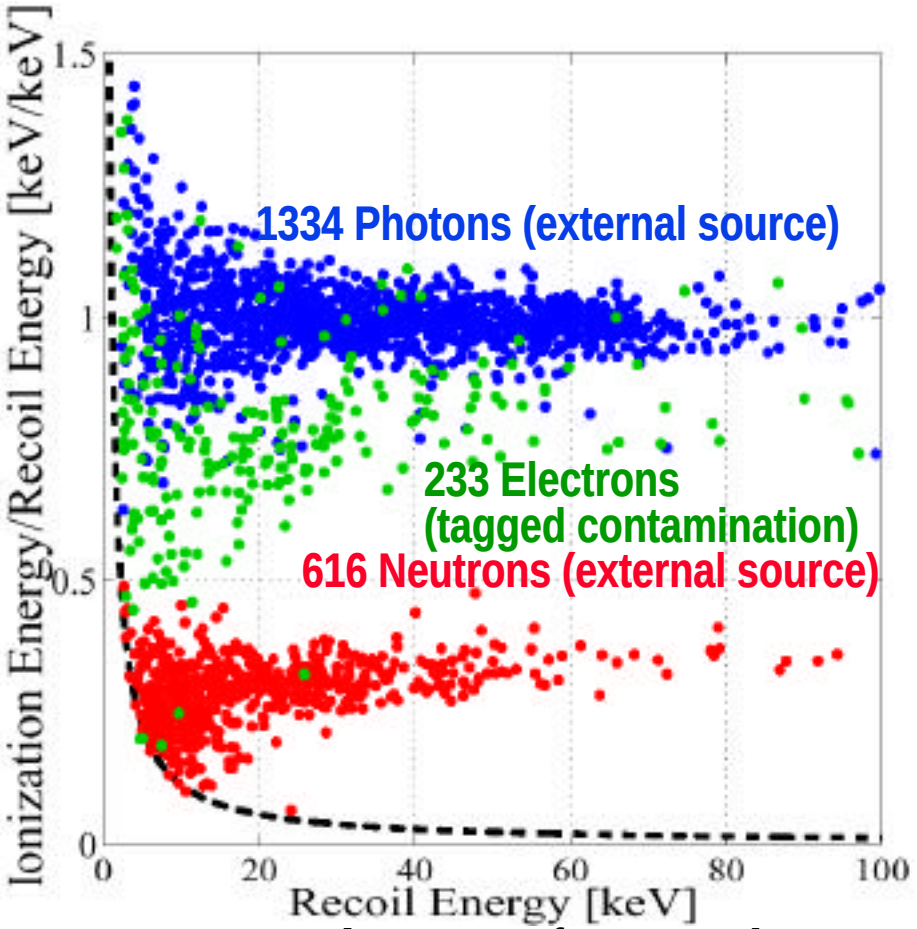
CDMS Background Discrimination

Ionization Yield (ionization energy per unit recoil energy) depends strongly on type of recoil

Most background sources (photons, electrons, alphas) produce electron recoils

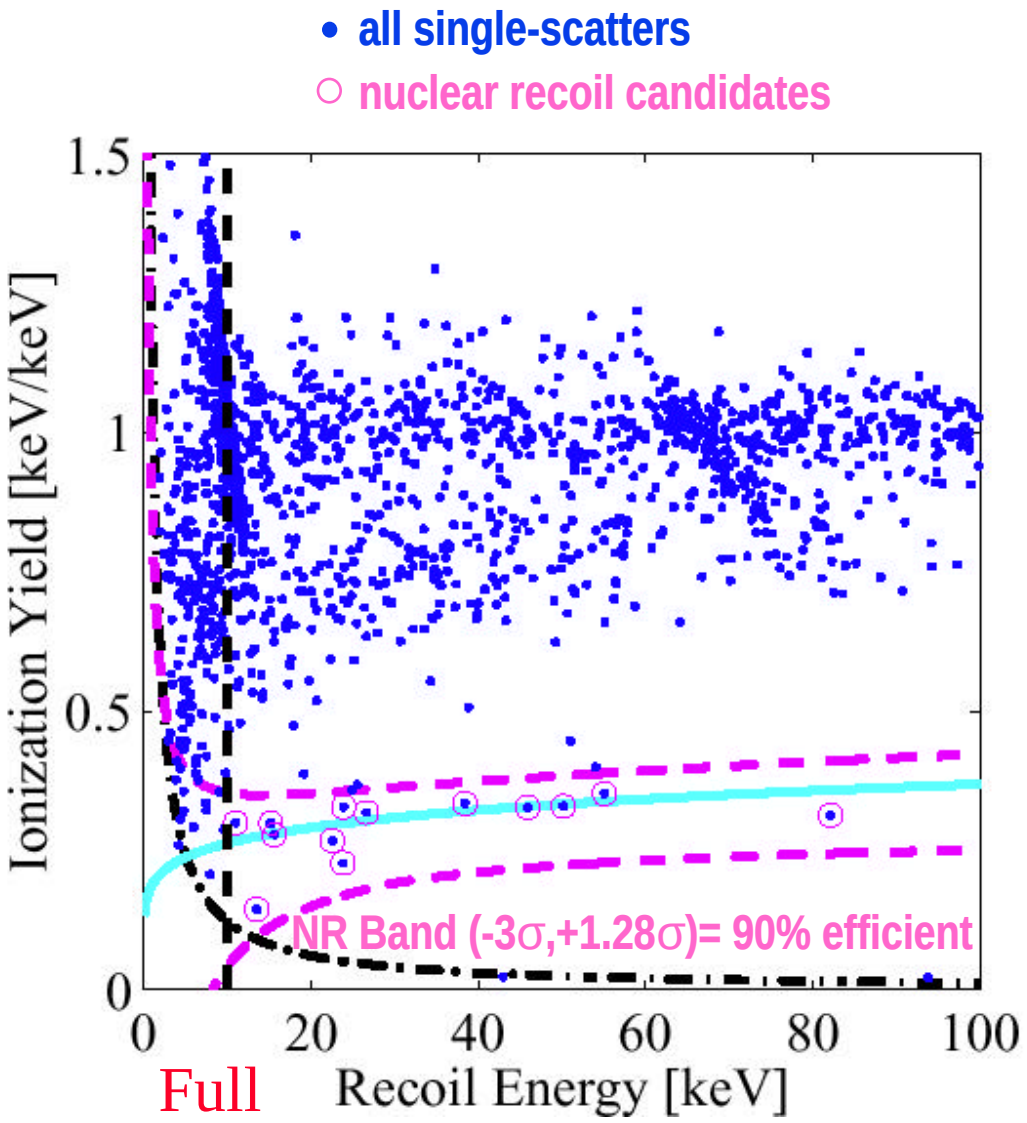
Electron recoils near detector surface result in reduced ionization yield

WIMPs (and neutrons) produce nuclear recoils



Detectors provide near-perfect event-by-event discrimination against otherwise dominant bulk electron-recoil backgrounds, very good (>95%) against surface electron-recoil backgrounds

CDMS 1999 Data Set (Stanford 17mwe)



0.25 kg Ge for 45 live days at shallow, low-background site

13 NR candidates > 10 keV

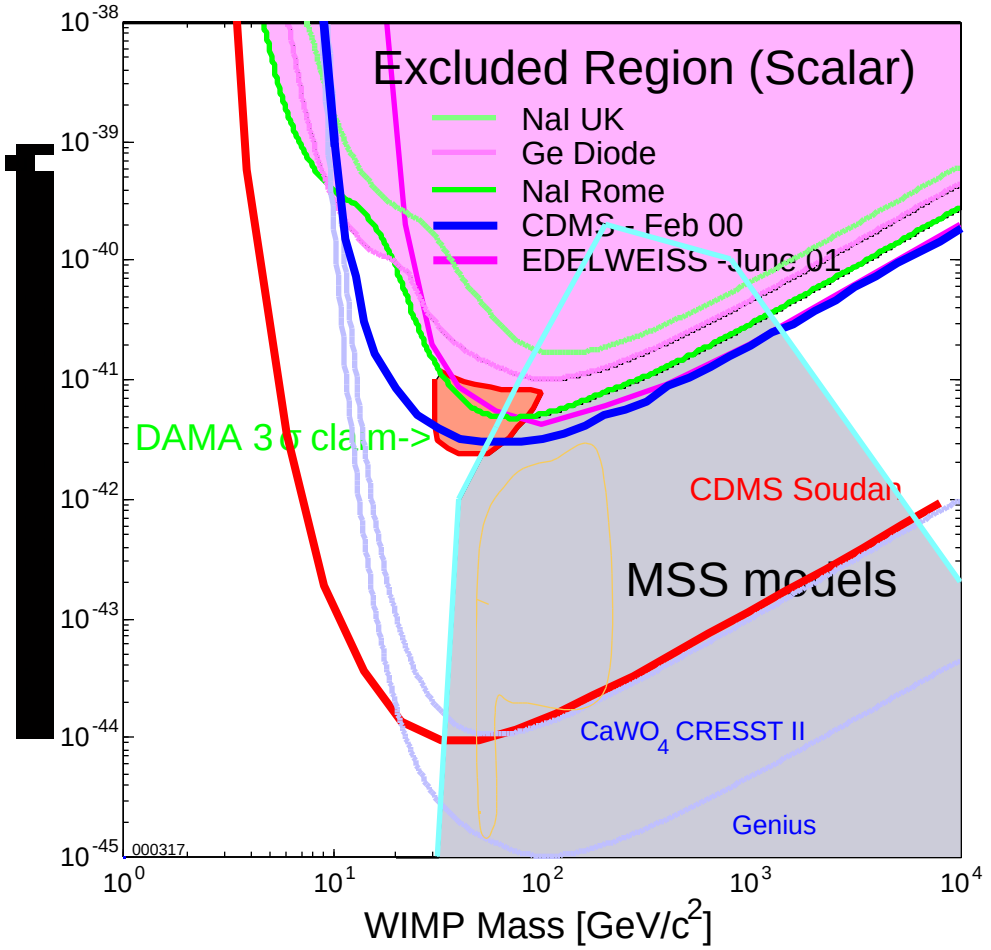
Most likely neutron background

4 multiple-scatters

4 Si events compatible with a nuclear recoil

Published in Phys. Rev. Lett. 84, 5702 (19 June, 2000)

1st and 2nd Generation WIMPs



CDMS II
CRESST II
EDELWEISS II
GENIUS TF
GEDEON
……..

CDMS Strategy

Difficult choice in early 2000

- Continue running at shallow site with that generation (BLIP) of detectors
  Unfortunately deep site (Soudan) not ready till early 2002
- Focus our limited resources onto the next generation (ZIP) of detectors for Soudan

we chose the second strategy

Greater pay off in the long run

cf. Tarek Saab talk this afternoon

Meanwhile

Cross check our analysis and relax our fiducial cuts to enlarge our sample

Sunil Golwala thesis sent to a number of groups + available on the web

This talk summarizes current status

Neutron Multiple Scatters

Basis of our whole story!

How well do we identify them?

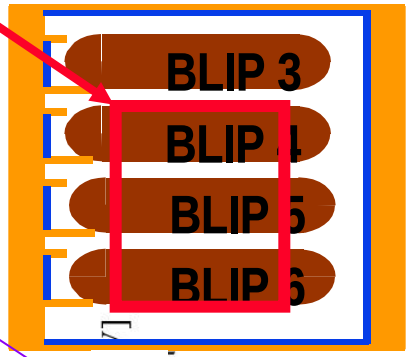
Use the strong contamination in B3

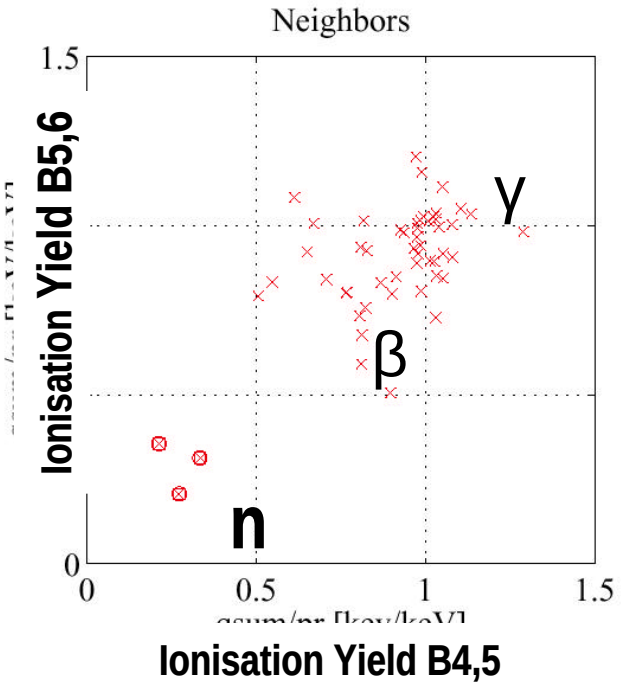
We now understand why!

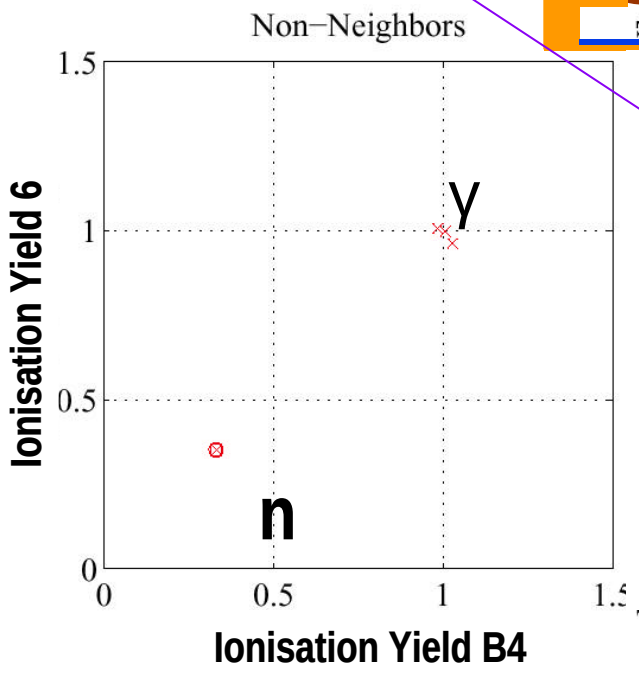
^{14}C contamination by unsealed source

At least one interaction in the fiducial region

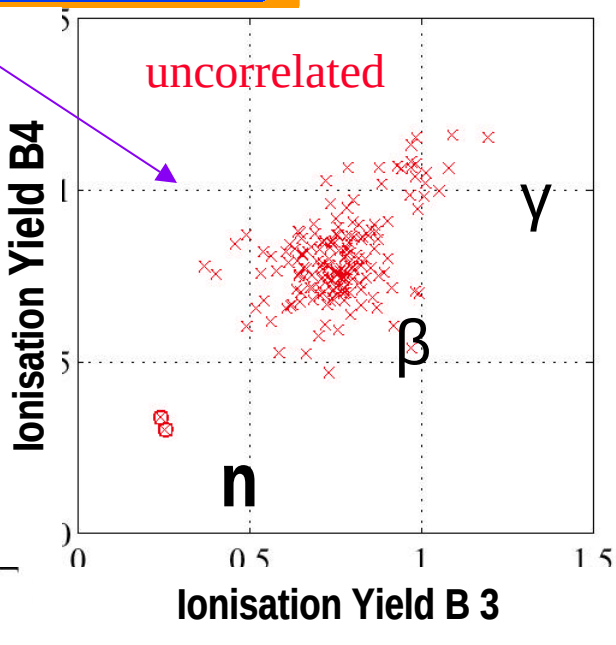
Fiducial region





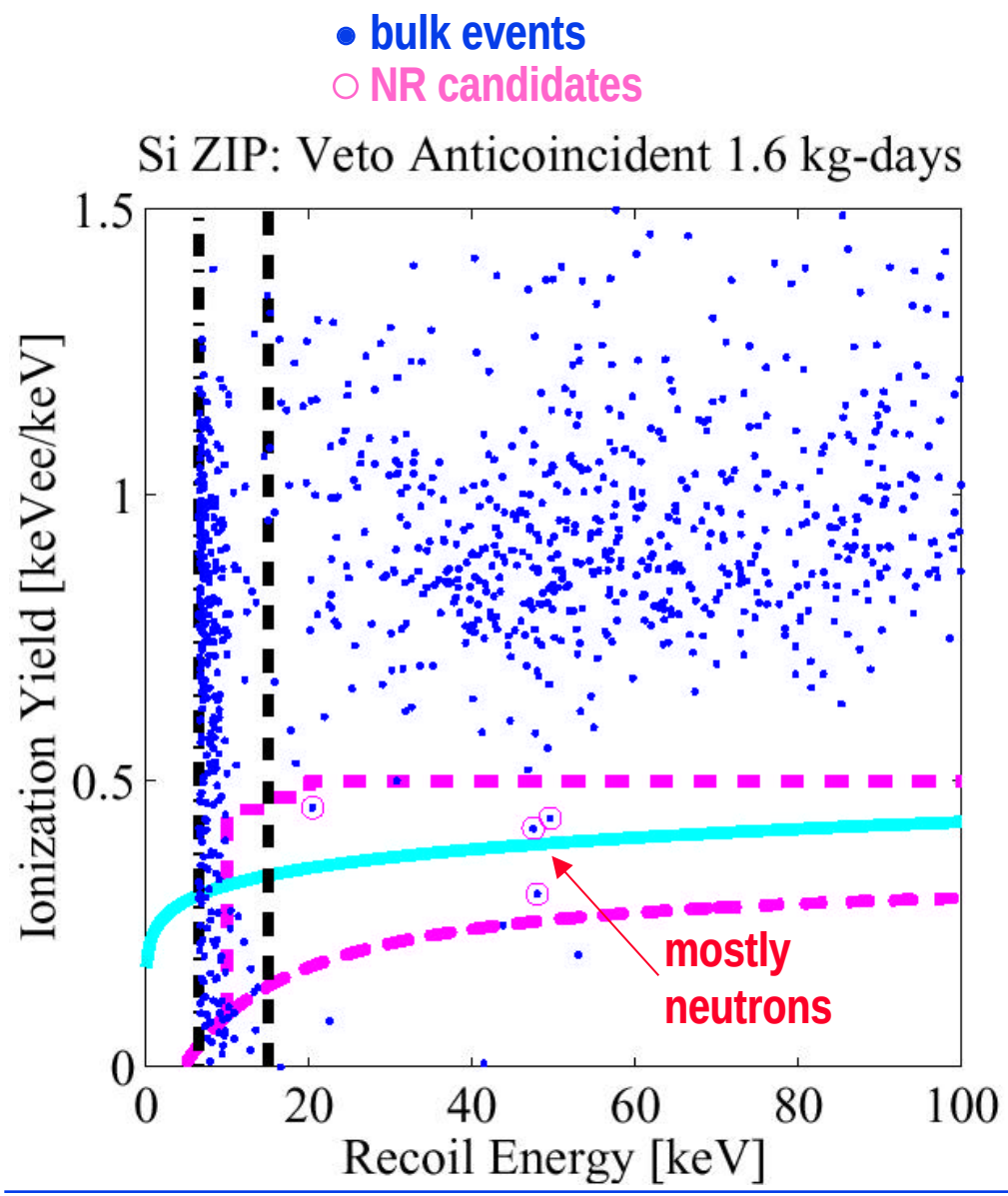


uncorrelated



Misidentification less than 0.05 event at 90%CL

Comparison with Silicon



1998 run of Si ZIP measured external neutron background

4 events: consistent picture!

However we underestimated the electron-recoil leakage into nuclear recoil band

Originally <0.26 events in 20-100 keV range at 90% CL

Our current estimate is <2 events at 90% CL

Very little statistical weight! Does not significantly change our previous limit!

Ratio of Double to Single Neutron Scatters

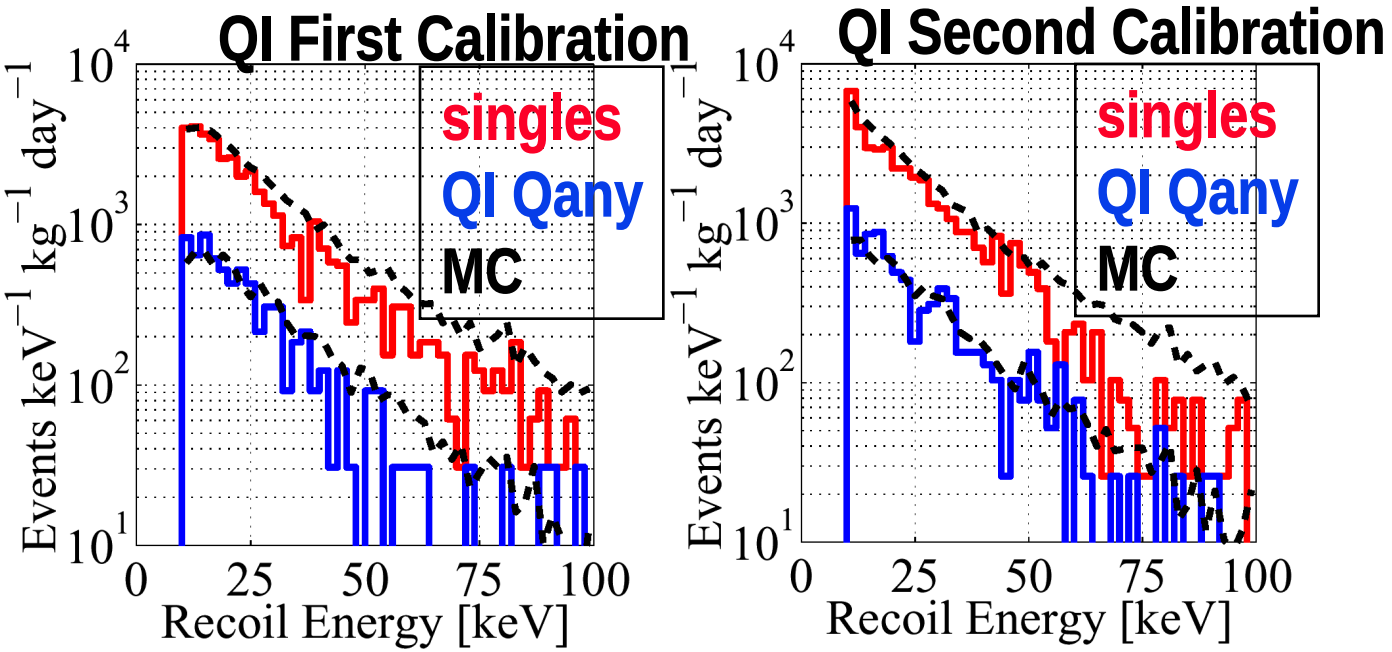
Dependent on Monte Carlo!

=>Scrutinize Monte Carlo

Agreement with single data not perfect

e.g. Calibration neutron source (activity rechecked)

MC 10% too high at low energy (10keV), 50% at high energy (50keV)



However double/single is extremely robust.

Very little energy dependence! Comparison between GEANT 3 and GEANT 4 in progress

Enlargement of Sample

Inner-Electrode

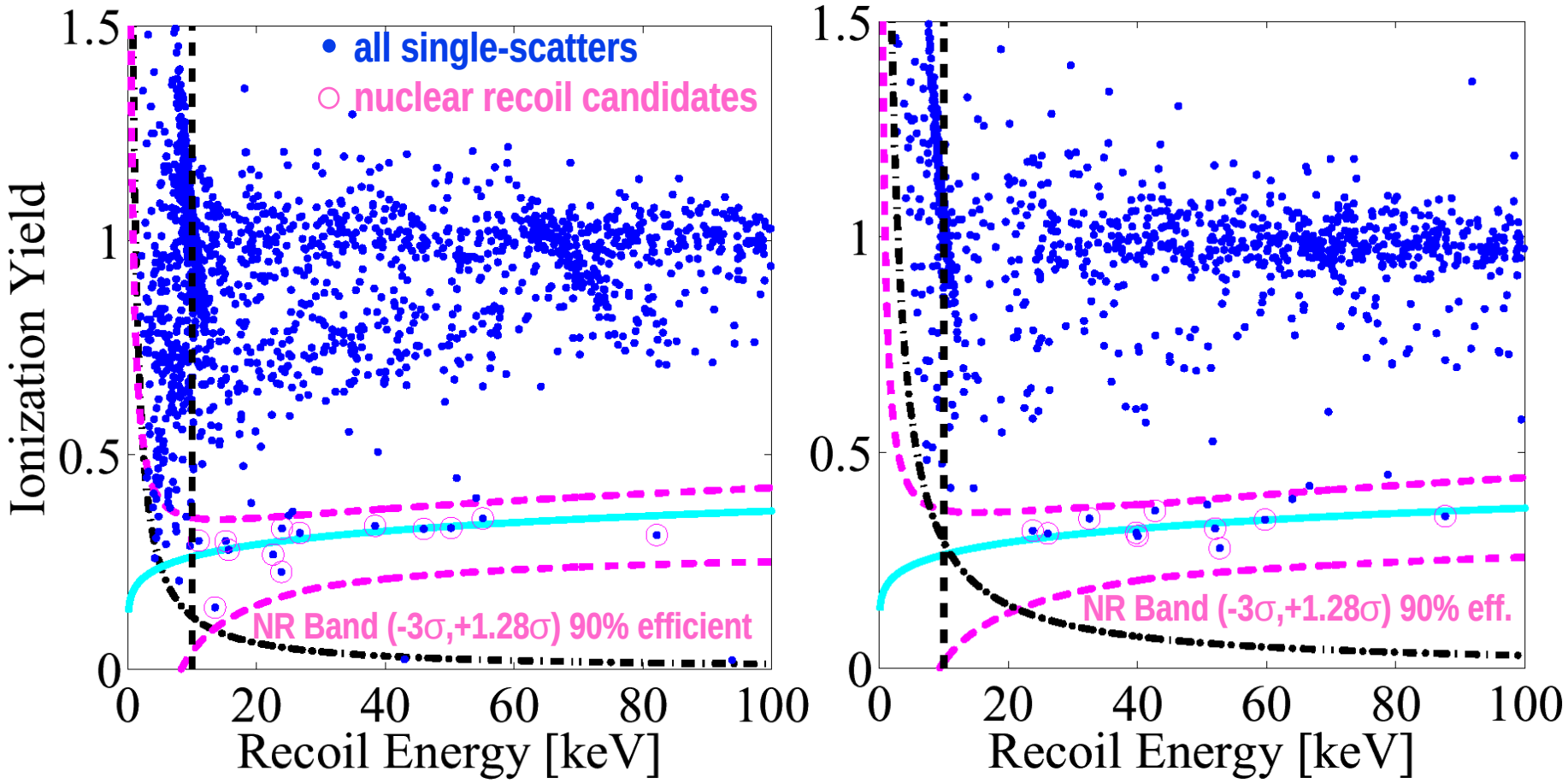
12.4 kg-days for WIMPs (≠ 10.7 better efficiencies)

13 nuclear-recoil candidates > 10 keV

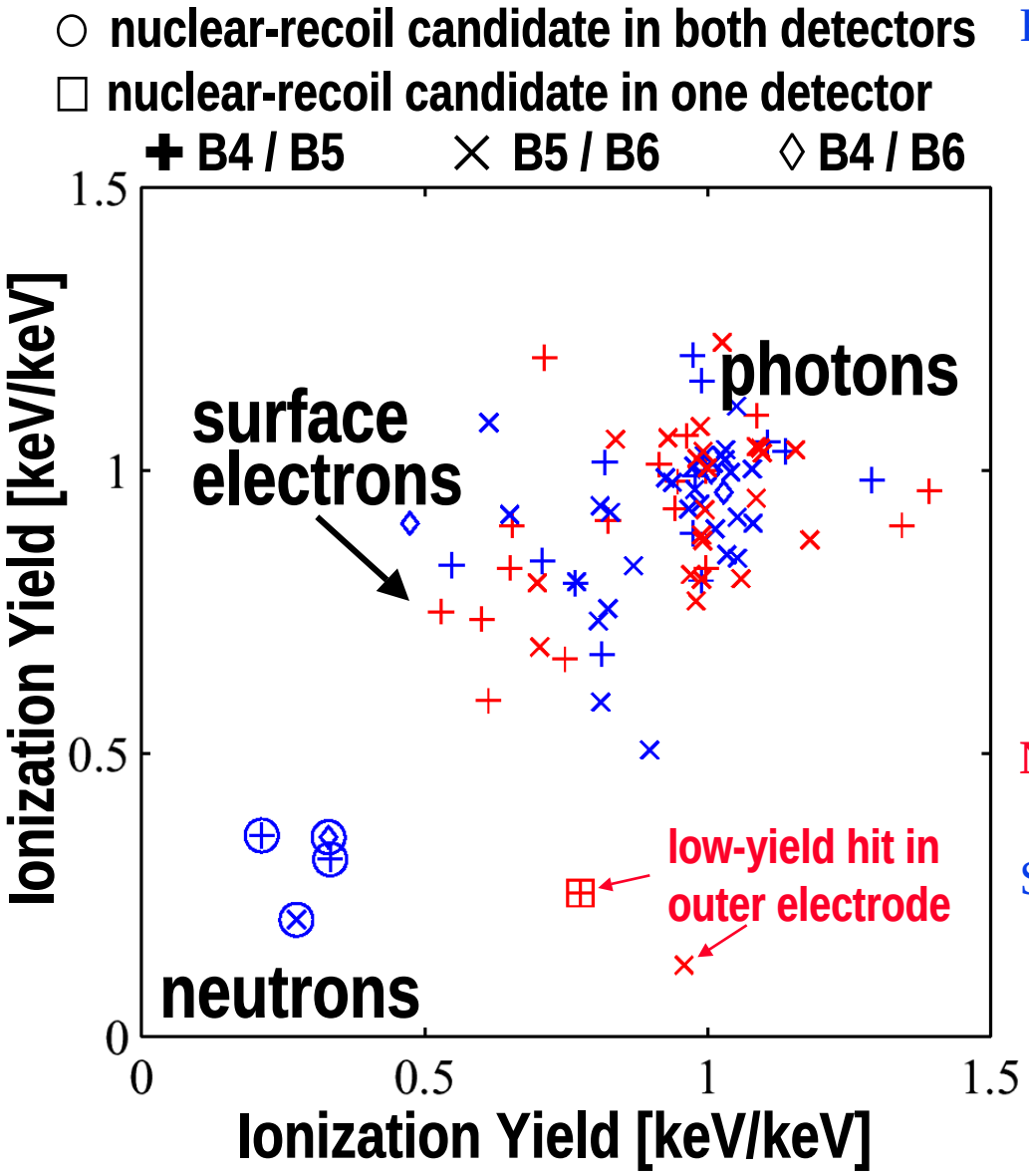
Shared-Electrode

4.6 kg-days for WIMPs

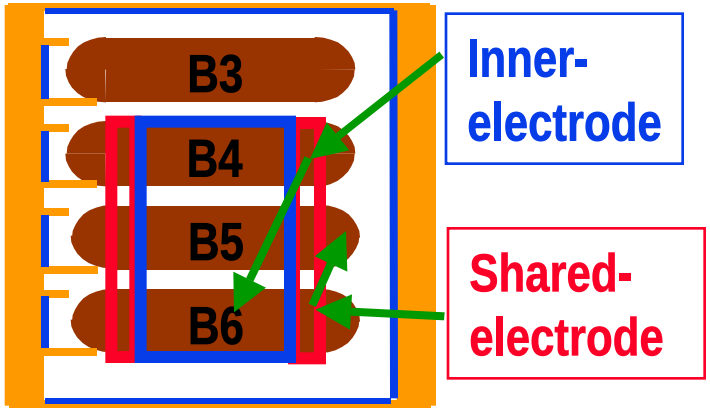
10 nuclear-recoil candidates > 10 keV



Neutron Multiple Scatters



Require that at least one hit be in fiducial volume



No additional neutron multiple scatters in 10-100 keV

Still negligible contamination by electron multiples

Inclusion of Shared Events

Stable

Add 10 singles to 13 original ones for 41% increase in exposure, no additional multiple

Confirms that we have been lucky with our first sample

Somewhat large double/multiple

But within statistics! With GEANT 3, likelihood ratio test indicates we should expect worse agreement 25% of the time (note we were saying erroneously 6%)

Our 90% CL was 1.5 lower than the expected sensitivity.

Bottom line?

Unfortunately not ready yet @$%! Tantalizingly close…

More in line with the expected sensitivity, but our exposure increased by a factor 1.6

Comprehensive PRD to be submitted in a few weeks + version on web

Conclusions

Basic story unchanged

In spite of a year of scrutiny of the data + corrections of small errors +enlargement of sample

PRD to be submitted very soon with complete sample and extensive details

Unfortunately left with our apparent discrepancy with DAMA for:

- conventional supersymmetry (scalar couplings)
- and standard halo models

Incompatible with the raw modulation signal observed by DAMA (Fig 2 of their 2000 publication) at >99.9% CL

We are now focusing on CDMS II

First complete tower of ZIPs now running at Stanford Underground Facility with internal neutron shield (factor 2.5)

To be transported in Soudan in early 2002. See Tarek Saab's talk!