FUTURE STRATEGY of CRESST

MPI, TUM, Oxford, Tübingen, LNGS, Vienna

Based on presentation by Federica Petricca (spokes'man') at Gran Sasso

The Two Big Problems

of 'WIMP' search via nuclear recoils.

I Low Energy Threshold, Resolution

II Background—Remarkable progress, more needed

CRESST is undertaking new radical steps on these two fronts

Optimize on small recoils

- low WIMP masses
- other applications

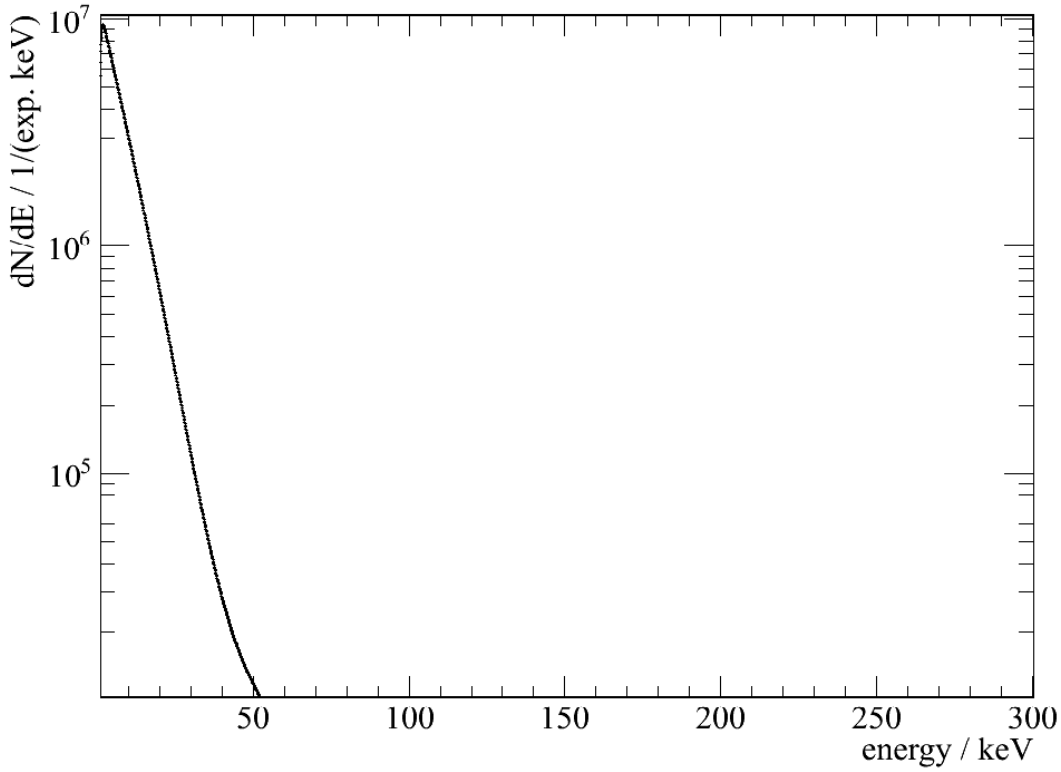
I

The Recoil Energy is small

From astro we believe we know $velocity$
$v/c \approx 2 \times 10^{-3}$

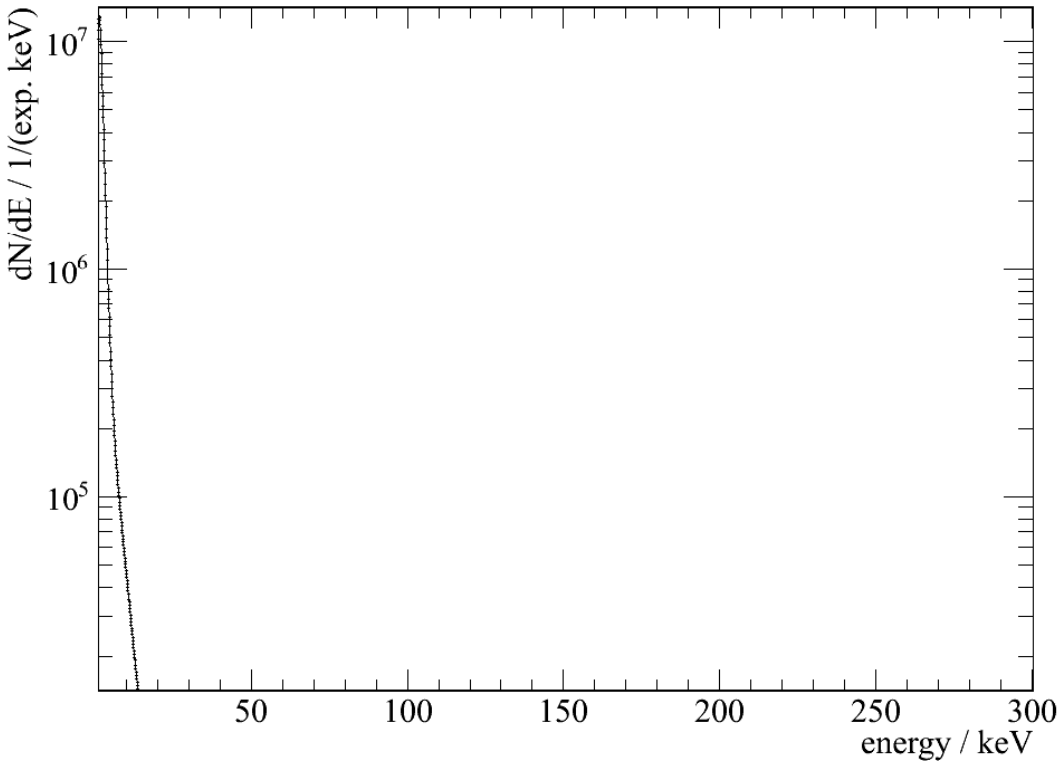
Given velocity, smaller mass means smaller energy for WIMP $\rightarrow$ smaller recoil for Nucleus

WIMP spectrum dN/dE



$M_{wimp} = 50$ GeV

WIMP spectrum dN/dE



$M_{wimp} = 10$ GeV

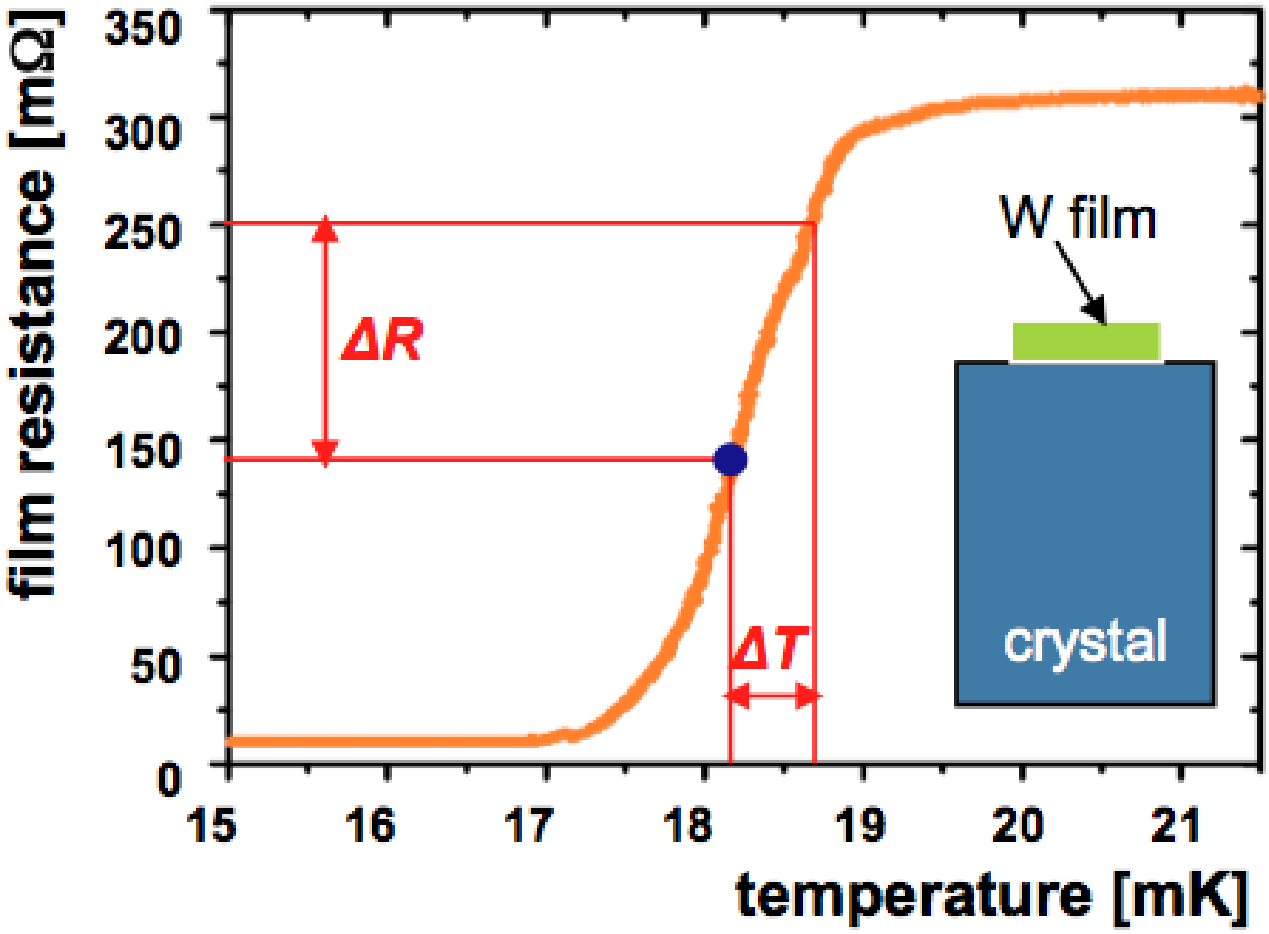
Cryodetectors

At LOW T a little energy can mean a lot!

Solid state, liquid detectors: energy unit $\approx$ 1 eV

But cryo devices: e.g. superconductor, energy to break Cooper pair $\approx 10^{-4}$ eV

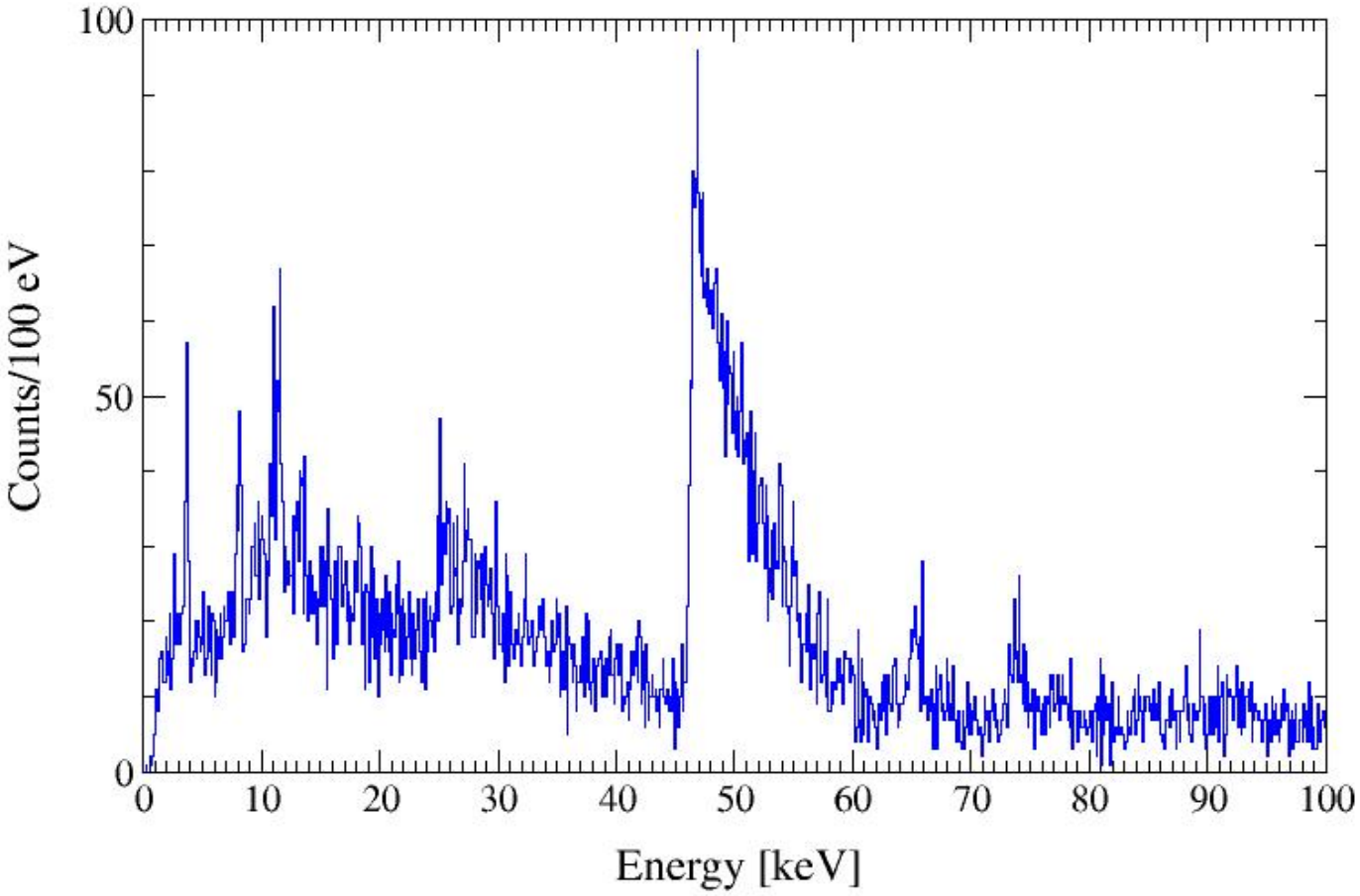
CRESST operates around 10 milliKelvin. Transition temperature of Tungsten thermometer $\approx$ 14 mK.



The "superconducting strip" or "transition edge sensor (TES)"

Crystal $= CaWO_4$

Great E resolution, low threshold



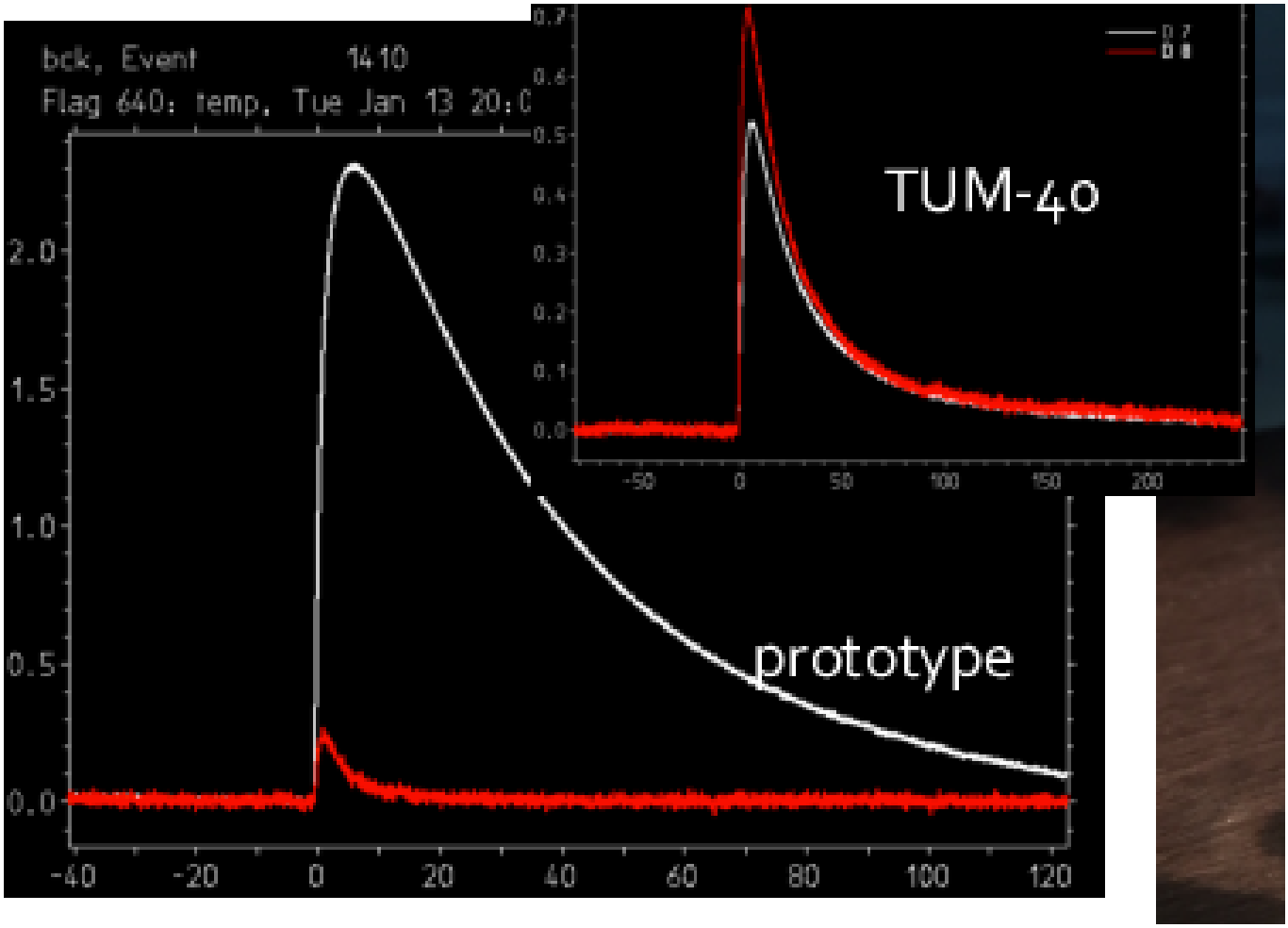
Still not down to fat part of recoil curve
especially for light WIMPs

New generation of CRESST detectors aim to get there

Principle: $\Delta T = \Delta E/C$, C very small at low T

New Generation of CRESST detectors

Smaller C via smaller crystals (25 gm instead of 250 gm)



Red: Light signal, same in both

White: Phonon signal, small/big crystal

from Raimund Strauss

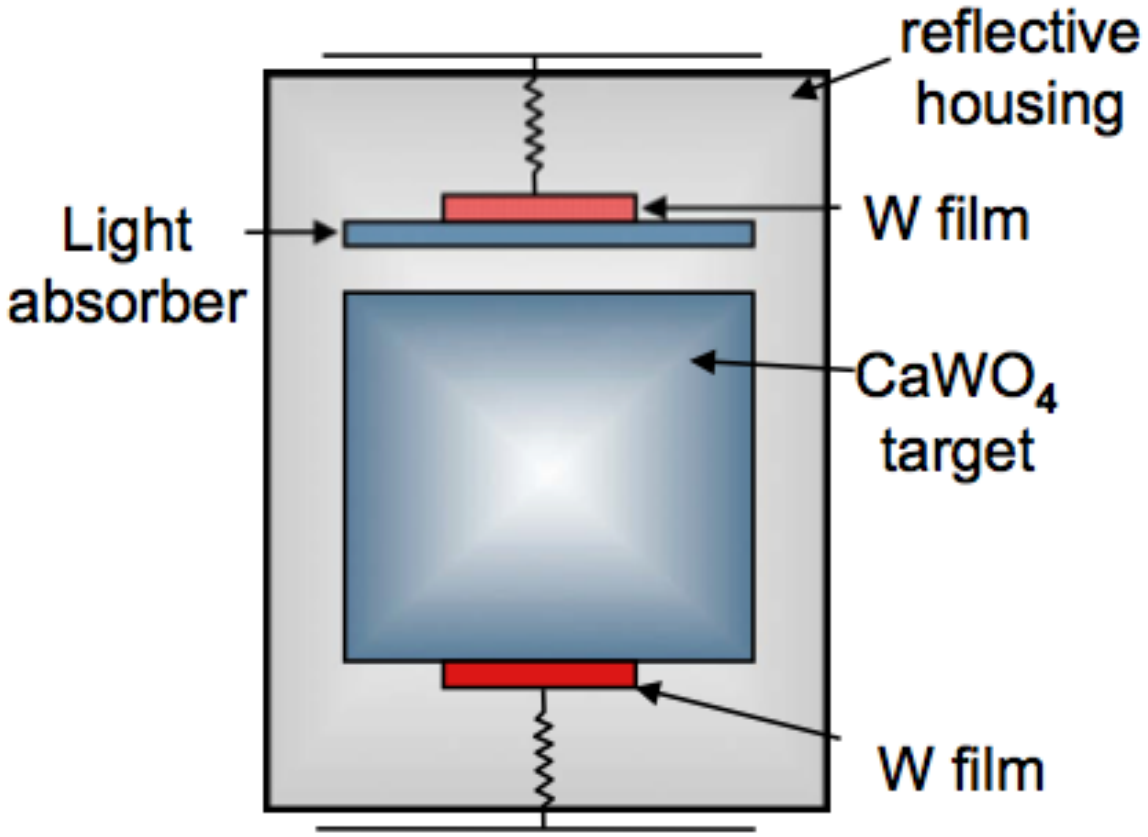
Get to 100 eV recoils

Can see WIMP masses below 10 GeV

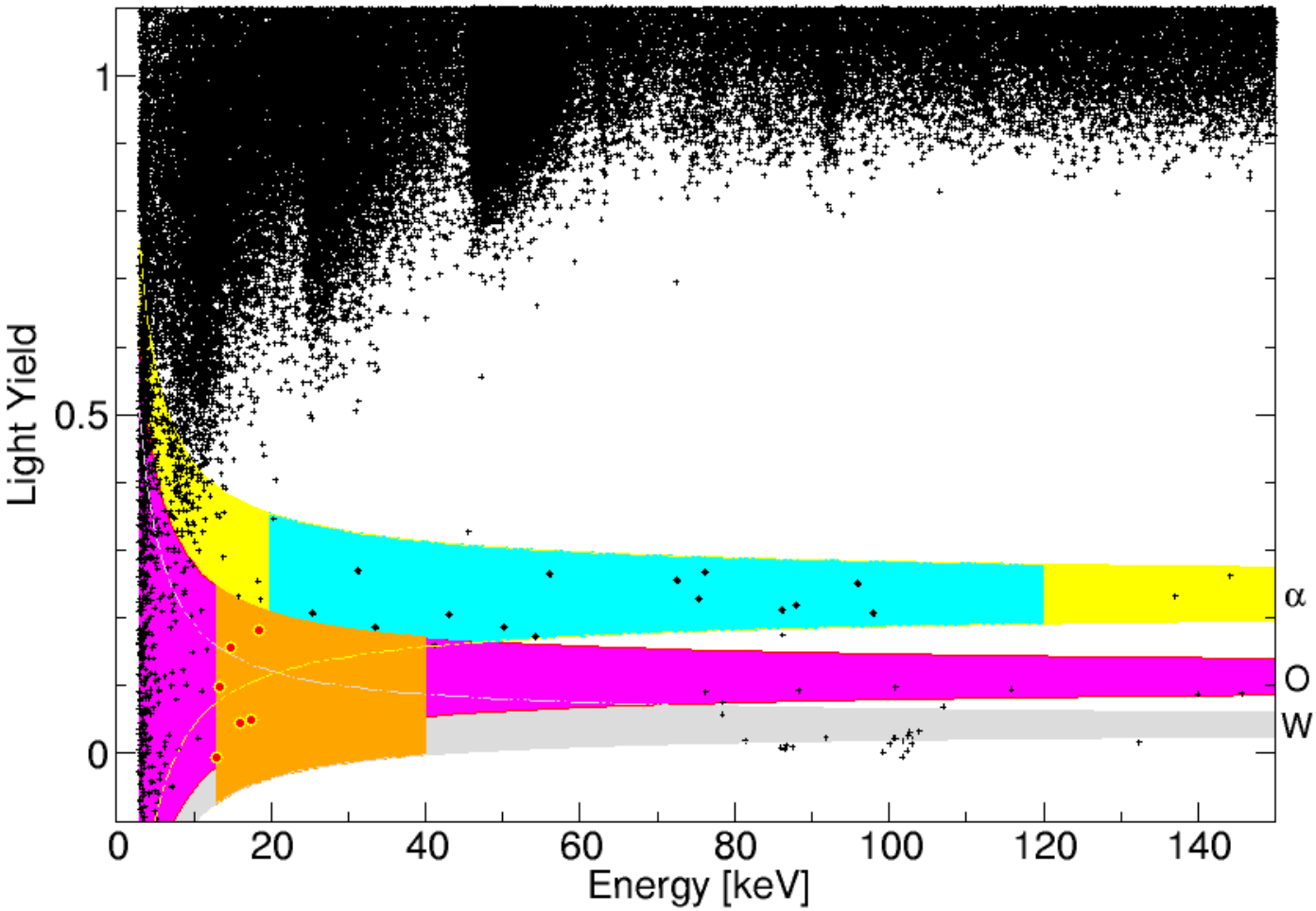
II

Two-channel readout separates (γ, e) from nuclear recoils

Heat (phonons) and Light



Events are represented as points in heat-light plane



Beige= WIMP signal region

Group around 100 KeV

$^{210}Po \rightarrow ^{206} Pb\,(103\,keV) + \alpha\,(5.3\,MeV)$ (from Radon)

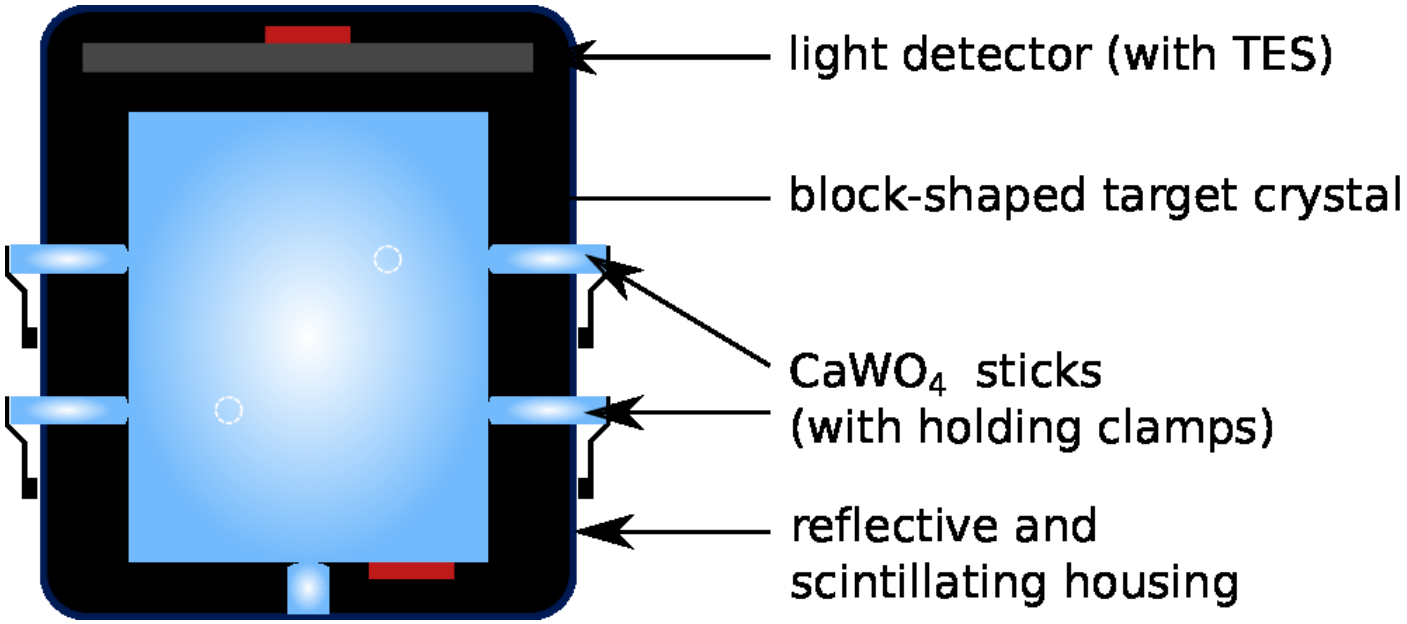
Great Improvements

- Radon control

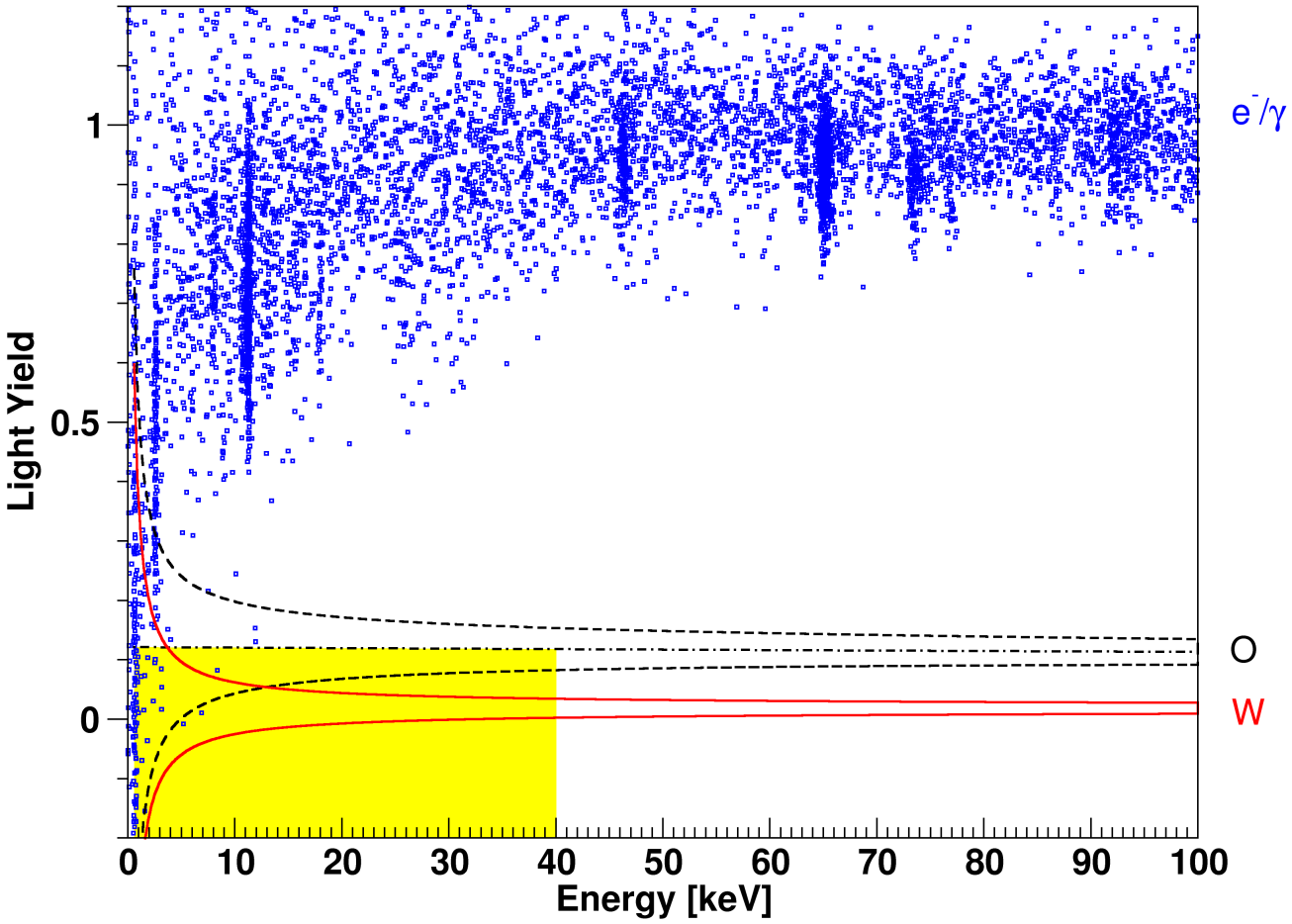
- Radiopurity (own crystal lab)

- New innovative class of detectors with scintillating clamps

$^{206}Pb\,(103\,keV)$ was hitting metal clamps



– Nothing that doesn't scintillate

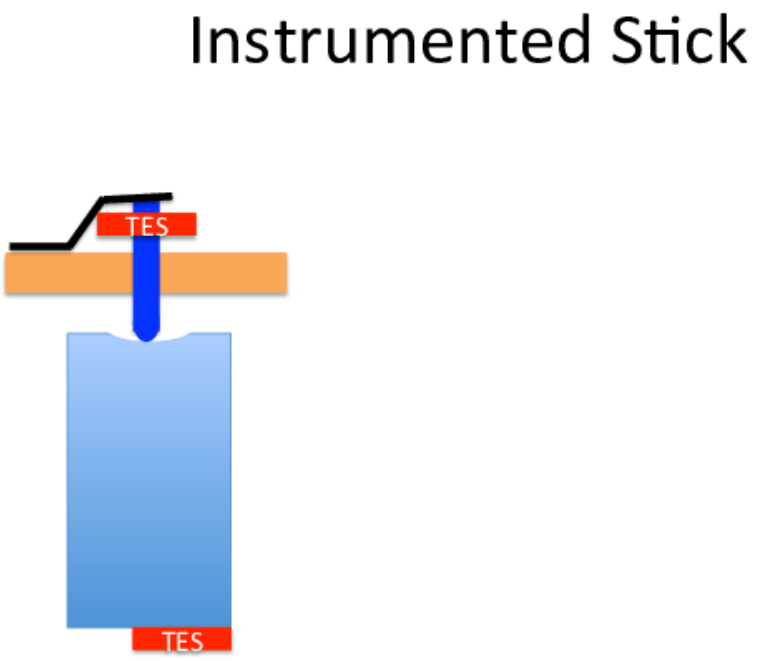


From only one stick- module: In latest published results yellow region (where WIMPS expected) is essentially empty [arXiv:1407.3146. Eur.Phys.J. **C74** (2014) 12, 3184]

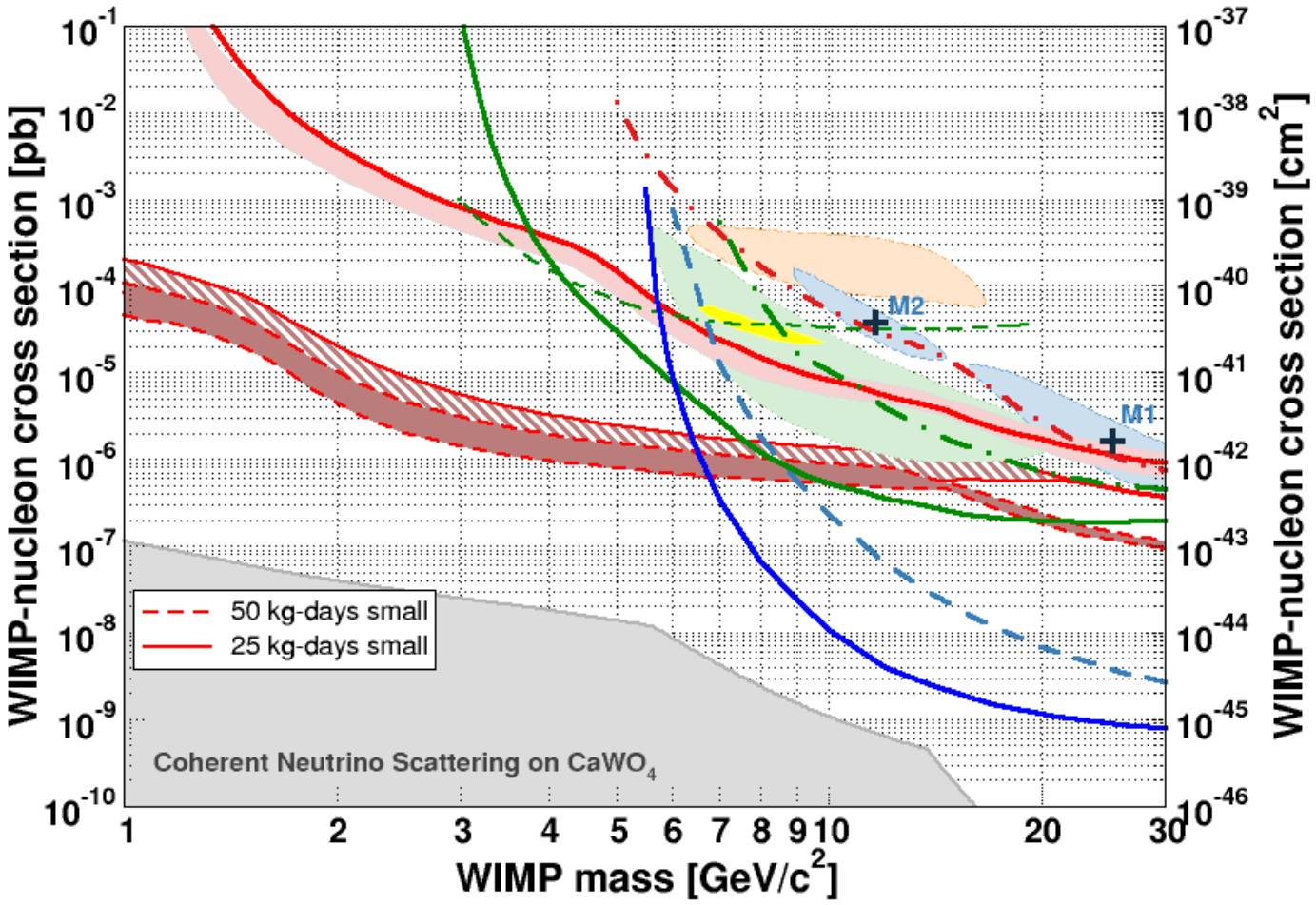
latest and greatest

I-sticks

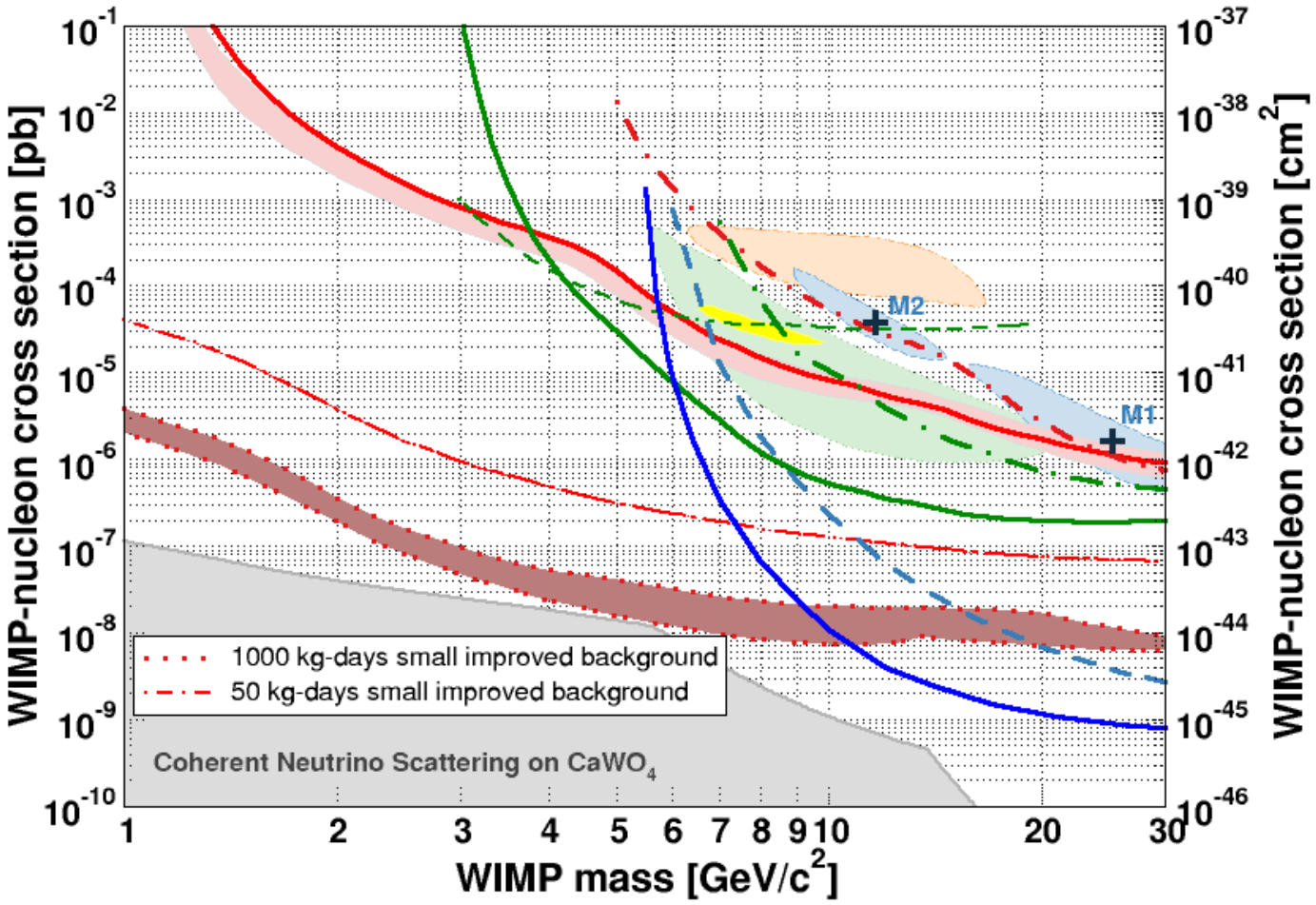
Hits on outer stick ends are identified



•CRESST will have outstanding performance in low-recoil, low WIMP mass region.



Could maybe even reach level set by ν background



- Different nuclei in one detector Ca, O, W

One of few ways to make a positive signal convincing