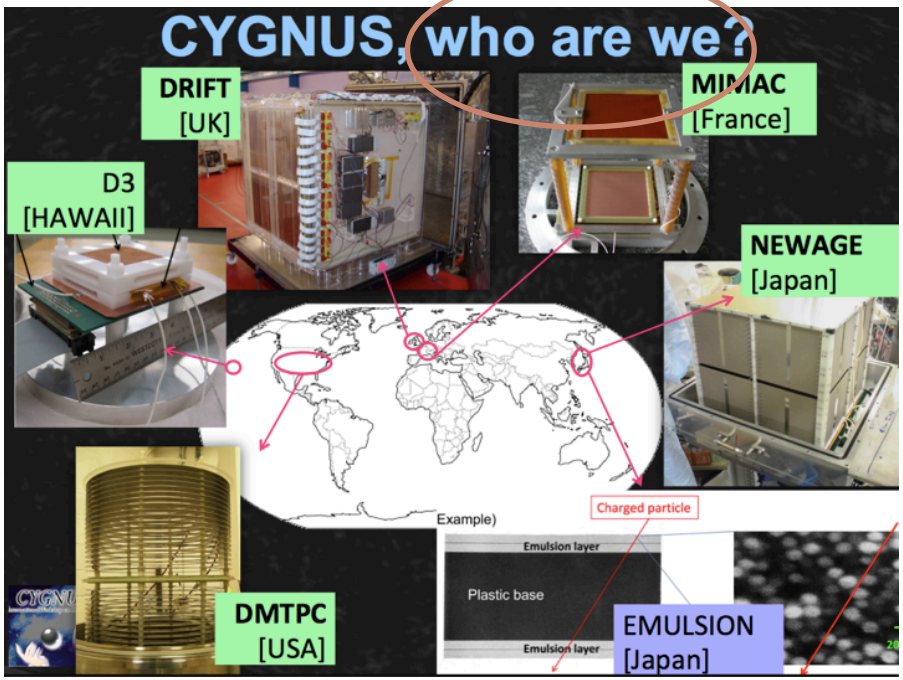
Thank You Miss Cygnus 2013

Neil Spooner

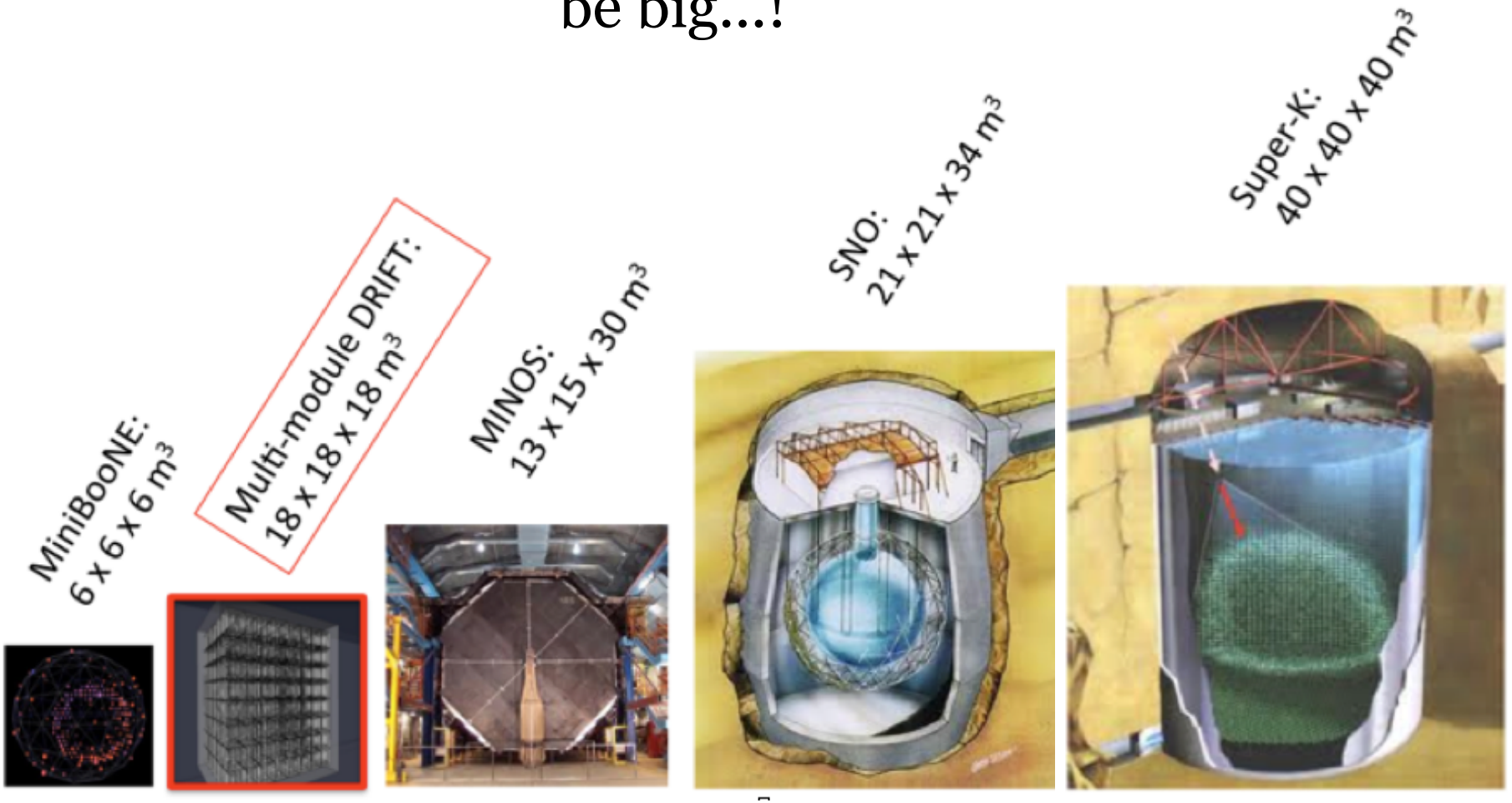
CYGNUS is meant to be more than just another workshop

a community, the start of a collaboration

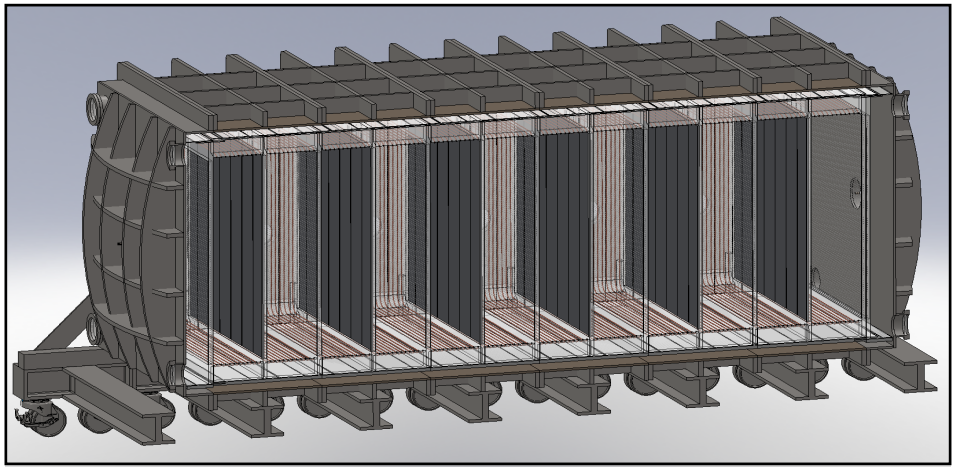


Why

Because directionality is hard and may need to be big…!



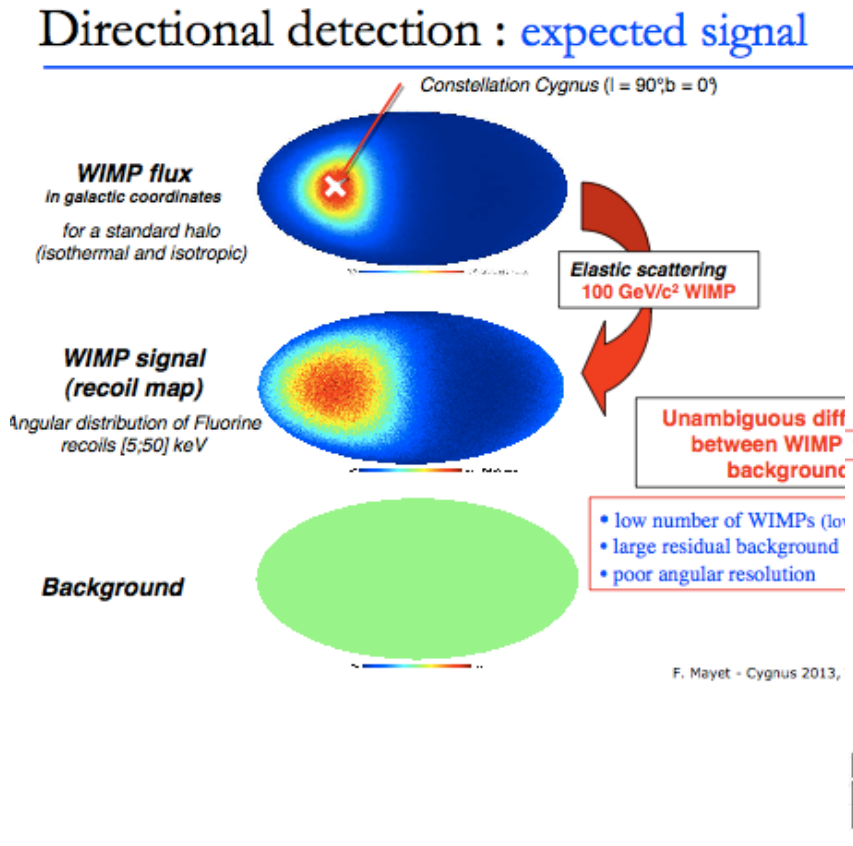
Is this first step?



Prize for most ambitious effort so far DRIFT III?

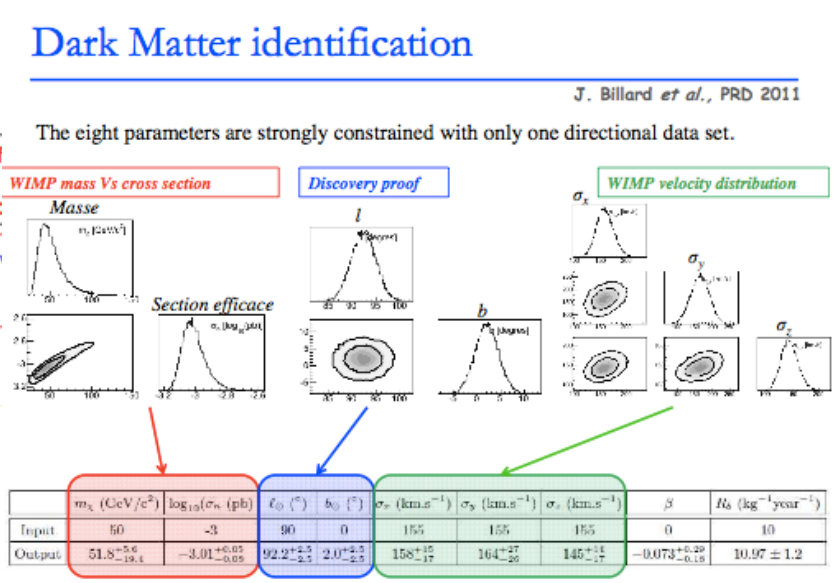
Also

Because we need to show the non-directional people that they are WRONG....
we DO NEED a SIGNAL to discover WIMPs..

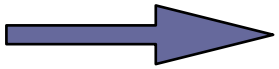


Frederic Mayet

Prize for showing the strength and POWER of a directional signal



Also to show the amazing Particle ID Power we have



Track Range (σ_{mm})

Track dE/ dx (topology)

Track total ionisation energy (σ_{energy})

Track direction (angular resoution)

(*buy two discriminants and get two more for free…!*)

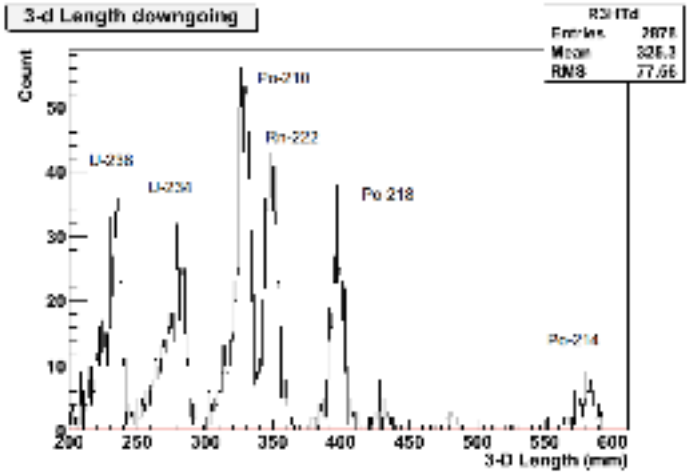
So low pressure TPC is not just good (best) for directionality but may also be best at doing the non-directional (discrimination) job….

e.g. discrimination at low energies persists…

Particle ID Power Demonstrated

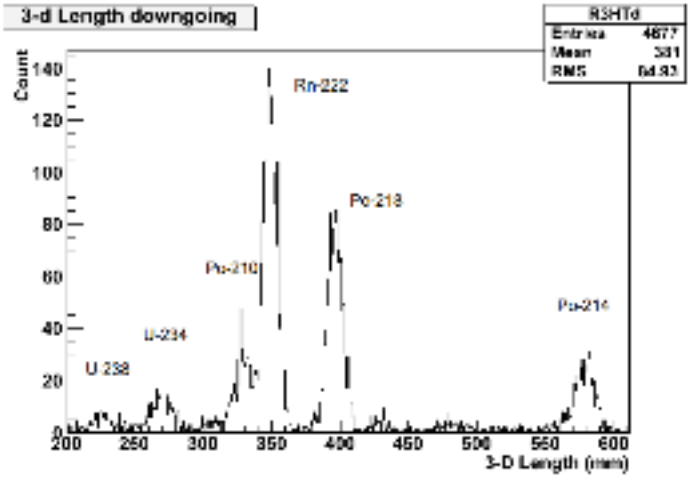
Before: (~15 days)

Isotope	Dirty	Clean
^{234}U	14 ± 1.2ppt	2.5 ± 0.24ppt
^{238}U	284 ± 22ppb	20 ± 2.4ppb



DRIFT has amazing sensitivity to measure backgrounds in-situ from detector materials!

After (~50 days):

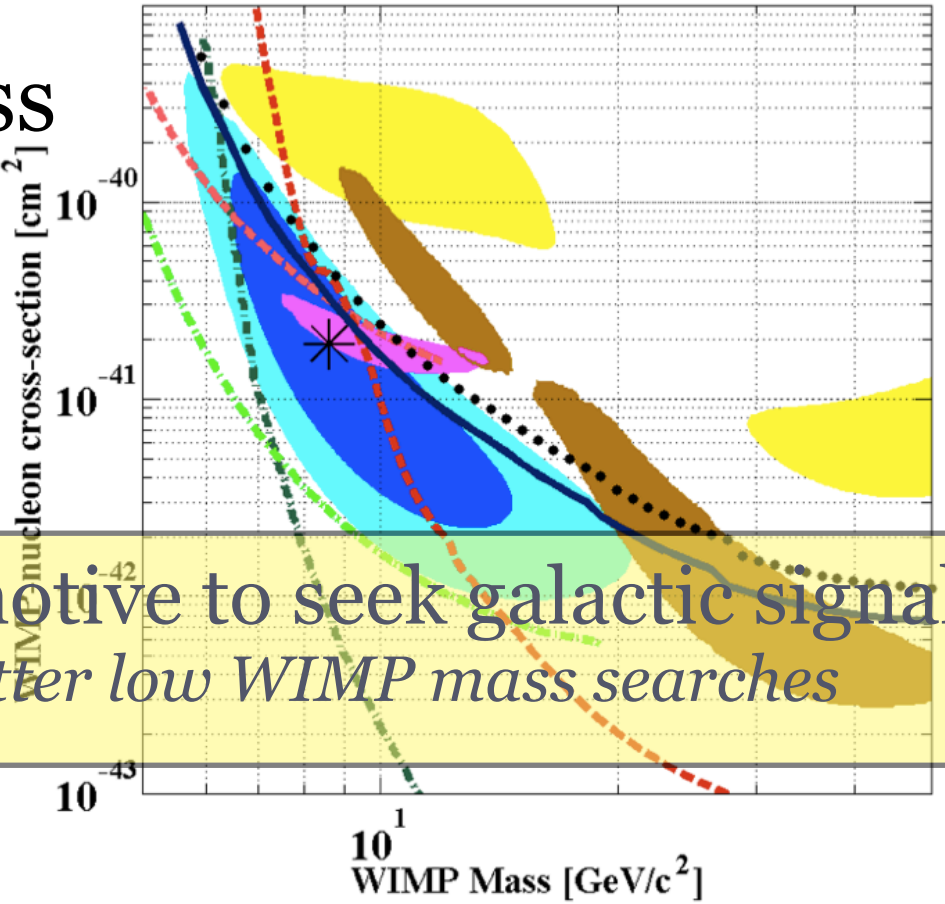


Dimesh Loomba (UNM)

But also discrimination works at low energies.... (unlike most conventional ideas)

Prize for most exciting new idea...!

we can do low mass WIMPs with directionality...

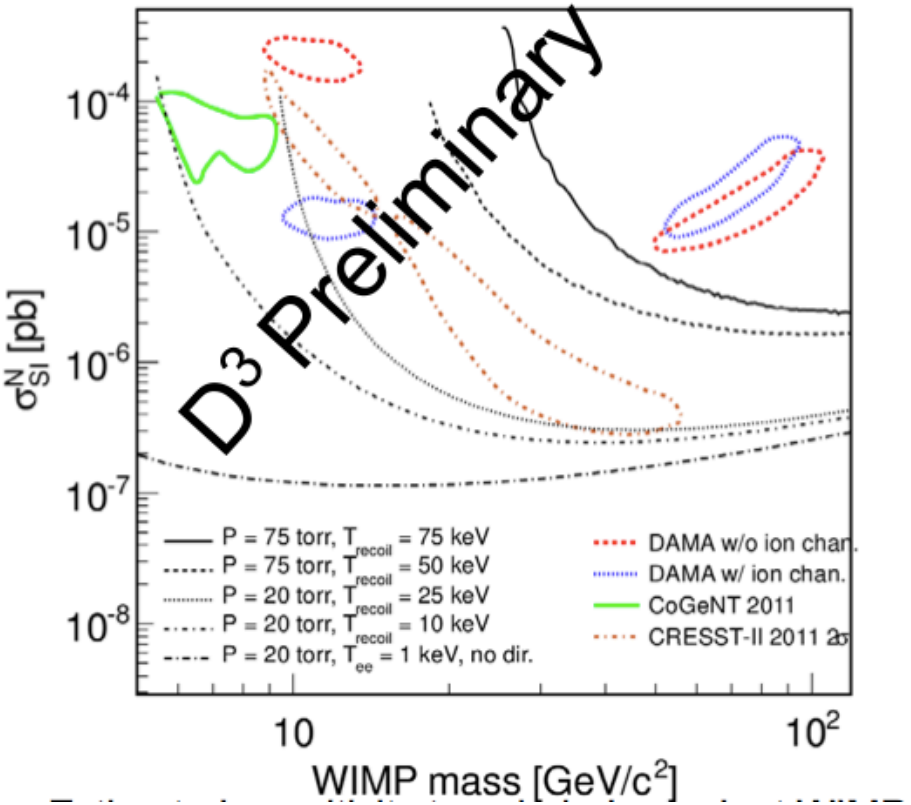


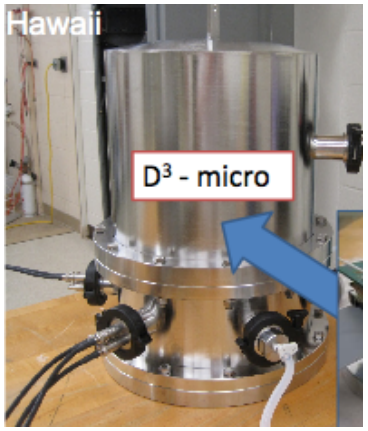
There is ugrent motive to seek galactic signals

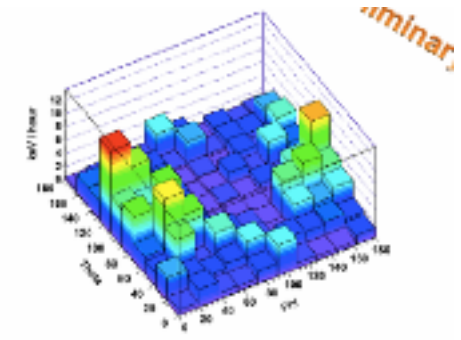
and perform better low WIMP mass searches

D3 Predictions

Sven Vahsen

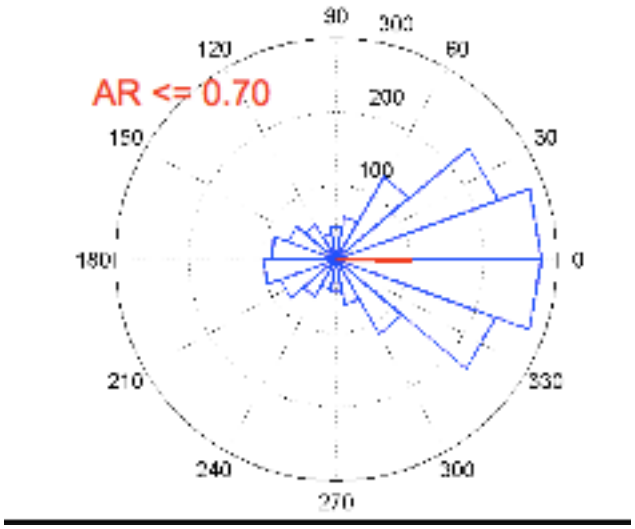




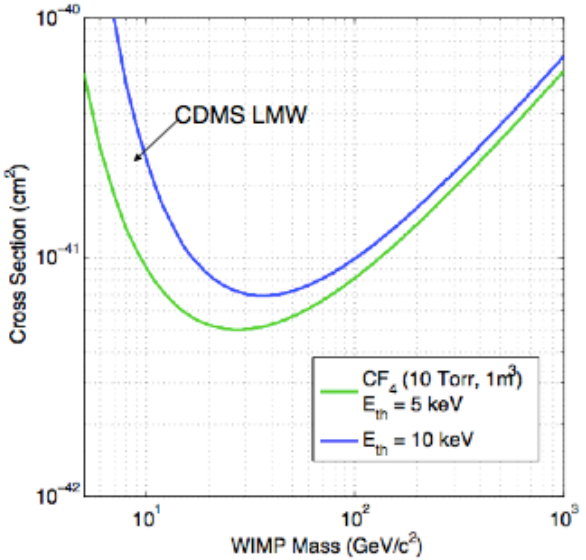


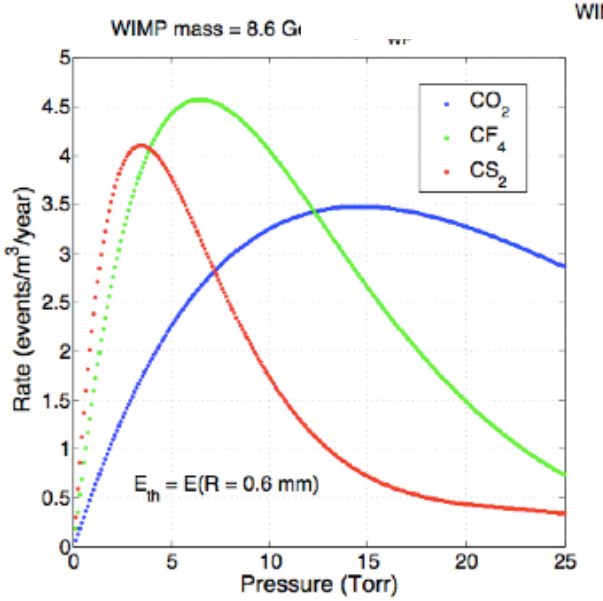
Also gets prize for best location to do dark matter - Hawaii

UNM Predictions



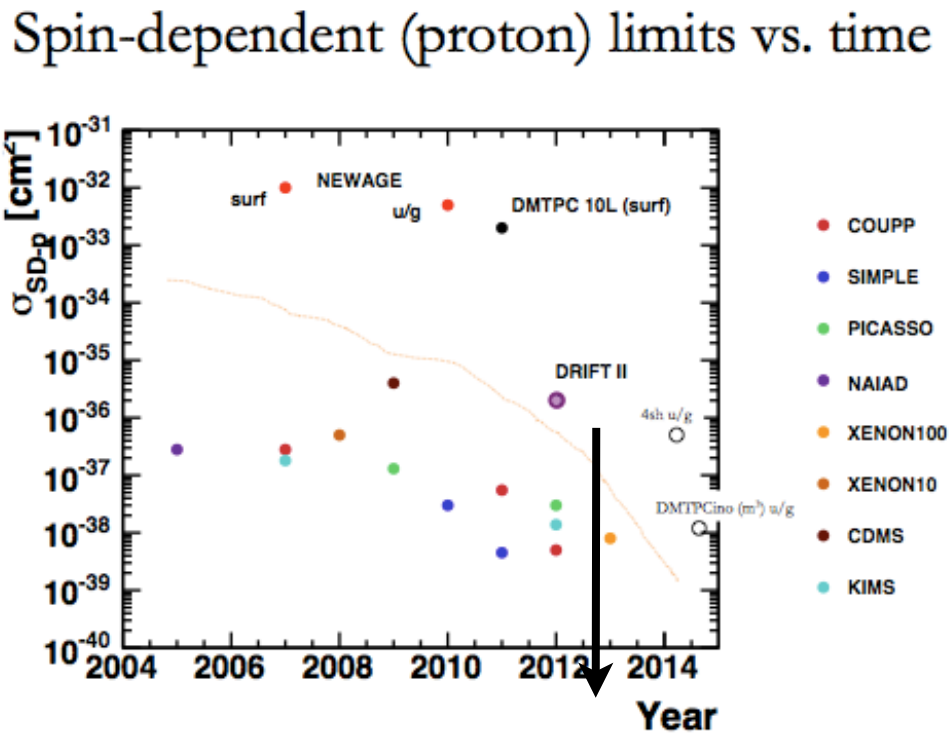
Limits in 1 yr for 1 m^3





To succeed we also need to show the non-directional people that they we can produce results that they understand…

James Battat DM-TPC



we need to compete in the non-directional world

means hard work on backgrounds…

means hard work (period)

So it is best for CYGNUS people not to fight....

Eric Lee (UNM)

Eric Miller (UNM)

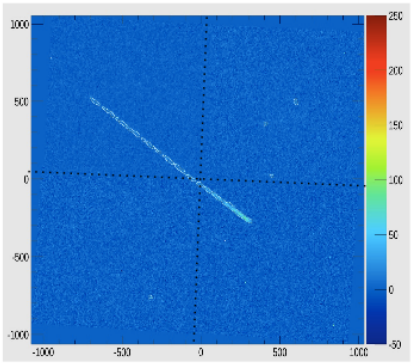
Particularly not with the Erics...

Thankfully CYGNUS people have made huge progress recently…

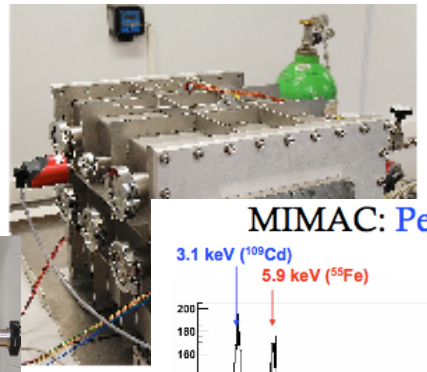
James Battat DM-TPC

4Shooter (20L)

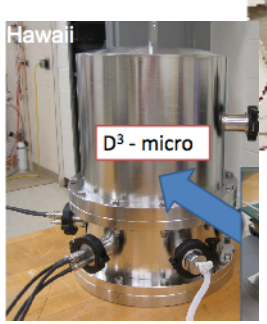
Track reconstruction in mosaic image



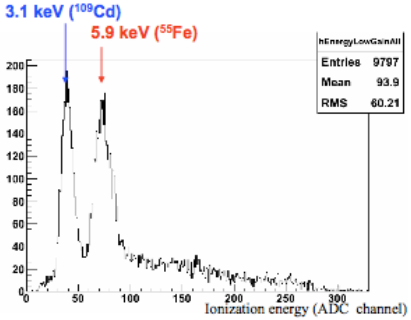
Daniel Santos MIMAC

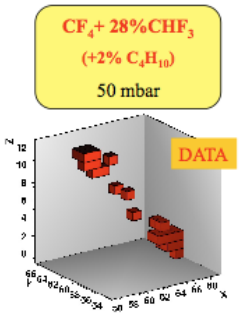


Sven Vahsen

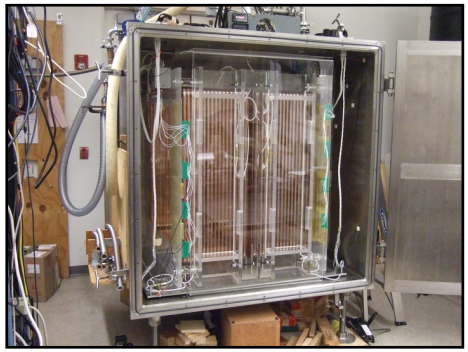


MIMAC: Performance at low energies

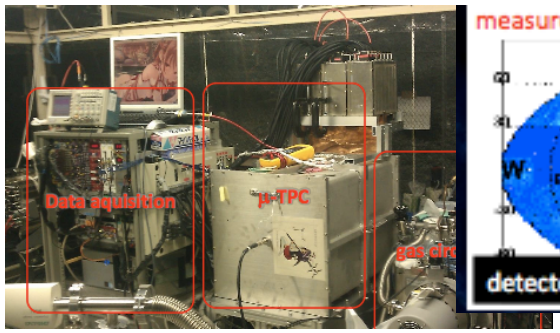


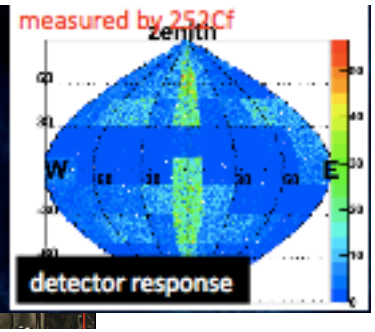


Dan Snowden-Ifft DRIFT IIe



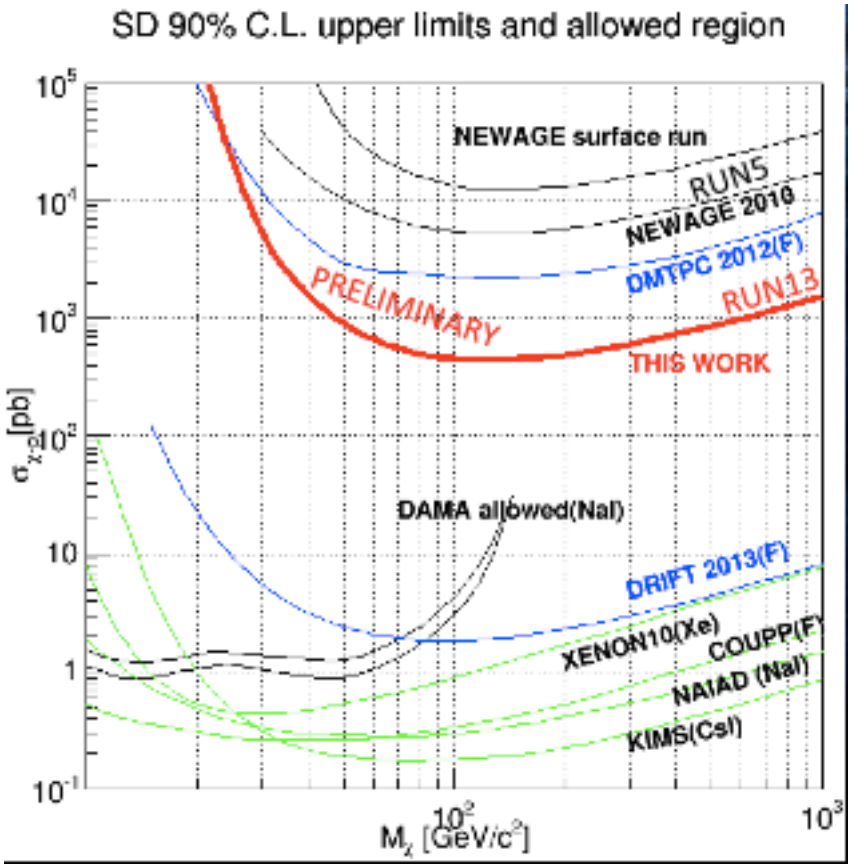
Kentaro Muichi NEWAGE





Prize for new limit…

Kentaro Muichi NEWAGE



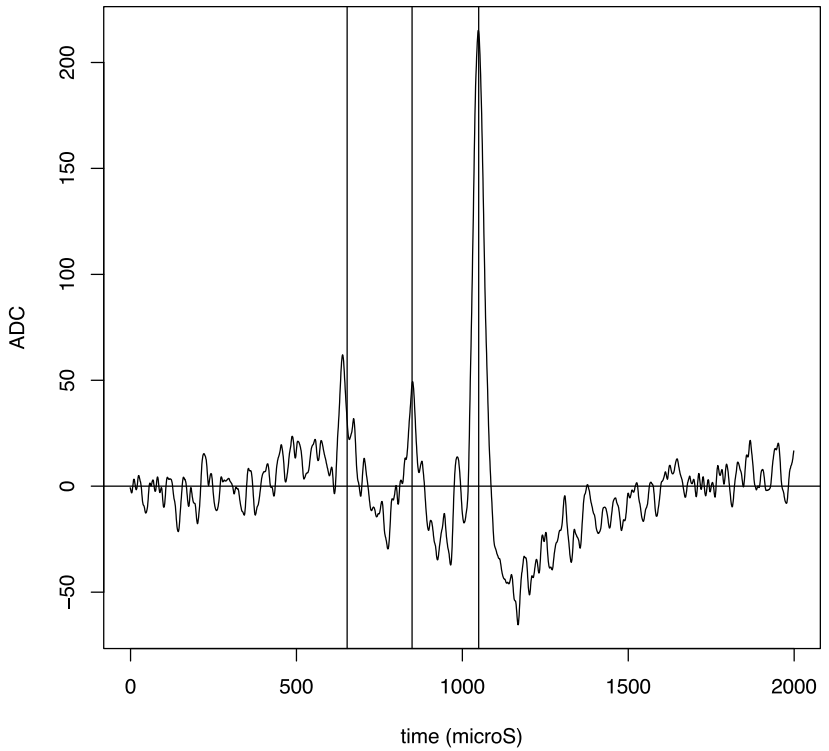
Prize for best biggest progress...

Fiducialisation with Oxygen

Dan Snowden-Ifft

Before O_2 Fiducialisation

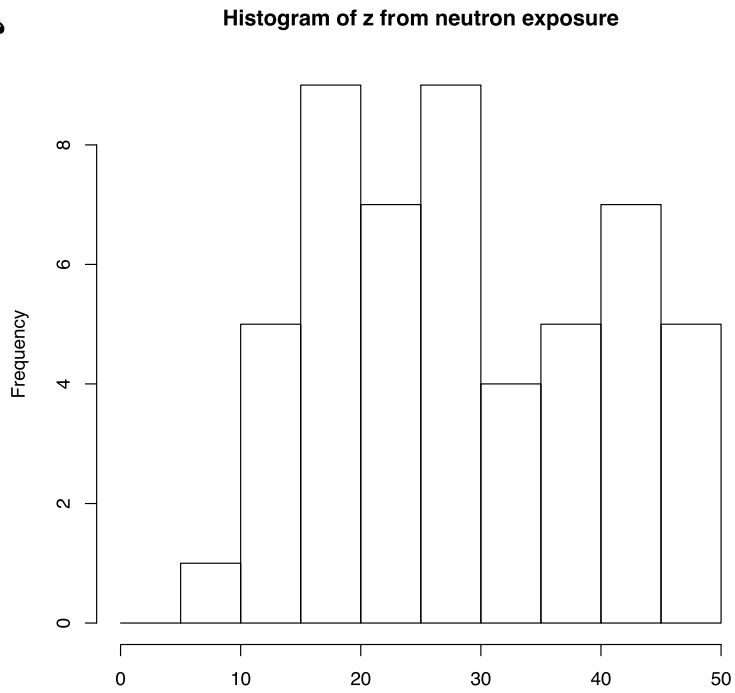
WIMP efficiency ~5%



After O_2 Fiducialisation

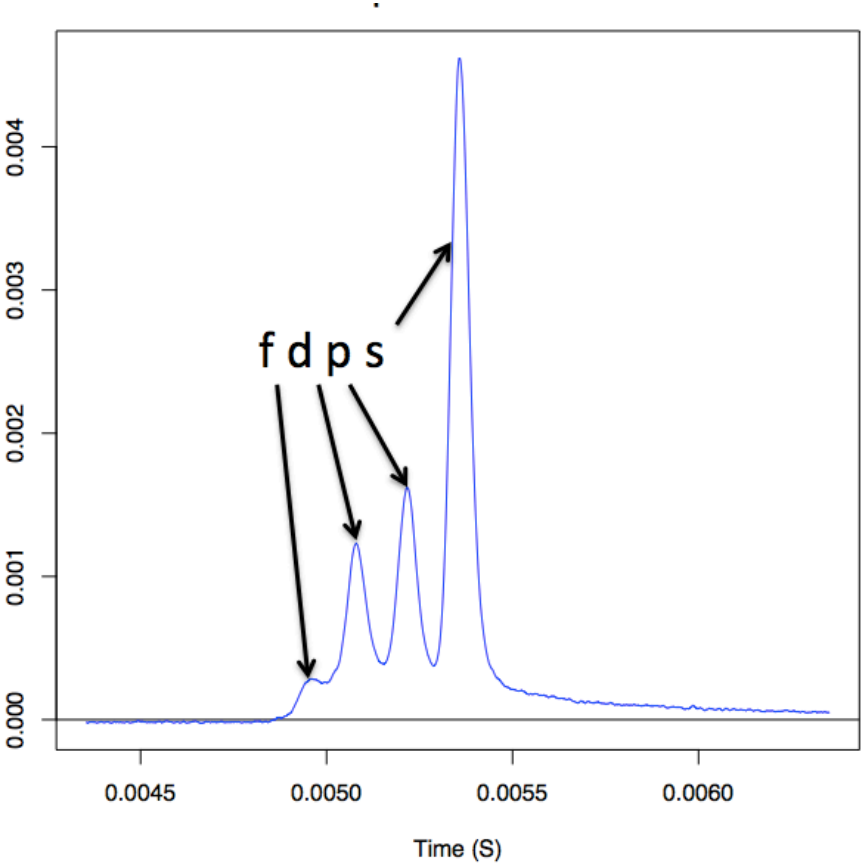
WIMP efficiency ~90%?

Nuclear Recoil Efficiency



Depth in DRIFT IId

But also Prize for biggest mystery…

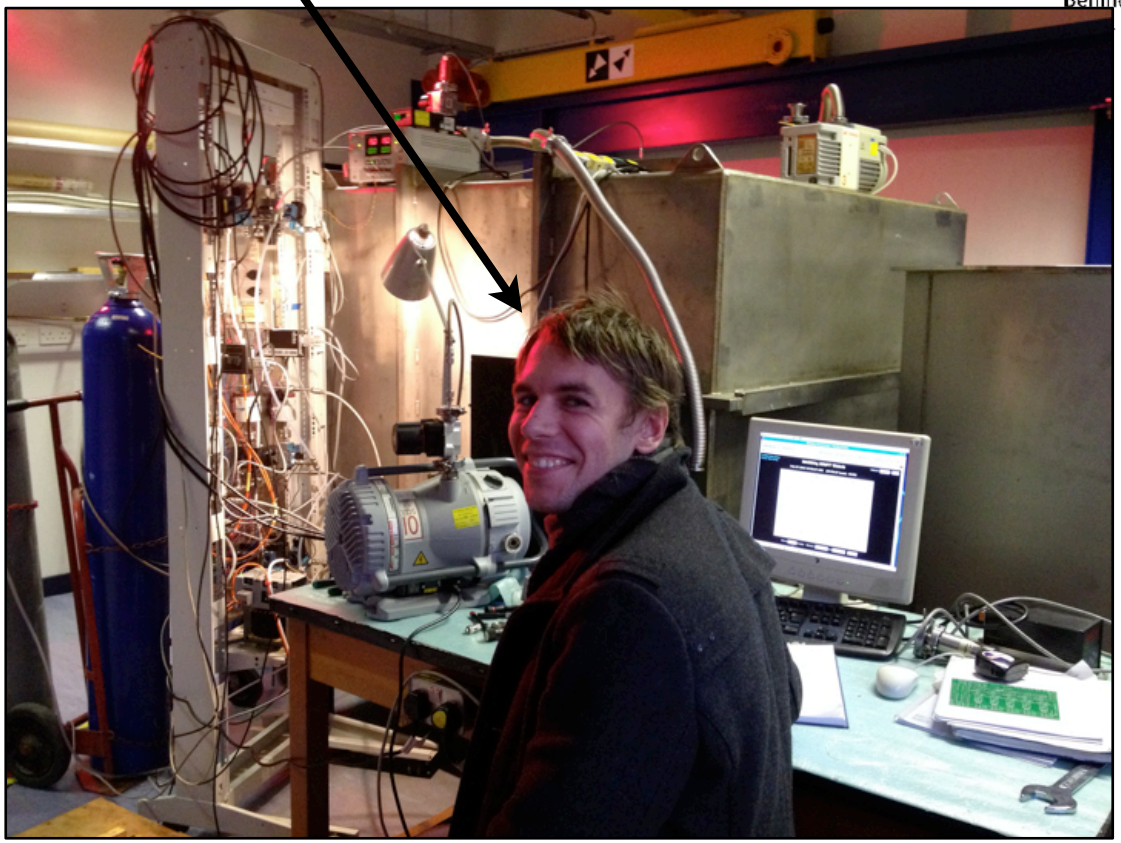


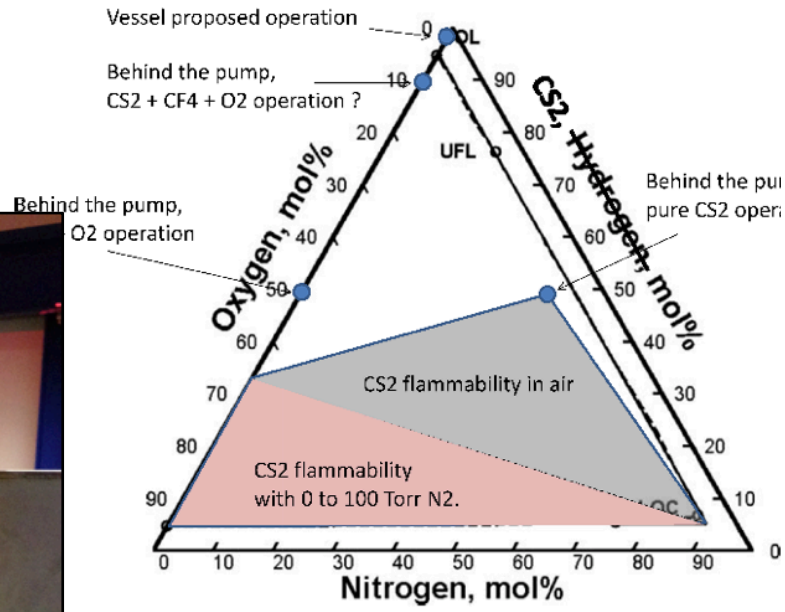
30 Torr CS_2 + 10 Torr CF_4 + 1 Torr O_2

But what causes it?

Prize for most dangerous activity…

Happiness comes from breathing CS_2 and O_2



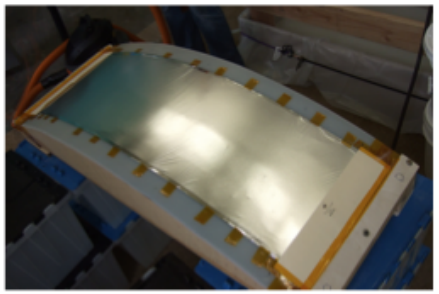


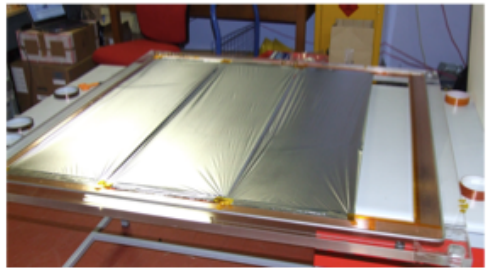
Leonid Yuriev (Sheffield)

First Prize - for most daring innovation to reduce background

to Eric Lee, Dimesh Loomba (UNM)

Thin film and texturised cathode





Dinesh Loomba

Texturization and Fiducialization:

Coup de Grace

(とどめ)

for RPRs?

Can we find a directional technology in a solid/liquid

David Nygren

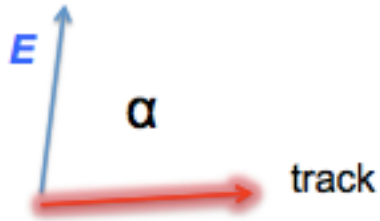
It would be nice!

But a long history of looking has not so far produced much

- Stilbene
- Rotons in Lq He
- Phonon focussing
- Multilayers….

It is hard…

Substantial CR



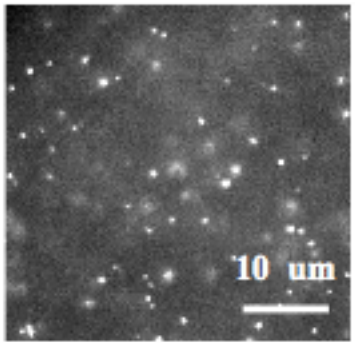
~No CR

- WIMPs exist with mass 50 – 300 GeV? Not sure…
- Head-tail effect? Not sure…
- Penning efficiency? Not sure…
- Reduction of Fano factor? Not sure…
- How much drift field? Not sure…
- How much TMA? Not sure…
- Do transfers happen quickly enough? Not sure…
- Behavior of TMA in large system? Not sure…
- Optimal conditions:
  - Identical for both WIMP and 0-ν ββ? Not sure…

Prize for most likely dark horse... Emulsions

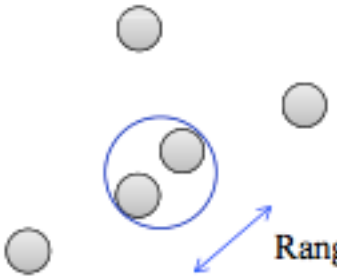
Takayoshi Katsuragawa Takashi As

grain size, 18nm, is record

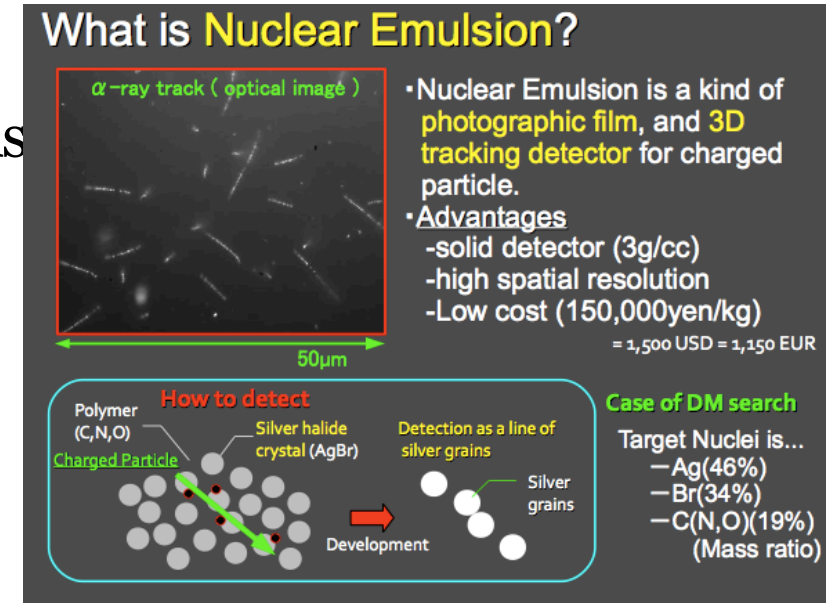


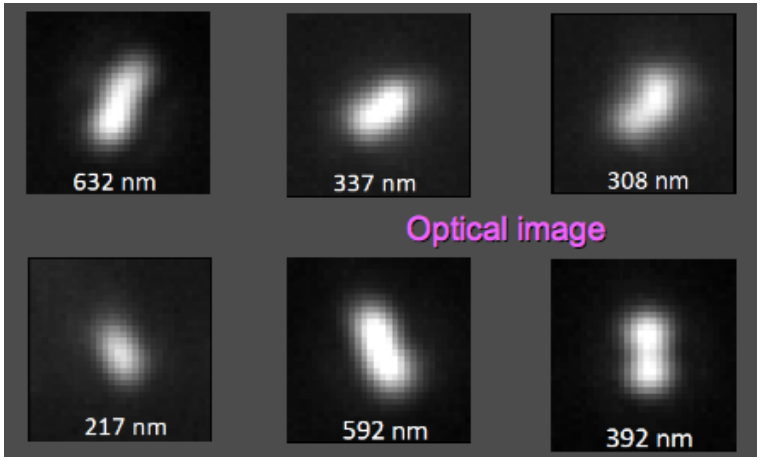
With developing, unexpected silver grains are generated at random.

If they are generated too close, they become noise tracks.



We can only do 0.1g mass experiment without BG





Annual Modulation (or not)

PICO-LON (Ken-Ichi Fushimi)

low background control, problem of NaI supplier
use PSD
elastic and inelastic

good purity results - 300 microBq for Pb-210

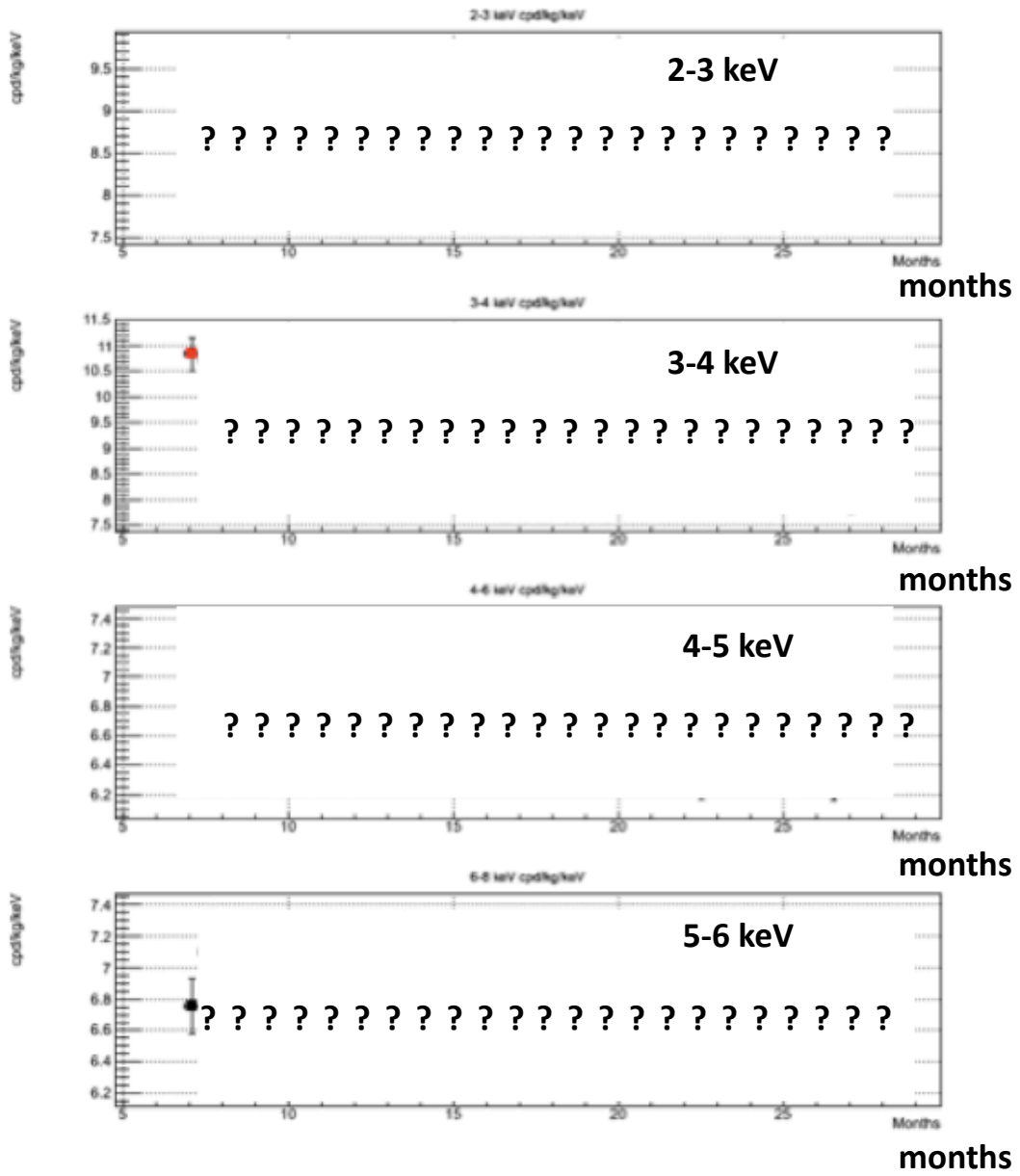
KAMLAND-PICO put NaI in KAMLAND

most serious background is...

Prize for worst data….

DM-ICE (Neil Spooner)

- **24 months data analysed for modulations**
- **Results coming soon!**
- **Remember this is for 17 kg NaI, with background ~x7 DAMA in low enery region**



LXe/LAr

XMASS/ANKOK

Oh no not another non-directional detector

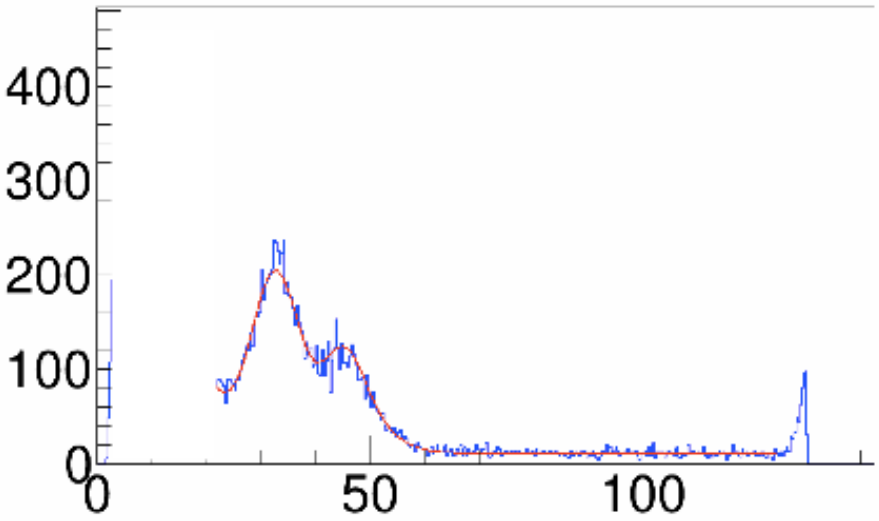
Technical Challenges Ahead

There are three big challenges

Radon, Radon, Radon,

Prize for the biggest shock when you go underground…

Spectrum of nuclear recoil tracks detected at Modane (coming from the ^{222}Rn chain decay, surface events) and the alpha particles through the cathode…



Mon Dieu c'est RPRs n'est pas..!!

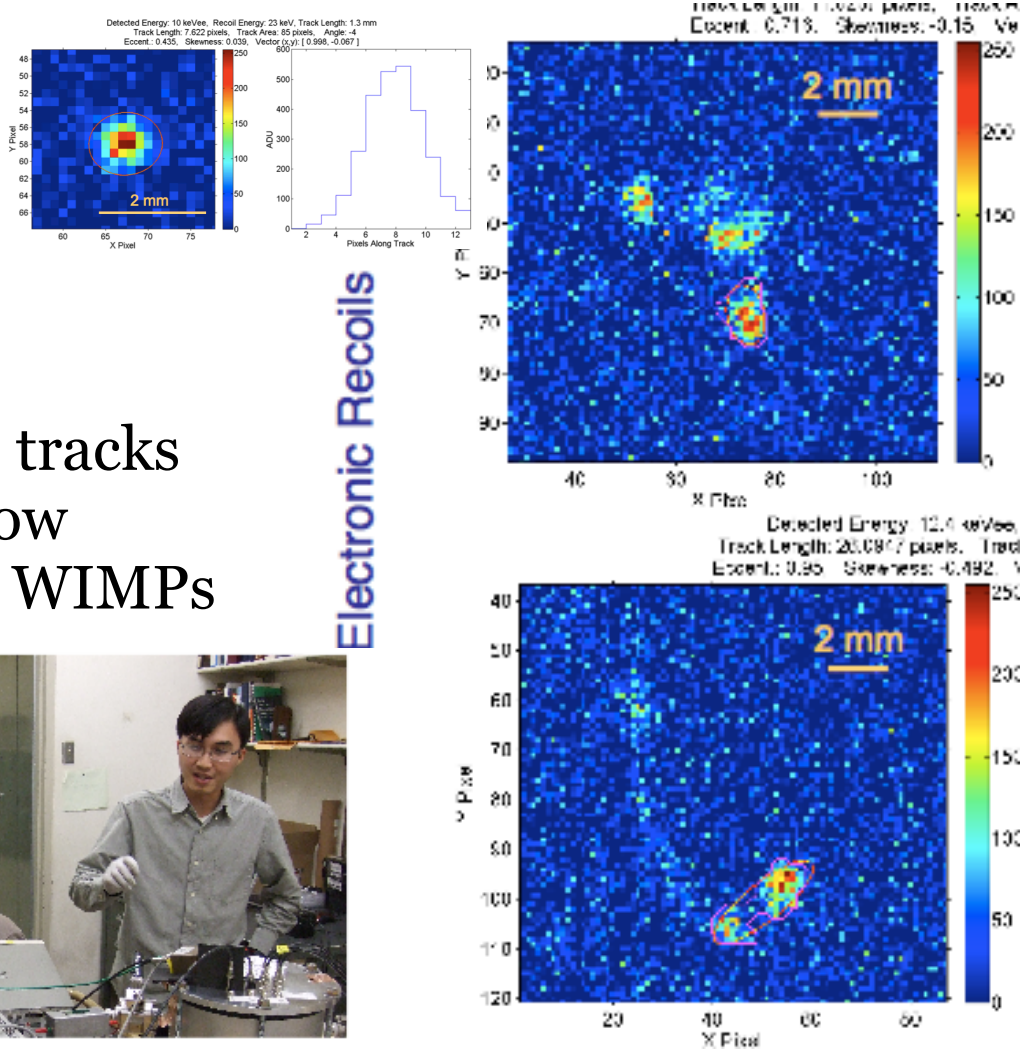
Daniel Santos (MIMAC)

Of course other challenges..

Need low thresholds to see dE/dx of electrons at low energy...

Prize for the most blobby result

very low energy electron tracks look blobby so without low threshold might mimick WIMPs

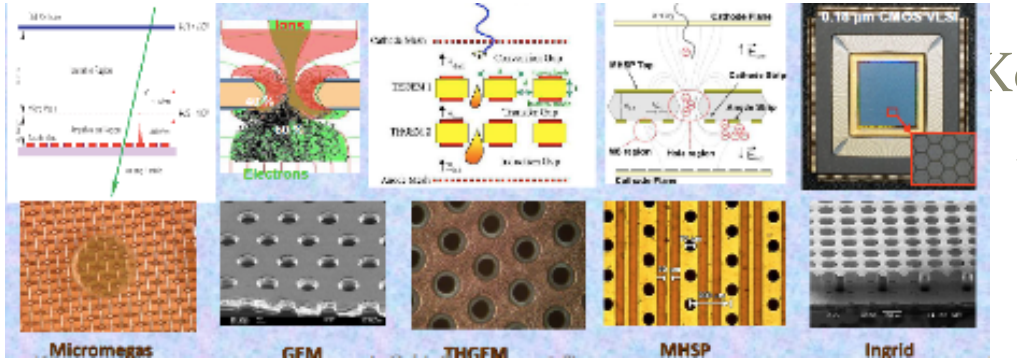


Nguyen Phan (PhD student, UNM)

Dinesh Loomba,
Nguyen Phan (UNM)

New Technology

Many readout technologies....

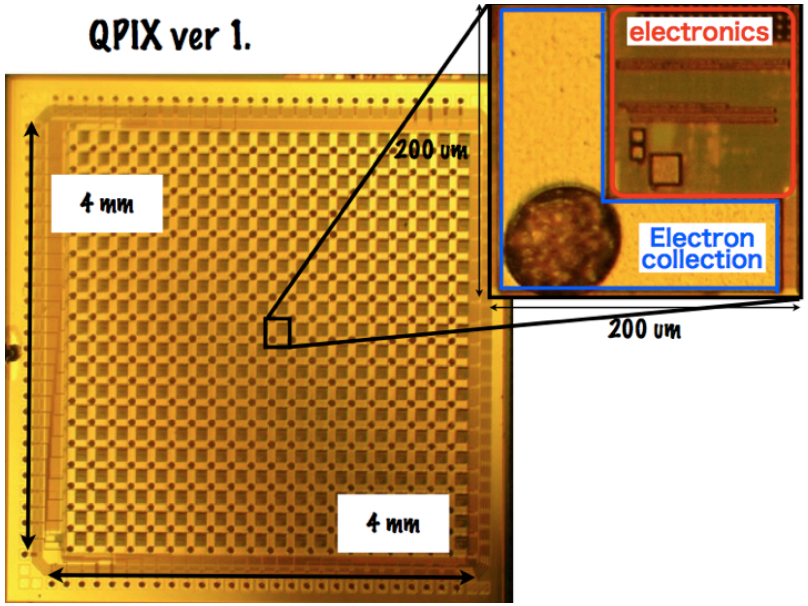


continuous development means may be things will be a lot easier in years time...?

Kobe University

Atsuhiko Ochi

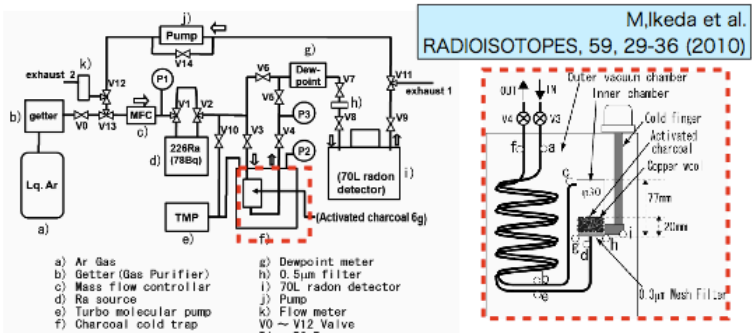
Akira Sugiyama



Radon work is vital....

Keishi Hosokawa

Radon extraction from gas/water



M,Ikeda et al.
RADIOISOTOPES, 59, 29-36 (2010)

CYGNUS Complementary Expertise

An atonishing array of skills needed, and that WE HAVE

electronics
background
engineering
chemistry
computing
....

So Finally Congratulations to Us..

We keep going despite the difficulties

We can do the Dancing for WIMPs

Next CYGNUS.....?