

## Minutes, CYGNUS meeting, Dec 2<sup>nd</sup> 2015. Written by Sven Vahsen.

### Attendance

Elisabetta Barberio, Sven Vahsen, Hiroyuki Sekiya, James Battat, Dan Snowden-Ifft, Kentaro Miuchi, Neil Spooner (chair), Elisabetta Barachini, Camille Couturier, Daniel Santos, + one person identified by Uber as calling in from Bakersfield (**FIXME Sven: who was that?**)

### Agenda

First heard brief updates from groups that had not reported in recent meetings, or that had news since then.

#### (1) Dan Snowden-Ifft on DRIFT status, followed by discussion of CYGNUS goals by many

Dan: Have collected and analyzed 55 days of background-free data underground in Boulby. Taken approx. twice that amount of data. Currently technical problems w/ broken wires. Jan-Luc and Dan will be at Boulby in January. Hence the desire to have the CYGNUS meeting there.

Dan on goal for CYGNUS efforts: "Only reason to have a CYGNUS collaboration is to build a big detector. If only interested in R&D, there is no reason to have collaboration. I'm only interested in conversation about building a big detector. Only hope is to build what works, i.e. DRIFT detector."

This triggered a long discussion.

Sven: Directional sensitivity also matters. Needs to be part of optimizing detector. Number or recoils to exclude isotropy in galactic coordinates should be part of Figure Of Merit. Not just exposure. Is directional sensitivity clearly quantified for DRIFT, and good enough?

Dan: agreed that this is a consideration, and a number exists for DRIFT.

James: another way to look at it: is scaleup the right thing to do? No matter how large a directional detector we can realistically build in the near future, it will only probe cross sections that have already been excluded, hence not find anything. One could instead focus on improving directional sensitivity in a smaller detector, in a way that can be scaled up in the future.

#### (2) Daniel Santos on CYGNUS plans and MIMAC activities

Daniel: All people working on TPCs share the same problems. Should decide what type of TPC we would like to build together. Should demonstrate what we can do on the low-WIMP mass region. I think we don't yet have a detector that can do this ready. I think we (the different TPC groups) can converge on one large TPC detector in the next year. We have all the elements to work together to build a TPC targeting low-mass WIMPs, 10-keV nuclear recoils tracks, with ability to change target.

Neil: what about your proposal for China?

Daniel: In France, we have proposed to build a  $m^3$  with 200-300 micron resolution and 3-D readout. We are waiting for phase 1 selection (~600 keuro). Should be enough to build one  $1m^3$  scale detector. If we pass this phase 1, we should be in a good position to work on a larger, unified detector as a larger collaboration. Proposal decision expected in Feb 2006.

Have signed MOU with Tsinghua University (Beijing, China).

Last week: have combined co-MIMAC and MIMAC setups to measure different types of recoils (e.g. Flourine) with known kinetic energy, versus drift distance etc. Doing this in collaboration with Chinese team. Problems with MIMAC gas quality. Trying different gases now (He-4+isobutane). Characterizing quality of 3d tracks.

Neil: have you considered SF6?

Daniel: yes, have tried it, and seen some signal, but with low gain. Plan to study it more. Need a larger data buffer in readout to take data with the slow SF6 drift time, but it should be possible.

### **(3) Neil on CYGNUS proposal, w/ lots of discussion**

Neil: have looked at what is needed to get 400 kg of target. SF6 gas, 2-300 micron resolution, 100 torr pressure, volume similar to Icarus TPC (20 meters long)

Sven: need pressure closer to 20 torr, to get sufficiently low directional energy threshold ( $\leq 50$  keV). Especially for low-mass WIMPS. Tracks will be too short at 100 torr to get directionality at required energies ( $\sim 50$  keV recoils).

Dan Snowden Ifft: CS2 works. SF6 may not. Would like to distinguish between CYGNUS collaboration and R&D.

Daniel Santos: Before 1 tonn detector, need to show low-mass (low-energy) 3d tracks with good quality. None of our detectors, even MIMAC, have shown this with good fiducialization. Need to improve our detectors before considering 1 tonn directional detectors. This is one of our week point seen from the rest of the community. Need to show very low ionization threshold + good 3D quality tracks.

Dan Snowden Ifft: agree partially. A 1 tonn detector would have a certain appeal. But important discussion is: what's the next step, i.e. a  $10 \text{ m}^3$  detector? I don't think we have to get everything right to go to the next size scale. Think we can propose to build a known solution for  $10 \text{ m}^3$  scale, and include in that proposal a path to improving the performance as well. Many detector elements (field cage, vacuum vessel) in common for any detector we might consider. In some sense, readout and gas are details.

Neil: People want to see that you have ambition. At the same time, you have start with something that works. But it has to be part of a larger program.

Santos: If we can show  $1 \text{ m}^3$  with all features we need, then it is easy to scale up. Can just multiply the  $\text{m}^3$  detector. I am not convinced we have the  $\text{m}^3$  ready. DRIFT has shown some fiducialization that seems to work. If MIMAC readout can cope with negative ion drift (NID) from CS2, and we can see 10 keV F tracks with good quality... that could be a nice CYGNUS R&D project, coupling MIMAC readout with DRIFT's Negative Ions. May convince community that we are ready to build a  $10 \text{ m}^3$  detector.

### **(4) Kentaro on Newage status**

Has done tests of GEM+mupic detector with CS2 and SF6. Good gain with CS2 ( $>10\text{k}$ ). SF6 gain  $\sim 2\text{k}$ . So not as high gain with SF6. Kentatoro's proposal result is coming next April (1-2  $\text{m}^3$  detector).

Have some funds in proposal for new ASIC design for 100 x slower readout (for NID) with high segmentation. Would like to collaborate with some of you on readout R&D. Will also make m<sup>3</sup> vessel in Kamioka. Would like to make it like an observatory. If you are interested, you could put your readout into one of the modules inside the vessel.

Neil: Did you ask for two vessels, or one? Kentaro: one vessel.

**(5) Elisabetta on becoming a CERN-recognized experiment**

[**FIXME SVEN: There was a lot of static from someone else, I may not have heard everything.**] Update from CERN and Australia: Has checked with CERN. If an experiment does not need to use a CERN accelerator, or is not connected to R&D at CERN, then it needs to go through hosted experiment procedure. Then the first requirement is that the experiment is funded by a funding agency. [FIXME Sven: something more about funding, could not hear what she said]. CERN is quite strict. Perhaps it's better work at KEK?

**(6) Giovanni on CYNUS physics goals, Gran Sasso:**

Have written a first draft of physics goals for the CYGNUS collaboration. From the emulsion side we have a project feasibility study funded by INFN, for the next 2 year, to build small prototype to show feasibility for much larger detector to be built. Personally would be in favor of merging efforts of larger collaboration for a common goal.

Neil: I was recently at Gran Sasso. Asked if Gran Sasso would welcome a large TPC project. The answer was yes. There is space. If there was a way to bring more Italian groups into a project there, that might have some merit.

Elisabetta: Stefano would really like to host this experiment, especially now that Opera moved out, there is quite a bit of space at Gran Sasso.

**(7) Sekiya on recent progress**

1cm size zinc-tungsten crystal fabricated. Getting ready to measure directionality. Will use gammas first, then CF-252 neutron source. Energy threshold.

Dan Santos: What is energy threshold? A: so far, only tried MeV region particles.

**(8) Neil on scheduling a CYGNUS workshop:**

Quite a bit of discussion. The upshot: We converged on holding the meeting on January 8<sup>th</sup> and 9<sup>th</sup>, a Friday and Saturday.

**Action items:**

Neil to check on video conferencing for the CYGNUS workshop in January.