**Minutes, CYGNUS Phone Meeting, 8/12/2015. Written by Sven Vahsen.**

**Attendance:** Elisabetta Barberio, Sven Vahsen, Giovanni De Lellis, Dinesh Loomba, Jocelyn Monroe, Hiroyuki Sekiya, Dan Snowden-ifft, James Battat, Antonio Polosa, Elisabetta Baracchini, Kentaro Miuchi *(Due to a limit on 10 participants in the conferencing system used, potential participants may have been unable to connect. Elisabetta and Kentaro were only able to attend part of the meeting for that reason.)*

**Meeting Agenda**

1. update on actions from last meeting(s), which were
* Determine whether SRS can cope with the slow signals. ACTION: **James** to contact Hans Muller at CERN.
* Perform GEANT4 simulations needed to check sub-10keV gamma and micromegas backgrounds. ACTION: **Neil/Frederic Mouton**
* Determine how the proposed gas TPC work here fits with work on non-gaseous techniques. Are there areas that can make a common proposal?
* The next phone meeting will be in around 3 weeks. Hopefully this will also fix dates for the proposed face-to-face meeting in January 2016. ACTION**: Sven** to arrange

(2) recent progress from each group relevant to CYGNUS, science and funding

(3) updates on CYGNUS papers

(4) discussion on possible CYGNUS proposals - low WIMP mass TPC, large TPC, multi-site, multi-technology, other

(5) discussion on formalizing a CYGNUS collaboration, bylaws, MOUs

(6) web site and doc server

(7) next meeting

**Minutes**

**(1) update on action items from last meeting:**

James has contacted Hans Mueller. SRS readout system has a number of different front end modules with different shaping times etc, none of which are optimized for the slow signals expected from Time Projection Chambers with negative ion drift (NID). Cost is 2-3 Euro per channels for thousands of channels, including everything. Which nothing off-the-shelf would work with NID, new generation of front ends is under development, and these could be adapted to NID. (The existing frontend could, however, be suitable for electron drift. There is CERN interest in engaging about CYGNUS needs. **September / October timeframe is critical for getting involved and communicating our need to them.**

Jocelyn and Neal comment: Would be great to get CERN involved. SPSC (SPS and PS experiments Committee) accepts proposals for beam-line / test-beam projects. Cost sharing between proposers and CERN is possible. Elisabetta Barberio comment: CERN can get involved in R&D, but not in off-site activities. Jocelyn: What does it take to become an affiliate experiment? **ACTION ITEM**: Elisabetta Barberio will inquire at CERN.

 **(2)  recent progress from each group**

* Giovanni (emulsions): Need to fix scientific goal. Can have multiple technologies. Gas detector and emulsions. Two prototypes in same laboratory? Two prototypes could coexist in the same laboratory with interesting synergies between each other. Example science goal: Masses of 10 GeV or heavier and 10^-40 cross section. Gran Sasso might be interested in being more involved. There's good will. Future meeting at Gran Sasso? A future meeting at Gran Sasso would help the process of getting the Lab more and more involved in the directionality approach.

This led to some discussion: Dan comments: DRIFT’s limit is expected down below 10^-40. Be more ambitious. Neal comment: what is directional sensitivity? Not just limit. Jocelyn: definition of scientific limit must include directionality. Otherwise we're just one more of 10 other direct detection limits. Neal: Are there prospects for Gran Sasso support? Giovanni: Thinks yes, there is growing interest in directionality in INFN.

* Jocelyn (DMTPC): Commissioning our cubic-meter detector on the surface at MIT. Operating stably at 30 torr. Instability in amplification region design. D-D calibration source run starting in October. Using new charge readout with higher bandwidth and higher rate capability. Want to use shape of risetime pulse to measure longitudinal diffusion (as shown by Kentaro at CYGNUS 2015). Looks clear that deployment at WIPP won't happen. Exploring other option, including SNOWLAB.

Interested in pursuing funding for the next scale. Construction grant of DMTPC now finished. Right time to secure funding for engineering of next detector scale-up. Interested in exploring European Network funding (**Sven: Joceclyn, what is the official program name?**).

There will be new direct detection results, close to 10^-46 level this year. If we get to 10^-47, a competitive directional detector will be very challenging. Horizon 2020 funding is a possibility. (Sven: <http://ec.europa.eu/programmes/horizon2020/>). A proposal could involve arriving at an engineering design for CYGNUS. What happens next in DMTPC depends on performance of detector. This might be the right time for pursuing a 10's of cubic meter.

September 29th – Horizon 20/20 call for FET (Future and Emerging Technologies) open. Eenables blue-sky research. Could imaging building 4x4x4 detector and instrumenting part of it.

Multi-technology approach seems sensible. Emulsions surrounding the gas part?

* Sekiya: no update on crystals. Agrees with Giovanni on defining the scientific goal to make a common proposal with non-gaseous techniques.
* Dan (DRIFT): Received funding to keep DRIFT in operation for another three years. Minimal funding, so only that. Should be able to improve limits by another factor of 10.  Spin-independent cross-section limit currently around 10^-40, expect to reach 10^-41.
* Sven (D^3): Latest TPC prototype w/ pixel chip readout currently at D-D generator test at Berkeley Lab. It is now a robust device that can be deployed. We’re current in production, building eight such detectors to be deployed as fast neutron detectors at KEK in Japan. Two of Sven’s students have started on the next-generation detector, which will have a plane of pixel chips and negative ion drift, starting with SF6 for safety reasons. This activity is supported by the remainder of Sven’s startup funds. Work in future years will require new funding. Explored this with DOE’s (US Department of Energy’s) site monitor for the University of Hawaii. DOE (which is funding Sven’s accelerator-based work) did not seem enthusiastic about directional dark matter detection. But DOE is now compartmentalized into “Frontiers”. Sven will explore with the Dark Matter and Detector R&D Frontier contacts at DOE.

Neal comments: DOE is funding directional R&D at Argonne, on Xenon columnar recombination.

 **(3) Papers:**

1. James: Readouts paper is mature. Pixel chip readout internal review ongoing (Kentaro, Sven, Elisabetta). New drafts from other groups exist. MWPC + Optical readouts need work.
2. Physics Reach Paper (led by F. Mayet): Letter of intent submitted to journal Physics Reports. Journal sounds positive. Goal is September submission.

 **(4) discussion on possible CYGNUS proposals - low WIMP mass TPC, large TPC, multi-site, multi-technology, other.**

Neil proposed that Giovanni take a stab at formulating a physics goal. **Action: Giovanni** to draft a physics goal.

Dinesh (DRIFT): Many elements of a large directional detector are now in place. Low background demonstrated at cubic-meter scale in DRIFT. SF6 R&D at New Mexico encouraging, etc…

[This led to a discussion on SF6 R&D. Dinesh also disclosed some of the drawback / concerns he has, where more work on SF6 is still needed and in progress at New Mexico: Only gotten gain with thick GEMs, and it's not uniform. (Have not tried thin GEMs. New Mexico is beginning thin GEM tests next). Energy resolution is not great. Diffusion a bit higher than expected. Directionality of F in SF6 has to be understood.

**(5) discussion on formalising a CYGNUS collaboration, bylaws, MOUs**

Postponed to future meeting, due to lack of time.

(**6) web site and doc server:**

**Action: Sven** will set up a CYGNUS section on the Hawaii Indico server.

**(7) next meeting**

**Action: Sven** will arrange next phone meeting in ~4 weeks.

**Action: Elisabetta Barberio** will set up a phone system solution for > 10 callers. (Vidyo was proposed by someone, but requires CERN membership. S[ven comment while writing minutes: The Uber system worked well, except for the caller limit. I suggest we try the paid version so that > 10 people can connect?)]

**Action: all: need to finalize location of in-person meeting.** [Sven comment while writing minutes: Originally Hawaii in January was discussed, but this conflicts with potential DRIFT installation work in England. Would someone like to arrange a meeting in Europe? Gran Sasso? If people are willing to come to Hawaii, we can still host. But we would need to know soon.

**Summary of action Items**

* **Action**: **Elisabetta** **Barberio** will inquire with CERN about what is required to become an affiliate experiment.
* **Action: Giovanni** to draft a physics goal.
* **Action: Sven** will set up a CYGNUS section on the Hawaii Indico server.
* **Action: Elisabetta Barberio** will set up a phone system solution for > 10 callers.
* **Action: Neil/all:** need to finalize location of in-person meeting.