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Subject: DUSEL DM WG White Paper outline
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Dear colleagues,

Thanks again for your participation in the DM WG at the DUSEL Town Meeting. Following the parallel and plenary discussion on Sunday, we have revised the outline for the white paper, which we append below. We will begin writing based on this outline, though we also invite comment by email. While general remarks are welcome, it would be most helpful if suggestions made are as specific as possible.

We do not yet have a firm deadline from the S1 PI's, but the expectation is that we should aim to complete the paper by the end of next week (16 Nov) and post that version for a two-week comment period.

Thanks again for your past and ongoing help with this task.

Best,

Dan Akerib and Rick Gaitskell
DM working group conveners

A4: Dark Matter Working Group White Paper Outline

- DM is "Flagship Science"
- Strong emphasis on discovery potential

- Current Sensitivity of DM experiments $\sigma_{SI} \sim 10^{-43} \text{ cm}^2$
- Experiments for DUSEL ISE (Initial Suite of Experiments, construction 2012->) will likely have goals for σ_{SI} reaching at least 10^{-46} and beyond
 - The dm field is moving rapidly, so the goal for the ISE needs to exceed not just those of the current generation of detectors under construction/operation, but also the next generation following them
 - This will require minimum fiducial mass for ISE experiments of ~ 1 tonne, with 1-10 tonne fiducial likely
 - This level of mass may be a challenge for some of technologies
 - By the time of ISE operation there may already be signals (due to particle(s) beyond std model), either in an earlier dm experiment, dm indirect detection, or from LHC

- Field must present a strong plan to address science case broadly
 - search and discovery mode
 - Multiple detectors to ensure robust evidence of signal, with independent methods/targets
 - Strategy to scan both SD/SI couplings to cover parameter space
 - Large detectors to investigate to $\sigma_{SI} < \sim 10^{-46} \text{ cm}^2$
 - Exploitation (post discovery) phase
 - Large Detectors (Scale up by 10-30 fold on discovery instruments)
 - Multiple targets to determine WIMP mass and couplings (SI A^2 , SD-p, SD-n)
 - Directional -- R&D still necessary to cost/scale once known cross section
 - The field requires multiple targets likely chosen from F, Ar, Xe, Ge, Ne, I

- The community feels strongly that within the field as a whole that any down selects of supported technology should not be premature.
 - The MREFC presents a special opportunity for the funding of a (limited) number of big dm search instruments
 - At the same time the field will require continued support for research and development in wider range of technologies, which may be outside MREFC, but is important part of continued agency support and vitality of long-term beyond ISE

- So the strategy for MREFC submission recognizes that:

(A) Some of the current detector technologies could possibly match the proposed facilities MREFC submission timetable of Feb 2009

for the PDR (Preliminary design review, equivalent to ~CD2) level, and could certainly match a PDR-lite, followed by further stages of review

- The schedule will be very demanding, and will require support from specialists in PDR submission
- Softening in some of reporting requirements for submission -> "PDR-lite" would help.
- In some cases, the PDR will detail some options for a technology choice, eg, readout method for a target type, which could facilitate cooperation in the near term

(B) Other readout methods are still subject of R&D for targeted ISE sensitivity range

- (1) The performance of the technology and the associated dm sensitivity may not yet reliably be extrapolated to tonne scale
- (2) There are significant uncertainties in cost of large instrument

The white paper should list current detector technologies, and indicate likely readiness for MREFC by addressing the following points (to eventually be expanded in full proposals)

- We should provide \$ and FTE estimates of existing programs
- We should attempt to list technical readiness for MREFC
- What additional R&D is required in various techniques
- Future dm sensitivity and factors affecting uncertainty, with assessment of which improvement factors are justifiable extrapolations, less certain extrapolations, or targets that are subject of further R&D
- Likely cost estimates and factors affecting uncertainty
 - Typical costs of \$20-50M for 10 tonne fiducial experiments
 - DOE/International component (Not yet able to make estimate of contribution)
 - some potential saving for re-selling commodity materials, eg, xenon
- Manpower requirements (FTE)
- Should paper suggest cost of total dm program within MREFC (ie what fraction?)
 - Re-examine cost matrix: appears feasible to build broad program
- Can it be argued that smaller experiments, not at forefront, still have a role in ISE to enhance program for next phase
 - Is there a way to get R&D into MREFC?
- There was a request that the paper also include a decision tree indicating what information is still needed for determining optimum ISE composition.
- Include a suggestion for purchasing programs for accumulating target materials over a period of time for multi tonne experiments, especially if isotopically enriched material is needed.

(- Other sub-disciplines intend to make aggressive case for significant fraction of MREFC money. Likely oversubscribed.)

- It is apparent that some designs for dm detector are really multipurpose experiments
 - DBD and pp neutrino seems possible with 10 tonne detectors
 - important not to compromise primary goal
- Notes on use of S4 Money
 - fund individual collaborations (some jointly, at this level) to make detail design
 - very little of this funded effort would be in time for MREFC (Feb 09)
 - primarily for completing construction-ready design by MREFC construction
 - Many groups would need extra time (can MREFC ISE-component for PDR deadlines be extended?)
 - Note that the S4 does not define an MREFC subset, eg, international component
 - Can S4 fund a working group to continue this coordination
 - What is the expected role of Homestake PAC and DMSAG?
 - > is this sufficient input to shape S4 for DM?
 - Mode of S4 submission
- Other questions that should be addressed in the white paper
 - Why can't we do the priority science at other (existing) underground labs?
 - U/G space at existing labs for deep (<= 3 kmwe) is very tight for 1-10 tonne fiducial exps.
 - US dm program benefits from domestic synergy - improves chances of leading field with best sensitivity
 - What are our expectations about DUSEL lab support?
 - What assistance is required for PDR submission?
- E&O