

Questions and answers - Dan Akerib

The following questions were submitted through Zoom Q&A. Some / all may have been answered in the Q&A session already. Nevertheless, we request our lecturers to provide written answers here for the benefit of those who could not attend that session. Thank you!

(1) Page 16 shows a neutron background with several scattering sites. Can those scatterings be correlated in the data, for example by timing? *Yes! The events are recorded simultaneously and multiple scatters are rejected as dark matter candidates, as well as used to benchmark Monte Carlo simulations of the ambient neutron flux.*

(2) What are the prospects of future LXe experiments to detect DM via an annual rate modulation? *Very challenging... since the modulation is only about a 2% effect, hundreds of events would be needed. Since the current generation of detectors has ruled out WIMPs at 4-tonne-years of exposure, having a such a large sample to see a 2% seasonal effect seems implausible.*

(3) In the discussion of neutrino floor / fog, I think you mentioned it is partly due to knowledge of neutrinos. How much improvement in neutrino knowledge would be needed to make a difference? *If the error on the flux were reduced from 20% to something lower, the systematic error would be reduced linearly. Eg, reduction to 4% would allow a 5x improvement if sufficient exposure could be obtained.*

(4) What are the advantages/disadvantages of doping LXe with certain substances; is there any plan of doing this for LXZD? *One prospect under active investigation is "HydroX" - now in the R&D phase - which would dope the LXe with molecular hydrogen or other hydrogen-rich molecules. This would provide a better kinematic energy transfer for light WIMPs (eg, comparable to the proton mass). The disadvantage, which we are studying, is that negative impact on signal size, ie, would the energy threshold be compromised to the point that there no overall gain in sensitivity.*

(5) Was detectors in DAMA experiment ever analyzed to find what is their composition to find out why they do have a signal? *Not to my knowledge. There is a rich literature on claims by DAMA and refutations by other investigators.*

(6) Is ruling out the parameter space up to the neutrino floor the ultimate death for WIMP? Or is there still some hope? *For direct detection, I think it's extremely challenging to go further. That said, indirect detection or discoveries at colliders offer other vantage points on WIMPs. Also, see question 3 - perhaps the floor gets pushed down further.*

(7) Why is seasonal modulation different for northern and southern hemispheres? *I misspoke - it is not; what I'd intended to convey that many of the potential backgrounds have a seasonal variation due to winter/summer temperature effects on the planet and in the atmosphere. For example, in the summer, the muon rate is higher - the warmed atmosphere is more rarefied and so more charged pions produced in cosmic ray induced cascade decay in flight to muons before undergoing charge-exchange reaction to neutral pion (which decays to two photons)*

(8) What are the advantages/disadvantages of doping LXe with certain substances; is there any plan of doing this for LXZD? *Repeat of Question 4...*