Tim Tait Lecture 3 Questions

Most questions were answered during the Q&A session. Original questions listed without correction for grammar/spelling, except some similar/related questions are merged. Where a slide number was given it is shown.

Slide 4: Is there some special relationship between the axion and the pion? Could you also relate the mass of the axion to the mass of another meson?

You could, but the pion is the dominant contribution because it is the lightest.

Slide 6: Would the existence of a sterile neutrino imply the existence of a sterile lepton counterpart?

No - because it is an SU(2) singlet (not doublet).

Slide 6: Can sterile neutrinos dark matter also be produced via Freeze out? Can they also be much heavier than keV scale?

They can. Usually they will decay too fast if they are much heavier, but one could dial down the mixing angle to compensate.

Slide 7: Could you speak a little more on why the x-ray signal only a possible one? What sigma was the original one at?

Large sigma, so it is not likely to be a statistical artifact. But it is not observed in some other places one would expect to see it.

Slide 5: Where does the XENON1T experiment's axion hypothesis recently published fit into this plot, and is it in tension with current astrophysical limits?

It is in tension with current astrophysical limits, but these limits also have large uncertainties that are being investigated.

Slide 6: Recently there have been stringent limits on sterile neutrinos (3+1) from reactor neutrinos and global fits, how does this fit with the sterile neutrino being DM? Can you comment on that?

These are in a different parameter space from the one where neutrinos are dark matter.

Slide 7: This 7 keV line looks like it could potentially be seen in earth-based TPCs, mainly I'm thinking that XENON reported seeing an excess of order-keV electronic signals. Do you think the collaboration should have looked into the excess being from sterile neutrinos?

Slide 8: I'm not sure if I understand completely: is this "simplified model" basically searching through a more general parameter space (of DM mass, mediator mass, of coupling), and seeing which overall combinations of values are allowed so far by data or not---instead of trying to test one particular theory at a time?

Right.

Slide 12: For these plots, are the coloured areas allowed or prohibited by ATLAS and CMS?

Each plot is a different: For ATLAS, the region excluded is within the solid black contour. For CMS, the colors explain limits on the scaled QCD cross section.

Slide 14: Why does the limits plot on the right have vertical stripes? It seems to be saying that the limit on coupling is much more sensitive to mediator mass than m_DM.

Correct!

No slide indicated: In the vector and scalar dark mediator theories, are these mediators then the bulk of what we see as DM, or are they in addition to the DM that makes up 25% of the universe pie?

Usually, they decay early on and are not the dark matter today.

No slide indicated: Could you explain again the difference between the composite dark matter theories and the dark SU(N)?

Dark SU(N) is an example of composite dark matter, but is not the only example known.

No slide indicated: During the computation of relic density, do you treat dark matter as fundamental or composite? For example, can confinement scales be lesser than the freeze out scales in general? Then how does the composite dark matter will show up?

If the confinement is less than T_F, it freezes out as partons. If not, it freezes out as hadrons. This changes the calculation significantly in the two cases.

No slide indicated: Would dark photons affect the electron g-2?

Yes! It's a great constraint on such theories.

Slide 12: For full models, what is typical range of Br(Z_v->chi+chi), and how do they influence the result ?

There is a wide range of possibilities from ~1 down to very tiny.

Slide about light mediators: Would the new ~17 MeV mediator have large influence on the spectrum of CMB if it really exists?

I don't think so, but I am not entirely sure. it seems heavy to play much role.

Slide 36: What's the difference between the meanings of the adjectives "favored" and "allowed" for the muon and electron g-2 values?

Favored means it helps explain the anomaly, whereas allowed means it is consistent with bounds from the electron g-2.

Slide about dark gluons: Are the dark gluons from dark SU(N) theories not also a type of dark force carriers?

Yes, they are!

Slide about light mediators: is it possible to form bound states of dark matter using the light mediator particles ?

Absolutely, yes!