

Script Alan Tennant short version

Prof. Alan Tennant recipient of the 2012 European Physical Society Condensed Matter Division Europhysics Prize

...on magnetic monopoles:

„What a magnetic monopole looks like is... it looks like a place where the north makes all these lines just come out... and the south where they all go in.

What happens is you... when you create them there will be one north and one south but they get lost from each other. Somewhere in the universe... they will separate completely and behave independently... and then you would have one place in space, where these magnetic lines just come out like all directions just coming out of a single point. And that is a magnetic monopole.

It's a magnetic source. So it is like a magnetic charge. You are familiar with this in electric charge. Electric charge has charge lines coming out of positive charges and going into negative charges. Here it's magnetic lines coming out of north poles and south poles. So it is a familiar idea it is just that in magnetism we don't have an equivalent of an electric charge. Now magnetic monopoles if you realise them do give you equivalents of magnetic charge. That's why they are special.”

...on the process:

“The reasons I had that this wouldn't work... for example, I knew from my background of looking at quantum effects and magnets. In quantum systems we are already familiar with a special set of tricks that allows us to break apart so called quantum numbers. Now the idea behind getting these north and south charges is very similar, closely related. So from the experience we already had with quantum systems we knew what could stop the whole thing working. There were about ten different experiments we thought of, eight of them were essentially not going to work so we came up with two that looked realistic and then we developed those. It took us about a year to develop each one, a neutron experiment and a laboratory experiment, both demanded new techniques. We had to push the methods to do this.”

...on collaboration:

“The other experimental work was done at the University of St. Andrews with Santiago Grigera and his group. What they had done was...they had done a lot of measurements to do with equilibration. Santiago was also involved with the experiments here so we collaborated very closely on this. A key part of the whole story is, and something that had not been addressed in really detail properly, and we believed that because it was such an important question that it had to be done rigorously was that... When you go down to low temperatures the way the system behaves is more like syrup than water. It flows very slowly so you have to work at the time scales. And you have to do the measurements on a time scale where the sort of syrup starts behaving... starts to look like water flowing. So you have to be very careful that you are not looking at deformed states. You're looking at the actual real proper states. And that was a very important part of the collaboration determining the equilibration properties and the behaviour under magnetic field. So Santiagos contribution was crucial and he shares the prize as well. On the theory side Roderich Moessner, Claudio Casternovo, Shivaji Sondhi they all contributed, with Roderich especially, in actually relating their predictions to experimental observations. So we worked closely over relating what we

were actually measuring and analyzing it in terms of their theories and identifying what the crucial points were that would help prove yes or no this was working that way.

We are playing around. We actually have a much bigger tool box to play around with, a bigger toy box, because we just got awarded a virtual institute. Which is a Helmholtz program linking a whole series of centres together. And this virtual institute will bring us a lot of new researchers in to work not only on this problem but other problems to do with topology in quantum systems. So it's quite an exciting time and we hope for a much bigger activity forming around this set of problems here. And I hope we can remain a world leader and push this forward."

...on what it boils down to:

"The whole thing is this difference in perspective. Normally, when we look at material, we look with the eyes of a mathematician. We look at the symmetry, how, if you fold a material up, it would fold onto itself. And we classify materials that way. But some materials, like this one, have a local rule, which isn't a symmetry, it's a rule – this likes to have the equal number of spins point in as point out at any point in space – this is an extra rule, and it is this extra rule that actually creates this effect. Now, we have been ignoring these extra rules, we never bothered about them – until now. And these extra rules are in lots of materials, and that's what is exciting about it. It gives us a new perspective and a new place to look for things.

...on the prospects:

"So one thing is actually realizing and making materials better for practical applications, but the other one is that you can create scenarios where you transport not just charges but charges in quantum entangled states. Now that means you can build not just faster computers, but a completely new kind of computer, for example. Now that's one of the grand challenges in sciences: How to create so-called quantum computers? What's interesting here is that many of these special effects can happen at higher temperatures, which means that we can bring this up to the ordinary world and maybe that will allow us to do something really new."