Marco Gersabeck

So what we're looking at is one of the vertex locator modules. What we did here in Manchester is we received the sensors, which are the shiny rectangular bits here. And they were what we call bump-bonded to readout chips and they are the sort of golden bits, the three bits sticking out underneath.

And then we had a one millimetre thick silicon plate which is in the middle of this whole… you can hardly see it anymore. That holds everything. And we glued - literally - these sensors and also the readout circuitry, we glued that to the silicon bit from both sides - the two sides looked more or less the same - and then we had to connect them up electrically. So these sensors here, or rather the readout chips, they're connected to the readout circuitry but by tiny wires. If you look very, very closely along here, there are tiny silver and wires going this this way. There are actually 2 rows of them, one on top of the other that were put in place here.

That was one of the most complicated tasks we did here. And even the gluing I mean, it sounds simple, but it needs to be done with micron level precision.

Dave Espley

Not squeezing a drop of superglue on it, then(!)

Marco

Yeah, I mean, this this is obviously a prototype module here. And you can see that there's a little bit of glue sticking out there because we had deposited a little bit too much; it was a relatively early prototype. I mean, the components are all there, but still, it's not the perfect thing that we then use in the detector. And then it was a matter of cabling it up… all these connectors are quite fragile because one of the critical things when building a detector like that is to make it as lightweight as possible because you want to have as little material as possible in the way of the particles that you want to detect, because any material will interact somehow with the particles - will divert their path - and it's this path that we want to measure with very, very high precision. So that is why we did everything possible to, first of all, remove the material as far as possible from the sensitive area and in general make it as lightweight as possible. And the final detector will consist of 26 of these modules sitting next to each other. And then another copy of that will sit on another half, and then these two halves come together. So this module, and a partner will come from the other side, and then this sensitive area here will form more or less a square with a tiny cut-out of a square centimetre. And this corner here is where the LHC beam will shoot through going 27 kilometres around.

Dave

And then so this assembly, then, of the ones that way and the ones that way, then gets placed into the collider, is that how it works?

Marco

Yes. So we have… then this does not get placed into the vacuum of the collider, so the tube, where the protons fly through is in a very, very high vacuum. This one is shielded from that with a very, very thin foil. 150 microns thin. So a couple of layers of your kitchen aluminium foil. And it is it is an aluminium foil essentially. So this is also in what we call a secondary vacuum. Otherwise the foil would just explode. So there's a small separation there, which we also need because there's an electrical field that comes with the protons as they as they travel through. And that would disturb the electronics here. So there is this foil and then then we have the sensitive elements here and so this edge in obviously the modules that are installed would be just five millimetres away from where the beam flies past, and then in front of one of these modules is where the protons would actually, coming from both sides, would be made to cross each other and collide. So that's happening right in front of these guys. And then the collision products they fly outwards once they've reached these, these silver rectangles, they get detected and that’s our first signal that something happened, and just over a week ago, one of my students saw the first tracks from particles traversing the new module, so - they work.

Dave

That's amazing. It's great to put some sort of hardware to the theory. So you hear about, obviously particles whizz around and they collide but this is actually the stuff that measures the results of the project.

Marco

And that's the fascination of being in particle physics really, is that that you have all these things that somehow need to come together. You can't just do the analysis of the data there. They also need to reproduce somehow.

Dave

Wow. So what's this thing… what would it be called?

Marco

This is a module… we call it a module of the vertex locator. That's how we named the detector.