IoP Conference opening 7th April 2025

It is a pleasure to welcome you all to this conference on high energy and astroparticle physics. Many thanks to the sponsors and to the IoP for supporting it and so much of the physics programme in the UK. And thanks to Tina Potter for this invitation to speak. It is particularly nice that this is the first proper conference to happen in the Ray Dolby Centre, the new home for the majority of physics in Cambridge, including the High Energy Physics group. And it is even nicer since we are celebrating 150 years since the foundation of the Cavendish Laboratory by James Clerk Maxwell.

I should say a little about this building, which I hope you agree is a spectacular place to do our science. Together with our Physics of Medicine building, the Battcock Centre for experimental astrophysics and the Maxwell Centre, which focusses on industrial impact, the RDC completes the modernisation of the Cavendish Laboratory. The building was designed by Jestico + Whiles and completed by Bouygues UK. It is intended to offer the most advanced laboratories, in particular for low vibration performance in the basement areas and for device fabrication and characterisation in the clean rooms.

It is also intended to offer an attractive environment to work in and to encourage collaboration. If anyone is intending to try such social engineering in their own buildings, the architects gave us many hints, such as avoiding dead end corriders where people can hole up and avoid their colleagues. Whole research groups have been discovered barricaded in dark areas of our old buildings! Don't try to force academics into large shared offices – they don't like it and they work from home. But perhaps most important is the coffee gradient: the best coffee should be in the main canteen area and the quality of the coffee offering should decline monotonically towards the offices. That will create a potential which drives physicists into a coffee condensate, where they interact strongly!

We were extremely fortunate to receive a massive legacy from the estate of Ray Dolby. He did his PhD at the Cavendish, working in the electron microscopy group. His thesis work used X-rays emitted from samples in the electron beams to characterise the surface atoms. This was pioneering, not least because of the need to detect the X-rays inside the microscope. This task required sensors to work in a constrained space and in a noisy environment. It is believed that his work on building the electronics to do this led to his interest in noise suppression which is now embedded into an enormous number of devices under the Dolby audio brand.
I had the pleasure of speaking to his widow, Dagmar Dolby, who supported the building project as well as endowing a number of Professorships, postdocs and studentships to enhance the research here. She showed

me some of Ray's papers from the early days of Dolby Laboratories. Two things struck me: first that he had modelled his R&D on the bottom-up academic model he had found at the Cavendish, rather than a top-down management system. It turned out to be an enormous success. It is also the culture in our own field, where responsibility is given to young scientists very early. The success of CERN and other big science experiments shows how well that works. I think that many businesses could learn from that.
Secondly, in his letter to investors, he suggested that his audio noise suppression system was a good starter project before he moved onto something more ambitious. That starter project turned into one of the most successful electronics spin-outs ever, so goodness knows what his other ideas were – he never had time to develop them.

The funding from the Dolby family was matched by the UK government under George Osborne's Chancellorship. I am very grateful to him for understanding the value of science and for having the vision to back us. I am less nostalgic about my time trying to square investment in science with the Treasury rules, which was necessary to get sign-off. Physics and astronomy do not fit neatly into a spreadsheet about economic growth. But it turns out that the Treasury integrates the benefits of investments without a clear definition of the upper time limit for the integral. Rather like some supersymmetric models, you can get the answer you need by tuning the cut-off to your integral – the benefits are much bigger after 50 years than after 20!

Our negotiations were all with governments which did not attract much love from the science community. I think it does show that with the right vision, (and a creative approach to interpreting the financial questions), it is possible to get major investments even from governments that don't appear supportive at first sight. That may be a useful lesson in these "interesting" economic times!

The government investment of course came with strings attached. The deal was that we would open up the Laboratory for other UK universities to use. That means that 25% of the time on our major facilities is available to others (in return for a payment based on fEC). We have some cutting edge facilities here, notably in solid state and semiconductor physics, which are well-supported with expert technical support and are now housed in superb low-vibration clean rooms. The offering is called CORDE, the Collaborative R&D Environment for physics. Not everyone can afford to host large scale facilities, and it is not capital efficient for the research councils to fund them everywhere, with each setup being used for a small fraction of time. Such facilities can also be a burden on the host Universities if they cannot generate enough income to pay for the maintenance and technical support. We hope that CORDE will be an example of how such facilities can be shared to the benefit of everyone.

The building is already home to the Cambridge HEP group, with brand new labs and offices. Although we have historically specialised in silicon detectors, we did

build a muon veto wall for NA48 and the building therefore has a removable wall in case there is ever the need to extract structures up to 6m tall from the assembly areas. I think that the future is secure for our field in Cambridge.

Large scale work might be expected in the future. We are now well under way with the HL-LHC which was the top priority of the European Strategy for HEP in 2013. Many of you will be working on the next iteration of that strategy and that will lead, eventually, to the construction of the next CERN flagship project and set the course for other facilities. I am sure that Cambridge and the UK community will want to play their part in that new era, and having the facilities in place to construct advanced detectors is key to that. In fact, the UK already is more than playing its part. I was very pleased to see the leadership of early career researchers in the UK discussions. And I'm sure that we will all wish to congratulate Mark Thomson on his election as the next CERN Director General. I have known Mark for many years (sometimes, notionally, as his boss, not that he ever took any notice of that!) and I know that we are in safe hands. He will face decisions which will set the direction of the field for decades, and he will need all of his wisdom and all of our support. I look forward to hearing his talk on the future which is coming up next.

You certainly have a wealth of material to discuss. The grand challenges in the field remain. We often talk about finding new physics beyond the standard model. But we already know it is there. Dark Matter and Dark Energy show very clear signals at large scales and are

completely outside of the standard model framework. The absence of antimatter in the universe is at odds with our understanding of CP-violation. Inflationary cosmologies appear to require massive fields which are not accounted for. There are perhaps tensions in the Lambda-CDM model, with Hubble constant measurements and suggestions that the cosmological principle is flawed and that the universe is not in fact isotropic and homogeneous at large scales. The size of the cosmological constant challenges our understanding at a very basic level.

This sort of science is wonderful to do and endlessly fascinating to the public. We must do everything we can to capitalise on that public interest as we move the field forward.

Besides from these grand questions, the work of the field goes on in the vast number of challenging measurements and theoretical advances made every day by all of you. One can cite the flood of results from the LHC, the amazing precision of g-2, the astonishing gravitational wave detections, the new fields of gamma ray and neutrino astronomy and the search for dark matter both underground and at colliders. All of these results come from the hard work and dedication of yourselves and your colleagues.

Before I finish, I must congratulate the LHC experiments for the award of the 2025 Breakthrough Prize for the Run-2 results. For those who have not seen the announcement, it is awarded:

For detailed measurements of Higgs boson properties confirming the symmetry-breaking mechanism of mass generation, the discovery of new strongly interacting particles, the study of rare processes and matter-antimatter asymmetry, and the exploration of nature at the shortest distances and most extreme conditions at CERN's Large Hadron Collider. "

Congratulations to all who contributed!

So finally, I wish you all a very successful conference, starting with the vision of the future from the CERN DG-elect.