What has the Higgs Boson ever done for me?

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Nobody working in the subject was really surprised that this year's Nobel prize for physics was awarded to Peter Higgs; most of the speculation was over who he would share it with. Yet when Higgs and others first put forward their ideas in the mid 1960s, even specialists could have been forgiven for thinking that they were just plain crazy. On the basis of zero experimental evidence, they proposed a new field, completely different from anything previously known. Unlike the well-established concept of a gravitational field, it doesn't have a direction, just a size. More bizarrely still, it requires no source, being constantly present even in the depths of inter-galactic space. The associated Higgs boson is the first example of a fundamentally new third type of particle, quite distinct from those that describe the familiar ideas of the building blocks of matter and the forces that act between them. All this, just to tie up a loose end (admittedly a rather serious loose end) in the developing theory of the time.

The recognition of Higgs and Englert by the Nobel committee is richly deserved and continues a centuries-old theme in which UK scientists have been responsible for some of the most original and insightful thinking across a wide range of disciplines. Yet Nobel prizes are rarely awarded for ideas alone. It was the experimental observation of a Higgs boson in July 2012 [1] through the dedication and focus of more than 5000 members of the ATLAS and CMS Collaborations at the CERN Large Hadron Collider which was the catalyst. The Higgs boson discovery is well documented as one of the most amazing stories in modern science. Has there ever been a more stunning peace-time example of world-wide collaboration, overcoming boundaries of nationhood, race and religion in a quest to achieve something truly awesome? UK physicists working on the LHC have contributed strongly in terms of both management roles and hands-on science, from state-of-the-art detector construction to programming a massively parallel `Grid' distributed computing network to process unspeakably large data volumes in search of tiny signals. In the context of Birmingham's [2] contribution to the ATLAS experiment [3] alone, examples include the spokesperson (the most senior position in the collaboration), an electronics group that led the development, construction and implementation of the micro-processing responsible for identifying the most interesting collisions within around 2 millionths of a second and data analysts who were at the centre of identifying and verifying the presence of a Higgs signal.

It is commonly asked what the discovery of a Higgs boson will do for our everyday lives and whether the cost is justified in our times of austerity. Arguments based on spin-offs [4] into medical applications, national security, touch-screen mobile phone technology and the world-wide-web, to list but a few, are well rehearsed. Attracting the brightest young minds into Science, Technology, Engineering and Maths subjects is a further motivation; in a recent survey [5] of 673 first year physics students at leading UK universities, 72% listed fundamental particles as a topic in which they held `significant interest' - the highest of any topic. Most of these students will not go on to become particle physicists, but will provide the technically gifted ground-base necessary to sustain the UK's position in the industrial and financial sectors in the coming decades. More ambitiously, one might point to unknown possible future applications: when JJ Thompson discovered the first elementary particle, the electron, in 1897, nobody understood the implications, but it now forms the basis of electronics, lasers and many other technologies. However, perhaps the best answer lies in the discovery itself, which provoked an unprecedented level of global media coverage for a scientific discovery. The Science and Technology Facilities Council estimates 26 million people were reached in the UK alone through TV and radio broadcasts on the day the discovery was announced, not to mention social media. It is basic human instinct to want to understand where we come from and the Higgs story contributes to answering such questions at the most basic level. It is a modern successor to the cathedral building of the middle ages in leaving behind our lasting cultural legacy; now that the Higgs boson has been discovered, it will not be undiscovered.

For the theorists who won the prize, the Higgs discovery represents a long-awaited vindication of their ideas. For the current generation of particle physicists, it marks a step-change in their focus of research, with the next decades at current and future colliders likely to focus on understanding the Higgs and probing it for hints of still more spectacular unknowns. For the rest of us, it implies a collective deeper understanding of the fundamental mechanisms at work in our universe and a reminder of the importance of continued support for out-of-the box thinking and for the innovation and technology developments necessary to make such formidable projects as the LHC possible.

References:
[1] Higgs discovery papers:
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[2] Birmingham HEP web page: **http://www.ep.ph.bham.ac.uk (http://www.ep.ph.bham.ac.uk)**
[3] ATLAS web page **http://atlas.ch (http://atlas.ch)** [4] STFC impact: **https://www.stfc.ac.uk/Resources/pdf/STFCImpactReport2012.pdf (https://www.stfc.ac.uk/Resources/pdf/STFCImpactReport2012.pdf)**
[5] PP2020: **http://www.pp2020.info/ (http://www.pp2020.info)**

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