THE UNIVERSITY *of* EDINBURGH

News Release

Issued: Friday 20 November 2015

Supercomputers help confirm theory of how Universe was born

Powerful computers are helping scientists test a longstanding theory of how the universe was formed in the aftermath of the Big Bang.

Physicists are using supercomputers to better understand how fundamental particles, known as quarks, behave.

Their research helps explain why an abundance of matter – and not anti-matter – in the shape of the physical universe, was created following the event, 14 billion years ago.

The calculations pave the way for an in-depth analysis of the how the Standard Model of Physics, a unifying theory that brings together all the known particles and forces in the universe, could choose to create matter.

The latest research, which builds on previous studies, suggests the Standard Model correctly describes the relevant experimental observations. However, further studies should enable more precise calculations that allow scientists to either more precisely verify, or even update with new physical laws, our fundamental understanding of the physical realm.

An international team of scientists used supercomputers to model the movement of a type of particle within atoms, known as a kaon. They analysed millions of these short-lived particles to determine how those with opposing charges can sometimes behave differently as they decay into other particles. This variation occurs only a few times in a million.

Their study is the first to demonstrate a rare but important phenomenon in which particles that are identical, apart from their electrical charge, can behave differently to one another.

The calculation, which involved the equivalent of 200 million processing hours on a single processor, was carried out using a suite of machines. These were the DiRAC Blue Gene/Q facility at the University of Edinburgh, the Blue Gene/Q supercomputers at the RIKEN BNL Research Center (RBRC), at Brookhaven National Laboratory, and the Argonne Leadership Class Computing Facility at Argonne National Laboratory.

The research, published in *Physical Review Letters*, was carried out by Columbia and Plymouth Universities, the Universities of Connecticut, Edinburgh and Southampton, the Brookhaven Lab and RBRC. The work was funded by the US Department of Energy's Office of Science (HEP), by the RIKEN Laboratory of Japan, and the UK Science and Technology Facilities Council.

For further information, please contact:
Press & PR Office, tel 0131 651 4401, email Catriona.Kelly@ed.ac.uk