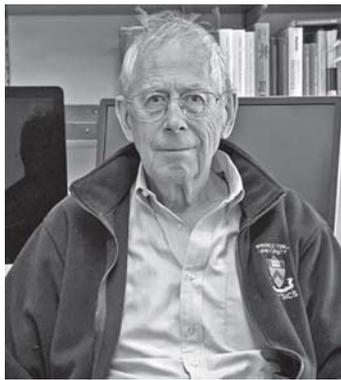


## PHYSICS

Our understanding of the origin and evolution of the universe has undergone many changes in the past 100 years since the Belgian astronomer Georges Lemaître proposed what became known as the Big Bang theory. Cosmic background radiation was discovered in 1965 and turned out to be a gold mine for our understanding of how the universe developed from its early childhood to its present day. On another scale, a major discovery of an Earth-like planet orbiting a sun-type star outside our solar system was made in 1995. Together these discoveries led to a new understanding of our place in the universe.



**James Peebles**

The 2019 Nobel Prize in Physics has been awarded to three scientists “for contribution to our understanding of the evolution of the universe and Earth’s place in the cosmos”. James Peebles of Princeton University, USA, receives the prize “for theoretical discoveries in physical cosmology” while Michel Mayor of the University of Geneva, Switzerland and Didier Queloz, of the University of Geneva and Cambridge University, UK, have been awarded “for the discovery of an exoplanet orbiting a solartype star”.

The Big Bang model describes the universe from its very first moments, almost 14 billion years ago, when it was extremely hot and dense. Since then, the universe has been expanding, becoming larger and colder. Barely 400,000 years after the Big Bang, the universe became transparent and light rays were able to travel through space. Using his theoretical tools and calculations, James Peebles was able to interpret these traces



**Didier Queloz**

from the infancy of the universe and discover new physical processes.

The results showed us a universe in which just five per cent of its content is known, the matter which constitutes stars, planets, trees – and us. The rest, 95 per cent, is unknown dark matter and dark energy – that still remain a mystery and a challenge to modern physics. Peebles’ insights into physical cosmology have enriched the entire field of research and laid a foundation for the transformation of cosmology over the last fifty years, from speculation to science. His theoretical framework, developed since the mid-1960s, is the basis of our contemporary ideas about the universe.



**Michel Mayor**

In October 1995, Michel Mayor and Didier Queloz announced the first discovery of a planet outside our solar system, an exoplanet, orbiting a sun-type star in our home galaxy, the Milky Way. Before this finding, the only confirmed exoplanet known orbited a pulsar – a dense remnant from a supernova explosion. Using custommade instruments at the Haute-Provence Observatory in southern France, they were able to see planet 51 Pegasi b, a gaseous ball comparable with the solar system’s biggest gas giant, Jupiter. Mayor and Queloz carefully measured a star’s velocity using Doppler shift and found that it wobbles back and forth in a tell-tale pattern produced by the gravitational pull of an orbiting planet. This discovery started a revolution in astronomy and over 4,000 exoplanets have since been found in the Milky Way.

This year’s laureates have transformed our ideas about the cosmos. While James Peebles’ theoretical discoveries contributed to our understanding of how the universe evolved after the Big Bang, Michel Mayor and Didier Queloz explored our cosmic neighbourhoods on the hunt for unknown planets. Their discoveries have forever changed our conceptions of the world and strange new worlds are still being discovered, with an incredible wealth of sizes, forms and orbits. □

**Biman Basu**  
*Dream 2047, November 2019, Vol. 22, No. 2*