

# Proposal : Centre for Cosmic Origins and Extremes

## Theme 1: Origin of Extreme Particles

Accelerated particles such as cosmic rays and electrons are an indicator of the Universe's extreme processes. Topics and challenges within this theme include: extreme particle acceleration processes in the early and the current Universe; how are these processes set up?; What roles do accelerated particles play in galaxy and stellar formation?; What role do they play in the early Universe's evolution?; Is the Standard Model valid beyond collider energies?; How can we probe beyond-Standard Model physics in astrophysical settings? How do accelerated particles influence the conditions for life?

## Theme 2: Origin of Mass and Matter

The origin of particle masses and the origin of matter itself is one of the deepest mysteries of fundamental physics. Solving this problem requires understanding the acquisition of particle mass in the early Universe, and the evolution of baryon, lepton and dark matter abundance over cosmic history. Some of the most important specific questions are: How did particles acquire mass in the early Universe? What is the theoretical mechanism that gives neutrinos mass? Why is there much more visible matter than antimatter in the universe? How were the elements that make up our solar system and us synthesized?

## Theme 3: Origin of Expansion and Structure

In its 13.8 billion year history, our observable Universe has grown by a factor of about  $10^{50}$ . In the course of this enormous expansion, it has experienced temperatures and energies extending far beyond the comfortable realms of physics testable by modern laboratory experiments. The focus of this theme is to investigate the origin of the Universe's expansion, which happens to also be inextricably linked to the origin of the Universe's structure: firstly, because the initial seeds for the formation of cosmic structures were generated during cosmic inflation – a period of exponential expansion in the earliest stages of the Universe's history. And secondly, because our most powerful source of information about the Universe's composition and history are probes of the cosmic structure, such as the anisotropies of the cosmic microwave background (CMB).

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**Director:** Gavin Rowell (Adelaide)

**Deputy Director:** Celine Boehm (Sydney)

## **Preliminary CI List (alphabetical order)**

Adelaide: Bruce Dawson, Gary Hill, Gavin Rowell, Martin White

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UNSW: Jan Hamann, Michael Schmidt, Yvonne Wong

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**Further discussion welcome! Please contact either**

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# The 2020 Gordon Godfrey workshop on Astroparticle Physics

30 Nov. to 4 Dec. 2020 <https://indico.cern.ch/event/887490>

**Godfrey Bequest** <https://newt.phys.unsw.edu.au/Godfrey/2017/Godfrey.htm>

The Department (at the University of New South Wales) is fortunate to have the support of the Gordon Godfrey fund which finances visits to the University by world-leading theoreticians for the purpose of collaborative research [...]

Gordon Godfrey was born in Sydney in 1892, and studied at Fort Street High School and the University of Sydney. He took his BA with first class honours in 1914, and his MA with first class honours and the University Medal (the second ever awarded) in 1919. He graduated with his BSc in 1922.

Godfrey entered the NSW teaching service in 1916, and was an assistant master at both Sydney Boys High School and Parramatta High School. From 1921 he was head teacher of physics, and later lecturer-in-charge of the Department of Physics, at the Sydney Technical College. At the college he developed the new diploma course in optometry and then created the diploma course in physics. In 1951 he was appointed an Associate Professor of the NSW University of Technology (later renamed the University of New South Wales) - he was the first representative of theoretical physics at the University. Following the death of Professor Gordon Godfrey in 1979, and his wife Mrs Mabel Godfrey in 1980, the Godfrey Bequest was established. This gift funds a number of initiatives supporting theoretical physics at UNSW, primarily by providing financial support to assist in the travel and accommodation expenses of academic visitors to the University

**For this meeting organisation - big thanks to:**

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