

# LECTURE 44



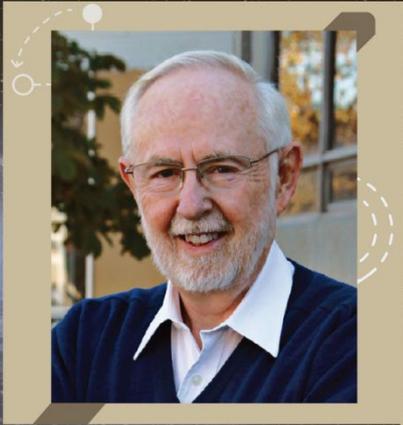
## **Prof. Arthur B. McDonald**

- Professor Emeritus, Queen's University, Canada

**Date: 2026.3.9**

TAMKANG CLEMENT AND CARRIE CHAIR

# Answering Existential Questions About Our Universe and Its Evolution



**Prof. Arthur B. McDonald**  
*Nobel Prize in Physics 2015* Queen's University, Canada

Mar 9, 2026 (Mon.) 14 : 10 p.m. to 15 : 40 p.m.  
Chang Yeo Lan International Conference Hall, Hsu Shou-Chlien International Conference Center, HC310  
The Department of Physics, cordially invites you.  
AI+SDGs = ∞ ESG+AI = ∞

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## INTRODUCTION

- Gerhard Herzberg Canada Gold Medal (2003)
- Bruno Pontecorvo Prize (2005)
- Benjamin Franklin Medal (2007)
- Henry Marshall Tory Medal (2011)
- Nobel Prize in Physics (2015)
- Breakthrough Prize in Fundamental Physics (2016)

● Topic : Answering Existential Questions About Our Universe and Its Evolution

## **ABSTRACT**

Prof. Arthur B. McDonald delivered a lecture at Tamkang University on the role of international scientific cooperation in understanding the origin and evolution of the universe. He highlighted key advances in cosmology, including dark matter, dark energy, and neutrino oscillations, as well as his work with the Sudbury Neutrino Observatory. The talk emphasized that large-scale global collaborations are essential for major scientific breakthroughs. The lecture concluded with an interactive discussion, inspiring students to engage in future scientific research.

## **MINUTE**

### **1. Opening**

The session began with an introduction of Prof. Arthur B. McDonald's academic background and his major contributions to neutrino physics. The chair welcomed faculty members, students, and guests, and highlighted the significance of hosting a Nobel Prize laureate at Tamkang University. The lecture was part of the university's Panda Lecture series and attracted a wide audience from both within and outside the campus.

### **2. Main Presentation**

Prof. McDonald delivered a lecture titled "Answering Existential Questions About Our Universe and Its Evolution". The talk focused on recent scientific progress in understanding the universe and the crucial role of international collaboration in achieving major breakthroughs.

Key points included:

#### **- Understanding the Universe:**

Over the past ~60 years, scientists worldwide have worked together to construct a comprehensive picture of the universe, from the Big Bang to its current state. By combining astronomical observations, particle physics experiments, and cosmological models, researchers have gained deeper insights into the origin, structure, and evolution of the universe.

**- Dark Matter and Dark Energy:**

The speaker emphasized that ordinary matter accounts for only about 4% of the universe, while dark matter (~26%) and dark energy (~70%) dominate. Although dark matter cannot be directly observed, its gravitational effects shape galaxy dynamics and large-scale structures. Dark energy is believed to drive the accelerating expansion of the universe and remains one of the most challenging topics in modern cosmology.

**- Neutrino Physics and Nobel Prize Work:**

Prof. McDonald discussed his leadership in the Sudbury Neutrino Observatory experiment, which confirmed neutrino oscillations, showing that neutrinos can change between different types (flavors). This discovery demonstrated that neutrinos have a small but non-zero mass, leading to significant revisions of the standard model of particle physics and deepening our understanding of stellar processes and cosmic evolution.

**- Large-Scale International Collaborations:**

The lecture highlighted major global scientific projects, including underground dark matter detection experiments, particle accelerators, and neutrino observatories. These projects often involve hundreds to thousands of scientists across multiple countries, requiring long-term collaboration and shared resources.

**- Taiwan's Contribution – BURSTT:**

Prof. McDonald also introduced the Bustling Universe Radio Survey Telescope in Taiwan, an international fast radio burst (FRB) detection project led by Taiwan, with participation from Tamkang University. Fast radio bursts are brief but extremely energetic signals from distant galaxies, offering new opportunities to study extreme astrophysical phenomena and the distribution of matter in the universe.

**- Value of International Cooperation:**

He emphasized that scientific progress is built on open, global collaboration. Scientists from different countries work together toward shared goals, creating a model not only for advancing science but also for promoting mutual understanding and potential global cooperation.

**3. Interaction and Discussion**

Following the lecture, Prof. McDonald participated in a discussion session with faculty, university students, and visiting high school students. Questions covered

topics such as learning physics, challenges in scientific research, and how to deal with difficulties and setbacks. The session provided a valuable opportunity for direct interaction with a leading scientist and inspired many participants to pursue future involvement in international scientific research.