

FEATURES

Physics Prof. Daniel Baumann: Enhancing Cosmology Research

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Intro video of Prof. Baumann, Director of LeCosPA.

Daniel Baumann is the Chee-Chun Leung Distinguished Chair Professor in NTU's Department of Physics and the new Director of the Leung Center for Cosmology and Particle Astrophysics (LeCosPA). On his office desk lies a beach ball, covered with red, blue, green and yellow spots. Prof. Baumann explains that the different colors represent differences in the intensity of light emitted 13.8 billion years ago, when the Universe first became transparent to light. The image on the beach ball---based on data collected by NASA's Wilkinson Microwave Anisotropy Probe (WMAP)---is the first snapshot of inhomogeneities in the early universe. "Ultimately, these fluctuations grew into all the structures we see around us. It is an amazing story!"



Prof. Daniel Baumann, Director of LeCosPA and Chee-Chun Leung Professor in NTU's Department of Physics. In 2023, he won the prestigious Humboldt Research Award for outstanding achievements in academic research and teaching.

Rewinding the Universe to before the Big Bang

In earlier cosmological research, the Big Bang was understood to be the beginning of time. However, recent observations, such as those by WMAP, have shown that the Universe's origin must have predated this event. "We now know that the hot

Big Bang was not the beginning of time. A focus of my research is to uncover what exactly happened before the hot Big Bang,” Prof. Baumann remarked. Likening this pursuit to detective work, he noted that we cannot observe this period in the Universe’s history directly, but rather must reconstruct it by analyzing subtle patterns in the distribution of galaxies today.

In his latest research, Prof. Baumann uses methods developed for the physics of particle scattering to predict these patterns in the large-scale structures of our Universe. One of the world’s experts in the field of scattering amplitudes is Prof. Yu-Tin Huang of NTU’s Department of Physics, and Prof. Baumann is looking forward to future collaborations with Prof. Huang and members of his group. Now that Prof. Baumann has joined NTU’s Department of Physics, everyone at the department has high expectations for possibilities of new research projects and advances in the field. Describing Prof. Baumann as “a rising star” in cosmology, Prof. Huang highlighted his ability to attract postdoctoral researchers from around the world, fostering international exchanges for local doctoral students to keep abreast of global research trends.

Designing open spaces for discussion

Upon becoming Director of LeCosPA, Prof. Baumann prioritized creating new discussion spaces for the members of the Institute. He remarked: “We have just set up a room where people can meet for coffee in the morning and discuss physics on a blackboard. We also created a new lounge for discussions in a relaxed setting.” As Prof. Baumann emphasizes “discussions on the blackboard are essential for the creative process of theoretical research and we now have many great spaces for such interactions at LeCosPA.”

Creating an international center for cosmological research

Prof. Baumann aims not only to showcase LeCosPA’s research findings at international conferences, but also to strengthen NTU’s position as a hub for global collaboration. Building on NTU’s current strengths in attracting exceptional talents and participating in international academic activities, he seeks to forge robust new partnerships with other institutes. Emphasizing LeCosPA’s strategic location near the Department of Physics and the Astronomy-Mathematics Building, Prof. Baumann also envisions the seamless integration of the talents and resources available on campus.

Prof. Baumann’s next initiative will be to host the international conference “QCD Meets Gravity” in December at LeCosPA, when leading researchers will come to Taiwan. Additionally, he will teach a course in the Department of Physics next spring---he eagerly anticipates interacting with the students. Prof. Baumann expressed his fondness of teaching, likening it to appreciating a panoramic view from the mountain top, as he guides students through the wonders of General Relativity, an experience he deems among life’s most beautiful revelations. He said: “For me, it’s a privilege to tell students for the first time in their life about General Relativity, because it is one of the most beautiful things they will ever envision and appreciate.”



Prof. Baumann on the 7th Floor of LeCosPA.

Year	Experience
2024 -	Director of LeCosPA
2024 -	Chee-Chun Leung Professor, National Taiwan University
2015 -	Professor of Theoretical Cosmology, University of Amsterdam
2011 - 2015	Associate Professor (Reader), Cambridge University
2009 - 2011	Long-Term Member, Institute for Advanced Study (Princeton)
2008 - 2009	Postdoctoral Researcher, Harvard University
2008-	Ph.D., Princeton University



Prof. Baumann loves discussing physics with students and postdocs at LeCosPA.



Open spaces created for discussions.



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