

Thursday, August 28, 2025

Refreshments at 3:15pm outside of PSF 101

Colloquium from 3:30pm-4:30pm in PSF 101

Did the Universe Have a Beginning?

Prof. Damien Easson

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Abstract:

One of the most profound questions in cosmology is whether the universe had a definite beginning in time. The modern picture, framed within the inflationary universe paradigm and supported by well-known theorems in general relativity, suggests that the universe must be geodesically incomplete, pointing to a Big Bang-type singularity. In this talk, I will explain these “no-go” theorems in plain terms, focusing on the celebrated Borde–Guth–Vilenkin result and why it has been taken as evidence that inflation cannot be eternal into the past.

I will then present recent work that overturns this conclusion. Using new mathematical theorems, we construct explicit cosmological models that are smooth, nonsingular, and geodesically complete for all time—even into the infinite past. I will show a key ingredient is the role of spatial curvature in allowing the universe to avoid singularities while satisfying important physical energy conditions. Remarkably, curvature can even mimic the behavior of “phantom” dark energy without introducing exotic new matter.

The talk will begin with an accessible introduction to spacetime geometry, cosmic inflation, and energy conditions, ensuring that advanced undergraduates can follow. I will then describe these new eternal universe models, discuss their physical plausibility and their place in the multi-verse, and conclude with what they imply for our understanding of the origin, or non-origin, of the cosmos.

Bio:

Damien Easson is a theoretical physicist and cosmologist whose research spans the interface of particle physics and cosmology. He is the Director of the Cosmology Initiative at ASU. His work has addressed topics including the early universe, inflation and bouncing cosmologies, string cosmology, modified gravity, dark energy, quantum gravity, and the gravity/gauge theory correspondence.

Easson earned bachelor’s degrees in Physics, Mathematics, and Astronomy from Vassar College in 1996, followed by an M.S. in Physics from Brown University in 1998 and a Ph.D. in Physics from Brown in 2002. He subsequently held postdoctoral positions at the University of Tokyo’s Institute for Physics and Mathematics of the Universe, Durham University in the U.K., Syracuse University, and McGill University in Canada. He joined the Department of Physics at Arizona State University as an Assistant Professor in 2010 and was promoted to Associate Professor in 2017.

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