



# INVITATION

as part of the Gravitational Physics Literature Seminar

to the talk by

**Elliot MARSHALL**

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on

***“Singularities, Fluids, and the BKL Conjecture”***

**Abstract:**

The Penrose-Hawking singularity theorems guarantee that a wide class of cosmological models are past geodesically incomplete, indicating that these spacetimes contain ‘big bang’ singularities. However, these theorems do not provide any information about the nature of the singularity. A longstanding problem in mathematical cosmology, therefore, has been to understand the dynamical behaviour of solutions to the Einstein equations near the big bang. In the seminal work of Belinskii, Khalatnikov, and Lifschitz (BKL), it was conjectured that the initial singularity is generically spacelike, local, and oscillatory. Roughly speaking, this means that solutions to the Einstein equations are well-approximated by a chaotic system of ODEs near the big bang. Rigorous results in this setting have thus far been limited to spatially homogeneous spacetimes, although there is an extensive body of numerical work for vacuum spacetimes which supports the BKL picture. However, there has been comparatively little research (numerical or otherwise) into the dynamics of inhomogeneous cosmologies containing non-stiff matter near the big bang. In this talk, I will give an overview of the BKL conjecture and discuss recent numerical work for inhomogeneous cosmologies containing a non-stiff perfect fluid. In particular, I will show that the fluid velocity in these models develops chaotic oscillatory behaviour, known as tilt transitions.

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**Time:** Wednesday, 11 March 2026, 2:15 p.m.

**Location:** Seminarraum A, Währinger Straße 17, 1090 Vienna, 2<sup>nd</sup> floor

sgd.: D. Fajman