GLOBAL STABILITY RESULTS FOR RELATIVISTIC FLUIDS IN EXPANDING SPACETIMES

JARED SPECK

Abstract

In this talk, I will discuss the future-global nonlinear behavior of relativistic fluids evolving in expanding spacetimes. I will focus on how the global behavior of the fluid is affected by both the spacetime expansion rate and the fluid equation of state. These topics are physically relevant for the following reasons: **i)** In cosmology, the relativistic fluid model is the most often used model for the "normal" matter content of our spacetime. **ii)** Experimental evidence indicates that our spacetime is expanding. **iii)** The precise expansion rate is not known, and is in fact a current topic of debate. **iv)** Prior mathematical results show that the fluid behavior is quite sensitive to the expansion rate. For example, in Minkowski spacetime (which is expansion-free), D. Christodoulou showed that the constant fluid solutions with positive energy density are *unstable*. More precisely, he showed that arbitrarily small perturbations of their initial conditions can launch solutions that develop shock singularities in finite time. In contrast, I. Rodnianski and I showed that under some often-made assumptions on the equation of state, the spatially constant fluid solutions with positive energy density are future-stable when the fluid is irrotational and spacetime is expanding at an exponential rate. This talk concerns the expansion rates in between 0 and exponential without the irrotationality assumption. Furthermore, I will discuss several new results for the "radiation" equation of state $p = (1/3)\rho$, which plays a fundamental role in cosmological models of the early universe.