Aspherical collapse of a complex scalar field using pseudospectral methods

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Abstract

It has been three decades since the groundbreaking work by Choptuik on critical phenomena in gravitational collapse involving a real scalar field minimally coupled to general relativity within a spherically symmetric framework. This seminal work spurred a comprehensive investigation of extreme spacetime scenarios in numerical relativity, with the aim of challenging the weak cosmic censorship conjecture. While it might seem intuitive that these critical phenomena extend naturally to three-dimensional scenarios, recent research has presented numerical evidence suggesting the breakdown of universality in critical solutions, even in cases of axisymmetry, such as the vacuum collapse of gravitational waves. In this study, we explore of gravitational collapse involving a massless complex scalar field, with minimal coupling to general relativity. We employ the pseudospectral code bamps to investigate a neighbourhood of the spherically symmetric critical solution in phase space, including aspherical departures from it. Our primary objective is to bridge an existing gap in the literature by examining the universality of threshold solutions in both spherical and non-spherical contexts, drawing parallels with recent investigations in the real scalar field collapse for comparative purposes. In this talk, I will present a series results aiming to address cutting edge questions that arise in the study of the threshold of collapse in axisymmetry.

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