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Title: Comparison of linear Brill and Teukolsky waves

Abstract: Motivated by studies of critical phenomena in the gravitational collapse of vacuum gravitational waves we compare, at the linear level, two common approaches to constructing gravitational-wave initial data. Specifically, we construct analytical, linear Brill wave initial data and compare these with Teukolsky waves in an attempt to understand the different numerical behavior observed in dynamical (nonlinear) evolutions of these two different sets of data. In general, the Brill waves indeed feature higher multipole moments than the quadrupolar Teukolsky waves, which might have provided an explanation for the differences observed in the dynamical evolution of the two types of waves. However, we also find that, for a common choice of the Brill-wave seed function, all higher-order moments vanish identically, rendering the (linear) Brill initial data surprisingly similar to the Teukolsky data for a similarly common choice of its seed function.