

The trichotomy of primordial black holes initial conditions

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We show that the threshold to form a black hole, in an asymptotically flat, radiation dominated, Friedman-Robertson-Walker (FRW) universe, is not solely (mainly) determined by the behavior of the compaction function at its maximum, as earlier thought, but also by the three-dimensional curvature at smaller (but super-horizon) scales, which we call “the core”. We find three classes of initial conditions characterized by an open (O), closed (C), or flat (F) FRW core surrounded by a shell with higher three-dimensional curvature. In the case of Type O and F, the core works against the collapse of the surrounding shell. In contrast, in the C case, the core helps the collapse and the required threshold for black hole formation is the lowest among all cases. Type II black holes might only be generated by type O or F (each of those with different thresholds with O being the highest) or by a type-C with an effective F core.

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