

# The abundance of primordial black holes depends on the shape of the in power spectrum

Cristiano Germani and Ilia Musco

**Abstract:** In this letter, combining peak theory and the numerical analysis of gravitational collapse in the radiation dominated era, we show that the abundance of primordial black holes, generated by an enhancement in the inflationary power spectrum, is extremely dependent on the shape of the peak. Given the amplitude of the power spectrum, we show that the density of primordial black holes generated from a narrow peak, is exponentially smaller than in the case of a broad peak. Specifically, for a top-hat profile of the power spectrum in Fourier space, we find that for having primordial black holes comprising all of the dark matter, one would only need a power spectrum amplitude an order of magnitude smaller than suggested previously whereas in the case of a narrow peak, one would instead need a much larger power spectrum amplitude, which in many cases would invalidate the perturbative analysis of cosmological perturbations. Finally, we show that, although critical collapse gives a broad mass spectrum, the density of primordial black holes formed is dominated by masses roughly equal to the cosmological horizon mass measured at horizon crossing.