Supermassive black hole seed formation and the impact on black hole populations across cosmic time

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Abstract. Although it is well understood that supermassive black holes are found in essentially all galaxies, the mechanisms by which they initially form remain highly uncertain, despite the importance that the formation pathway can have on AGN and quasar behaviour at all redshifts. Using a post-processing analysis method combining cosmological simulations and analytic modeling, I will discuss how varying the conditions for formation of supermassive black hole seeds leads to changes in AGN populations. Looking at formation via direct collapse or from PopIII remnants, I will discuss the impact on black hole mass and luminosity functions, scaling relations, and black hole mergers, which each have effects at both high- and low-redshifts. In addition to demonstrating the importance of initial seed formation on our understanding of long-term black hole evolution, I will also show that the signatures of seed formation suggest multiple means by which upcoming electromagnetic and GW surveys (at both high- and low-z) can provide the data required to constrain initial supermassive black hole formation.

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