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Formation of SMBH in galactic nuclei: LISA binaries & intermediate-mass ratio inspirals

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Supermassive black holes (SMBHs) are found to co-exist with a nuclear star cluster (NSC) in the nuclei of most galaxies. The work presented in this talk builds on the idea that the NSC forms before the SMBH through the merger of several stellar clusters that may contain intermediate-mass black holes (IMBHs). These IMBHs can subsequently grow in the NSC, and form an SMBH. To check the observable consequences of this proposed SMBH seeding mechanism, we created a mock population of galaxies and constructed their NSCs by aggregating stellar clusters. Each aggregating stellar cluster was assigned a probability for forming an IMBH based on its properties. If multiple IMBH are delivered to the NSC by stellar clusters than they may form a binary which can merge by gravitational wave emission. By looking at the NSCs in which we deliver two IMBHs to the NSC, we find that about 10% of these binary mergers maybe detectable with LISA and will have observed frequencies between 0.01 to 0.3 Hz. However, if we allow for the first IMBH to grow moderately (via gas accretion and/or tidal disruption of stars) before the delivery of the second IMBH, we find that more than 50% of the BH binaries will have properties at merger that may make them observable with LISA. In this case, many of the mergers will be intermediate-mass ratio (~0.001-0.01) inspirals with observable frequencies between 1E-4 to 0.3 Hz. The detection (or non-detection) of such binaries with LISA will provide insights and constraints on the seeding and growth mechanisms of SMBHs at the center of galaxies.

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