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Formation of discs around super-massive black hole binaries from infalling clouds

There is compelling evidence that most -if not all- galaxies harbour a super-massive black hole (SMBH) at their nucleus, hence binaries of these massive objects are an inevitable product of the hierarchical evolution of structures in the universe, and represent an important but thus-far elusive phase of galaxy evolution. Gas accretion via a circumbinary disc is thought to be important for the dynamical evolution of SMBH binaries, as well as in producing luminous emission that can be used to infer their properties. One plausible source of the gaseous fuel is clumps of gas formed due to turbulence and gravitational instabilities in the interstellar medium, that later fall toward and interact with the binary. In this context, we model numerically the evolution of turbulent clouds in near-radial infall onto equal-mass SMBH binaries, using a modified version of the SPH code GADGET-3. We present a total of 12 simulations that explore different possible pericentre distances and relative inclinations, and show that the formation of circumbinary discs and discs around each SMBH ('mini-discs') depend on those parameters. We also study the dynamics of the formed discs, and the variability of the feeding rate onto the SMBHs in the different configurations.

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