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The contribution of inspiraling massive black hole binaries to the LISA data stream

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Massive black hole binaries, with masses in the range 1E3-1E8 Msun, are expected to be the most powerful sources of gravitational radiation at mHz frequencies, and hence are among the primary targets for the planned Laser Interferometer Space Antenna (LISA). We detail the gravitational wave signal expected from a cosmological population of massive black hole binaries following the merger history of dark matter halos, the dynamics of the massive black holes they host, and their growth via gas accretion and binary coalescences in a LCDM cosmology. Stellar dynamical processes dominates the orbital evolution of black hole binaries at large separations, while gravitational wave emission takes over at small radii, causing the final coalescence of the pairs. We show that the GW signal from this population, in a 3 year LISA observation, will be resolved into approx 90 discrete events with S/N>5, among which approx. 35 will be observed above threshold until coalescence. These "merging events" involve relatively massive binaries, M=10E5 Msun, in the redshift range $2 < z < 6$. The remaining approx. 55 events come from higher redshift, less massive binaries (M=5E3 Msun at $z > 6$) and, although their S/N integrated over the duration of the observation can be substantial, the final coalescence phase is at too high frequency to be directly observable by space-based interferometers such as LISA. LISA will be able to detect a fraction approx. 90% of all the coalescences of massive black hole binaries occurring at z=5. The residual confusion noise from unresolved massive black hole binaries is expected to be at least an order of magnitude below the estimated stochastic noise.