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Detecting dark matter around massive black holes using gravitational waves

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Gravitational waves could be used as a novel probe of dark matter. In compact binary mergers with extreme mass-ratios, the gravitational interaction between the secondary object and its dark matter environment can speed up the inspiral, leaving an imprint on the gravitational waveform. With the recently approved LISA space interferometer, many extreme mass ratio signals will become detectable. A positive detection of a dark matter imprint in these signals requires extremely high dark matter densities known as "spikes", the formation of which is closely linked to the dark matter particle model. Such a detection would thus constrain the current model landscape. In this talk, I will start with the current state of the imprint analysis and of spike models. I will then present the work done in my master's thesis, for which I looked into the next evolution of CDM spike models that take realistic formation and growth history into account. Finally, I will discuss the impact of realistic models on spike detectability.

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