

Measuring Parameters of Massive Black Hole Binaries with Partially-aligned Spins
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It is important to understand how well the gravitational-wave observatory LISA can measure parameters of massive black hole binaries.

It has been shown that including spin precession in the waveform breaks degeneracies and produces smaller expected parameter errors than a simpler, precession-free analysis. However, recent work has shown that gas in binaries can partially align the spins with the orbital angular momentum, thus reducing the precession effect. We show how this degrades the earlier results, producing more pessimistic errors in gaseous mergers. However, we then add higher harmonics to the signal model; these also break degeneracies, but they are not affected by the presence of gas. The harmonics often restore the errors in partially-aligned binaries to the same as, or better than, those that are obtained for fully precessing binaries with no harmonics. Finally, we investigate what LISA measurements of spin alignment can tell us about the nature of gas around a binary.