Abstract Submitted
for the APR20 Meeting of
The American Physical Society

The electromagnetic chirp of a supermassive black hole binary
ZOLTAN HAIMAN, Columbia Univ — Supermassive black hole (SMBH) binaries are expected to be produced during galaxy formation, with many of these binaries surrounded by plenty of gas. I will discuss the coupled dynamics of a SMBH binary with a circumbinary gas disk, and the expected characteristics of electromagnetic (EM) emission from such a system. In particular, I will argue, based on analytic arguments and two-dimensional hydrodynamical simulations, that in the final stages of the merger of a SMBH, inside LISA's frequency band, it will remain bright, and that its emission will be highly time-variable. In particular, relativistic Doppler modulations, lensing effects, and hydrodynamical modulations of the accretion will inevitably imprint periodic variability in the EM light-curve, tracking the phase of the orbital motion, and serving as a template for the GW inspiral waveform. Advanced localization of the source by LISA weeks to months prior to merger will enable a measurement of this EM chirp by wide-field instruments in X-rays and possibly other wavelengths. A comparison of the phases of the GW and EM chirp signals will help break degeneracies between system parameters, and probe a fractional difference difference in the propagation speed of photons and gravitons as low as 1e-17.

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Date submitted: 12 Jan 2020 Electronic form version 1.4