

# Department of Physics and Materials Science



## SEMINAR

The Ongoing Hunt for Supermassive Black Hole Binaries

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**Abstract:** Supermassive black hole binaries are thought to be an inevitable product of the prevailing galaxy evolution scenarios where most massive galaxies host a central black hole and undergo mergers over cosmic time. The early stages of this process have been observed in the form of interacting galaxy pairs and widely separated dual quasars, but the close, gravitationally bound binaries that are expected to follow have so far eluded electromagnetic observation. The detection of this population is important because at the smallest separations they become bright sources of low-frequency gravitational waves. I am leading a systematic search for close supermassive black hole binaries among quasars based on the hypothesis that the secondary black hole in the system is feeding and the resulting emission lines will be doppler shifted due to its orbital motion. Binary candidates are therefore selected from nearby quasars via substantial ( $>1000$  km/s) shifts of the broad H-beta lines relative to the systemic redshift. The keystone of this search is an ongoing spectroscopic monitoring campaign to look for signs of bulk motion of the quasar indicative of orbital motion. I will describe the observational research program that I have been leading in the context of the multi-messenger ecosystem and my efforts to evaluate the credentials of the candidates in the face of quasar variability.

**Bio:** Jessie Runnoe is an assistant professor of Physics and Astronomy at Vanderbilt University. She is a graduate of Whitman College, received her PhD in physics from the University of Wyoming in 2013, and held postdoctoral research positions at Penn State and the University of Michigan. Her research is focused on growing supermassive black holes, which we view as quasars. To do this work, she uses space telescopes like the Hubble Space Telescope and big-data surveys of large areas of the sky (including time-domain surveys, which show a movie of the sky instead of a single image) taken with ground-based optical telescopes. In her free time, she is an avid cyclist and ascribes to the belief that the correct number of bikes to own is  $N+1$ , where  $N$  is the number of bikes you currently own.

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