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Gravitational waves from black hole mergers: From waveforms to astronomy

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The merger of binary black holes is a key target for measurement by both ground and space-base detectors. Not only are their waves very loud, and hence promising targets for detection, but they are also information rich. Measurement of these waves can teach us a great deal about the system and environment that produced the binary system, making it clear that the measurement of these waves will provide a wealth of astronomically interesting data. In this talk, I will summarize this situation from the standpoint of measurements with the space-based LISA detector. LISA's target waves come from the coalescence of massive black hole systems, in the range $10^4 - 10^7\,M_\odot$; many of these systems will be at relatively high redshift ($z > 3$ or so). Measuring these waves will thus give insight into the cosmological growth and evolution of massive black holes; in particular, we expect to be able to determine the holes' masses and spins with great precision, to determine the luminosity distance to the binary with high precision, and to locate the event on the sky with moderate precision. I will summarize what is known about how well these measurements can be done, and discuss how this information can be used to learn about the cosmological growth of black holes and possibly even help map the large structure of the universe.