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Kilonovae: Electromagnetic Counterparts of Neutron Star Mergers Powered by the Radioactive Decay of R-Process Nuclei

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The coalescence of binary neutron stars (NSs) are the most promising sources for the direct detection of gravitational waves by Advanced LIGO and Virgo. However, maximizing the scientific opportunities from such a discovery will require the detection of a coincident electromagnetic counterpart. One possible counterpart is a short gamma-ray burst (GRB), powered by the accretion of NS debris left over from the merger onto the newly-formed black hole. However, GRBs are thought to be relativistically beamed and hence to accompany only a small fraction of mergers. NS mergers also produce isotropic supernova-like emission, powered by the radioactive decay of heavy (r-process) elements which are synthesized in the neutron-rich ejecta from the merger. I will describe the first calculations of such "kilonovae" which include realistic nuclear physics and radiative transport. In addition to providing a smoking gun for detecting binary NS mergers, kilonovae inform the unknown origin of the heaviest elements in the Universe. The first kilonova may have been discovered by the Hubble Space Telescope last year.