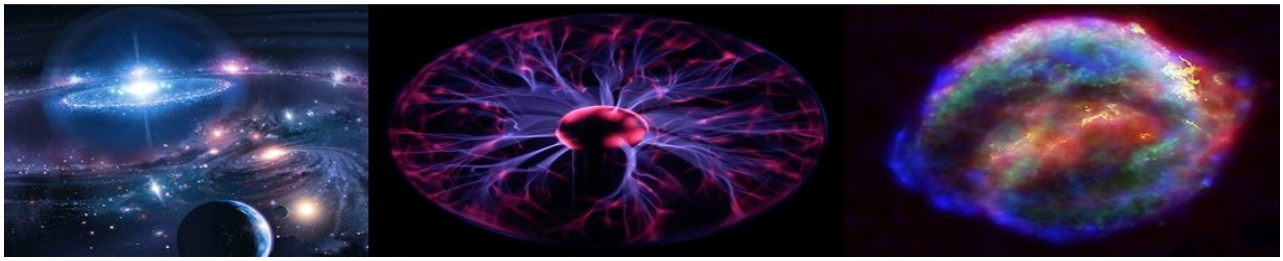

Physics Colloquium

Dr. Brian Metzger

(Columbia University)

"The Multi-Messenger Picture of a Neutron Star Merger"

Friday, April 12, 2019

2:30 PM- 3:30 PM

210 Robeson Hall.

On August 17, 2017 the LIGO/Virgo gravitational wave observatories detected the first binary neutron star merger event (GW170817), a discovery followed by the most ambitious electromagnetic (EM) follow-up campaign ever conducted.
Within 2 seconds of the merger, a weak burst of gamma-rays was discovered by the Fermi and INTEGRAL satellites. Within 11 hours, a bright but rapidly-fading thermal optical counterpart was discovered in the galaxy NGC 4993 at a distance of only 130 Million light years. The properties of the optical transient match remarkably well predictions for “kilonova” emission powered by the radioactive decay of heavy nuclei synthesized in the expanding merger ejecta by rapid neutron capture nucleosynthesis (r-process). The rapid spectral evolution of the kilonova emission to near-infrared wavelengths demonstrates that a portion of the ejecta contains heavy lanthanide nuclei. Two weeks after the merger, rising non-thermal X-ray and radio emission were detected from the position of the optical transient, consistent with delayed synchrotron afterglow radiation from an initially off-axis relativistic jet (or a shock-heated "cocoon" produced as the ejecta interacts with the kilonova ejecta). I will describe efforts to create a unified scenario for the range of EM counterparts from GW170817 and their implications for the astrophysical origin of the r-process and the properties of neutron stars (particularly their uncertain radii and maximum mass, which are determined by the equation of state of dense nuclear matter). Time permitting, I will preview the upcoming era of multi-messenger astronomy, once Advanced LIGO/Virgo reach design sensitivity and a neutron star merger is detected every few weeks.