The Spatial Correlation of Binary Black Hole Mergers Calculated from Localization of LIGO/Virgo Detections of Gravitational Waves

Modi, Ashini (School: Caddo Parish Magnet High School)

LIGO/Virgo's first and second observing runs (O1 and O2) successfully confirmed 10 Gravitational Wave (GW) detections from Binary Black Hole mergers (BBHs). These detections are GW150914, GW151012, GW151226, GW170608, GW170729, GW170809, GW170814, GW170818, GW 170104, and GW170823. To further understand the nature of these BBHs we conducted a two point auto correlation on the BBH population. Maps to localize Binary Black Hole mergers were created, and the maps were combined into a singular map with all of the detections. From the combined map, a correlation between the BBH detections was found, yet a statistical test revealed the correlation was not significant. Through the use of O3 data, and a new map with more BBHs was created to explore the prospect of recomputing the correlation function for the new detections. A higher correlation in the spatial distribution of the BBH mergers was found, however it did not surpass the 5 sigma band of significance. What this implies is that BBHs may not be randomly distributed and may in fact spatially distributed at certain angular distances, and with more observations of BBHs by LIGO in future observing runs, we predict the correlation will have a higher significance. However, the bigger question is, what may be causing a slight correlation between the BBHs and what is in those locations which attracts BBH formation? This is why I am currently trying to cross correlate the BBHs with catalogs of other astronomical objects such as galaxies to see which objects they are more closely related to and tell us even more about their origin, formation, and evolution.

Awards Won: