The effects of Dark Matter upon Neutron Stars' Properties.

Vikiaris M.[1], , Moustakidis Ch.[1]
[1]Department of Theoretical Physics, Aristotle University, 54124 Thessaloniki, Greece

In this work, we study models of neutron stars that contain dark matter. We have found theoretical constraints on the properties of neutron star's mass, radius and tidal deformability constant Λ, depending on our choice of the star's equation of state (EoS), which we can verify to be true or false thanks to our observational data. So, further constraints are found on these macroscopic properties. By inserting dark matter to our models, we can find further constraints on these properties and change the range of acceptance of EoS. The discovery of gravitational waves (GWs) by the Advanced LIGO and Virgo Collaborations has opened a new window on the Universe, making possible novel probes of gravitational physics, astrophysics, cosmology and other aspects of fundamental physics. Moreover, the observation of GWs from the merger of a pair of neutron stars (NSs), by constraining the tidal deformability Λ of dense nuclear matter, has provided a new probe of the nuclear equation of state (EoS). Observation of GWs from a NS-NS merger also opened a new window on possible models of dark matter (DM) that could modify the GW signal emitted following the merger, yielding one or two additional peaks in the postmerger frequency spectrum that might be detectable in the future GW signals from NS mergers. In this model, we solved the TOV equations for a neutron star, alongside with the equations for the Tidal Polarizability. But this time, when we reach the surface of the star, we keep the code running but this time using the equations of dark matter (DM energy density, pressure and chemical potential.) This way, we get the Pressure-Radius profile that describe a structure of ordinary matter that is engulfed in a dark matter halo. The rest results, give us a complete picture of how this model behaves, with diagrams that depict these profiles but each and every one of them solved for different values of key parameters like the coupling strength and the dark matter particle mass. Lastly, this work poses some new constraints for the EoS of the neutron star and provides insight on the parameters of the neutron stars that can be observed directly.

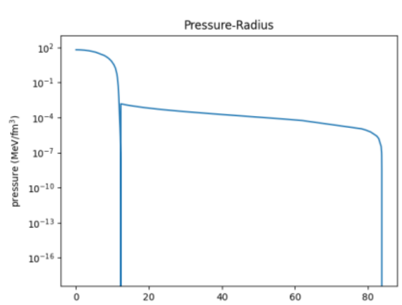

Fig. 1: Pressure-Radius diagram of the Neutron Star with the Dark Halo