Particle Astrophysics in Poland

Monday 20 May 2019 - Tuesday 21 May 2019

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Constraining the halo size from possible density profiles of hydrogen gas of Milky Way Galaxy

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Galactic magnetic field (GMF) and secondary cosmic rays (CRs) (e.g. 10beryllium, boron, antiproton) are important components to understand the propagation of CRs in the Milky Way Galaxy. Realistic modeling of GMF is based on the Faraday rotation measurements of various Galactic and extragalactic radio sources and synchrotron emission from CR leptons in the radio frequency range, thereby providing information of halo height. On the other hand, diffusion coefficient and halo height are also estimated from the 10Be/9Be and B/C ratios. Moreover, density distribution of gaseous components of interstellar medium (ISM) also plays an important role as secondary CRs are produced due to interaction of primary CRs with the gaseous components of ISM. We consider mainly molecular, atomic, and ionized components of hydrogen gas for our study. Recent observations and hydrodynamical simulations provide new forms of density profiles of hydrogen gas in Milky Way Galaxy. In the \texttt{DRAGON} code, we have implemented our chosen density profiles, based on realistic observations in radio, X-ray and γ-ray wavebands, and hydrodynamical simulations of interstellar hydrogen gas to study the variation in the height of the halo required to fit the observed CR spectra. Our results show the halo height (zt) varies in the range of 2 to 6 kpc for the density profiles considered in our work.

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Environmental dependence of properties of galaxies in Galaxy and Mass Assembly (GAMA) survey and its evolution using Marked statistics

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Observed galaxies trace an underlying network of gravitationally dominant dark matter; we know however that they trace it in a biased way, and that this bias depends on galaxy properties. In many studies galaxy luminosity and/or galaxy stellar mass is used as a convenient (even if also biased) proxy of its host dark matter halo; in the same time it was also observed that clustering of luminosity-selected and stellar mass-selected samples is not identical, especially at higher redshifts (see Marulli et al. 2013; Durkalec et al. 2018), and these differences are quite complex. We use marked correlation function as a tool to study small-scale galaxy clustering weighted by these two properties. We present our first results from the study of the dependence of galaxy clustering on luminosity and stellar mass in the redshift range $0.1 < z < 0.5$ using 54262 galaxies from the Galaxy And Mass Assembly (GAMA) survey, covering a total area of 180 sq. deg. We measure the real space luminosity-marked and stellar mass-marked correlation functions for a set of volume-limited subsamples selected by the absolute magnitude and stellar mass. We present the results of a comparative study of both the properties with the aim to show how these two properties trace dark matter halo mass and local density field.

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Search for Axionlike Dark Matter through Nuclear Spin Precession in Electric and Magnetic Fields

Data collected in the measurement of the neutron electric dipole moment (nEDM) were used to look for the ultralow-mass axionlike dark matter. Analysis of ratio of frequencies of spin-precession of ultracold neutrons and 199Hg atoms enabled us to estimate an axion-induced oscillating electric dipole moment of the neutron and an axion-wind spin-precession effect. Our null result sets the first laboratory constraints on the coupling of axion dark matter to gluons, which improve on astrophysical limits by up to 3 orders of magnitude, and also improves on previous laboratory constraints on the axion coupling to nucleons by up to a factor of 40.

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Testing dark matter with Cherenkov light – prospects of H.E.S.S. and CTA for exploring minimal supersymmetry

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Time variability of low angular momentum accretion flows around black hole.

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Observations show the emission of hard and soft photons at high energies (X-ray or gamma ray) in the black hole accretion flow's spectra. These hard photons are observed at very high frequency which implies that they are produced near black hole horizon. As the quality and quantity of the high energy observations improved over the years, evidence mounted showing that photons must be created in a hot, tenuous, advection dominated region called the corona. This corona, boiling violently above the comparatively cool disk, is very close to the event horizon of the black hole. A relativistic fluid flowing into the black hole must have a varying adiabatic index rather than a constant one throughout the accretion disk.
Our recent work present the relativistic 2D simulation of such axisymmetric, inviscid, hydrodynamic accretion flows in a fixed Kerr black hole gravitational field. The flow is considered to have low angular momentum with respect to Keplerian one. In quasi-spherical, transonic accretion flow, occurrence and location of shock and sonic points depends on the parameters of the flow. Studying the evolution of this kind of flow with time shows oscillation of shock position in response to pressure against rotational force for some particular parameter space. I will talk about such oscillatory behavior of shock position and respective effect on mass accretion rate and frequency with varying adiabatic index. I will also discuss the relevance of our results with the observed phenomenon - QPO's (Quasi periodic oscillations) from galactic black holes and micro-quasars

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