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Discs around magnetized giant exoplanets and other astrophysical objects

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The accreting ionized gas surrounding a neutron star or white dwarf creates an accretion disc. The Alfven radius, where the magnetic energy density is equal to the kinetic energy density is an inner boundary of disc, where plasma leaves the accretion disc and flows to the central object. Accretion disc in a binary system will be disrupted also at the Alfven radius. The heliospheric current sheet's inner edge is also located at the heliocentric distance where the solar wind velocity equals to the Alfven velocity, i.e. at the solar Alfven radius. The same is related to discs in the magnetospheres of giant planets of the solar system - Jupiter and Saturn: their inner edges are located close to their Alfven radii. Due to the continuous expansion and ionization of the upper atmosphere of a giant exoplanet at close orbit about the host star ("Hot Jupiter") heated by the stellar XUV radiation, an exoplanetary magnetodisc is formed under the conditions of the rotating planetary magnetic dipole field. This results in certain specifics of the star-exoplanet interaction and the magnetosphere of the "Hot Jupiter". A magnetodisc was firstly introduced in the exoplanet magnetosphere in the paraboloid magnetospheric magnetic field model [Khodachenko et al., 2011]. The distance from the center of the planet to the inner edge of the disc is a key parameter of the exoplanet magnetospheric model. It determines the disc's magnetic moment, the total magnetospheric magnetic field, and as a consequence, the size of the magnetosphere of a "Hot Jupiter". Here we discuss the exoplanet's disc inner edge location at Alfven radius in the context of other astrophysical discs and emphasize that under certain conditions (in particular, in the presence of magnetic field) some of them also have locations of their inner edges at the Alfven radii independent of nature of their origin, of the disc's material, and of the motion direction in the disc, which means that in such discs the kinetic energy density exceeds the magnetic field energy density.