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Accretion disk around a super-Eddington accreting neutron star

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One of the ultraluminous X-ray sources M82 X-2 was recently identified as a neutron star accreting at a rate significantly larger that ordinary X-ray pulsars. The accretion disc outside the magnetosphere probably still remains below the local Eddington limit but its structure may be affected by the radiation of the central source (accretion column) that together with magnetic torques shifts the centrifugal balance in the inner parts of the accretion disc thus increasing its surface density and thickness. Magnetosphere radius is also affected by the structure of the disc and may be calculated self-consistently in the framework of our model. We consider the structure of such a disc and corrections to the magnetosphere radius. For large magnetic moments (surface magnetic field ~10^{13}G), the structure of the accretion disc is very close to the standard accretion disc model (Shakura and Sunyaev, 1973), and magnetosphere radius is proportional to the classical Alfven radius with a constant coefficient. Small magnetic fields, on the other hand, allow the disc to penetrate further inside the magnetosphere, but the radius of the magnetosphere becomes relatively larger with respect to the classic Alfven radius. The inner disc parts in this case show sub-Keplerian rotation (slower by a factor of about 0.75).

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