Modelling and Analysing Pulse Shape Formation of Accreting X-ray Pulsars - Hollow Column -

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An X-ray pulsar is a highly magnetized neutron star with a main sequence star companion. The closeness of the stars in the binary system allows the neutron star to accrete matter from its companion. Gas approaches the star via an accretion disc, spiraling inward and following magnetic field lines onto the magnetic poles producing two X-ray hot spots. Due to the rotation of the neutron star the emission is observed pulsed.
In the last years the number of X-ray pulsar observations has risen. Although the observational data gained in quality there is still no comprehensive model that could explain both physical and geometrical properties of X-ray pulsars.

We study beam patterns of medium-luminosity X-ray pulsars by developing a hollow column model for producing energy-dependent beam patterns. The model includes reprocessing of radiation in the accretion stream, the generation of a halo on the neutron star surface as well as all relativistic effects. For detailed analyses the beam pattern was divided up into the contributions of the halo outside the column, the halo inside the column, the column outside, the column inside, and reprocessing in the accretion stream. Through variations of physical parameters such as cyclotron energy, plasma velocity at the column boundary, width of the column, wall thickness and effective temperature of the inner column wall, their influence on the total beam pattern and on the individual contributions were studied. The results presented here are a small part of the parameter study for the variation of the cyclotron energy.