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Modeling CR electron propagation with PIERNIK & CRESP: simulations vs. observational data of NGC891

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Galactic outflows and extended non-thermal emission due to Comic Ray (CR) electrons were observed from many edge-on galaxies in radio range of electromagnetic radiation, allowing i.a. to estimate the strength and vertical structure of galactic magnetic field.

We construct a global model of NGC891, based on observational characteristics of this galaxy. We assume that on the large scales the dynamics of the magnetized ISM is driven by Cosmic Rays.

We apply the algorithm of energy-dependent propagation of CR electrons in ''Cosmic Ray Energy SPectrum" (CRESP) module of PIERNIK MHD code to model CR propagation in this galaxy. The overall propagation of cosmic rays is described by energy-dependent diffusion-advection equation. We assume a piece-wise power-law, isotropic CR distribution function and apply a conservative, finite volume-type propagation of CR gas in momentum space.

The numerical model exhibits magnetic field amplification by CR-driven dynamo. We perform a parameter study of the system by varying the efficiency of conversion of supernova energy to CRs, the magnitude and momentum dependence of the CR electron diffusion coefficients. We take into account the advection, diffusion, adiabatic changes as well as synchrotron and inverse-Compton losses.

We find that the spectrum of synchrotron radiation, polarization maps and spectral index maps reproduce very well the observed structures of the real edge-on galaxy. Comparison of different models suggests higher conversion ratios of SN into CR energies and likely higher diffusion coefficients.

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