Relativistic MHD turbulence simulations and synchrotron polarization properties of Pulsar Wind Nebulae

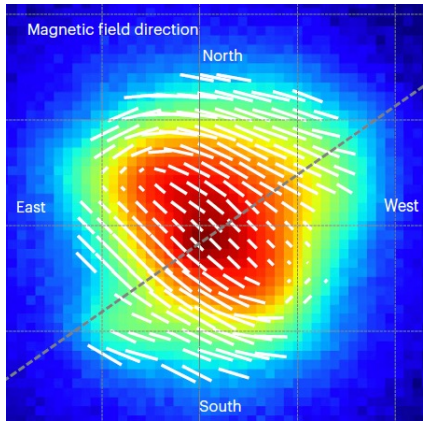
UNIVERSITÀ DEGLI STUDI FIRENZE

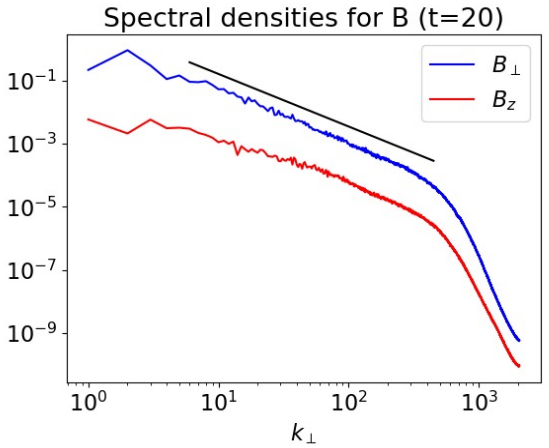
Luca Del Zanna, and S. Landi, N. Bucciantini, R. Bandiera

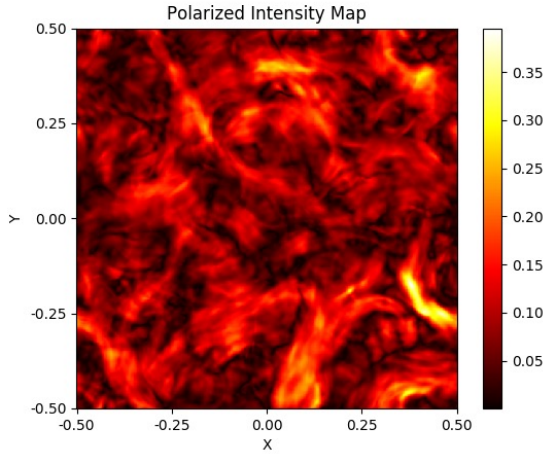
Dipartimento di Fisica e Astronomia, Università degli Studi di Firenze
INAF - Osservatorio Astrofisico di Arcetri

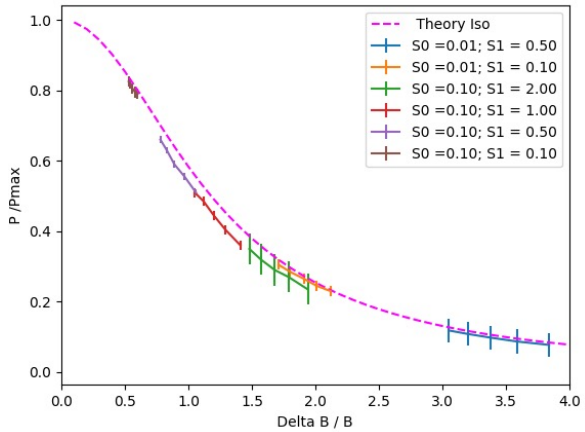
INAF ISTITUTO NAZIONALE DI ASTROFISICA

Pulsar Wind Nebulae, and the Crab Nebula in particular, are excellent laboratories for the study of relativistic plasmas (Del Zanna et al. A&A 453, 621, 2006). Recent X-ray polarization measures by IXPE show a dominant toroidal magnetic field, as expected, and different levels of depolarization of synchrotron emission, and of the polarized fraction in particular, implying a patchy level of turbulence in the nebula (Bucciantini et al., Nat. Astr. 7, 602, 2023).









We use the novel version of our ECHO code (Del Zanna et al., Fluids 9, 16, 2024), recently ported to GPUs (20x speedup and good scaling up to 1024 GPUs, using modern Fortran alone!), to produce 3D relativistic MHD simulations of decaying turbulence at different levels of the magnetization and of the initial magnetic fluctuations amplitude over the average field. The synchrotron polarization computed on top is different for the various cases and the polarized fraction agrees well with both observations and models (Bandiera & Petruk, MNRAS 459, 178, 2016; Bucciantini et al., MNRAS 470, 4066, 2017).

Work in progress, stay tuned!