A Large Scale MHD, Resonance-Related Instability in a Galactic-Like Spiral Disk and its Consequences

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Via numerical simulations with the ZEUS 3D code, the evolution of a flat gaseous disk in the galactic gravitational potential from the stellar component coupled to a spiral pattern in a self-consistent manner is followed. The model assumes observables in reasonable agreement with the main parameters of the Milky Way; particularly, the self-consistency constraint yields a plausible value for the spiral pattern speed, and the spiral arms are modeled following K band data. In the presence of an initial azimuthal magnetic field of the observed strength, the exchange of energy and angular momentum at the main resonances of the disk by the action of propagating spiral density waves, gives rise to an unstable global flow in a timescale of 1 Gy. The flow is that of the known rotation curve and stable in the purely hydrodynamic regime. In scales of various Gy, the disk experiences a profound transformation, becoming turbulent, filamentary, with field reversals but preserving an orderly component of the magnetic field, and is abruptly truncated. The process is secular, and a result of the explosive release of stored magnetic energy from the large reservoir of orbital energy. The consequences of the instability predict a set of observables that are here contrasted with observational data.