MHD Density Waves in Magnetized Spiral Galaxies

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A typical spiral galaxy involves a dark matter halo, a stellar disk, a disk of magnetized interstellar medium and a plasma of relativistic cosmic rays. Multiwavelength (from radio wavelengths to ultraviolet and X-ray bands) observations reveal overall large-scale spiral structures using various diagnostics. Magnetic field plays a key role of relating various diagnostics. It is therefore of considerable interest to formulate a density wave theory involving magnetic field. In the framework of large-scale magnetohydrodynamics (MHD), we summarize the theoretical development of MHD density waves in magnetized spiral galaxies since 1996. In particular, we describe fast and slow MHD density waves. We discuss pertinent physical concepts of swing amplifications of fast and slow MHD density waves, possible modes of (MHD) density waves in a composite disk system, magnetized spiral galactic winds and so forth. We also apply the MHD density wave theory to circumstellar spiral arms and starburst rings and offer a physical scenario.