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Electromagnetic waves in spin quantum plasmas[1] STEFANIE BRAUN, FELIPE ASENJO, SWADESH MAHAJAN, IFS, The University of Texas at Austin — We derive dispersion relations for electromagnetic (EM) waves in spin quantum plasmas using a two-vorticity theory, describing the plasma in terms of vortical structures similar to the vortex dynamics of ideal fluids. Contrary to previous work, where the spin vector was usually assumed to be aligned with the background magnetic field, this enables us to include the spin as a dynamical variable of the system. The resulting dispersion relations consist of branches which can be identified with the modes found in classical calculations, modified by the spin effects, plus new quantum branches which lack a classical analog. We study the stability of these modes in the presence of sources of free energy, such as magnetic moment energy, due to an energetically non-optimal orientation of the spin in the magnetic field, or gradients in the equilibrium spin density. Whereas all the modes are stable in a minimum-energy configuration, some of them may become unstable once such sources are introduced. In the former case, the instability is limited to a narrow range of the wave number k, whereas in the latter case, although its growth rate is smaller, it is much more pervasive in k. If both sources are included simultaneously, the effects overlap.

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