Effects of Na^+ ions on ULF waves in the Mercury's magnetosphere

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As revealed by Mariner 10 flybys in 1974 and 1975, Mercury's intrinsic magnetic field is strong enough to stand off the solar wind under usual conditions. Ultra low frequency(ULF) waves, which appear to be standing waves on the field, are observed in the magnetic records returned by the Mariner 10 spacecraft. These waves are oscillating at 40% of the proton gyro-frequency. Since the presence of different ion species has an influence on the plasma's dispersion characteristics near the ion gyro-frequencies, such relatively high frequencies of magnetospheric eigenoscillations at Mercury require a multi-fluid treatment for the plasma. Thus the Mercury's waves become different from the Earth's ULF waves which are often described in terms of magnetohydrodynamics(MHD). By adopting the multi-fluid numerical wave model, we examine how the magnetic eigenoscillations occur at Mercury's magnetosphere. Since sodium ions and protons are main constituents at Mercury, we assume an electron-proton-sodium plasma in our model. The dynamic spectra of electric fields are presented, and both linear and circularly-polarized modes are investigated. Our results suggest that 1) MHD approach is not useful in magnetic eigenoscillations of the Mercury's magnetosphere, and 2) circularly-polarized modes in multi-fluid plasmas should be considered in place of linear polarization of MHD waves.