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Investigation of Analogues to Plasmoids and Jets in the Mercury Magnetosheath

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Recently there has been an increased interest in transient, localized increases in plasma density and flow velocity in Earth's magnetosheath. Such enhancements have been studied under several different designations, e.g. magnetosheath jets or plasmoids. The latter designation specifically refers to the presence of clear magnetic signatures associated with localized density increases. These transients have been suggested to be universally present in planetary magnetospheres. As a first check of that hypothesis, we present results from the Mercury magnetosheath and near solar wind, using MESSENGER magnetic field data from the MAG instrument (and ion data from the Fast Imaging Plasma Spectrometer (FIPS) instrument for contextual information). We identify clear, isolated changes in the field magnitude, and study their properties in order to determine if they may be considered as analogues to plasmoids and jets in the terrestrial magnetosheath. Both isolated decreases of the magnetic field absolute value ('negative structures') and increases ('positive structures') are found in the magnetosheath, whereas only negative structures are found in the solar wind. The similar properties of the solar wind and magnetosheath negative magnetic field structures suggests that they are analogous to diamagnetic plasmoids found in Earth's magnetosheath and near solar wind. Positive magnetic field structures are only found in the magnetosheath, relatively close to the magnetopause. Their proximity to the magnetopause, their scale sizes, and the association of a majority of the structures with bipolar magnetic field signatures identify them as flux transfer events (which are associated with a decrease of plasma density in the magnetosheath). The positive magnetic field structures are therefore not likely to be analogous to terrestrial paramagnetic plasmoids but possibly to a sub-population of magnetosheath jets. We discuss some consequences of the findings of the present investigation pertaining to the different nature of the quasi-parallel bow shock at Mercury and Earth.