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Internal characteristics of magnetic clouds inferred from Ulysses measurements

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Magnetic clouds are a special kind of interplanetary coronal mass ejections in which the internal magnetic field configuration resembles that of a flux rope. Using data provided by several instruments onboard Ulysses, 40 magnetic clouds have been identified.

The ionization level of the solar wind plasma serves as a robust tool to differentiate magnetic clouds from the surrounding solar wind and from other transients. By combining ionization data with a magnetic field model, we provide insights into the internal structure of magnetic clouds. At higher energies (˜1MEV/nuc), bidirectional proton flows have been quantified and used as a proxy for the cloud-Sun connectivity. The elemental abundance of the population contained in the magnetic clouds can be used to identify the mechanism by which these particles were accelerated. The abundance ratios are consistent with those found for gradual solar energetic particle events (SEPs).