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# Magnetic Nulls in the Earth's Magnetotail

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Regions with vanishing magnetic field, also referred to as magnetic nulls, are of high interest in plasma physics. Near magnetic nulls particles become unmagnetized and can by interacting with electric fields be accelerated up to high energies. Magnetic nulls have been observed and studied before using different methods for a few events. Here we present a statistical study of magnetic nulls in the Earth's magnetotail. In addition we study the role of magnetic field disturbances on the magnetic null identification.

We study the magnetic nulls using full resolution data from all of the Cluster satellites when their maximum separation is less than one ion inertial length (approximately 1000 km). This is only fulfilled in 2003 when the maximum spacecraft separation is approximately 250 km. The magnetic nulls are not found using the more common method of Poincaré index. Instead we create a box surrounding the tetrahedron defined by the positions of the spacecrafts. If the positions of the magnetic nulls, using Taylor expansion, are within this box, they are saved for further analysis. All together 23 time intervals are found using this method and two error constraints. We find most of the nulls in the magnetotail current sheet, but a few of them are found at the magnetopause. We identify magnetic null types and currents associated with them. We present a detailed analysis of one example from August 6, 2003 00:45:40:00 UT - 00:45:41:05 UT when the satellites are in the magnetotail. Based on a linear magnetic field model created using parameters taken from the real data, we demonstrate the effect of magnetic field disturbance on the magnetic null identification. We show that magnetic disturbances of large enough amplitude can lead to a change in the magnetic null type, consistent with the data example. Therefore we suggest that for magnetic null type identification an additional constraint based on magnetic field disturbance amplitude have to be introduced. The obtained results are highly relevant for MMS studies of reconnection diffusion regions.