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# Magnetic boundary conditions at the surface of Ganymede in a plasma simulation

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The interaction of Ganymede's plasma and magnetic field environment with Jupiter's magnetosphere can be described with the magnetohydrodynamic (MHD) equations which are often solved by numerical models. For these models it is necessary to define physically correct boundary conditions for the plasma mass density, plasma velocity and the magnetic field.

Many planetary bodies have electrically non-conductive surfaces, which do not allow electric current to penetrate their surfaces. Magnetic boundary conditions which correctly consider that the radial current at the planetary surface is zero are difficult to implement if they include the curl of the magnetic field. Here we derive new boundary conditions for the magnetic field at non-conducting surfaces by a decomposition of the magnetic field in poloidal and toroidal parts and their spherical harmonics expansions.

We find that the toroidal part of the magnetic field needs to vanish at the surface of the isolator. For the spectral coefficients of the poloidal part we derive a Cauchy boundary condition that includes the Gauss coefficients of an intrinsic field. This condition can be used to describe Ganymede's intrinsic dynamo field as well as the induction in a possible subsurface ocean. We implement the new boundary condition in the MHD simulation code ZEUS-MP using spherical geometry and discuss its effects on Ganymede's magnetic field environment.