How a magnetic helix can develop at solstice in a Uranus-type rotating magnetosphere

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The characteristic relaxation time of the Uranus magnetosphere is of the order of the planet’s rotation period. This is also the case for Jupiter or Saturn. However, the specificity of Uranus (and to a lesser extent of Neptune) is that the rotation axis and the magnetic dipole axis are separated by a large angle (~60°) the consequence of which is the development of a highly dynamic and complex magnetospheric tail. In addition, and contrary to all other planets of the solar system, the rotation axis of Uranus happens to be quasi-parallel to the ecliptic plane which also implies a strong variability of the magnetospheric structure as a function of the season. The magnetosphere of Uranus is thus a particularly challenging case for global plasma simulations, even in the frame of MHD. We present a detailed analysis of MHD simulations of a fast-rotating magnetosphere inspired from Uranus at solstice. At first, a simplified case allows us to explain in detail the formation and the internal structure of a double helix that develops in the magnetotail at solstice. Then we analyse a "real" Uranus simulation with parameters for the solar wind and planetary magnetic field defined from the measurements of Voyager II flyby in 1986.