The asymmetry of the heliospheric current sheet during solar cycle 23: The last dance of the bashful ballerina?

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The heliospheric magnetic field has long been hemispherically asymmetric so that the field in the northern hemisphere is weaker and the area larger than in the south. This asymmetry, also called the bashful ballerina, has existed during three-year intervals in the late declining to minimum phase of solar cycles 16-22. We study here the HMF and its hemispheric asymmetry during solar cycle 23. We find that the latitudinal ordering of HMF sectors at low latitudes is exceptional in SC 23: the normal latitudinal variation was not established in the south by Spring 2009, implying that the Rosenberg-Coleman rule is abnormally delayed or broken during this cycle. Comparing the radial field at 1AU and at the coronal source surface footpoint, we show that the HCS was southward shifted even in SC 23 but the shift is considerably smaller than in earlier cycles. We also study the HMF observations during the third perihelion pass of the Ulysses probe in 2007, and find that the northern field was some 0.2 nT stronger than the southern field and that the whole HCS region was clearly shifted southward by about $2°$-$5°$. Accordingly, the north-south asymmetry existed even in SC 23 but was largely masked out in ecliptic observations due to the exceptionally weak polar fields, leading to an abnormally large HCS tilt angle and a wide equatorial belt region. We also note that historical evidence at the ecliptic suggests a connection between solar dipole strength and the size of north-south asymmetry observed there. Based on this, one can predict that, after the present period of weak solar activity started in SC 23, the hemispheric asymmetry will grow again with increasing activity, but the orientation of the asymmetry will be opposite. Thus, after SC 23, the solar ballerina will not be bashful for some 100-150 years.