Emission geometry, radiation pattern, and magnetic topology of the magnetar XTE J1810-197 in its quiescent state

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The return to the quiescent state of the Anomalous X-ray pulsar XTE J1810-197 following its 2003 outburst represents a unique opportunity to probe the surface emission properties of a magnetar. The quiescent emission of XTE J1810-197 is composed of two thermal components, one arising from the whole star surface, and the other from a small warm spot on it. By modeling the magnitude and shape of the pulse profile in narrow spectral bands, we have been able to constrain the physical characteristics and geometrical parameters of the system: the two angles that the line of sight and the spin axis make with respect to the warm spot axis (\psi\ and \xi\ respectively), the angular size of the spot, and the overall surface temperature distribution. Our modeling accounts for the general relativistic effects of gravitational redshift and light bending near the stellar surface, and allows for local anisotropic emission. We found that the surface temperature distribution on the neutron star is consistent with the expectations of a dipole magnetic field configuration; the local radiation requires a pencil-beamed emission pattern, suggesting the presence of a magnetized atmosphere. For a typical value of the radius, R=13 km, the viewing parameters (symmetric for an interchange between \psi\ and \xi), range from \psi=\xi=38 deg to (\psi,\xi)=(52 deg, 29 deg). These angles are consistent with those obtained by modeling the AXP in outburst, with uncertainty contours reduced by a factor of 2.5.

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