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Detection of Auroral Emissions from Callisto's Magnetic Footprint at Jupiter

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Abstract

HST observations of Jupiter's aurora in a large campaign reveal several cases where the main oval emission appeared at unusually low latitudes, making it possible to search for the first time for auroral emissions from the magnetic footprint of Callisto without the overlapping bright emissions from the main oval. Several cases have been found where point-source emissions have now been detected from locations consistent with Callisto's magnetic footprint on Jupiter at a brightness of ten's of kilo-Rayleighs. These observations confirm that there is an electrodynamic interaction between Callisto and Jupiter's magnetospheric environment that is similar to those at Io, Europa, and Ganymede, which all have auroral footprints. The properties of the emissions and a comparison with other observations and theoretical expectations will be presented in this paper.

1. Introduction

Two concentrated campaigns of daily Hubble Space Telescope (HST) imaging observations of the auroral emissions on Jupiter were undertaken in February and June 2007 as part of a large HST observing program [1]. While the main scientific goal of this program was to compare auroral activity with solar wind conditions, the large data set has enabled many other investigations. As part of the Ph.D thesis of S. Wannawichian, the image database was searched for all observed locations of the auroral emissions from the magnetic footprints of all the Galilean satellites [2]. Several cases were found where the predicted locations of Ganymede's magnetic footprint appeared poleward of the main auroral emission oval. Prior auroral observations have shown that the main oval can shift in latitude by up to 2 degrees in latitude depending on solar wind pressure and conditions in the current sheet [3]. These new cases presumably correspond to regions of unusual current sheet conditions in Jupiter's magnetosphere.

2. Interpretation of the Data

Non-thermal radio emissions have shown evidence for a strong electrodynamic interaction between Callisto and Jupiter's magnetosphere [4], but no prior observations have shown the auroral footprint at Jupiter. The expected electric potential across Callisto is lower than the other satellites due primarily to the decreased magnetic field strength far from Jupiter. The details of the electrodynamic interaction remain to be worked out, but the detection of the footprint suggests that these processes are active, perhaps most or all of the time.

3. Summary and Conclusions

We report here the first observations of auroral emission from the magnetic footprint of Callisto on Jupiter. The presence of this emission feature, and the implied electrodynamic interaction of Callisto with Jupiter's field and plasma, is an exciting prospect since Callisto is normally at the distance where the particles exciting the main oval originate.

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