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A New Mission-Supporting Era of Amateur Astronomy: The Juno Mission and the Role of Amateur Astronomers

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Abstract

The Juno mission is soliciting Earth-based observations during its remote-sensing orbits in 2016-2017 to provide contextual spatial information to supplement its narrow coverage of the planet in each orbit, as well as temporal that is relevant to the evolution of the features that will be observed. Both professional and amateur observations will be solicited, with the author serving as the point of contact for input from the amateur community. The value of joint amateur and professional observations are illustrated by images of different phases of the current global upheaval in Jupiter's atmosphere.

1. Introduction

The Juno spacecraft, launched in August of 2011, will reach Jupiter by the summer of 2016. It will enter orbit around Jupiter later that year, with the first of over thirty highly elliptical polar orbits whose periapsis distances are inside the radiation belts. The scientific phase of the mission is divided between gravity-mapping orbits, during which the high-gain antenna is pointed toward the earth, and "MWR" orbits, during which the MicroWave Radiometer and the other remote-sensing instruments will be scanning the atmosphere of the planet. Only orbits 3, 5, 6, 7 and 8 are currently designated MWR orbits, placed early in the mission in order to avoid overexposure to Jupiter's harsh radiation environment.

2. Need for Earth-Based Support

There will be a substantial effort mounted for ground-based observations to provide needed spatial context for the features that the instruments will sample. For example, the MWR will sample all latitudes, but the width of its useful coverage will range only from 5 to 10° in longitude, and observations will be needed to provide the spatial context of the features. Equally important will be observations of the temporal context of the atmosphere, which may well be particularly important in light of the rapid, global-scale changes taking place that are associated with the current global upheaval (Fig. 1). For example, our last observations from July, 2011, to March, 2012, showed no 5-μm hot spots. This is a particularly important planetary feature to Juno in order to relate the determination of H_2O abundances in the deep atmosphere with those of the Galileo probe, which descended into just such a feature in 1995. It will also be important to understand prior to solar conjunction in mid-2016 the planetary features Juno will sample in order to determine whether timing of the orbit-reduction manoeuvre in September, 2016, can optimize the variety of features that Juno's remote-sensing instruments will measure.

3. Role of Amateur Observers

The Juno science team hopes that this effort will involve not only astronomers in the professional community, but amateur astronomers as well. The recent quality and volume of amateur observations of Jupiter has become an invaluable tool for interpreting colors and reflectivity of the cloud deck (e. g. those in Fig. 1). The nearly ubiquitous coverage of Jupiter by the amateur community provides a nearly continuous sequence that provides a valuable time resolution to the lifetimes of features that cannot be matched in the professional community. Recent work extending amateur capabilities to spectroscopy are also considered a significant advance that may be used to distinguish further constraints on chemistry and altitude of Jovian clouds. Examples of successful relationships between amateur and professional measurements will be demonstrated, as well some specifics of the types of observations that would be most useful to the Juno science team.

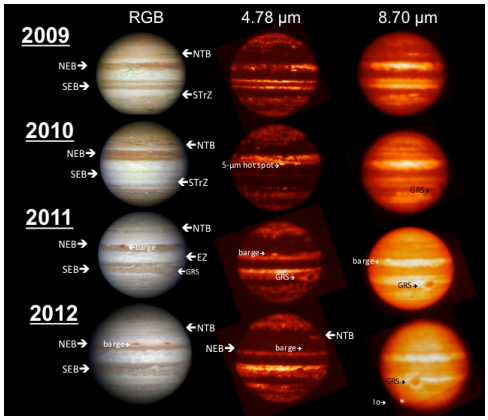

Figure 1: Multi-spectral images showing the current Jovian upheaval. RGB images from the amateur community are shown in the left column. Thermal-infrared images sensitive to cloud opacity in the 2-3 bar pressure level and the 0.6-1 bar level in the center and right columns, respectively, were acquired at the NASA Infrared Telescope Facility (IRTF). Axisymmetric regions and discrete features of interest are labeled.

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