EPSC Abstracts
Vol. 9, EPSC2014-30, 2014
European Planetary Science Congress 2014

The Juno Mission and the Role of Amateur Astronomers

G. Orton MS183-501, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, Calif. 91109, USA (glenn.orton@jpl.nasa.gov) /+01-818-354-2460.

Abstract

The Juno mission, now on its way to a 2016 orbit insertion at Jupiter, is soliciting Earth-based observations 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 continuing to serve as the point of contact for input. Details of the current planned mission are presented, and challenges to professional and amateur astronomers outlined.

1. Introduction

The Juno spacecraft was launched in 2011 and passed close to the Earth for a gravity assist in 2013. It will reach Jupiter in July of 2016 and enter orbit around Jupiter, with the first of over thirty highly elliptical polar orbits whose periapsis distances are inside the radiation belts. The purpose of the mission is to determine the abundance and distribution of water in Jupiter's deep atmosphere, map the close-in gravity field of the planet, and map the electromagnetic environment of Jupiter over all longitudes. These investigations will determine the structure, composition and dynamics of Jupiter's interior. It will relate features that are easily detectable in Jupiter's exterior to movement in the deep interior. Understanding these processes will provide clues to Jupiter's formation and evolution, providing insight into the formation of giant planets in general.

The complement of scientific instruments on board Jupiter consists of in-situ instruments that measure Jupiter's electromagnetic environment and remote-sensing instruments that cover a broad spectral range (Table 1).

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. However, observations by most of the remote-sensing instruments will take place during gravity-mapping orbits, as well.

Table 1. Juno Remote-Sensing Instruments

Instrument	Capability
MWR	Radiometry in channels centered at 1.3, 3.125, 6.25, 12.5, 25 and 50 cm wavelength
JIRAM	Broad-band imaging in filters centered at 3.4 and 5.0 μm; 9-nm resolution spectroscopy at 2.0-5.0 μm
JunoCam*	Broad-band red, green, blue filters; medium-band filter centered on the 890-nm CH_4 absorption feature
UVS	0.6-1.1 nm resolution spectroscopy at 70-205 nm

*not a scientific-grade instrument: for education and public-outreach purposes only

2. Need for Earth-Based Support

The Juno science team will benefit from substantial levels of ground-based support. A primary example during the mission will be supplying the spatial context for what will be pole-to-pole latitudinal coverage but only in strips that are 5 to 10° in longitude. Equally important during this period will be observations of changes in time, both to monitor the history and evolution of features that fall into Juno's remote-sensing coverage as well as to determine velocity fields around features. Prior to solar conjunction in mid-2016, it will be important to assess the extent and lifetime of features that might be 'captured' in Juno's coverage of the atmosphere, e.g. the Great Red Spot, Oval BA, brown barges or other cyclonic features, and blue-gray regions that are associated with clear and dry atmospheric conditions. This assessment will inform the precise timing of the orbit-reduction manoeuvre in order to increase the probability of measuring any of these features of interest around close passes with Jupiter (Table 2).

Table 2 Juno trajectory perijove times.

Orbit	Date	Key Event
0	2016 Aug 3	following orbit insertion
1	2016 Oct 9	following perijove raise manoeuvre
2	2016 Oct 30	following orbit "clean up"
3	2016 Nov 10	MWR orbit
4	2016 Nov 21	gravity-sensing orbit
5	2016 Dec 2	MWR orbit
6	2016 Dec 13	MWR orbit
7	2016 Dec 24	MWR orbit
8	2017 Jan 4	MWR orbit
9	2017 Jan 15	gravity-sensing orbit
10	2017 Jan 26	gravity-sensing orbit
11	2017 Feb 6	gravity-sensing orbit
12	2017 Feb 17	gravity-sensing orbit
13	2017 Feb 28	gravity-sensing orbit
14	2017 Mar 11	gravity-sensing orbit
15	2017 Mar 22	gravity-sensing orbit
16	2017 Apr 2	gravity-sensing orbit
17	2017 Apr 13	gravity-sensing orbit
18	2017 Apr24	gravity-sensing orbit
19	2017 May 5	gravity-sensing orbit
20	2017 May16	gravity-sensing orbit
21	2017 May 27	gravity-sensing orbit
22	2017 Jun 7	gravity-sensing orbit
23	2017 Jun 18	gravity-sensing orbit
24	2017 Jun 29	gravity-sensing orbit
25	2017 Jul 10	gravity-sensing orbit
26	2017 Jul 21	gravity-sensing orbit
27	2017 Aug 1	gravity-sensing orbit
28	2017 Aug 11	gravity-sensing orbit
29	2017 Aug 22	gravity-sensing orbit
30	2017 Sep 2	gravity-sensing orbit
31	2017 Sep 13	gravity-sensing orbit
32	2017 Sep 24	gravity-sensing orbit
33	2017 Oct 5	extra orbit
34	2017 Oct 16	deorbit

3. Role of Amateur Observers

The role of amateur observations in these efforts cannot be overstated. A global network of amateur observers provides the nearly continuous coverage of Jupiter that is not feasible from professional observatories. Such a network captures events that might be significant in a distant area or time that will be covered by Juno: an impact is an extreme example, or – more probable - an unexpected dynamical event. Amateur imaging will provide the full extent of the evolution and lifetimes of smaller-scale features of interest. They may capture wave phenomena over a full longitudinal extent that is not available to professional observatories. They may also be able to observe Jupiter at times not allowed by professional observatories because of solar-avoidance issues.

Such collaborative work extends successful amateur-professional partnerships that have already demonstrated success in understanding impact and dynamical phenomena in the atmospheres of Jupiter and Saturn.

Acknowledgements

Support for this work was provided by the Juno Project through an award from the National Aeronautics and Space Administration.