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How Amateur Astronomers Can Support the Juno Mission

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Abstract

The Juno spacecraft is on its way to orbit insertion at Jupiter in 2016. The Juno project is soliciting ground-based observations to provide contextual spatial information to supplement its narrow coverage of the planet in each orbit, as well as to track the evolution of the features that will be observed. We note their importance and how to upload images of Jupiter.

1. Introduction

Launched in 2011, the Juno spacecraft arrives at Jupiter in July of 2016 to begin the first of over thirty highly elliptical polar orbits whose periapsis distances are inside the radiation belts. The mission will 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 relate features that are easily detectable in Jupiter's exterior to the state of 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 scientific instruments on board Juno 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 can access nadir observations of the atmosphere. MWR orbits are placed early in the mission (Table 2) in order to avoid overexposure to Jupiter's harsh radiation environment. Remote-sensing observations will also take place during gravity-mapping orbits, as well. Table 2 updates information provided at the EPSC in 2014 (see [1]), with the biggest change adopting 14-day instead of 11-day orbits.

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. Images for E/PO purposes only.
UVS	0.6-1.1 nm resolution spectroscopy at 70-205 nm

Table 1. Juno Remote-Sensing Instruments

2. Role of Amateur Observers

Amateur observations can provide continuous monitoring of the atmosphere, creating a fluid documentation of the evolution of atmospheric features. This is particularly important during the active-mission phase because Juno's remote-sensing observations will cover all latitudes from pole to pole, but they will be confined to strips of only 5 to 10° in longitude, except close to the poles themselves.

The Juno mission plans for the public to vote on which features appear to be the "most interesting" and decide where JunoCam should point during each perijove pass. This voting will take place in the context of discussion threads on the Mission Juno web site on features of interest that will begin around the time of this meeting, about a year before scientific measurements of Jupiter are to be made by Juno. These discussions will be enabled by the creation of composite cylindrical maps of Jupiter when possible on a weekly basis, as well as individual images uploaded by the amateur orbits.

3. Uploading Observations

Images will be accepted in any format that is convenient to the observer, e.g. standard GIF, TIF, JPEG, etc. In addition, a recent upgrade to the WinJupos package, not only provides the means to

make cylindrical projections of images, but includes an option for compressing the data in a zip file for transmission to the Mission Juno web site (http://jupos.privat.t-online.de/index.htm). The most scientifically valuable images are not in a destructively compressed format (e.g. JPEG or GIF); if at all possible render them in a TIF or PNG (or FITS) format that preserves the linearity of the detector response.

Images can be uploaded using the Mission Juno web site (http://missionjuno.swri.edu/). Link on this site to "Participate in the Mission", which connects to a section devoted to the JunoCam instrument. Then link to "Planning: Upload your telescopic images of Jupiter to help the team plan the mission". That page ("Welcome to Planning") contains a detailed set of guidelines for submission in a PDF file. One final link to "+UPLOAD DATA" brings you to the upload site. You must upload a standard format (preferably PNG or TIFF, but JPG and GIF are accepted as well). Additionally you can also upload a zip file of FITS, IMS, measurement files, etc. that are derived from the WinJupos program. Although the WinJupos output is most convenient for the Juno science team, the Mission Juno web site currently has no means to parse the zip file and then transcode its contents into something standard for the display, so the Mission Juno web site needs the user to upload a standard browser-supported image file to be used for display. The uploaded information will also request information on where the data were taken, what date and time, and which filter was used (or whether a color camera was used). This process and the information to be provided will have been beta tested by the Mission Juno team with the cooperation of a small number of amateur astronomers who are experienced in observing Jupiter before being completely open. It is a Juno goal to display images well within a day of their submission to the Mission Juno web site.

An option is also to upload unsharpened images, as well standard sharpened versions that enhance the spatial resolution of planetary features. Because observers currently use a wide variety of approaches to image sharpening, Juno team will test using a single approach to image processing (accounting for differences in seeing between the images) that may result in more self-consistency in the weekly composite cylindrical maps that will form the center of discussion threads on the Mission Juno web site.

Orbit	Date	Key Event
0	2016 July 5	Jupiter orbit insertion
1	2016 Oct 19	Capture orbit
2	2016 Oct 30	Perijove reduction
3	2016 Nov 2	"Clean-up" orbit
4	2016 Nov 16	MWR orbit
5	2016 Nov 30	gravity-sensing orbit
6	2016 Dec 14	MWR orbit
7	2016 Dec 28	MWR orbit
8	2017 Jan 11	MWR orbit
9	2017 Jan 25	MWR orbit
10	2017 Feb 8	gravity-sensing orbit
11	2017 Feb 22	gravity-sensing orbit
12	2017 Mar 8	gravity-sensing orbit
13	2017 Mar 22	gravity-sensing orbit
14	2017 Apr 5	MWR orbit
15	2017 Apr 19	gravity-sensing orbit
16	2017 May 3	gravity-sensing orbit
17	2017 May 17	gravity-sensing orbit
18	2017 May 31	gravity-sensing orbit
19	2017 Jun 14	gravity-sensing orbit
20	2017 Jun 28	gravity-sensing orbit
21	2017 Jul 12	gravity-sensing orbit
22	2017 Jul 26	gravity-sensing orbit
23	2017 Aug 9	gravity-sensing orbit
24	2017 Aug 23	gravity-sensing orbit
25	2017 Sep 5	gravity-sensing orbit
26	2017 Sep 19	gravity-sensing orbit
27	2017 Oct 3	gravity-sensing orbit
28	2017 Oct 17	gravity-sensing orbit
29	2017 Oct 31	gravity-sensing orbit
30	2017 Nov 14	gravity-sensing orbit
31	2017 Nov 28	gravity-sensing orbit
32	2017 Dec 12	gravity-sensing orbit
33	2017 Dec 26	gravity-sensing orbit
34	2018 Jan 9	gravity-sensing orbit
35	2018 Jan 23	gravity-sensing orbit
36	2018 Feb 6	extra orbit
37	2018 Feb 20	deorbit

Table: 2 Juno perijove times (except for "Orbit 0")

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Reference

[1] Orton G., The Juno Mission and the Role of Amateur Astronomers, EPSC2014-30