

Refurbishing Voyager/PRA data

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Abstract

Voyager/PRA (Planetary Radio Astronomy) data from digitized tapes archived at CNES have been reprocessed and recalibrated. The data covers the Jupiter and Saturn flybys of both Voyager probes. We have also reconstructed goniopolarimetric datasets (flux and polarization) at full resolution. These datasets are currently not available to the scientific community, but they are of primary interest for the analysis of the Cassini data at Saturn, and the Juno data at Jupiter, as well as for the preparation of the JUICE mission. We present the first results derived from the re-analysis of this dataset.

1. Introduction

The Planetary Radio Astronomy (PRA) experiment [6] onboard the Voyager 1 and 2 spacecraft were the first radio instruments to explore the low frequency radio emissions of the giant planets. The PRA experiment is observing radio waves up to 40.5 MHz, and is capable of measuring the sense of circular polarization of the observed radio waves.

The Voyager 1 spacecraft approached Jupiter in March 1979 and Saturn in November 1980. The Voyager 2 spacecraft approached Jupiter in July 1979, Saturn in August 1981, Uranus in January 1986 and Neptune in August 1989. During each planetary flyby intense radio emissions of auroral origin were observed [7, 8, 9, 10, 11, 12]. The Jovian radio emissions reaches 40 MHz, as discovered from ground [1], whereas all other giant planets are showing radio emission up to ~ 1 MHz, as in the case of terrestrial auroral radio emissions [15]. Atmospheric radio flashes (lightning electrostatic discharges) were also observed at Saturn, Uranus and Neptune [13, 14].

The PRA data were analyzed by the Voyager 1 and 2 team and were partly archived at the NASA/PDS (Planetary Data System) PPI node (Planetary Plasma Interactions). Two PRA datasets are available in the

archive: the full resolution Low Frequency band (LF) data¹ covering 1.2 kHz to 1.3 MHz, and 48 s average spectra High Frequency band (HF) data² covering 1.2 MHz to 40.5 MHz.

While managing “orphaned” datasets in its repository, the CNES long term archive service (SERAD, *Service de Référencement et d’Archivage des Données*, Data Referencing and Archiving Service) identified a series of digitized Voyager PRA magnetic tape dumps. This paper described the refurbishment of this dataset.

2 Datasets and Access

The refurbished Voyager PRA full resolution data collection is composed of 5 datasets: Level 1 dataset (temporally sorted DEDR scans re-dispatched into daily files and operating modes); Level 2 dataset (daily files of “POLLO” mode DEDR individual records); Level 3f dataset (daily files of flux and polarization derived from “POLLO” mode DEDR Level 2 data, using L3f inversion); Level 3t dataset (daily files of flux and polarization derived from “POLLO” mode DEDR Level 2 data, using L3t inversion); Ephemeris dataset (daily files of planetary ephemeris, one file per planet, in the spacecraft frame); Summary plot dataset.

Since this work is still in progress, data are not publicly available yet. The data collection will be available from the MASER (Measurement, Analysis and Simulations of Emission in the Radio range) service³ at Observatoire de Paris. Direct access to data for download will be available at: <http://>

¹VG1-J-PRA-3-RDR-LOWBAND-6SEC-V1.0 and VG2-J-PRA-3-RDR-LOWBAND-6SEC-V1.0: Voyager 1 and 2 PRA data during the Jupiter flyby dataset, available at NASA/PDS-PPI.

²VG1-J-PRA-4-SUMM-BROWSE-48SEC-V1.0 and VG2-J-PRA-4-SUMM-BROWSE-48SEC-V1.0: Voyager 1 and 2 PRA data during the Jupiter flyby dataset, available at NASA/PDS-PPI.

³MASER web site: <http://maser.lesia.obspm.fr>

maser.obspm.fr/data/voyager/pra. Final data products will be prepared in CDF (Common Data Format), so that common tools (like Autoplot [3]) can handle the data easily. The data products are also available from the VESPA [2] query portal (<http://vespa.obspm.fr>).

3 Discussion

The reprocessing of the Voyager PRA data will provide the community with a unique dataset. The preliminary data samples presented in this paper are clearly showing that the reanalysis of this dataset will be very interesting, especially in light of the discoveries done by the Galileo, Cassini and Juno spacecraft at Jupiter and Saturn. At Jupiter, we will search for the galilean moon's modulated radio emissions, including the study of the polarization of the corresponding radio bursts [5]. At Saturn, the high temporal resolution measurements with polarization will provide crucial clues and new ideas on the still unexplained rotational modulations of the kronian system [4].

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