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SPICE usage within ESA planetary missions

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SPICE is a set of software routines (the SPICE toolkit) and a suite of data formats that help a scientist use ancillary data to plan scientific observations from a space vehicle and to analyze the science data gathered from those observations. It may also help scientists and engineers in planning future missions. In this context “ancillary data” means observation geometry data and time conversion functions.

SPICE was developed and is maintained by the Navigation and Ancillary Information Facility team of the Jet Propulsion Laboratory, California Institute of Technology, under contract with the U.S. National Aeronautics and Space Administration (NASA). The SPICE system is free of U.S. export restrictions and is available at no cost to the international space science community. The system is available in several languages and works-or can be configured to work-on all popular computing environments.

SPICE stores geometry and time data in files called “kernels”. These are the core of the system, since they provide:

- ephemeris information for spacecraft, solar system bodies and even ground stations.

- information about the spacecraft clock and how to convert from it to ephemeris time and/or UTC, and the other way around.

- mounting alignment and field-of-view geometry for the spacecraft’s instruments and antennas.

This multi-mission capability has been used for more than 20 years now on many NASA missions and more recently on ESA’s planetary missions: Mars Express, Venus

Express, Rosetta, Huygens and Smart-1.

In collaboration with the NAIF team ESA has implemented the Auxiliary Data Conversion System (ADCS), which makes sure that the most up to observation geometry dataare always available to the community, via an ftp server.

For the ESA missions, there are three different sources of SPICE kernels:

- The spacecraft orbit (SPK), attitude (CK) and clock correlation (SCLK) kernels are produced at the Science Operations Centre for each mission (ESA, based on source data produced by ESOC's Flight Dynamics group.

- Generic kernels, such as planetary constants (PCK), leap seconds (LSK) and ephemerides (SPK) are provided by NAIF.

- Instrument kernels (IK) and the frames specification kernel (FK) are created by the Science Operations Centre (ESA), in collaboration with the instruments teams

ESA's Planetary Science Archive (PSA) provides science data, and observation geometry data based on SPICE, for the European science community. SPICE is also used to calculate geometrical parameters of the observations that are used afterwards in the PSA.