



Navigation Ancillary Information Facility

NASA's SPICE System Models the Solar System

Charles Acton

Jet Propulsion Laboratory

California Institute of Technology



Navigation and Archiving of Mission Data

What is SPICE ?

NASA's multimission, multidiscipline information system for assembling, distributing, archiving and accessing space science geometry and related data* used by scientists and engineers for:

- Mission Design and Mission Evaluation**
- Detailed Observation Planning**
- Mission Operations**
- Science Data Analysis**

* Target body location, size, shape and orientation; spacecraft trajectory; instrument pointing and field-of-view specifications; sequence of events; experimenter's notebook



SPICE Components of Interest?

Navigation Ancillary Information Facility

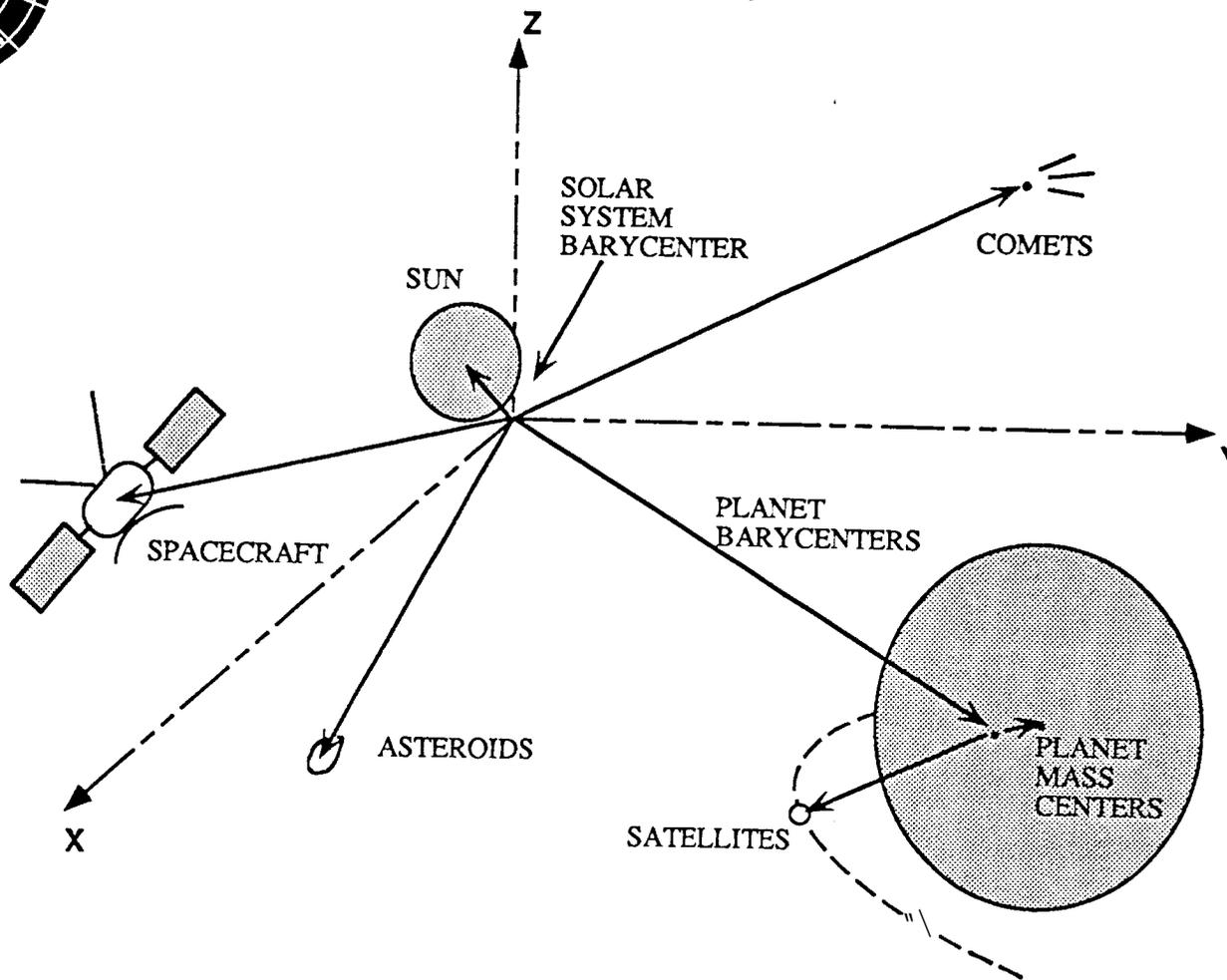
The following **SPICE** components could be of interest to you:

- Ephemerides (SPK files)
- Target Orientation, Size and Shape (**PCK** file)
- SPICE Toolkit



Ephemerides

Navigation Ancillary Information Facility

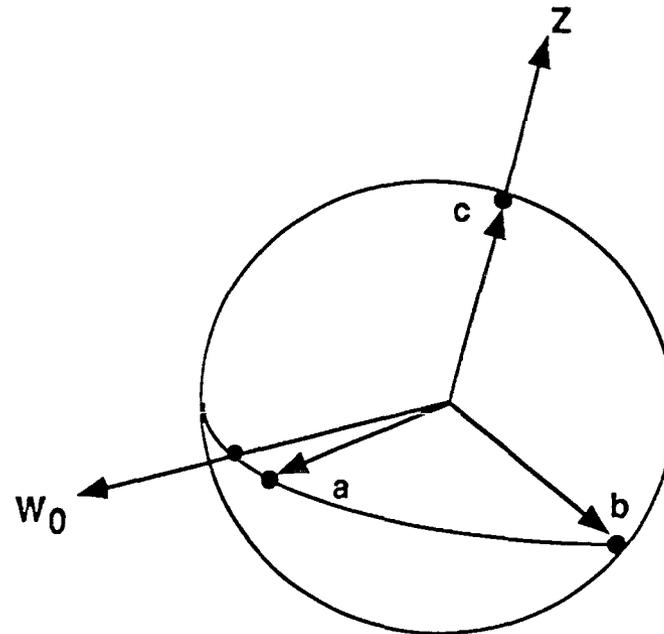


Cartesian state vectors for planets, satellites, comets, asteroids and some spacecraft



Target Orientation, Size, Shape

Navigation Ancillary Information Facility



- IAU values' for orientation, size and shape are generally used
- The user can easily substitute any desired values in the SPICE PCK file

•Report of the IAU/IAG/COSPAR Working Group on Cartographic Coordinates and Rotational Elements of the Planets and Satellites



SPICE Toolkit

Navigation Ancillary Information Facility

Contains many modules for accessing and further processing SPICE files. Examples:

– **Convert UTC time to TDB time**

```
» CALL UTC2ET ( "utc_string", TDB )  
.....
```

– **Get state vector from ephemeris file at requested time**

```
» CALL SPKEZ (target, TDB, ref_frame, correction, observer, state, lt_time )  
.....
```

– **Find the coordinates of the sub-observer point and the observer's altitude relative to a target body**

```
» CALL SUBPT ( target_ID, observer_ID, TDB, correction, point, altitude )  
.....
```

.....
Inputs

outputs



Sources for SPICE Ephemerides

Navigation Ancillary Information Facility

- **PLANETS - DExxx integrated ephemerides**
 - Produced by Myles Standish, JPL
- **SATELLITES - Integration and theory files**
 - Produced by Bob Jacobson, JPL
- **COMETS & ASTEROIDS - Integrated files**
 - Produced by Don Yeomans, JPL
- **SPACECRAFT - Assorted data types**
 - Produced by national space agencies
- **You can easily make your own SPICE-format ephemeris files**



Pertinent SPICE Characteristics

Navigation Ancillary Information Facility

- Files and modules are portable to nearly any computer system
- Files and modules are well documented
- New files and capabilities are constantly being added
 - But always backwards compatible
- Lots of flexibility in system design means SPICE can easily be adapted for many purposes



SPICE Project Customers

Navigation Ancillary Information Facility

PAST

Mariner 9,10 (R,P)
Viking (R,P)
pioneer 10,11(R,P)
Voyager (R,P)
Phobos 88 (R,P)
Ulysses (R,P)
Magellan (P)
Clementine

Current

Hubble Telescope (S)
Infrared Space Obs. (S)
Galileo
NEAR
Microlab
MSTI 3 (P)
Mars Global Surveyor
Mars Pathfinder
Mars 96
Space Interferometry (P)
Cassini
Stardust
Terrestrial observatories

Future

Mars 98,01,03
Discovery
Pluto Express
Solar Probe
SIRTIF
New Millennium

Possibilities?

EOS *
Rosetta
Japanese:
Lunar
Mars
Space Physics

* proof of concept
already demonstrated

R = restoration

P = partial use

S = special tools



For More Information ...

Navigation Ancillary Information Facility

For more information about SPICE products and capabilities, contact:

**Charles (Chuck) Acton
NAIF Manager
M.S. 301-125L
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109-8099**

**cacton@spice.jpl.nasa.gov
Phone: (81 8) 354-3869
FAX: (818) 393-6388**

**Development of the SPICE system was carried out by the
Jet Propulsion Laboratory, California Institute of Technology,
under contract with the National Aeronautics and Space Administration**