



Navigation and Ancillary Information Facility

Advances in SPICE Support of Planetary Science

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The research described in this publication was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

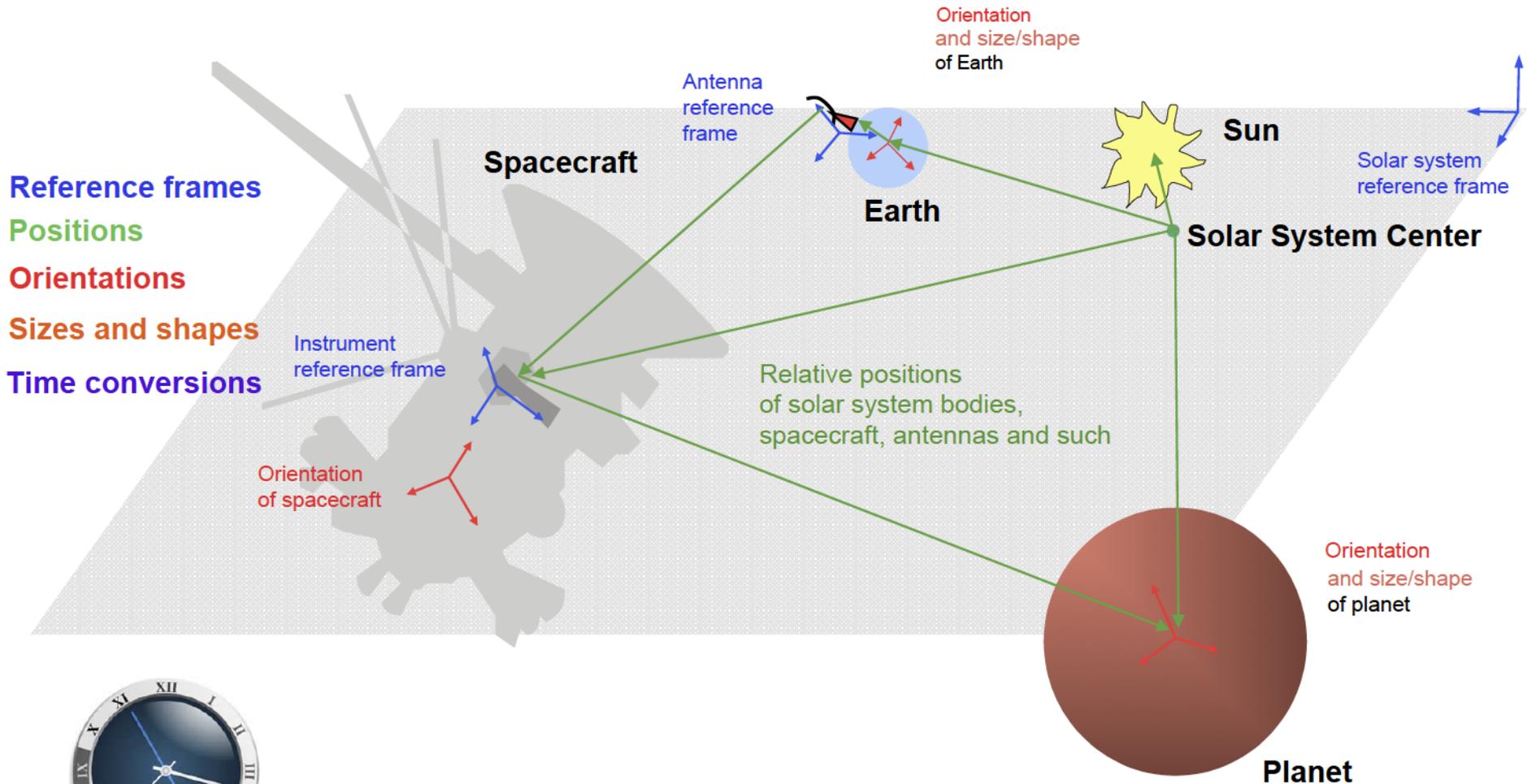
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SPICE Provides Scientists Access to a Variety of Observation Geometry

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Time System Conversions



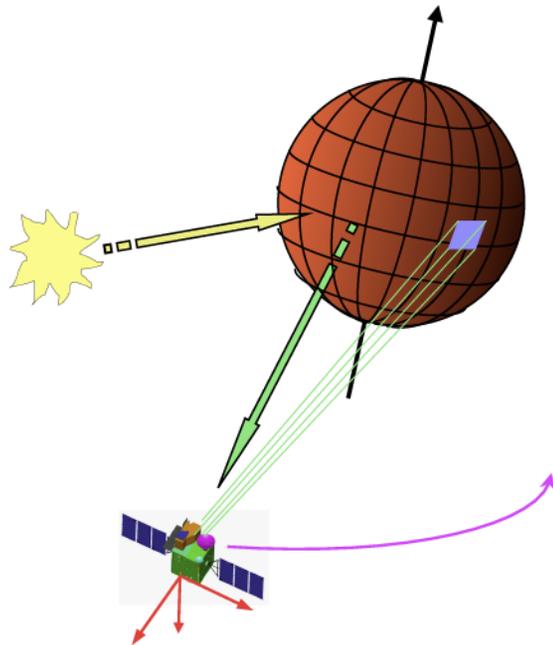


Historical Examples of Use - 1

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Compute many kinds of observation geometry parameters

$$x = f(t)$$

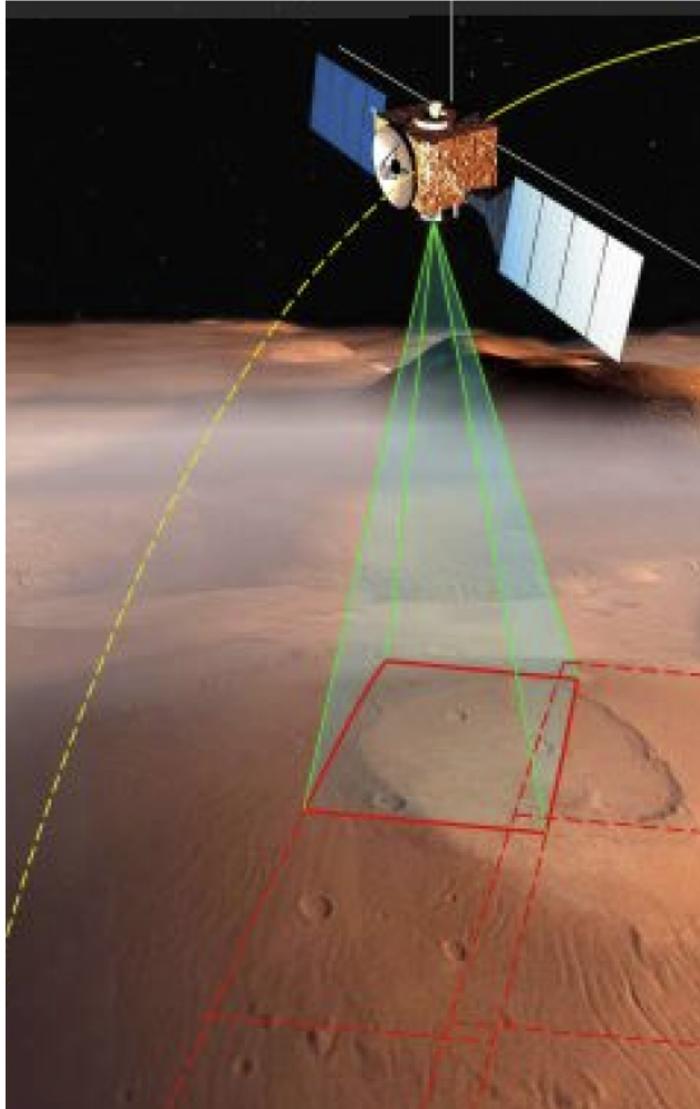


- **Positions and velocities** of planets, satellites, comets, asteroids and spacecraft
- **Size, shape and orientation** of planets, satellites, comets and asteroids
- **Orientation of a spacecraft** and its various moving structures
- **Instrument field-of-view projection** on a planet's surface, atmosphere or rings



Historical Examples of Use - 2

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**Build your own
program to plan when
and how to take a
mosaic of images
using “predicted”
SPICE data**



Who Can Use SPICE?

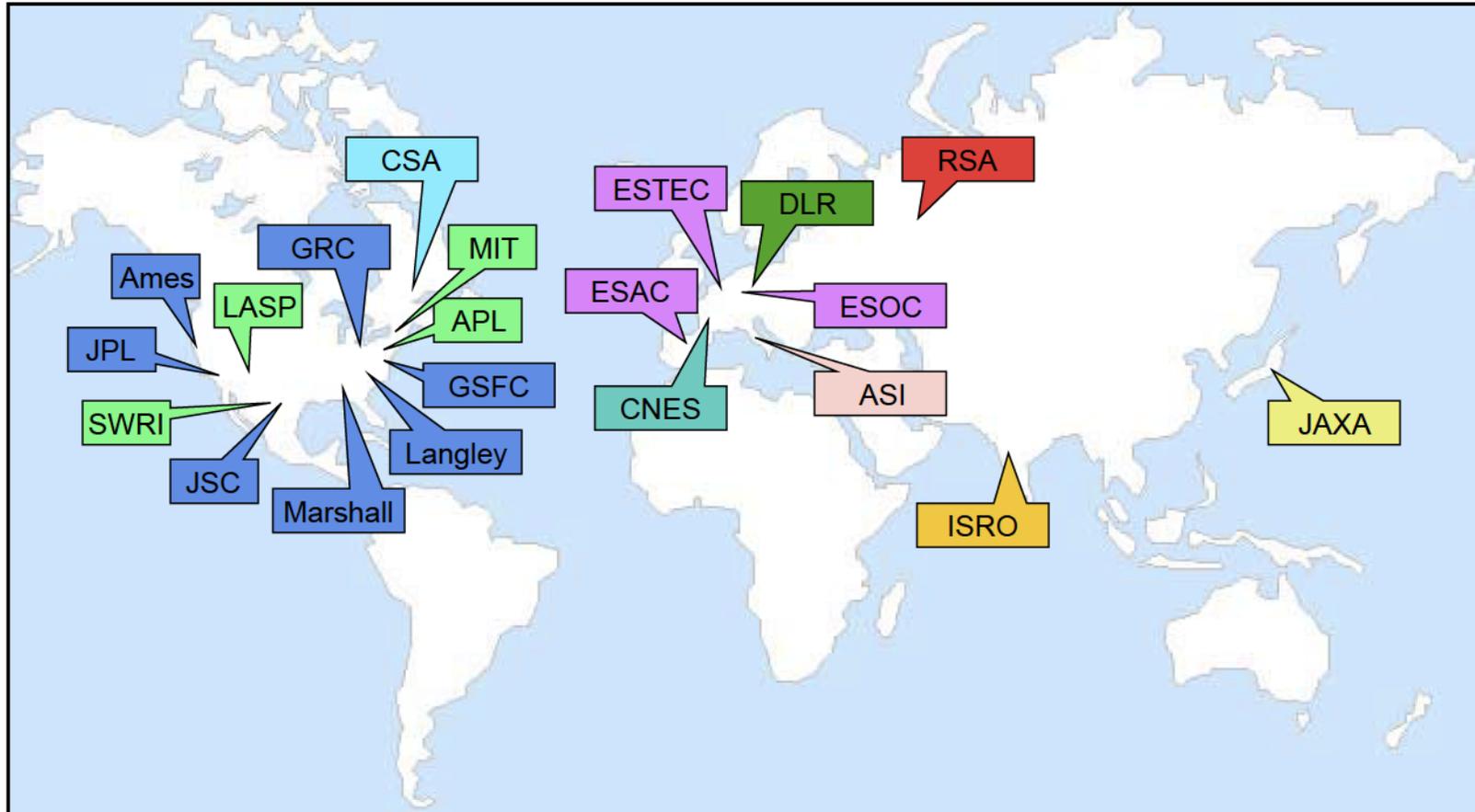
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- **Anyone... worldwide!**
 - No costs
 - No licensing
 - No restrictions (not even to commercial entities)
 - Excellent source code is provided
 - Extensive user-oriented documentation is provided
 - Free training classes are offered annually in the U.S.
 - » Sometimes elsewhere, under a shared costs agreement



Space Agencies Using SPICE

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- | | | |
|-------------------------|-------------------------|--------------------------------------|
| ■ NASA Field Centers | ■ European Space Agency | ■ Indian Space Research Organization |
| ■ U.S. Institutions | ■ French Space Agency | ■ Japan Aerospace Exploration Agency |
| ■ Canadian Space Agency | ■ German Space Agency | ■ Russian Federal Space Agency |
| | ■ Italian Space Agency | |



SPICE Components

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Data files



Toolkit software



Documentation



Tutorials



Programming lessons



Training classes



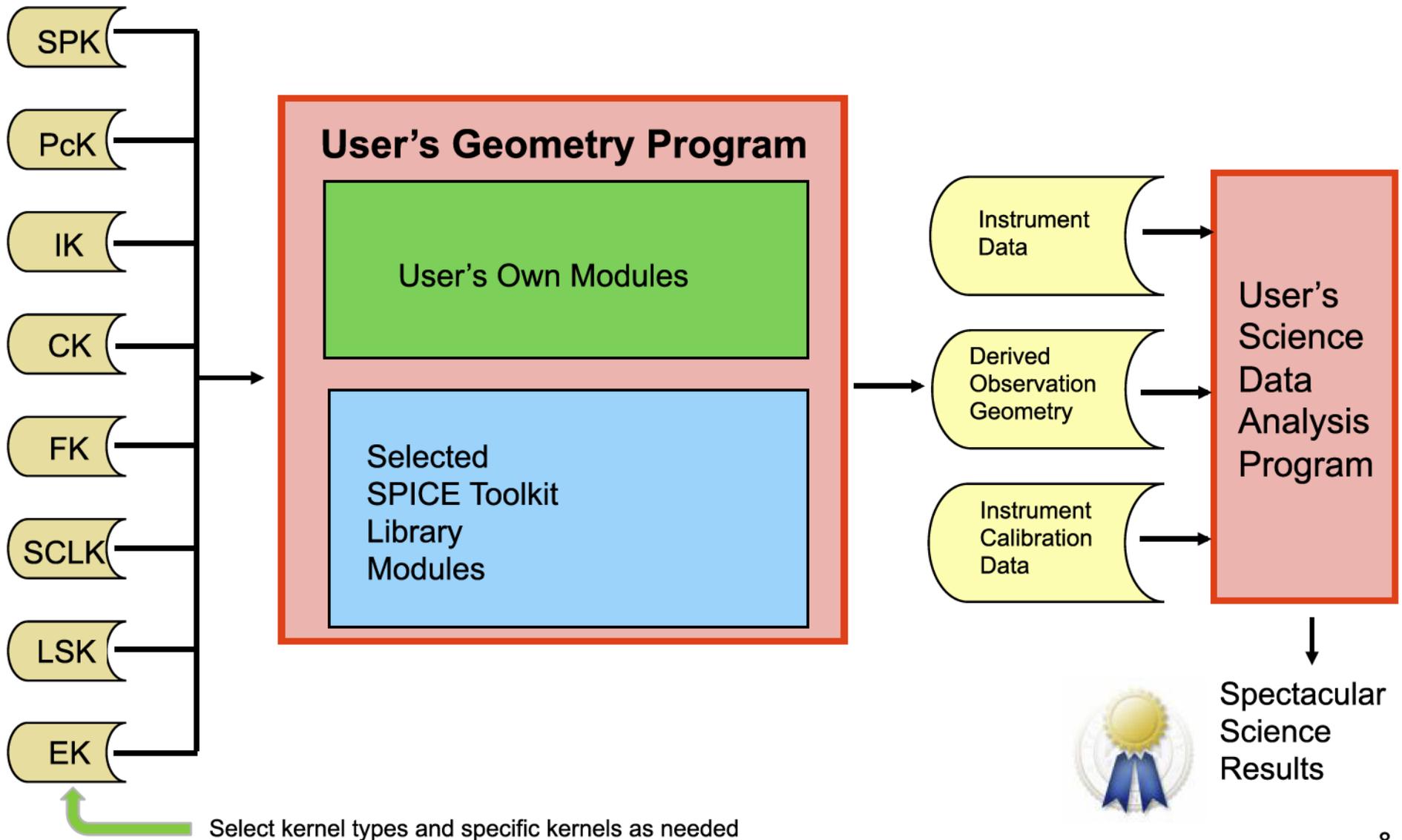
Consultation





Example of Using SPICE

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Looking Ahead

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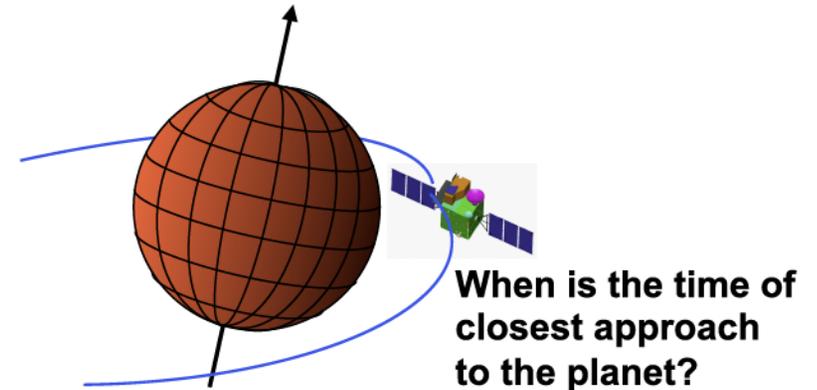
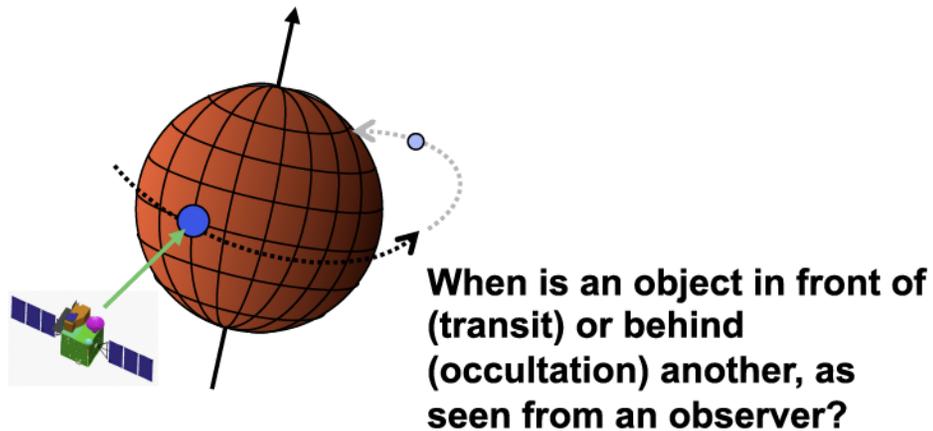
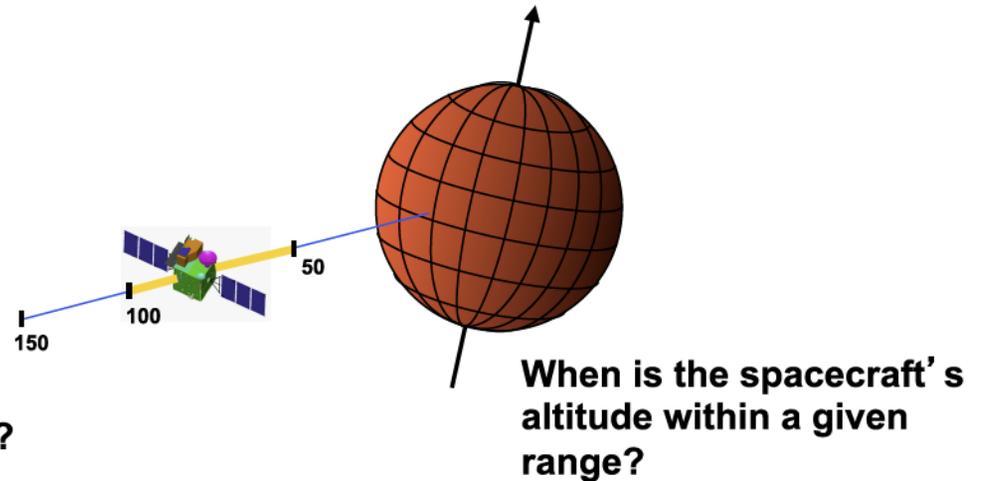
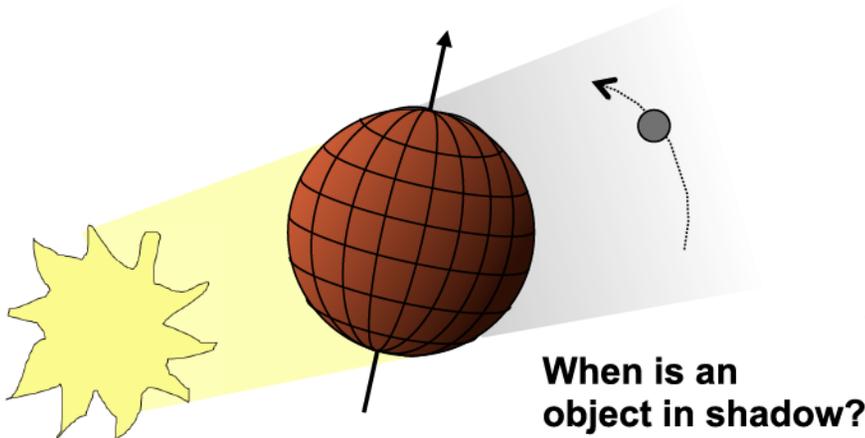
- **SPICE has been in use starting with NASA's Magellan mission to Venus (circa 1990 – 1994)**
- **But development of SPICE is still ongoing, 20 years later, as NAIF strives to meet the ever evolving needs of the planetary science community**
- **In the next charts we present three major new capabilities:**
 - Geometry finder
 - High fidelity shape models
 - A web-based GUI interface to SPICE computations



New “Geometry Finder” Subsystem

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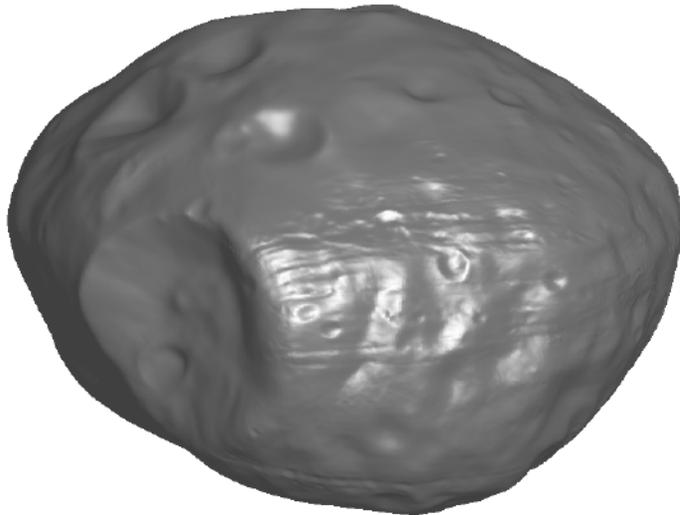
Find times when a selected “geometric event” occurs, or when a selected “geometric condition” exists.





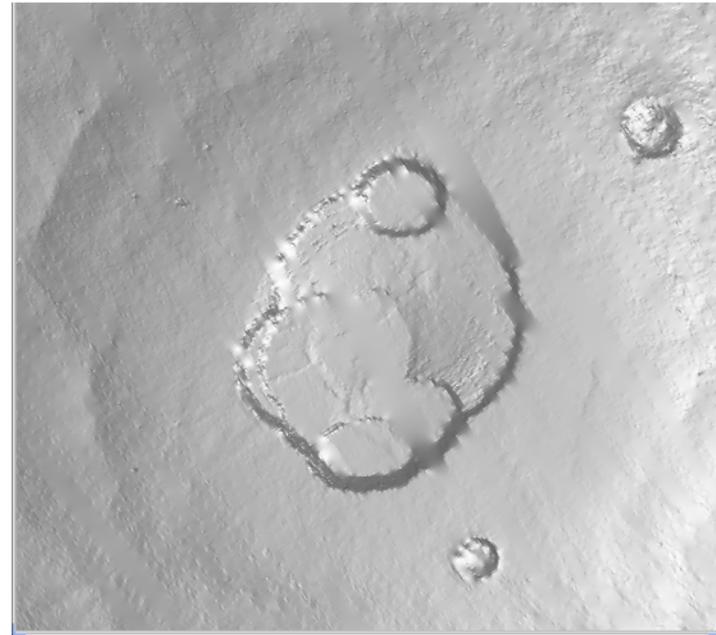
High Fidelity Shape Models

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Tessellated Plate Model

Example shown is Phobos



Digital Elevation Model

Example shown is from Mars MOLA



GUI Interface to SPICE – The Input

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Input Panel for Angular Separation Calculation

Angular Separation

Calculate the angular separation between two targets, as seen by an observing body. ?>

Kernel set: ?>

Target 1: ?>

Target 1 shape: Point Sphere ?>

Target 2: ?>

Target 2 shape: Point Sphere ?>

Observer: ?>

Input Time

Time system: ?>

Time format: ?>

Input times: Single time Time range List of times

Start time: ?>

End time: ?>

Time step: ?>

Aberration Correction

Light propagation: None To observer From observer ?>

Light-time algorithm: ?>

Stellar aberration: Include stellar aberration correction ?>

Plots: Angular Separation ?>

Error handling: ?>

In this example a scientist computes the angular separation of Titan and Dione, as seen from Cassini, from Jan 15 2012 to Mar 15, 2012.

The result will appear lower down on her/his screen. (See next page.)



GUI Interface to SPICE – The Results

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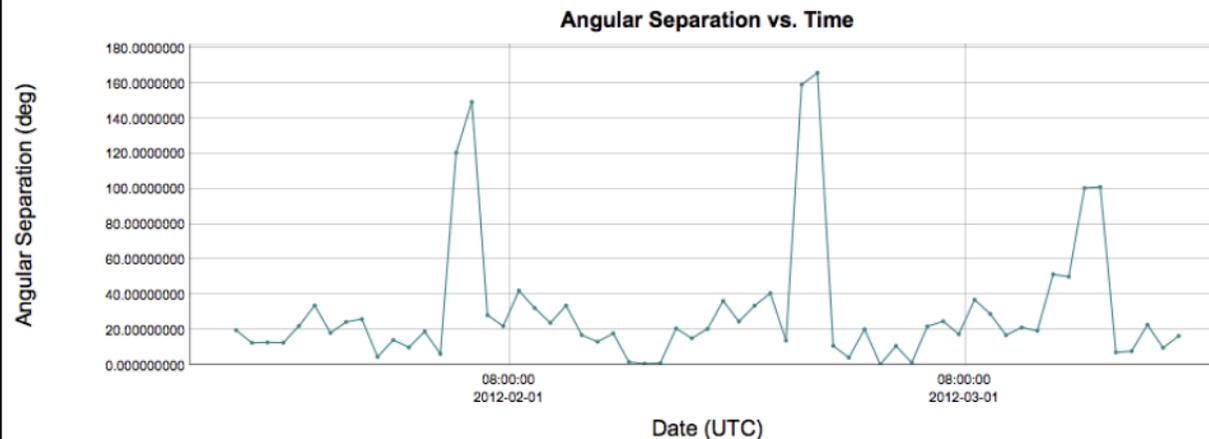
Results Panel for Angular Separation Calculation

Tabular Results

Click a value to save it for a subsequent calculation.

	UTC calendar date	Angular Separation (deg)
1	2012-01-15 00:00:00.000000 UTC	19.78369053
2	2012-01-16 00:00:00.000000 UTC	12.62577715
3	2012-01-17 00:00:00.000000 UTC	12.87489629
4	2012-01-18 00:00:00.000000 UTC	12.66519948
5	2012-01-19 00:00:00.000000 UTC	22.29206624
6	2012-01-20 00:00:00.000000 UTC	33.87599832
7	2012-01-21 00:00:00.000000 UTC	18.28940662
8	2012-01-22 00:00:00.000000 UTC	24.51517658
9	2012-01-23 00:00:00.000000 UTC	26.14902927
10	2012-01-24 00:00:00.000000 UTC	4.64592533
11	2012-01-25 00:00:00.000000 UTC	14.26055200
12	2012-01-26 00:00:00.000000 UTC	10.05535271
13	2012-01-27 00:00:00.000000 UTC	19.14354357

Click and drag to zoom, shift-click and drag to pan. Double-click or use button to reset zoom level.



Results:
Numeric results and optional plot of the angular separation of Titan and Dione as seen from Cassini.



How You May Get Started Using SPICE

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All NASA SPICE offerings may be accessed through the NAIF website

- <http://naif.jpl.nasa.gov/>
- **Read the [tutorials](#)**
 - <http://naif.jpl.nasa.gov/naif/tutorials.html>
- **Try some of the [programming lessons](#)**
 - <http://naif.jpl.nasa.gov/naif/lessons.html>
 - The lessons contain all needed data, and the correct answers
 - The lessons are available in all four supported languages
- **Go to a [training class](#)**
 - <http://naif.jpl.nasa.gov/naif/training.html>