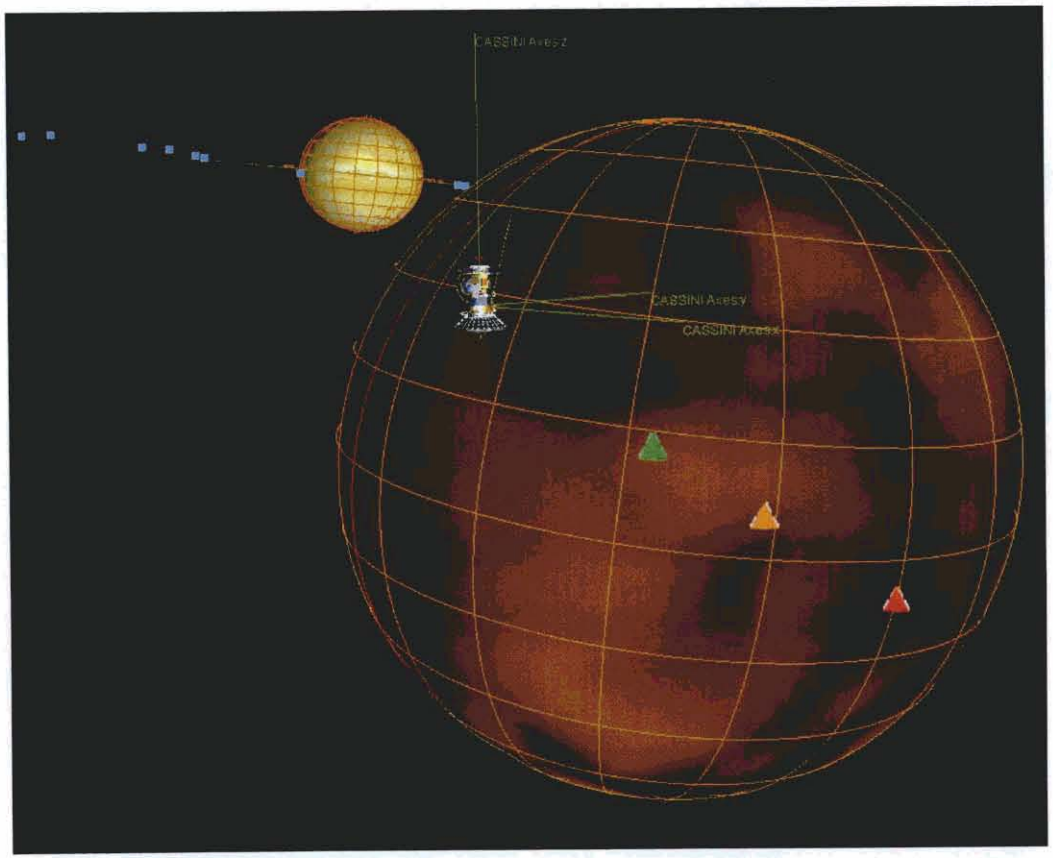
Science Opportunity Analyzer (SOA):

Science Planning Made Simple



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INTRODUCTION

- For the first time at JPL, the Cassini mission to Saturn is using distributed science operations for developing their experiments.
- Remote scientists needed the ability to:
  - Identify observation opportunities
  - Create accurate, detailed designs for their observations
  - Verify that their designs meet their objectives
  - Check their observations against project flight rules and constraints
  - Communicate their observations to other scientists

–Many existing tools provide one or more of these functions, but Science Opportunity Analyzer (SOA) has been built to unify these tasks into a single application.

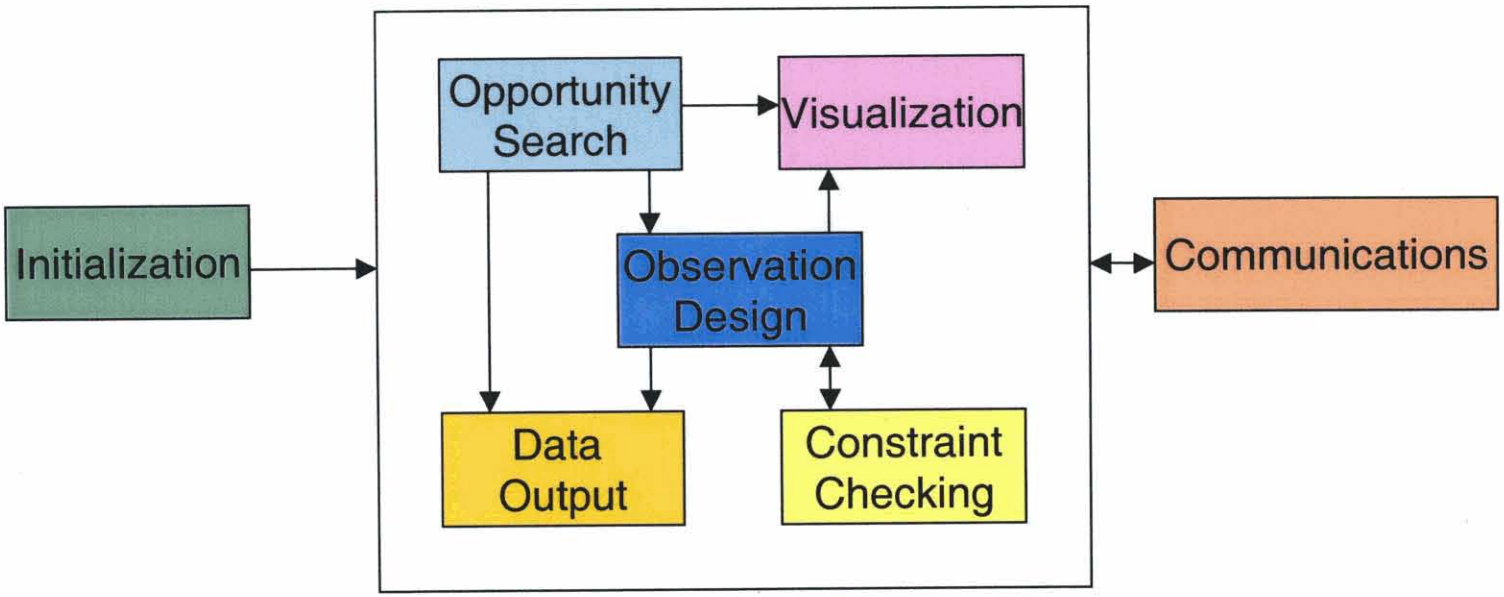
SOA's CHARACTERISTICS

- Accurate: Utilizes JPL Navigation and Ancillary Information Facility (NAIF) SPICE* software toolkit
  - Provides high fidelity modeling
  - Facilitates rapid adaptation to other flight projects
- Portable: Available in Unix, Windows and Linux
- Adaptable: Designed to be a multi-mission tool so it can be readily adapted to other flight projects

- Implemented in Java, Java 3D and other innovative technologies

*SPICE = Spacecraft, Planetary, Instrument, Constant, Events

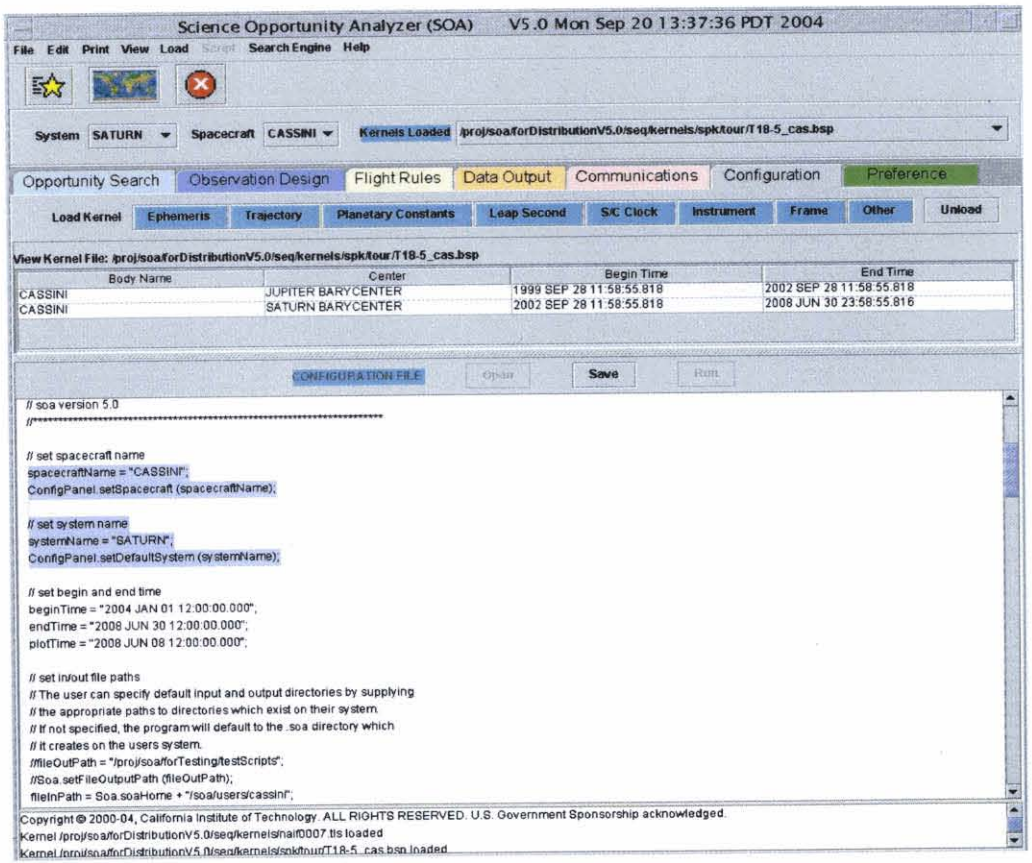
SOA FUNCTIONS



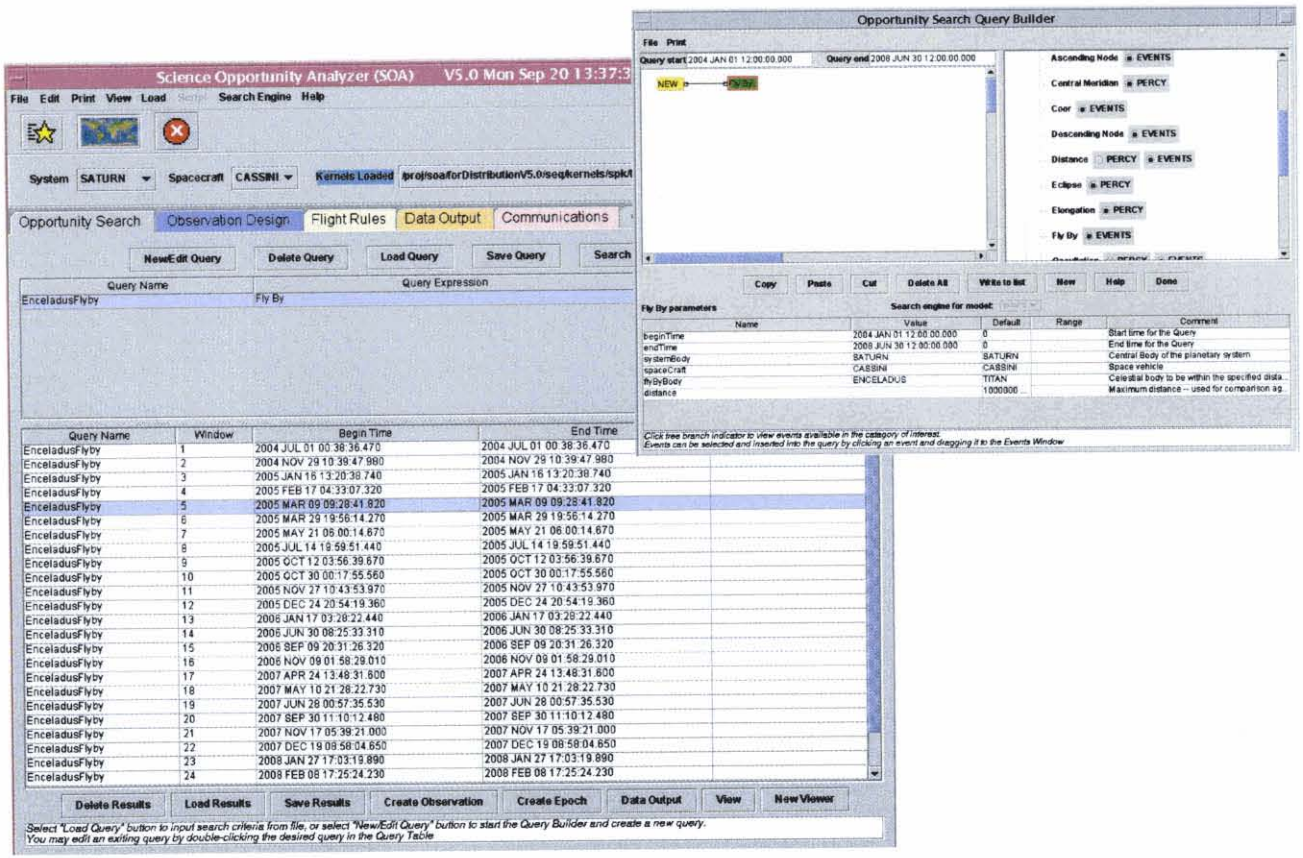
6 Simple Steps

1. Start SOA and run the Configuration File. The Configuration File contains the spacecraft trajectory information as well as other data to run SOA.
2. Select the Opportunity Search tab. Select an opportunity search option from the 34 available. Fill in the search parameters. Save the search and then run it.
3. Select one of the returned search result windows and view it in either 2-D or 3-D displays by pressing the View button.
4. Select the Observation Design tab. Select to create a new observation. Create the observation using one of the five observation types (scoping, mosaic, continuous scan, track-a-target, or roll-about-an-axis). Fill in the parameters and save it.
5. Press the constraint-checking button. Correct any constraint violations and then view the observation. If the observation meets the users criteria, then save the observation for later retrieval or for sharing with others.
6. Finally, select the Data Output tab and select any of the data items that are desired and the type of data required (opportunity search, trajectory related or observation related). Select the type of output – graph or tabular data.

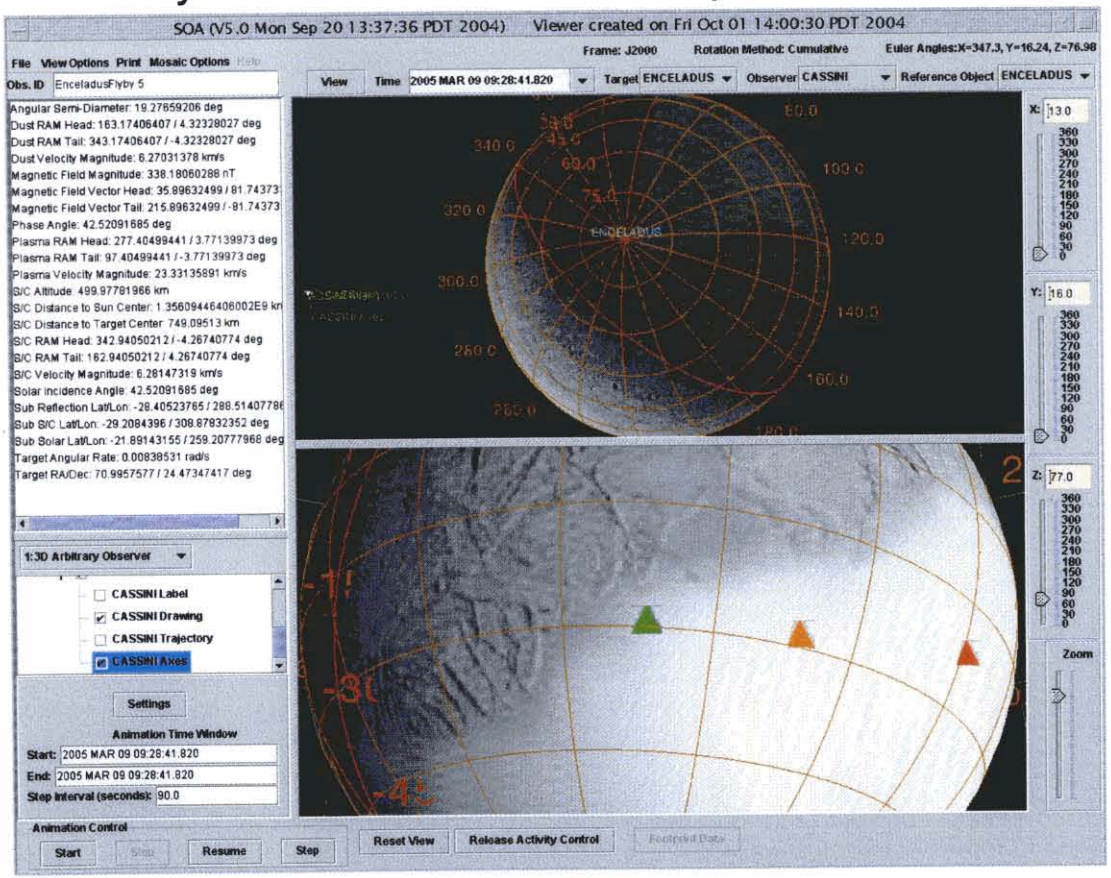
- Configuration
  - –Flight project adaptation is created by loading a project-specific configuration file, SPICE kernels and models.



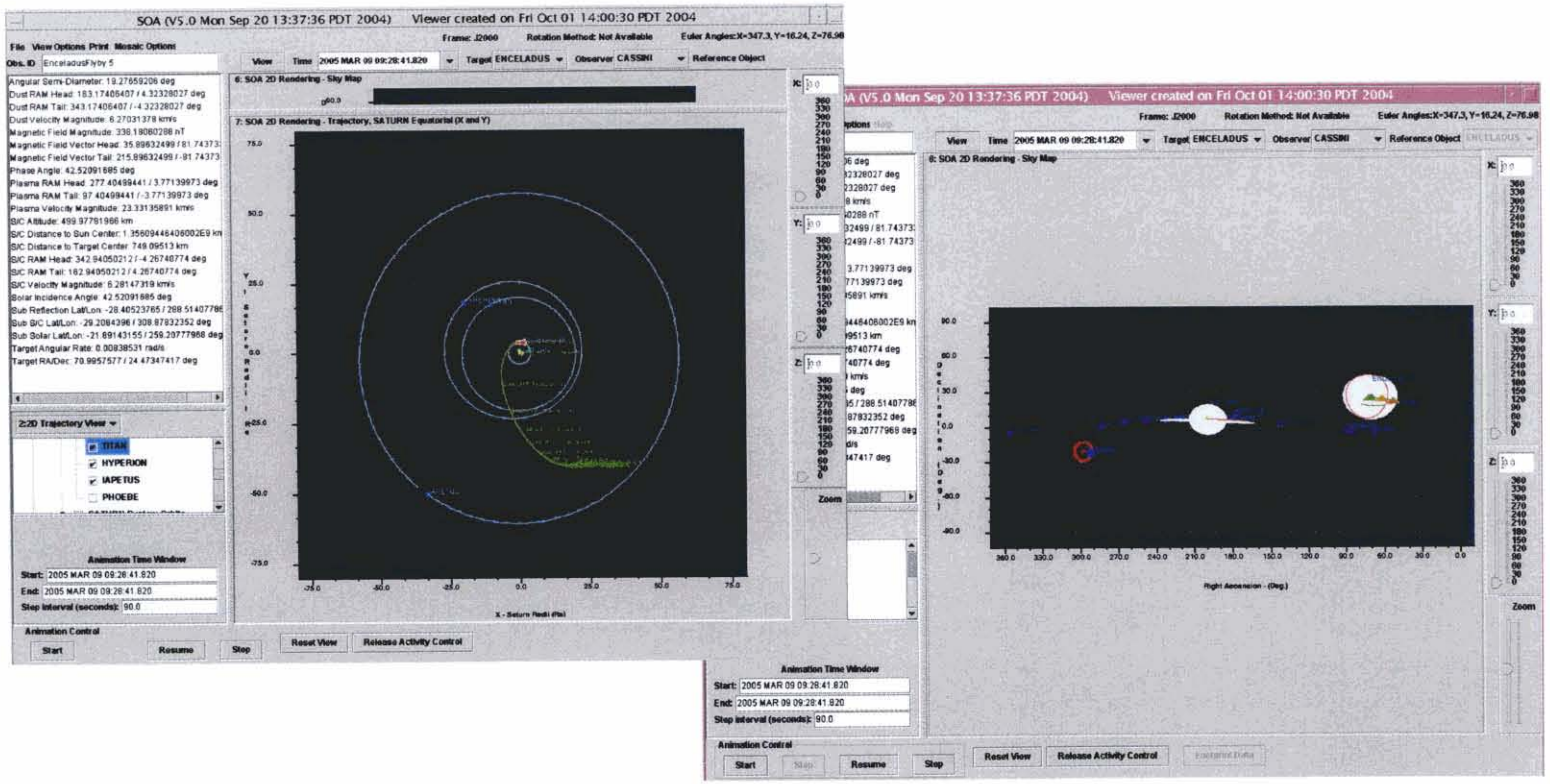
- Opportunity Search
  - –Find windows of opportunity for an observation based on 34 specific geometric criteria.



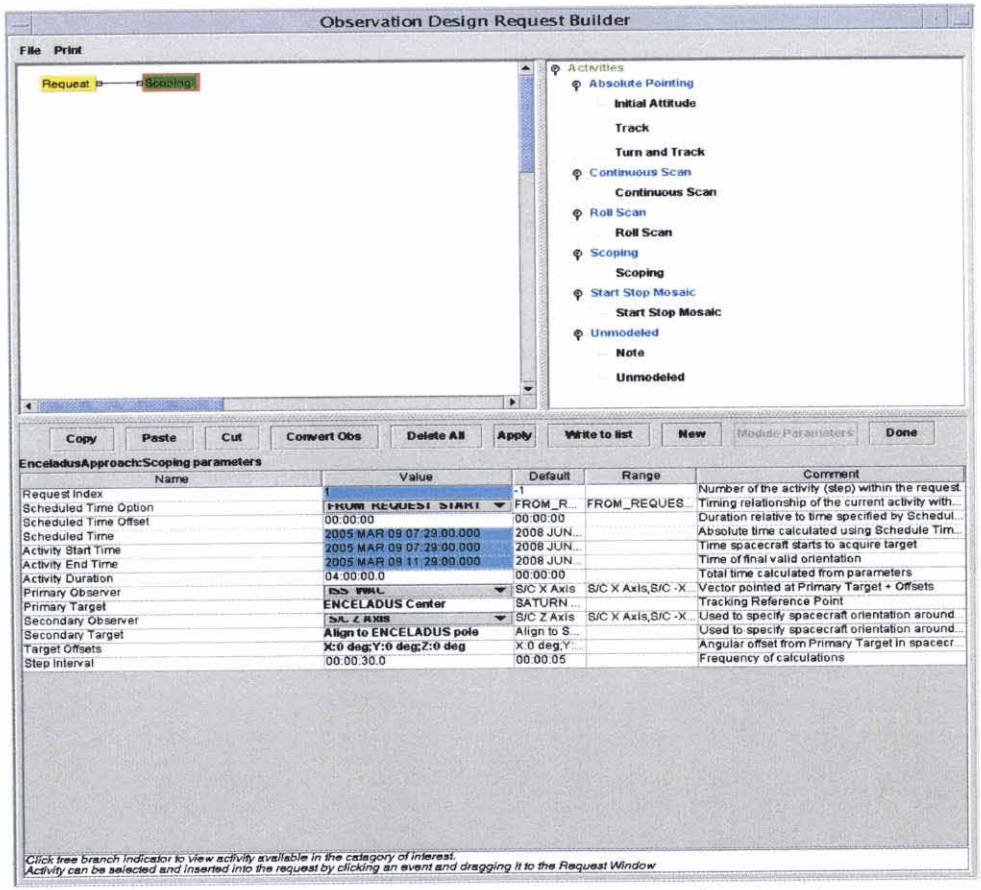
- Visualization
  - –Provides accurate representation of the solar system in multiple ways:
    3-D Arbitrary Observer and 3-D Perspective Projection



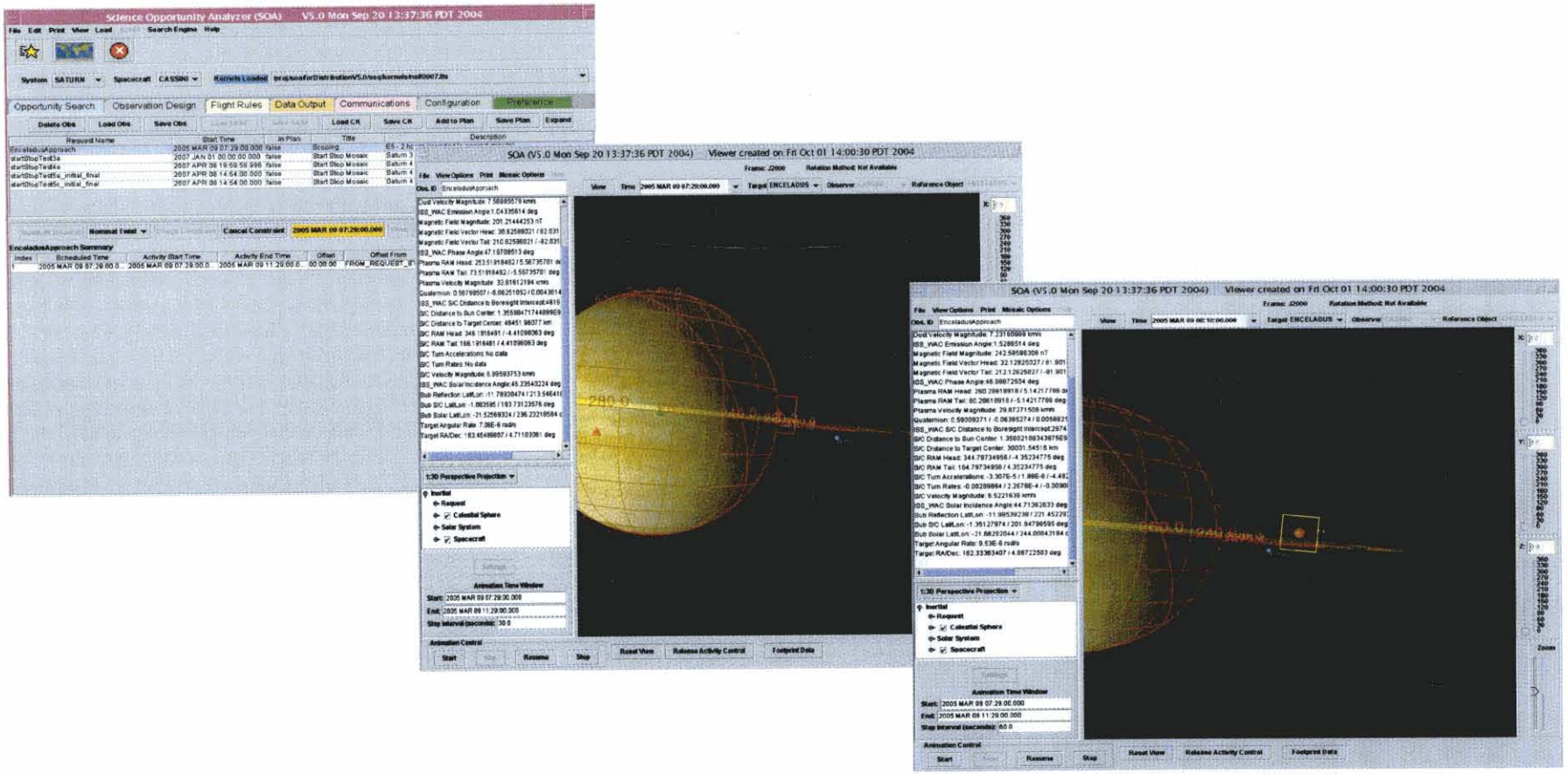
- Visualization
  - –Provides accurate representation of the solar system in multiple ways:
    2-D Equidistant Projection Skymap and 2-D Trajectory Plot



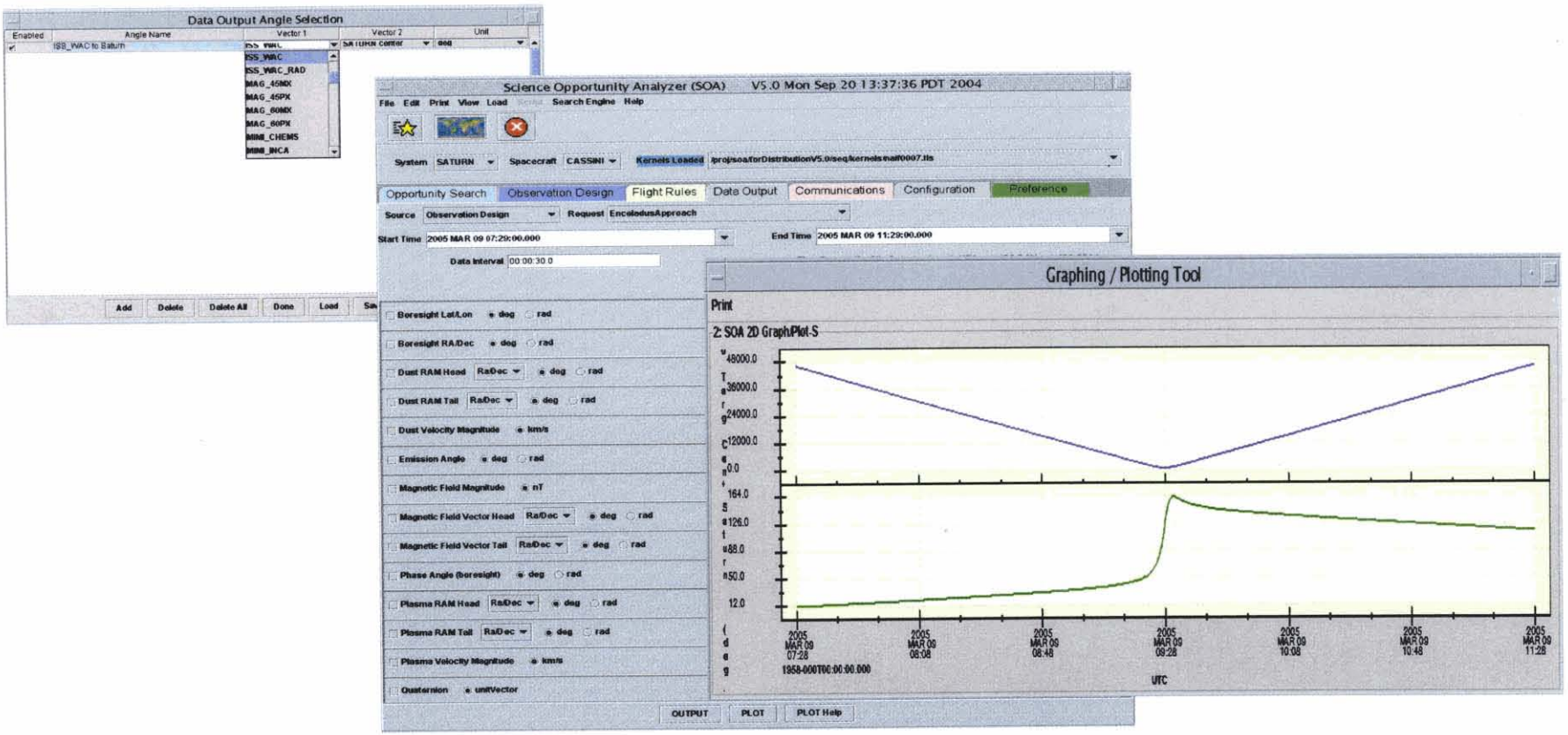
- Observation Design
  - –High level "Scoping" design tool for "what if" studies
  - –Create nxm mosaic, scan mosaic, roll-about-an-axis, or track-a-target



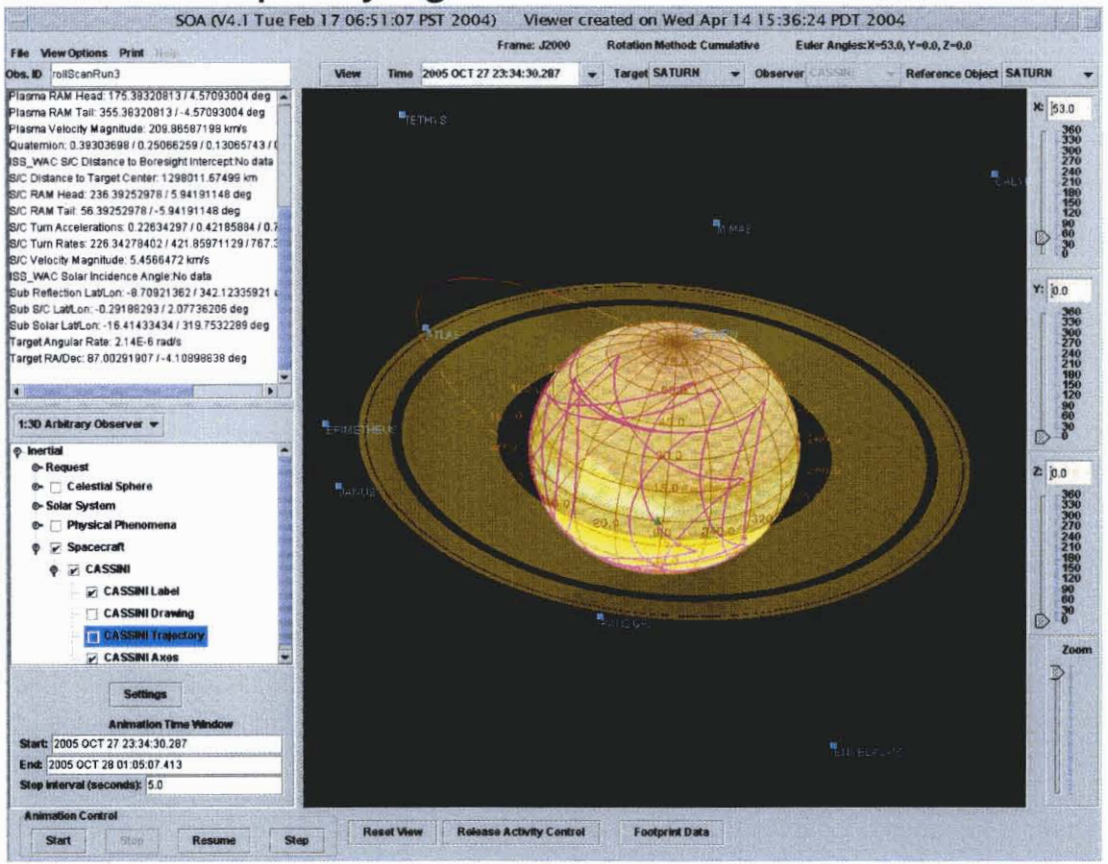
- Constraint Checking
  - –Check observations against specific geometric constraints



- Data Output
  - –Obtain ancillary data related to an opportunity search, a trajectory or an observation as either a text file or plots



- Communications
  - –Reads/writes spacecraft attitude files (SPICE* C-kernels), a universally accepted method for specifying attitude information

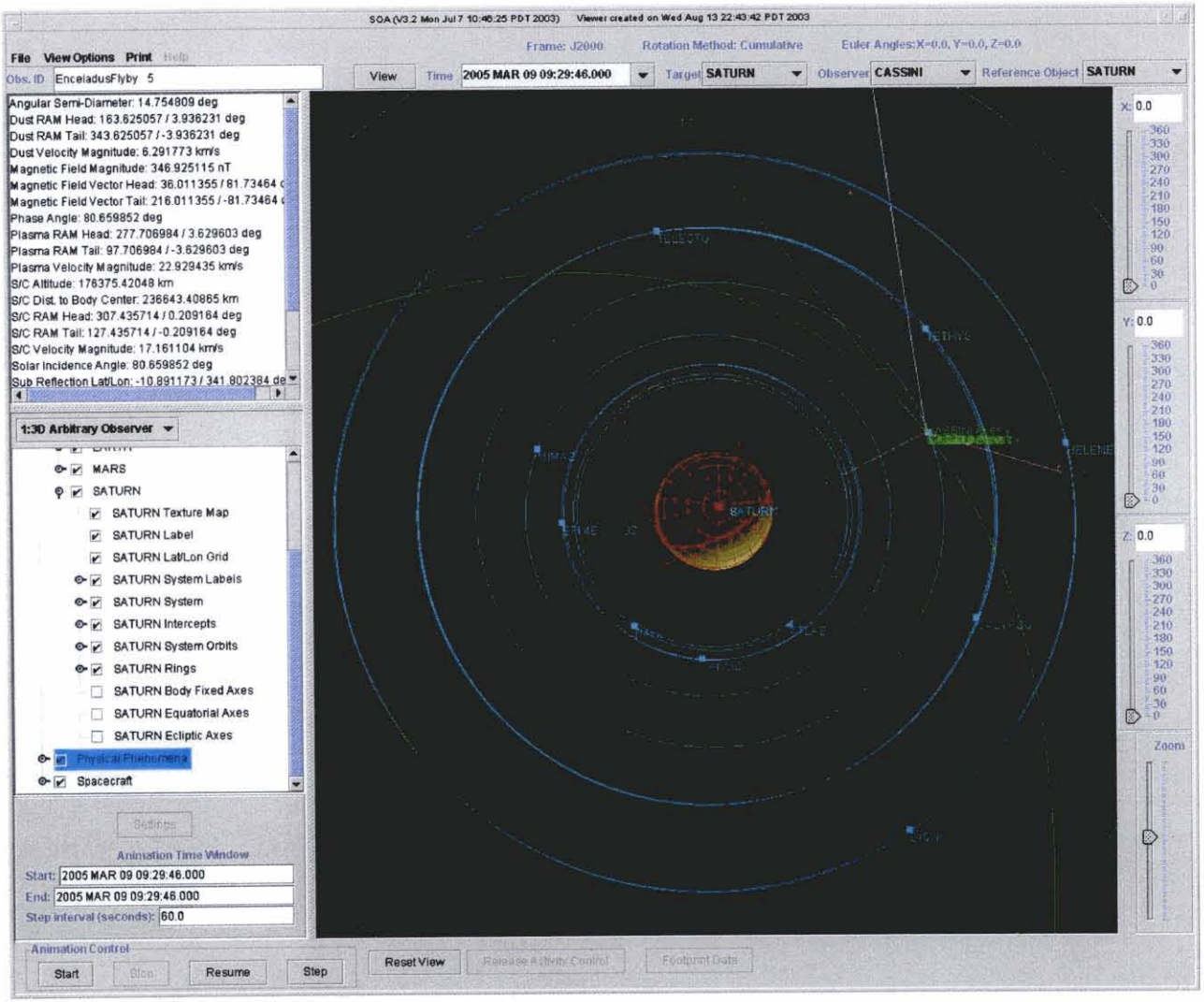


*SPICE = Spacecraft , Planet, Instrument, Constants, Events

Additional Displays

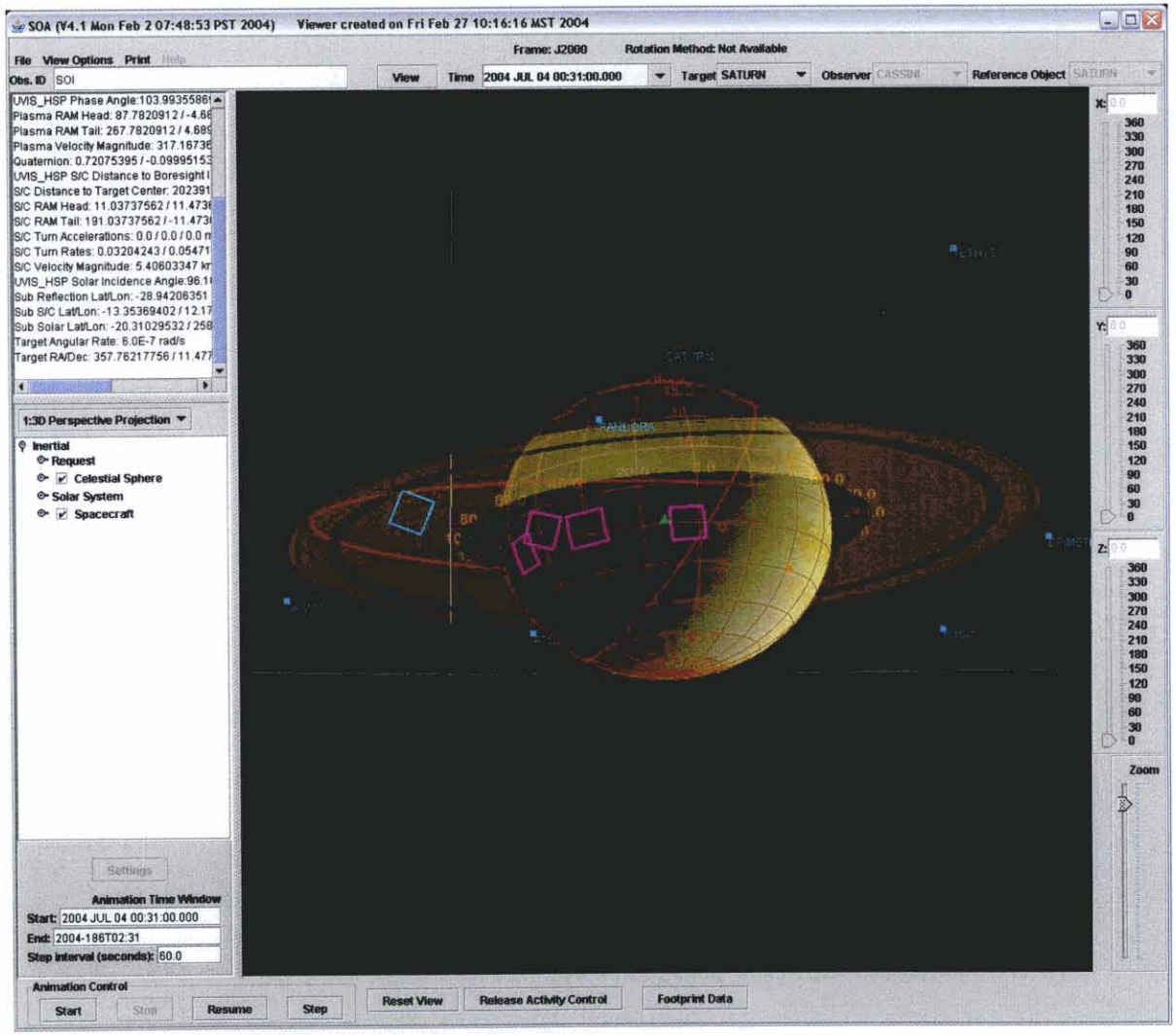
CASSINI

3-D Arbitrary Observer view of the Saturn system showing the Cassini trajectory in green and the satellite orbits in blue.



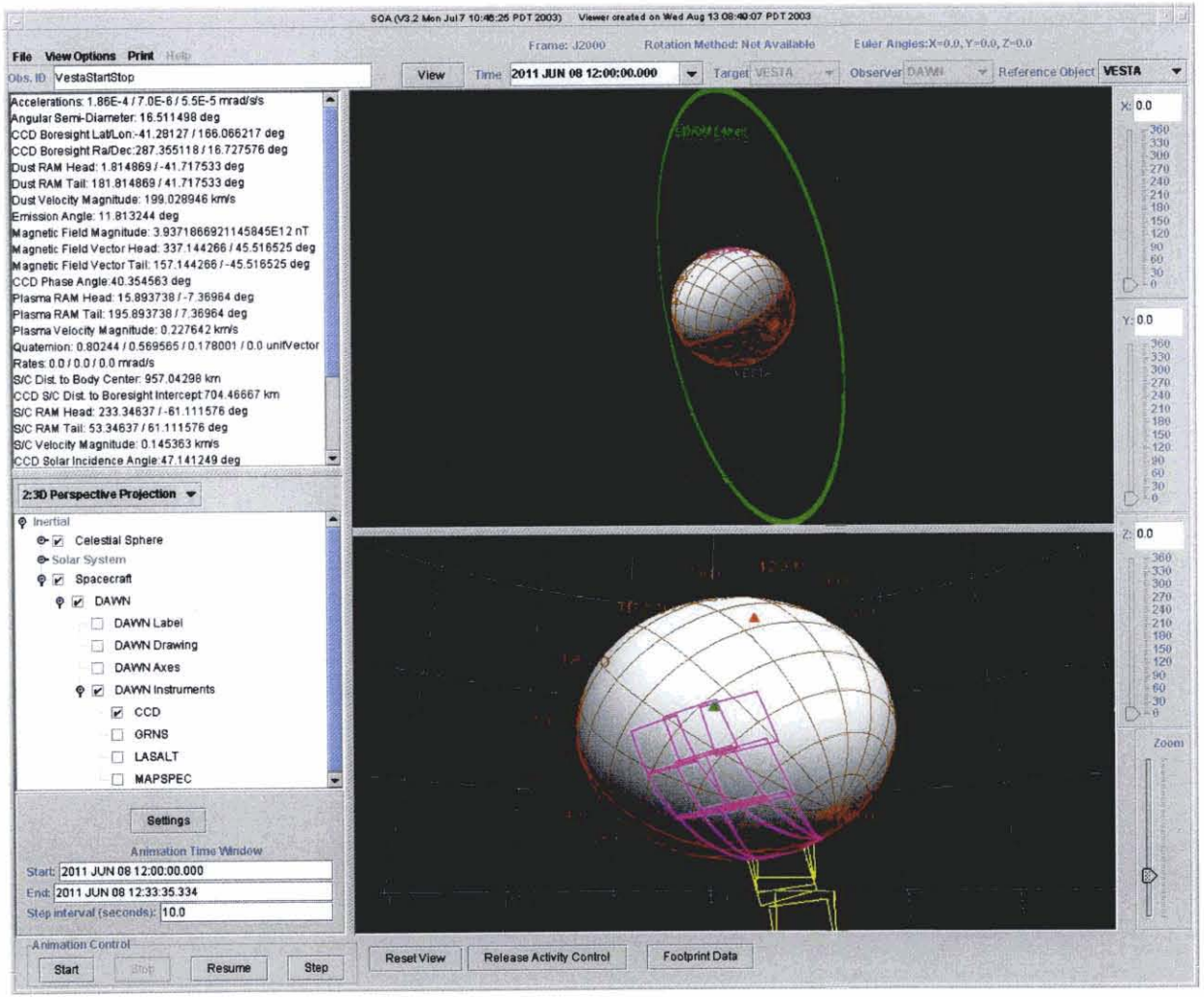
CASSINI

3-D Perspective Projection view of an Ultra-Violet Imaging Spectrometer (UVIS) observation of Saturn's rings in the shadow cast by Saturn. The blue UVIS field of view is close to the edge of the shadow.



DAWN

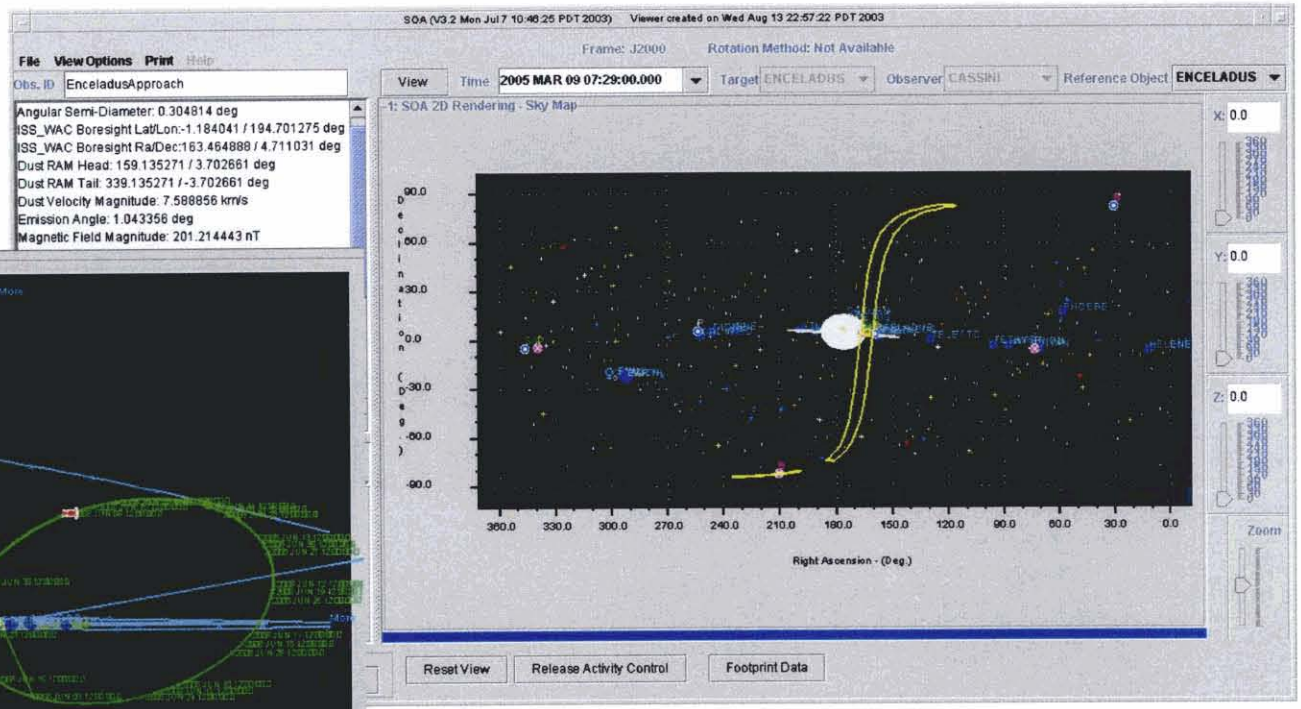
3-D Arbitrary Observer view and 3-D Perspective Projection of Vesta as viewed from the Dawn spacecraft. The start stop mosaic observation shows the camera field of view



JPL

CASSINI

2-D Sky Map view with the CAPS ELS FOV displayed

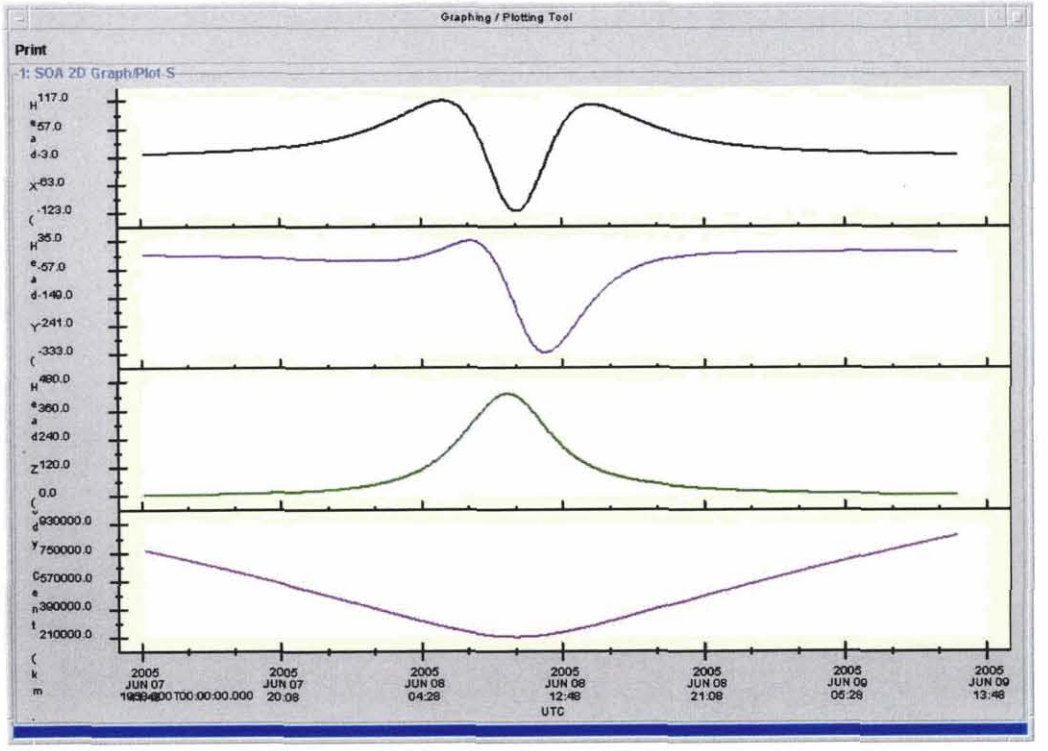


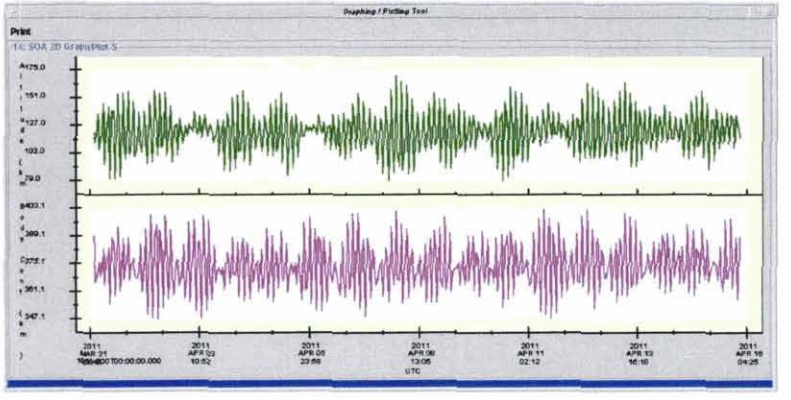
2-D Trajectory view of the X-Z plane, with Cassini spacecraft trajectory (green) and satellite trajectories (blue) shown. Time tick marks help the user identify times of interest for an observation.

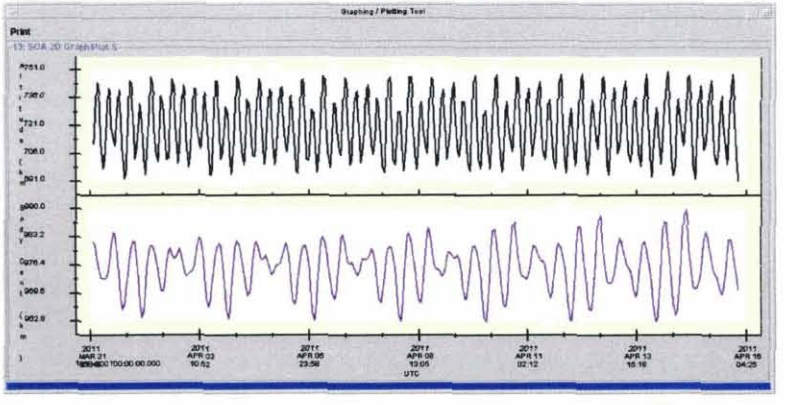
Data Output

CASSINI

The Graphing/ Plotting Tool shows x/y data in a stacked graph. This figure is an example of Saturn's magnetic field x,y,z components and the Cassini spacecraft distance to Saturn.



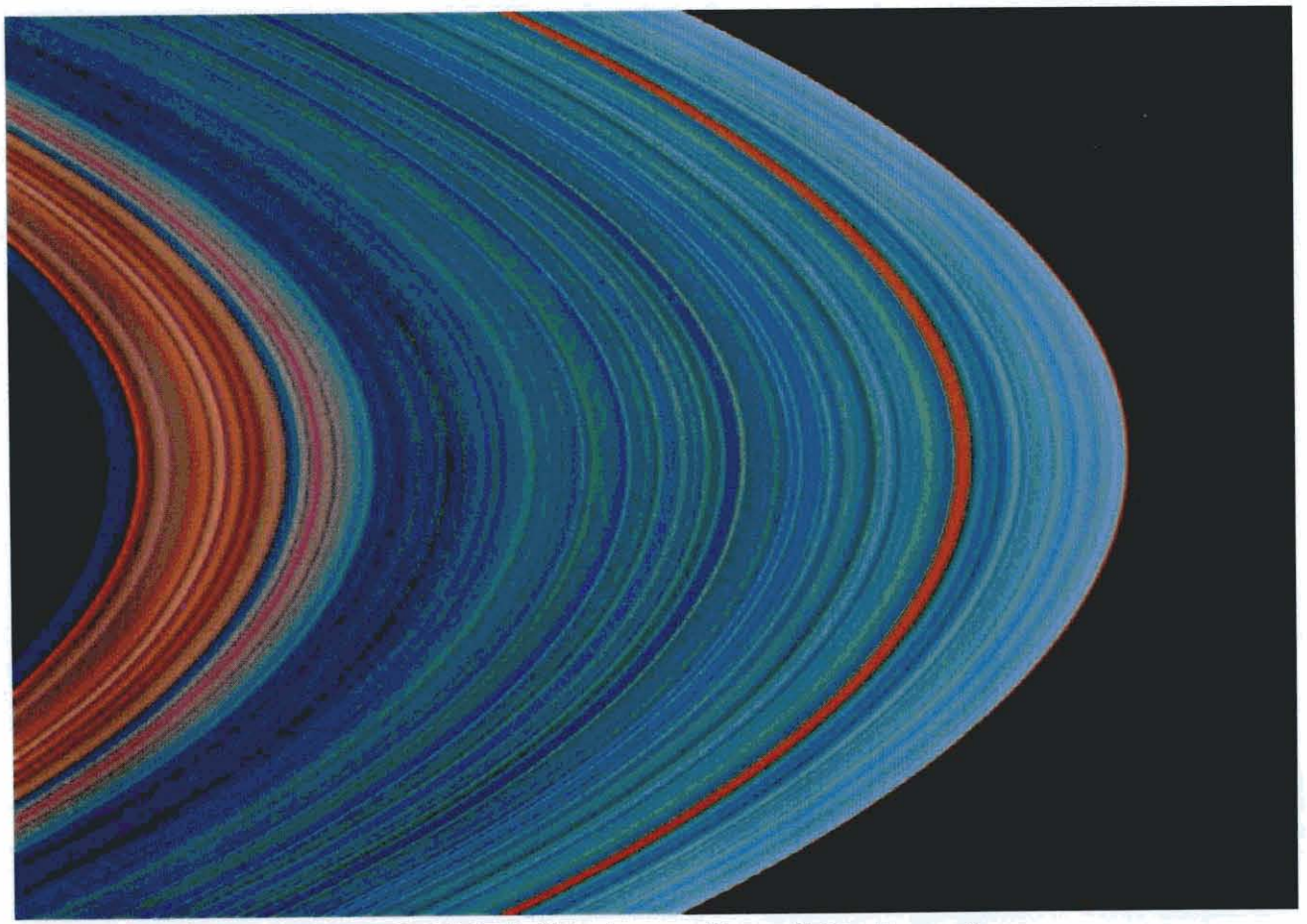




DAWN

Two Data Output plots show the Dawn spacecraft altitude and the spacecraft distance to the center of Vesta for two different trajectories. Mission planners can use these types of comparisons to evaluate candidate trajectories.

Actual Cassini Observation of Saturn's Rings



Courtesy of NASA/JPL/University of Colorado

CONCLUSION

- SOA is easy to use. It only requires 6 simple steps.
- SOA's ability to show the same accurate information in multiple ways (multiple visualization formats, data plots, listings and file output) is essential to meet the needs of a diverse, distributed science operations environment.