The Jupiter Environment Tool

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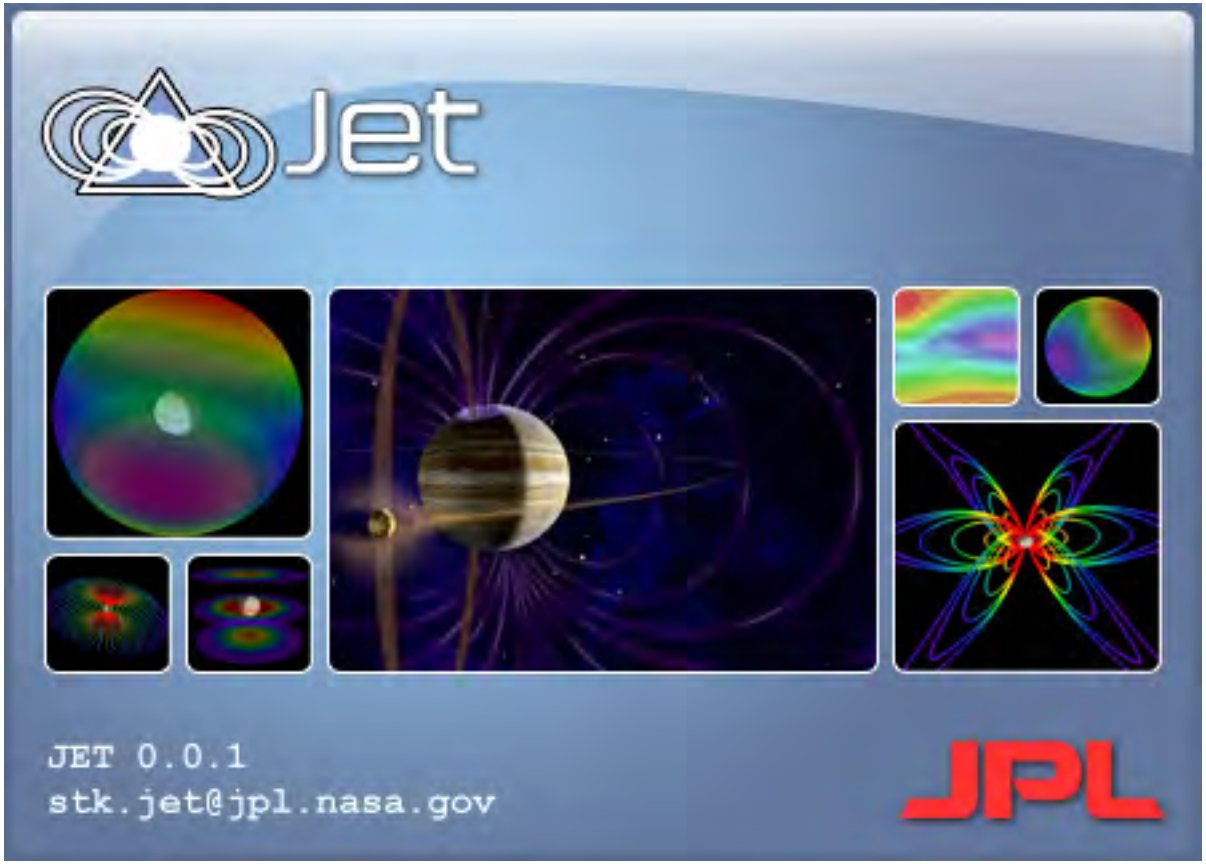
Custom User Interface Plugin for STK



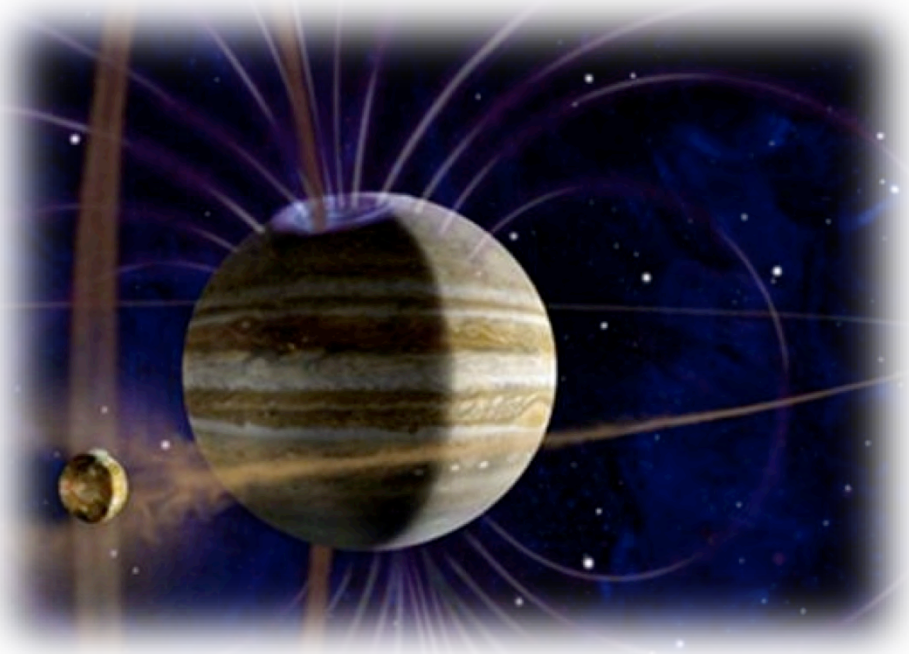
Background

The Europa Jupiter System Mission wanted:

– Geometric analysis with respect to:

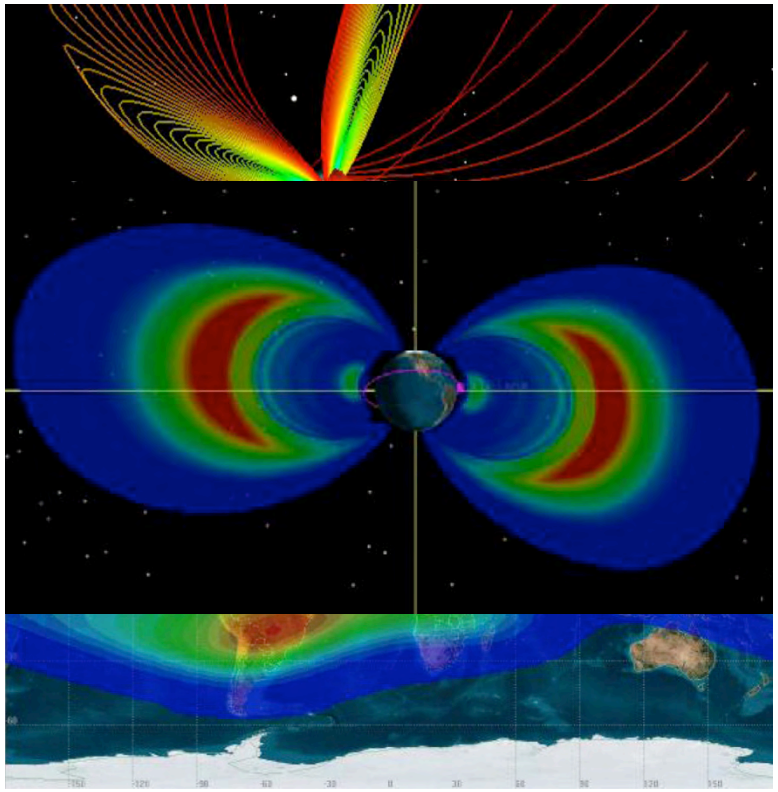
& Visualization of:

- Magnetosphere
- Radiation Field
- Plasma & Neutral Tori
- Rings / Dust / Small Bodies
- Satellite Atmospheres



– Fast turn-around Jovian tour radiation dose estimation

AGI / AER released the Space Environment and Effects Tool (SEET)



- Modules
  - Magnetic Field
  - South Atlantic Anomaly
  - Radiation Environment
  - Particle Impacts
  - Vehicle Temperature
- Only for the Earth, with no planned extensions to other planets

Development History

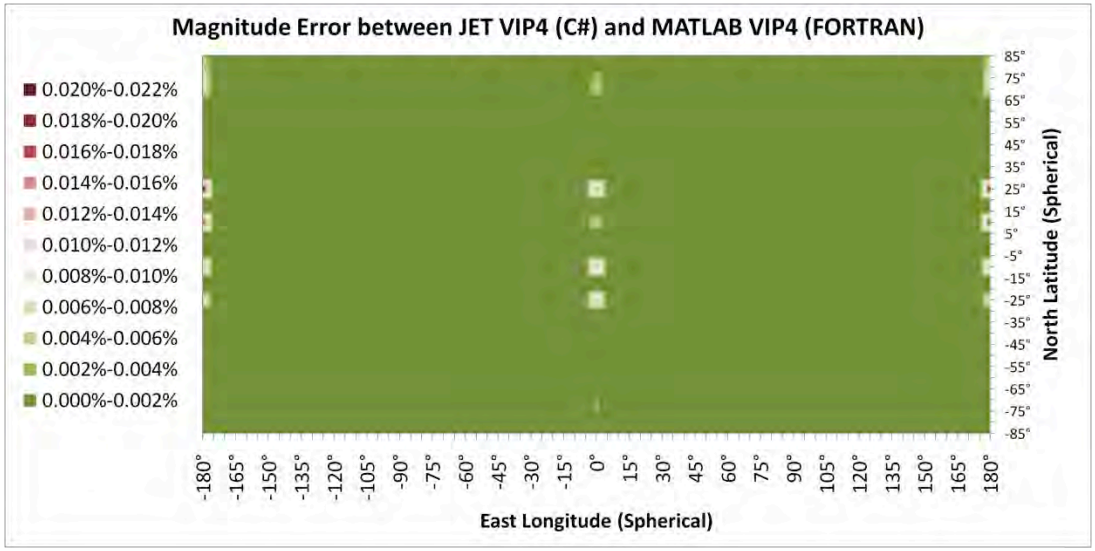
- **Development started in July 2010, all in-house at JPL**
- **Primary Goal: Integrate Jovian magnetic field models into STK as a proof-of-concept for further environment model integration**
- **Small team of 3 JPL employees & 3 summer hires**
  - Erick Sturm, JPL
    Team Lead & Developer – Fortran/C# Translation, GUI Design
  - Michael Kokorowski, JPL
    Magnetic Field Model Expert – Model Validation
  - James Biehl, JPL
    Developer – XML Schema, GUI Save/Load Routines
  - Kenneth Donahue, MIT (now at JPL)
    Developer – Plugin Architecture, Primitive Renderers
  - Jordan Boedeker, Iowa State University
    Developer – Custom Vectors
  - Cedrick Ngalande, USC (now at Microcosm, Inc.)
    Developer – Plugin-FORTRAN Interface

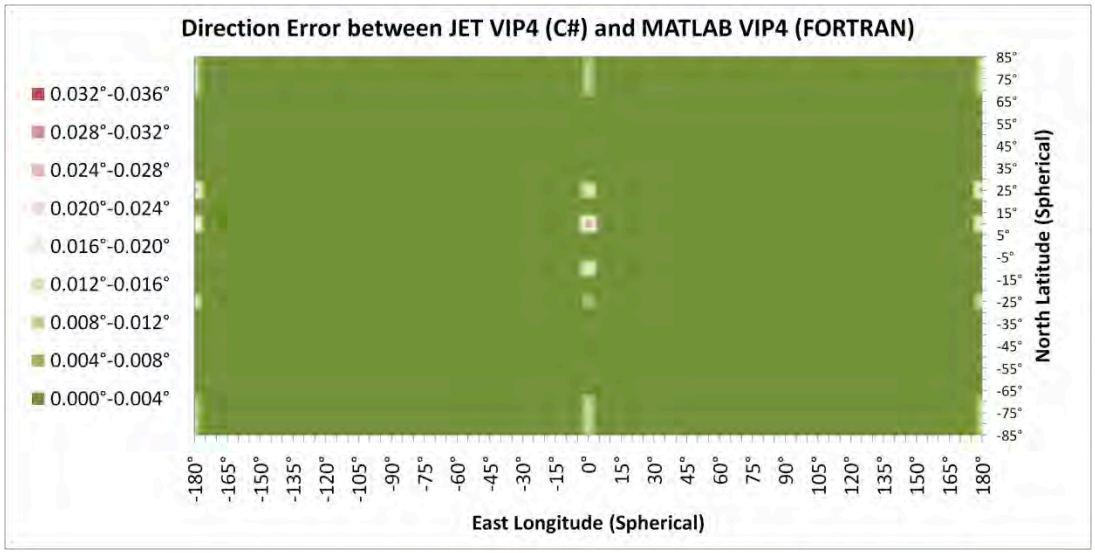
Development Status (After ~1 Year)

- **Three magnetic field models integrated into Plugin**
  - Simple dipole model
  - VIP4 model (original Fortran code)
  - VIP4 model (translated into C#)
- **Integrated user interface window, toolbar, & context menu**
- **Four visualization types rendered in the 3D Window**
  - Field lines
  - Flux-tube footprint ovals (auroral ovals)
  - Plane contours
  - Spherical-sector contours
- **Area & line target generation from footprint oval primitives**
- **Addition of three custom vectors in the VGT**
  - Magnetic field vector
  - Field-line/central-body intersection vectors (North & South)
- **Custom report & graph templates**
- **Compiled Help chm file with context-sensitive access from GUI**
- **Packaged as an msi file for quick & easy installation**

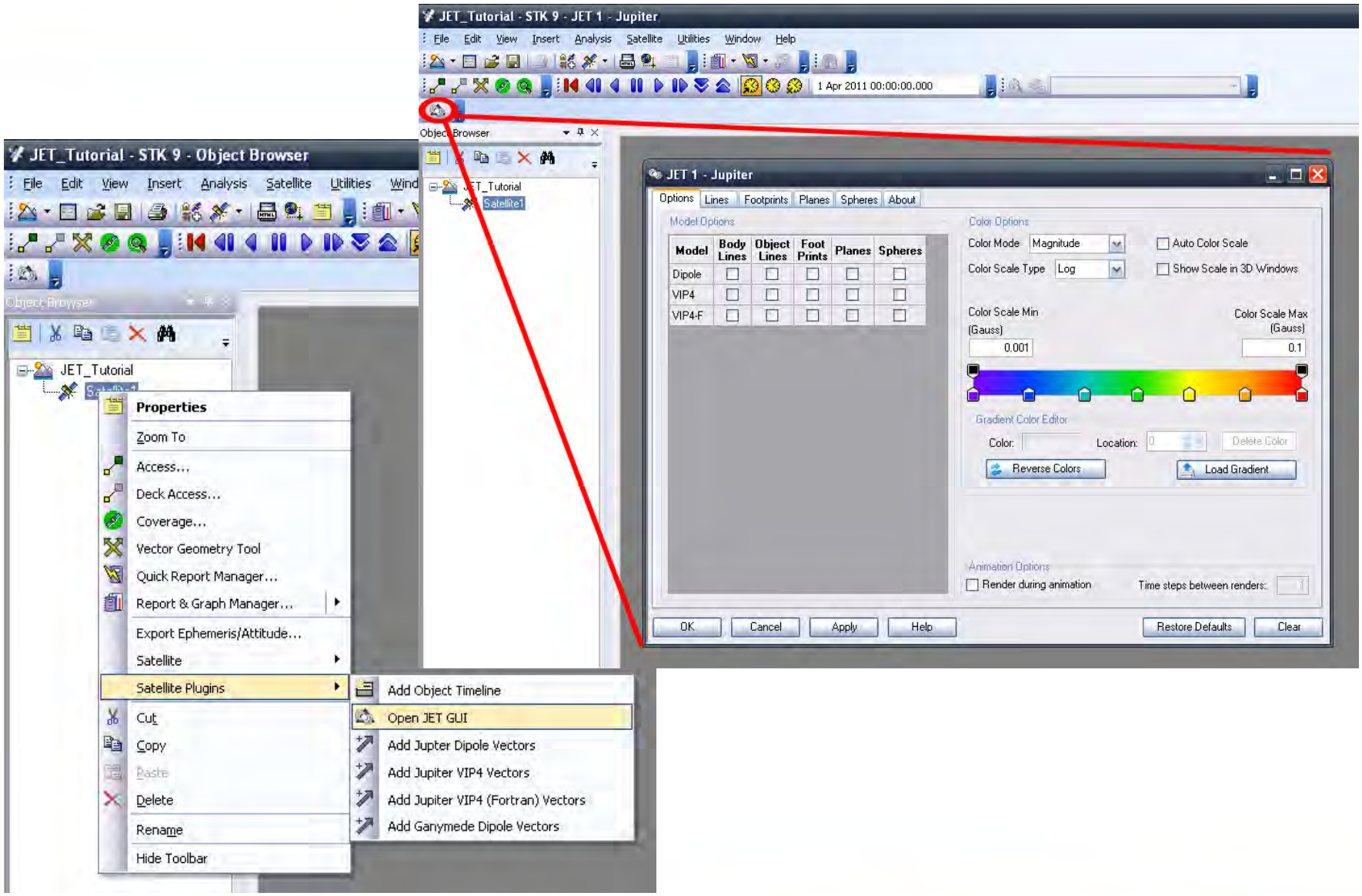
Magnetic Field Model Validation

- **Validated Plugin VIP4 C# & F models against original F code**
- **Sampled points on a 5° Lat/Lon Grid**
- **Sampled at 1, 1.1, 1.25, 1.5, 2, 5, & 10 R_J**
- **Calculated error in magnitude & direction of magnetic field vector**
- **Max Errors:**
  - 0.022% Magnitude
  - 0.036° Direction

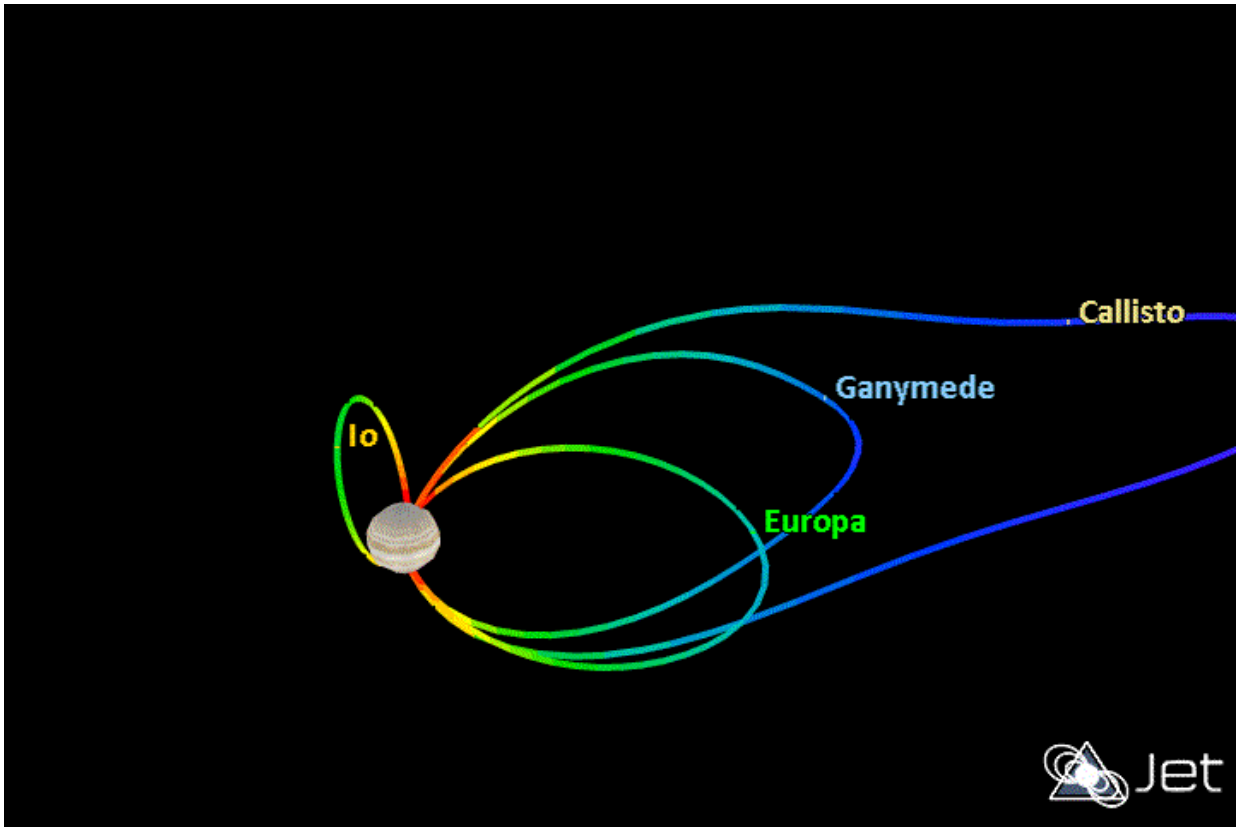


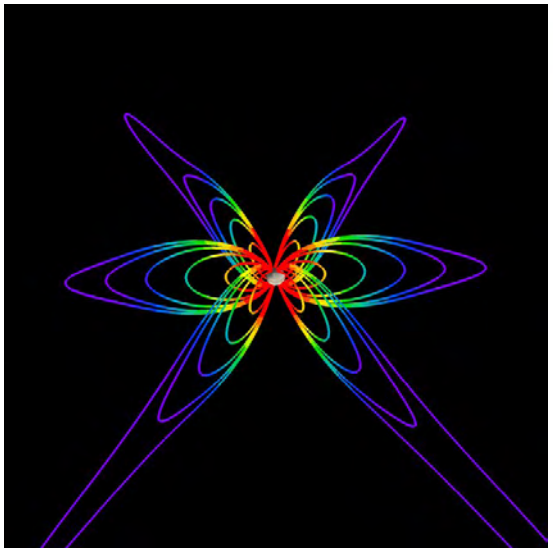


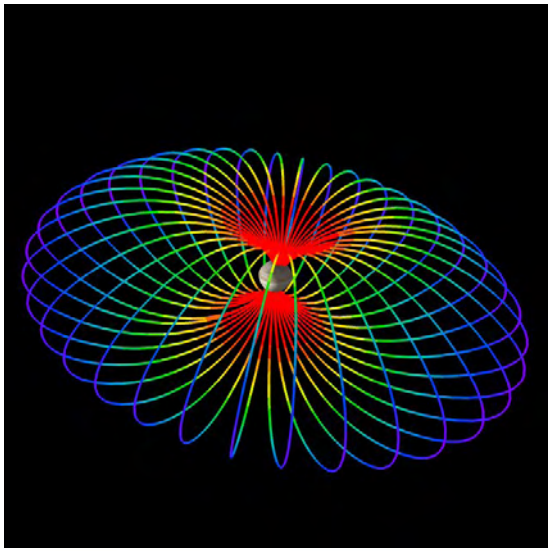
JET User Interfaces within STK



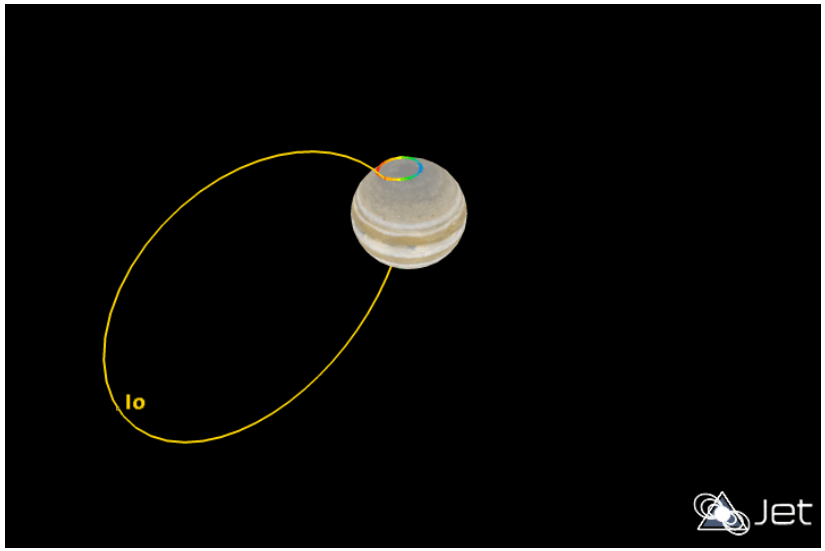
Visualization: Field Lines

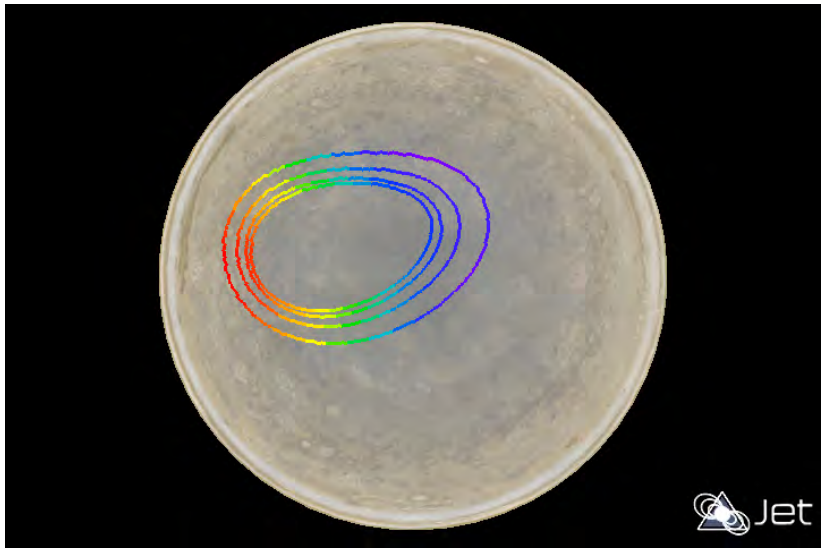


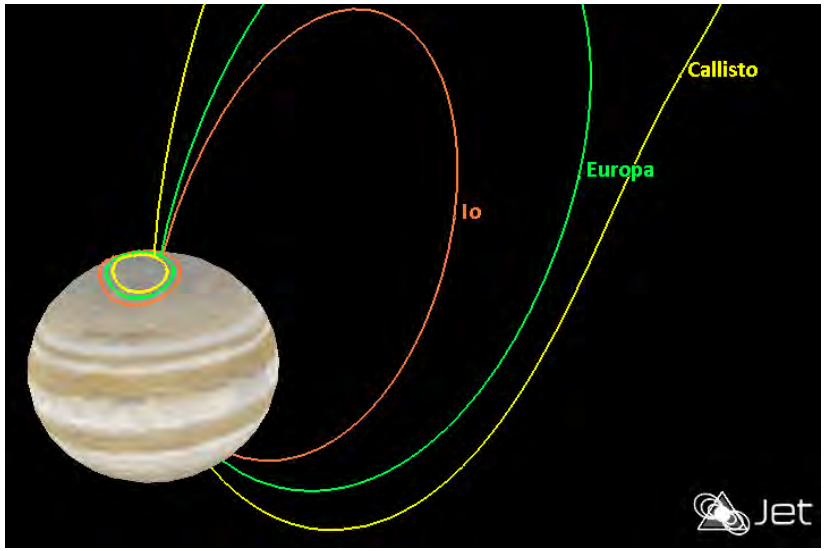


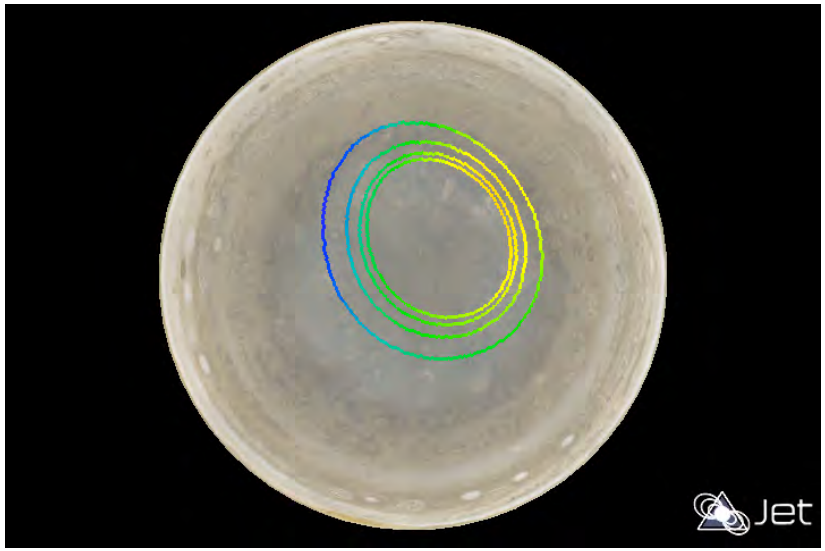


Visualization: Footprint Ovals

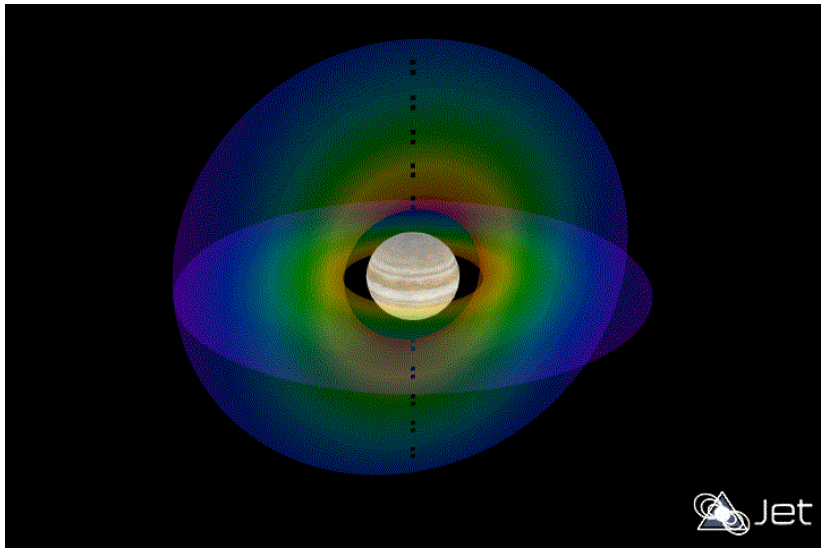


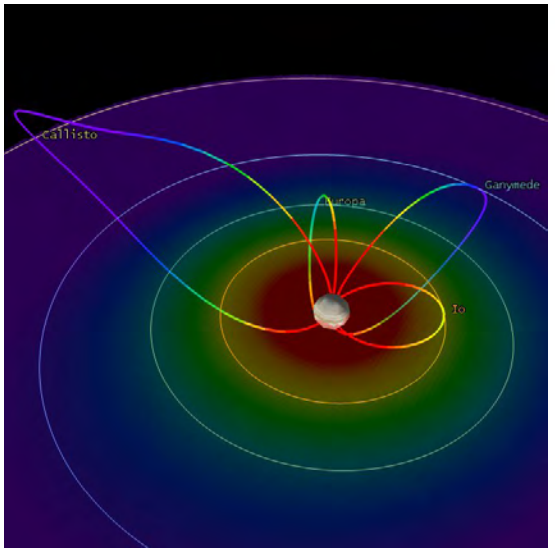


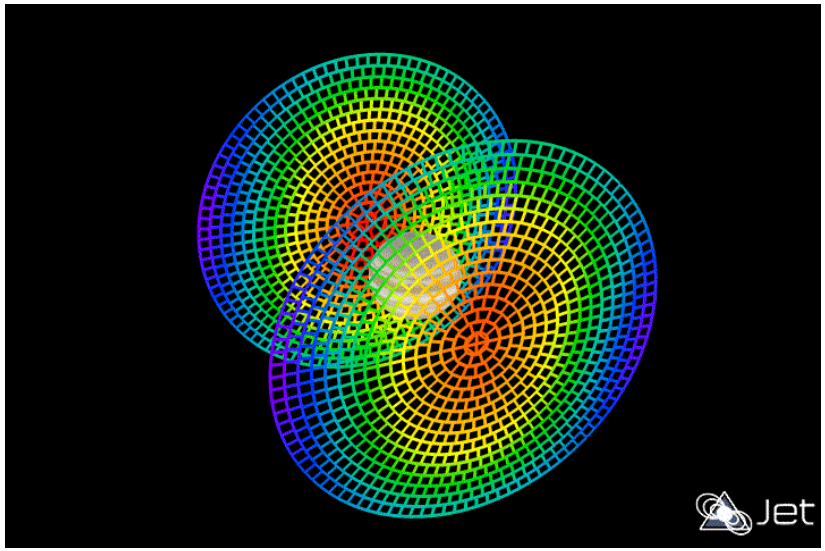


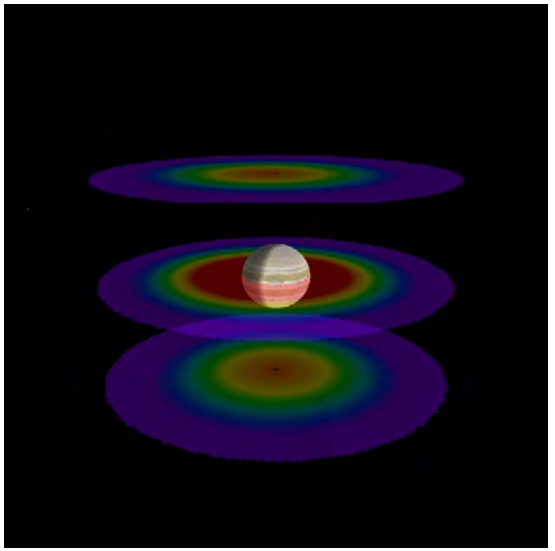


Visualization: Planar Contours

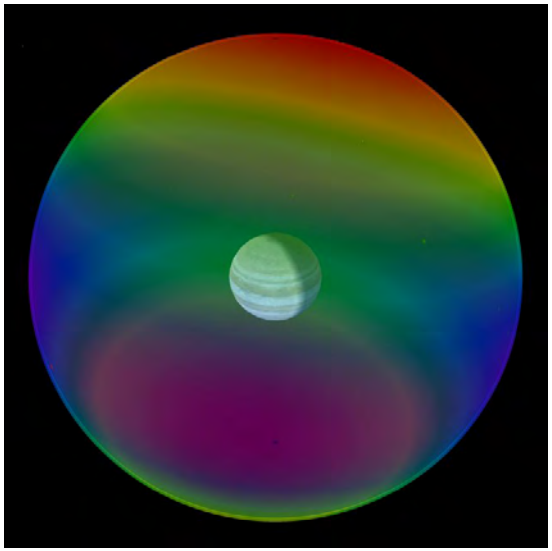


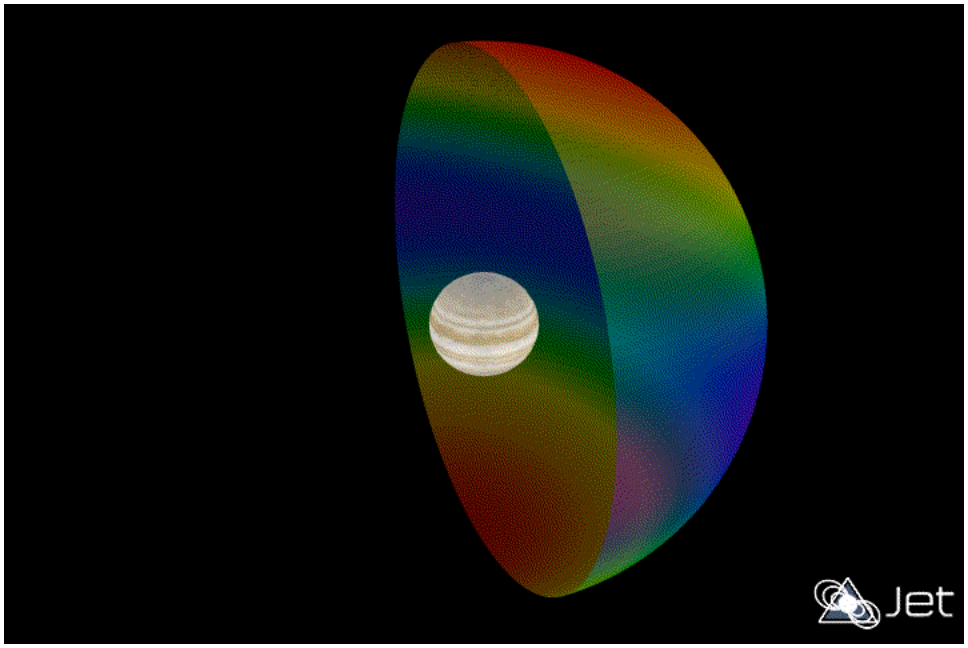


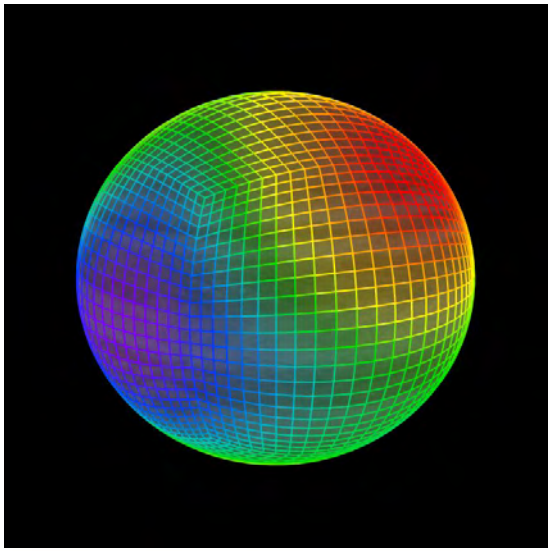


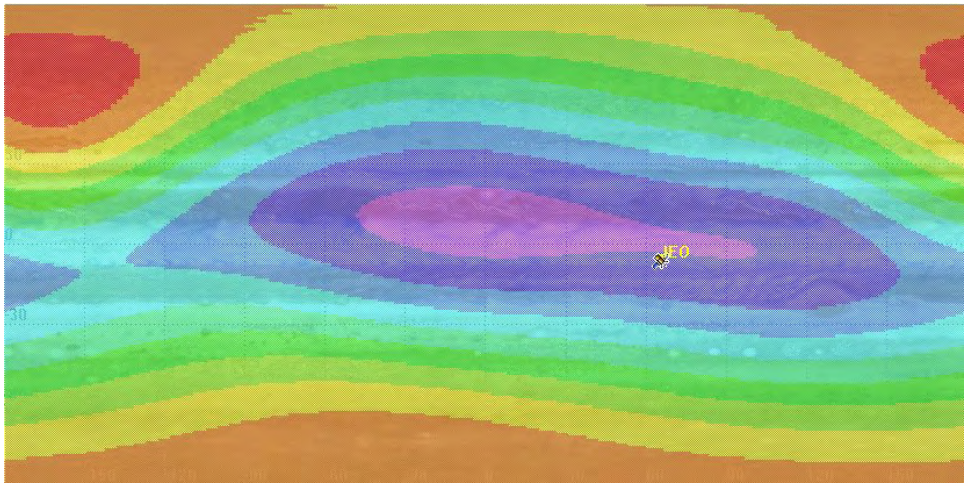


Visualization: Spherical Contours

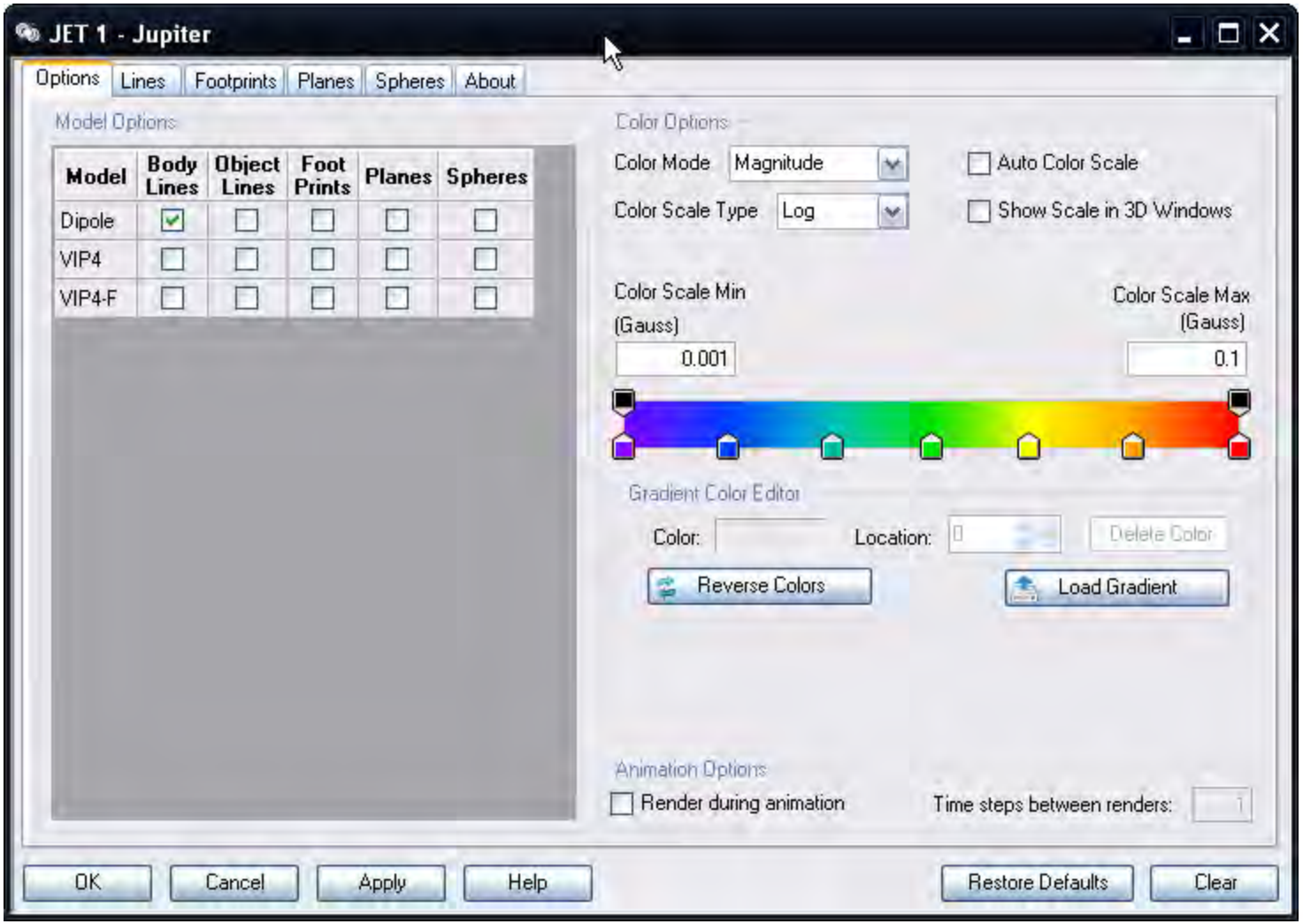








Visualization: Options



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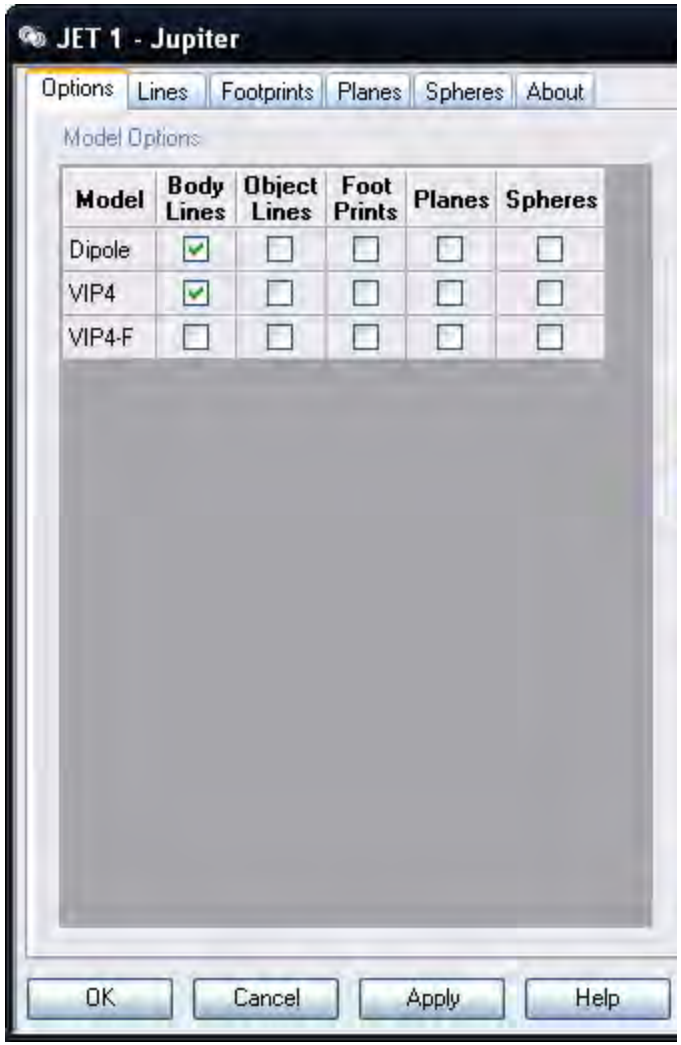

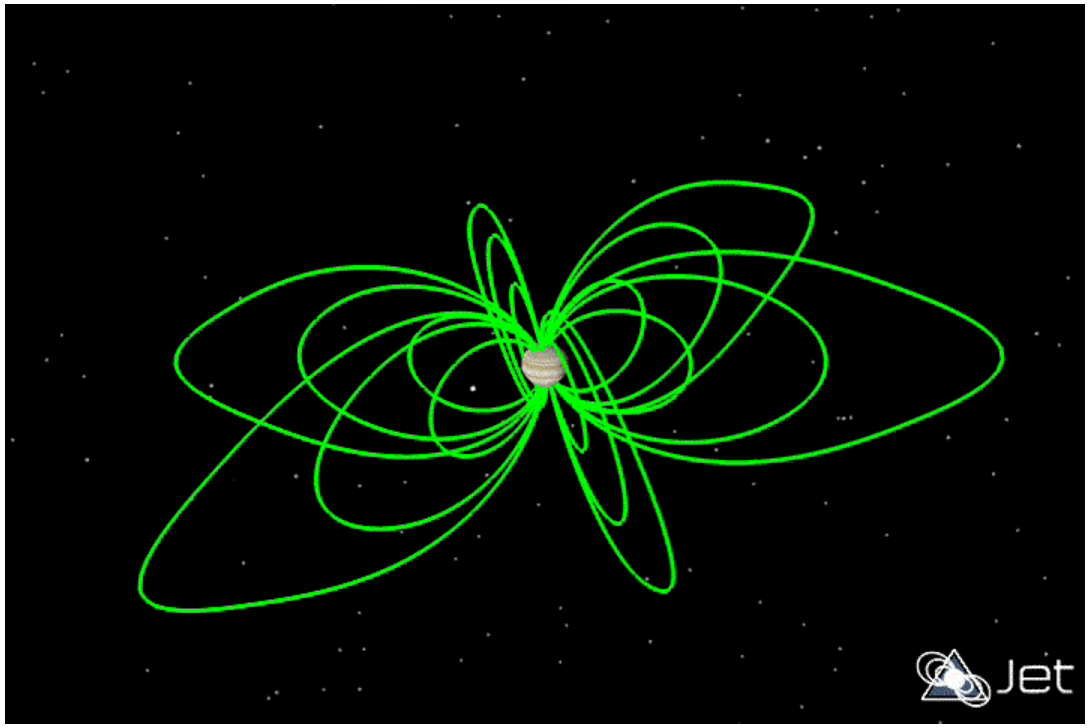

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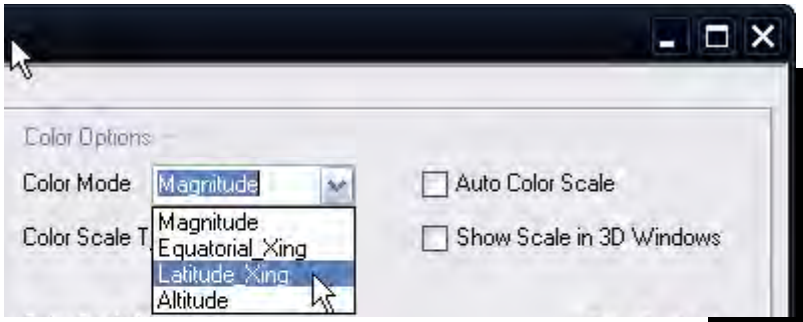

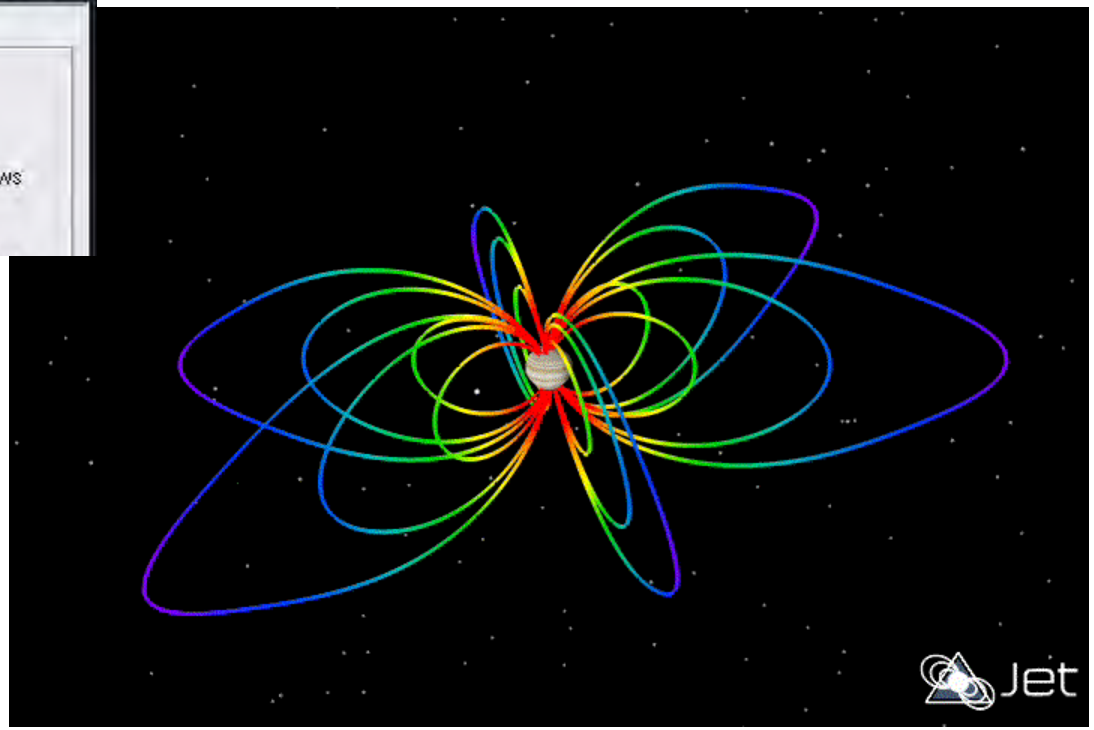

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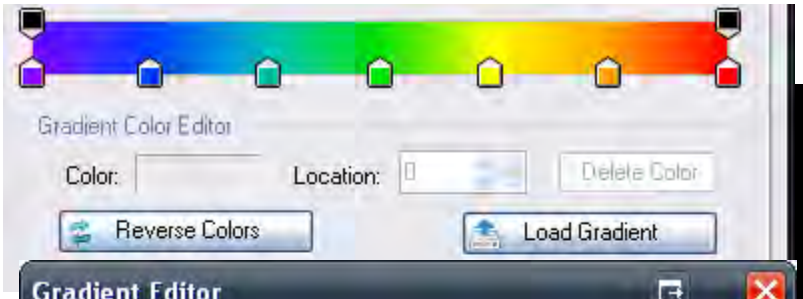
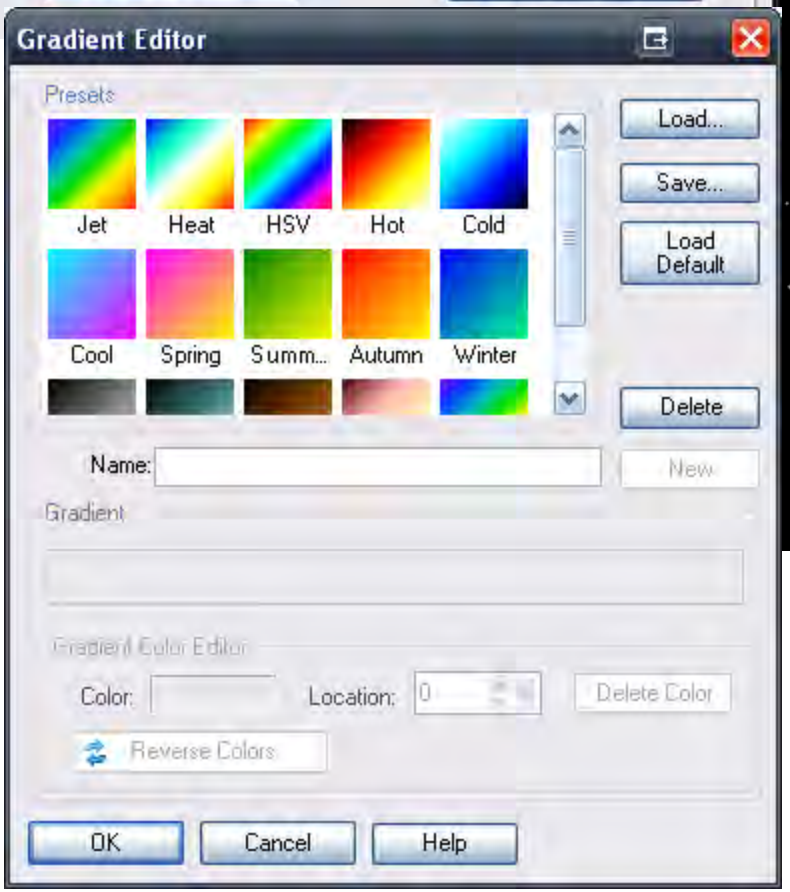
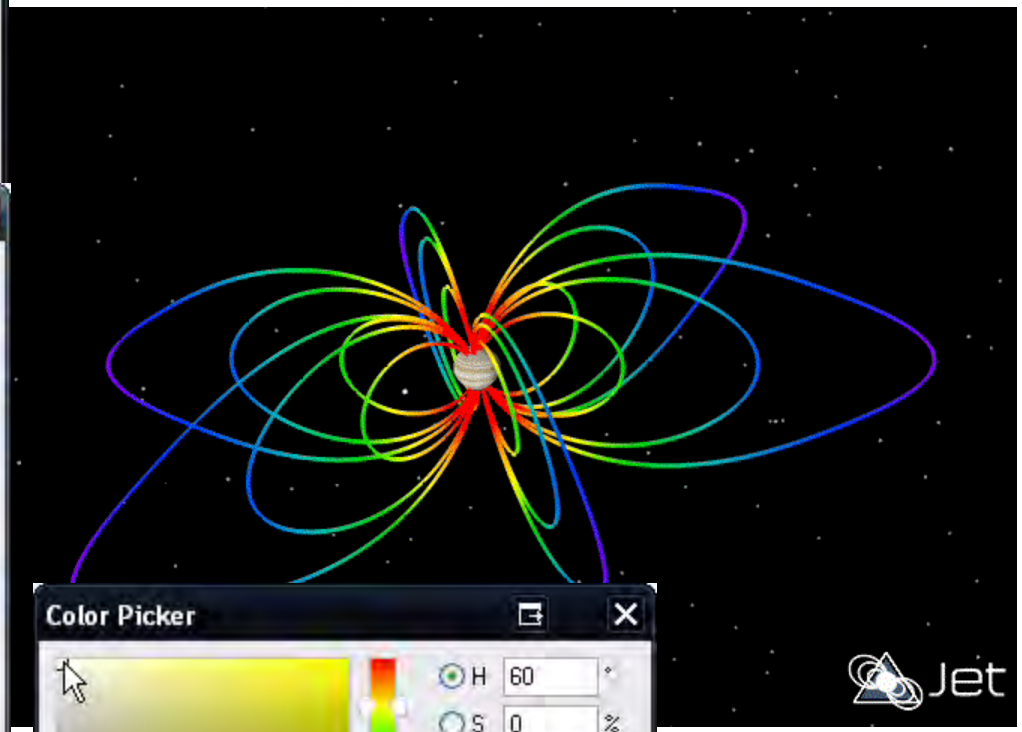
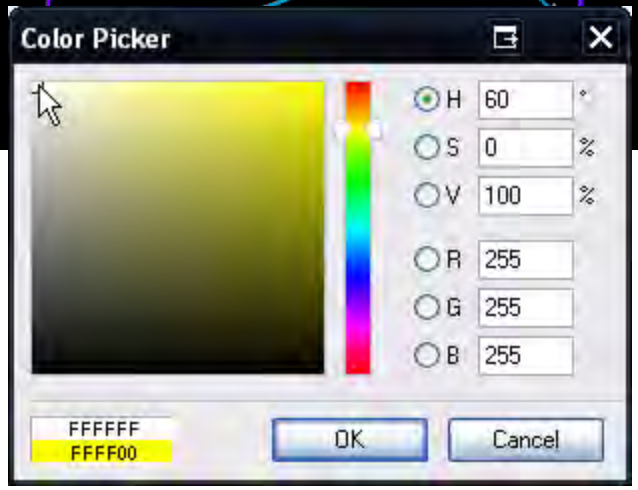




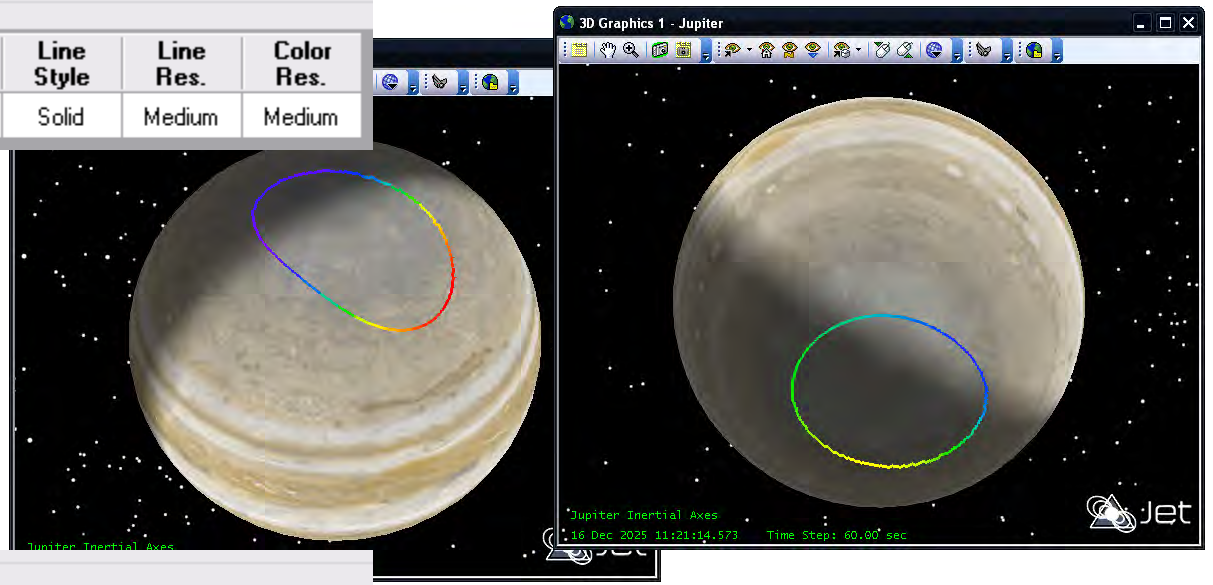




Footprint Oval Area & Line Targets

Object Footprints

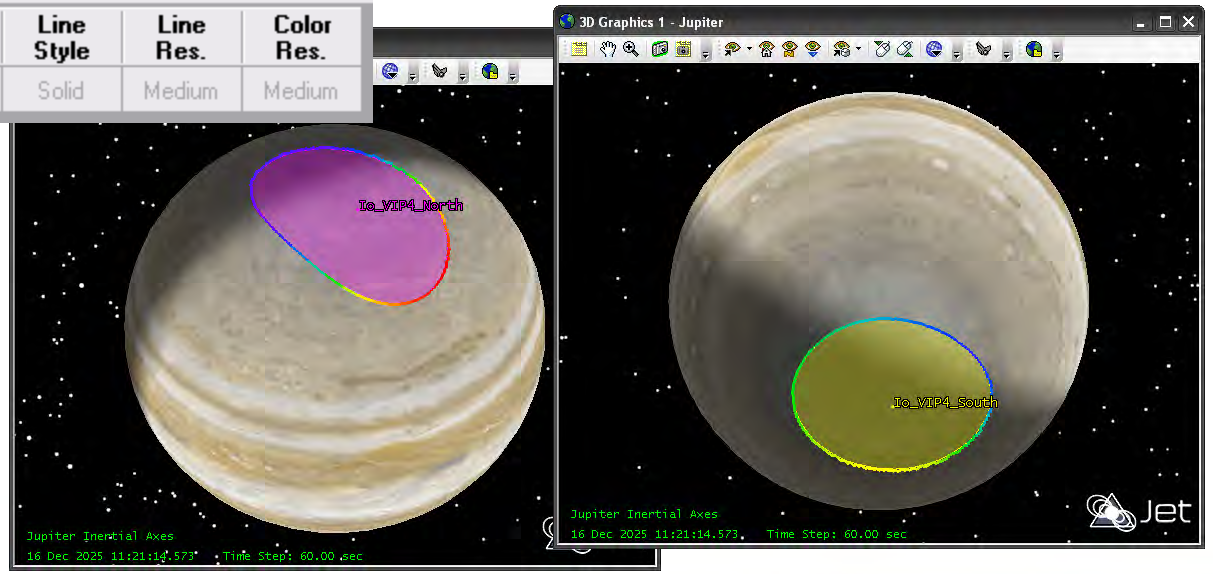
Objects	Track			Show	Color	Line Width	Line Style	Line Res.	Color Res.
Planet: Io	Lead			☑	☐	Medium	Solid	Medium	Medium



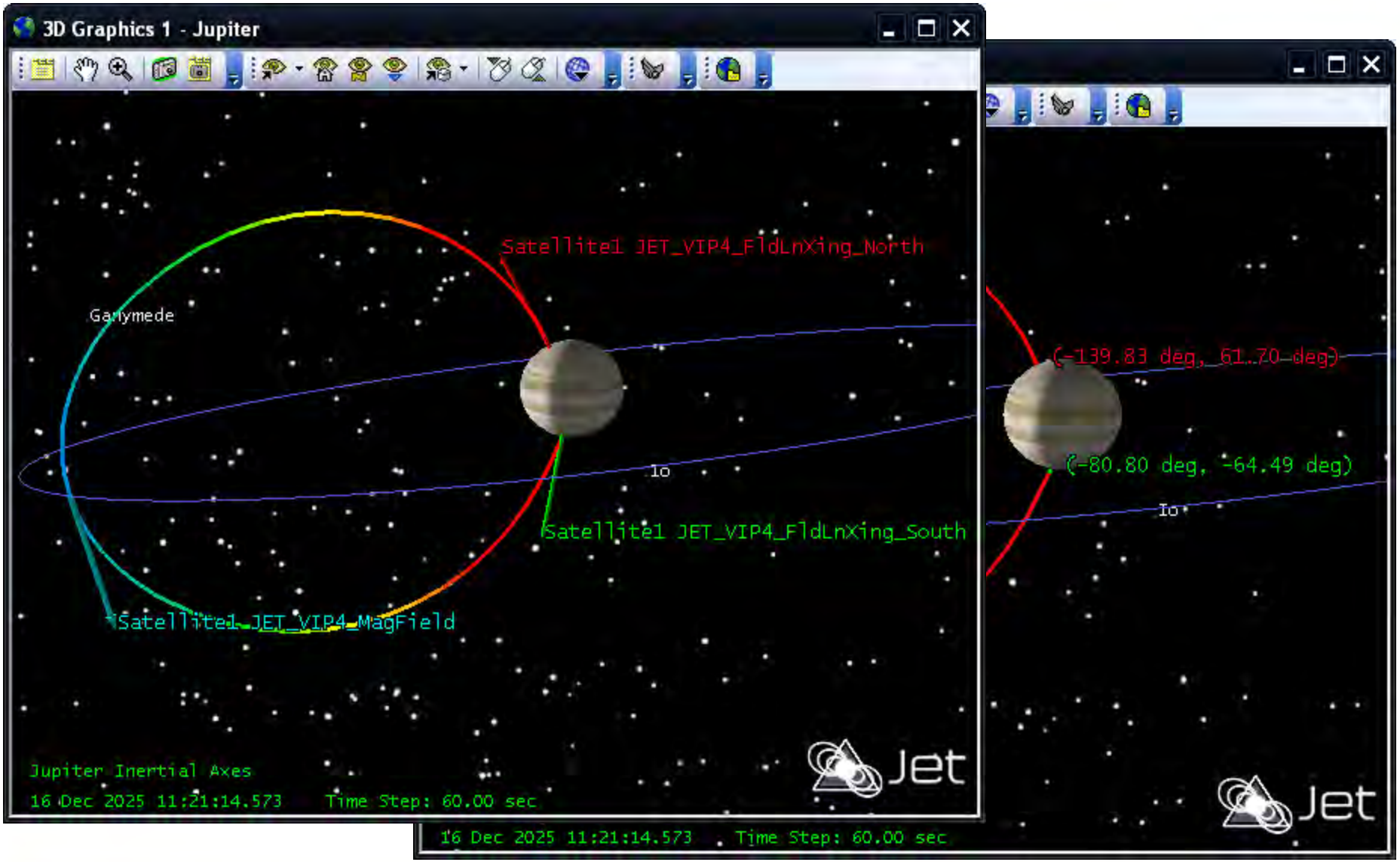
Object Footprints

Objects	Track			Show	Color	Line Width	Line Style	Line Res.	Color Res.
Planet: Io	Lead			☐	☐	Medium	Solid	Medium	Medium

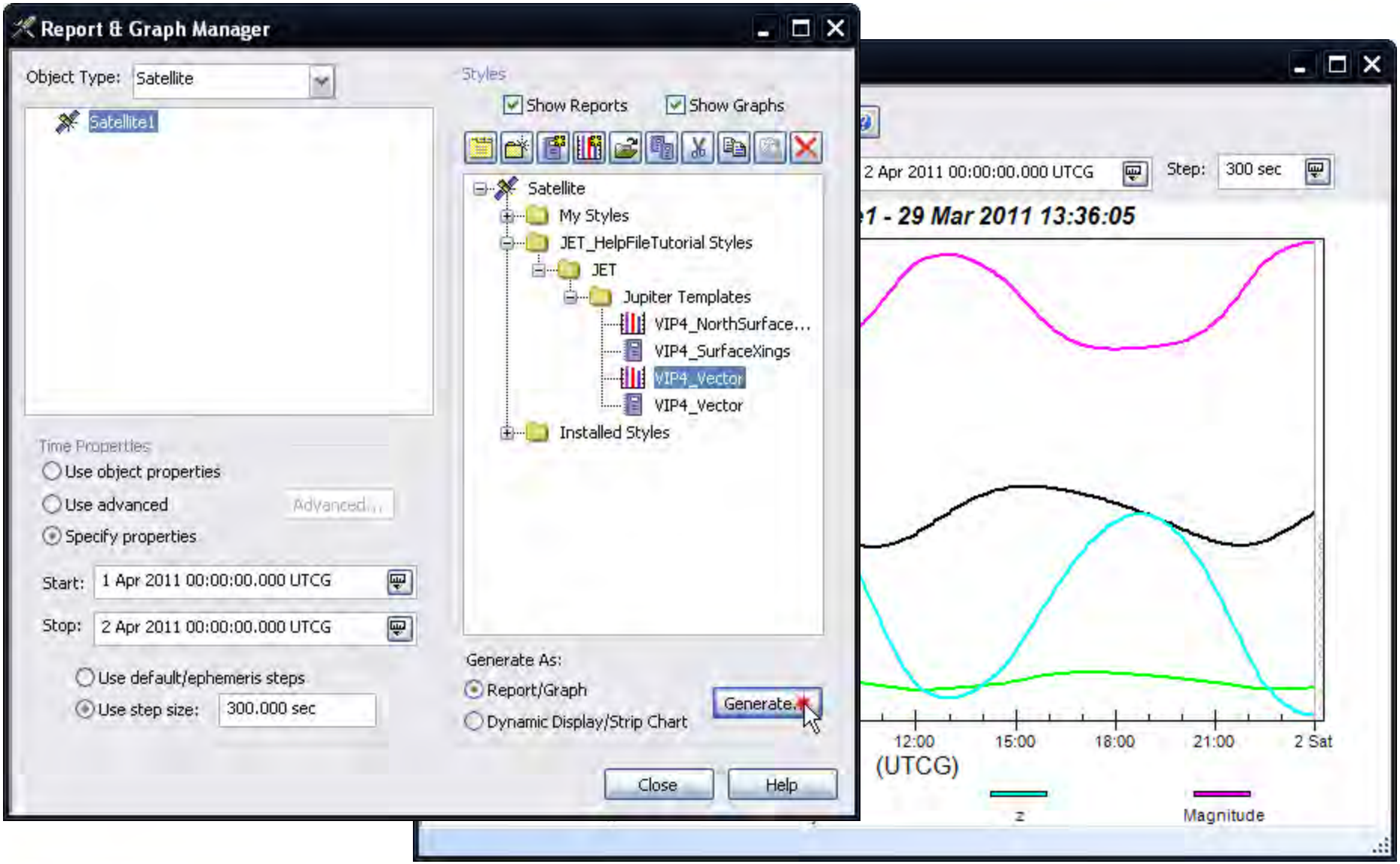
- Scenario23
  - Io_VIP4_North
  - Io_VIP4_South
  - Io



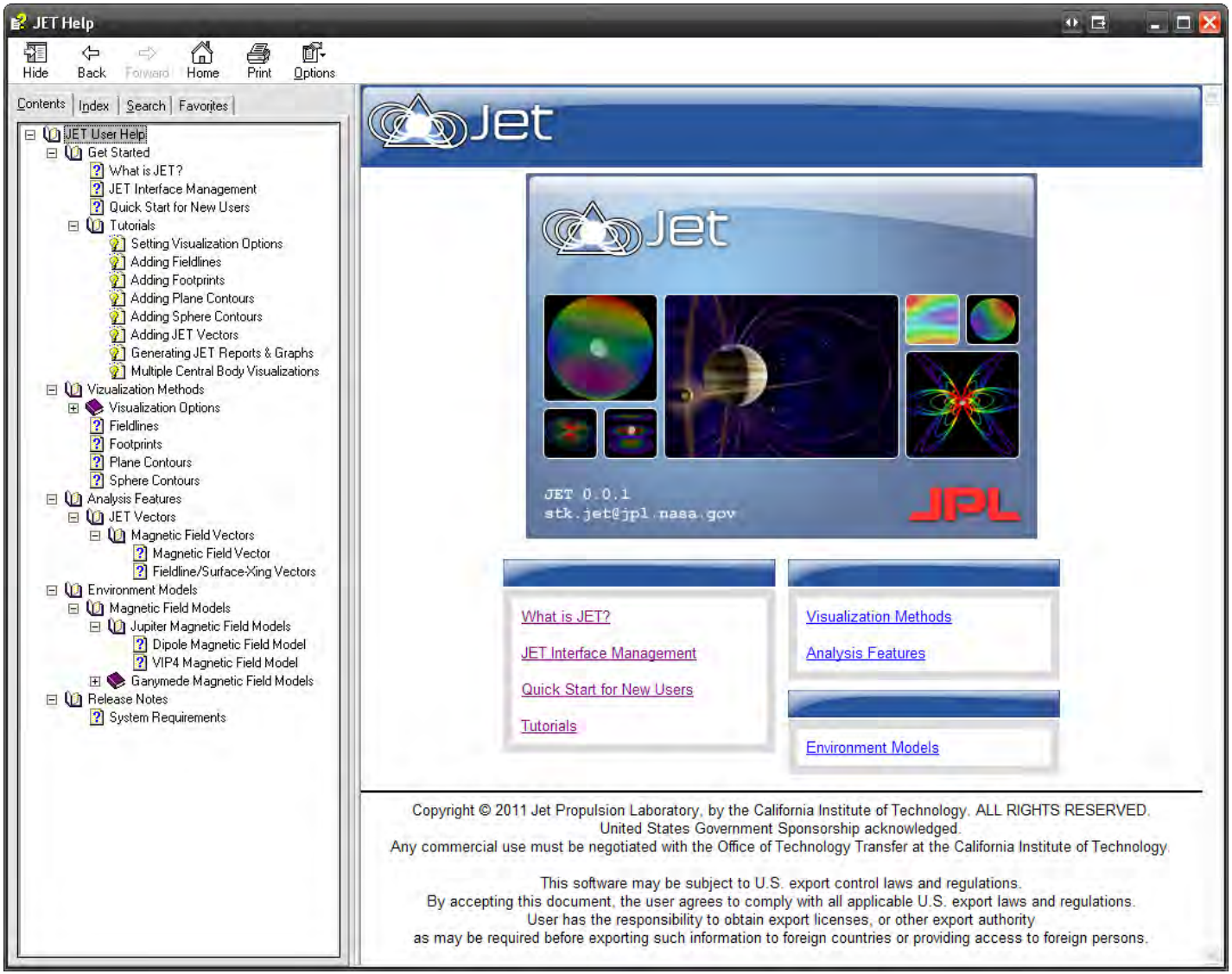
Custom Magnetic Field Vectors



Custom Report & Graph Templates

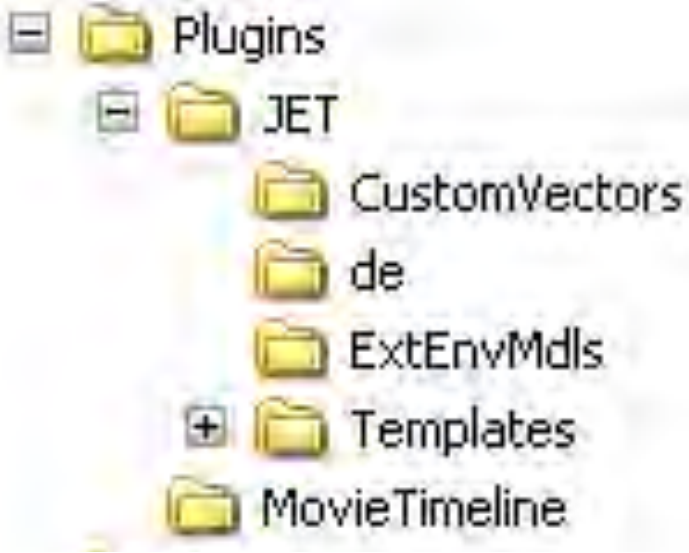


Compiled Help File

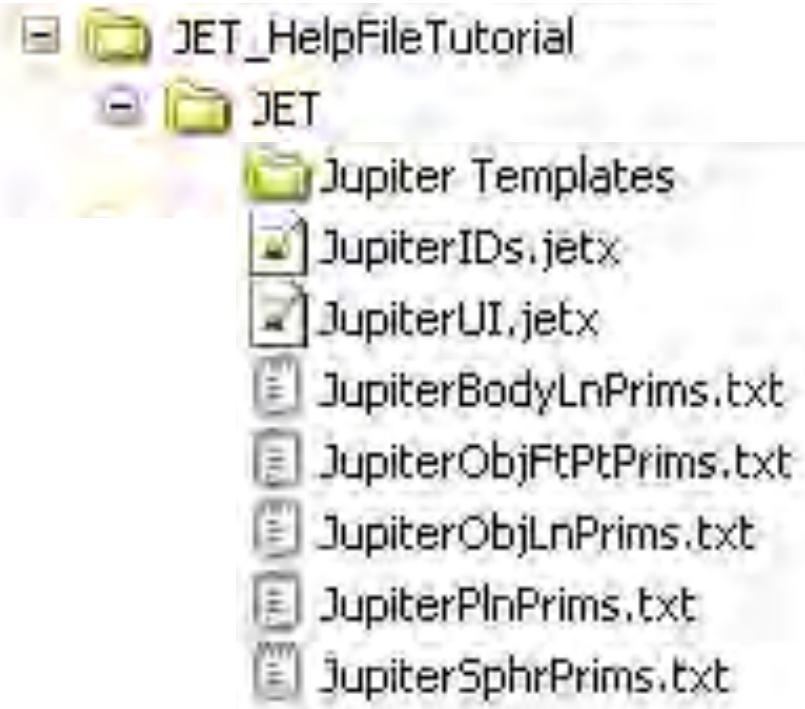


JET File Structure

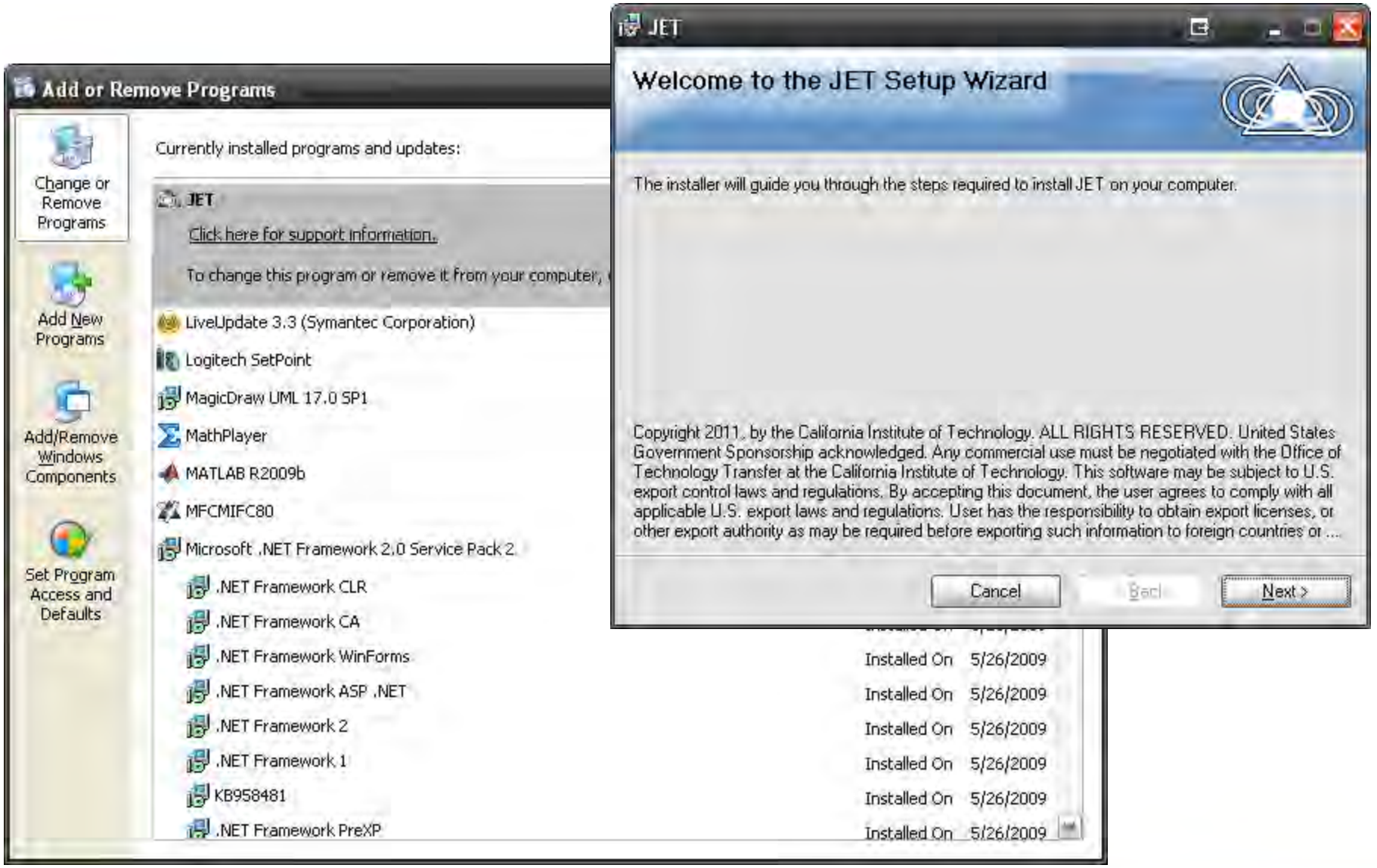
STK Install Directory



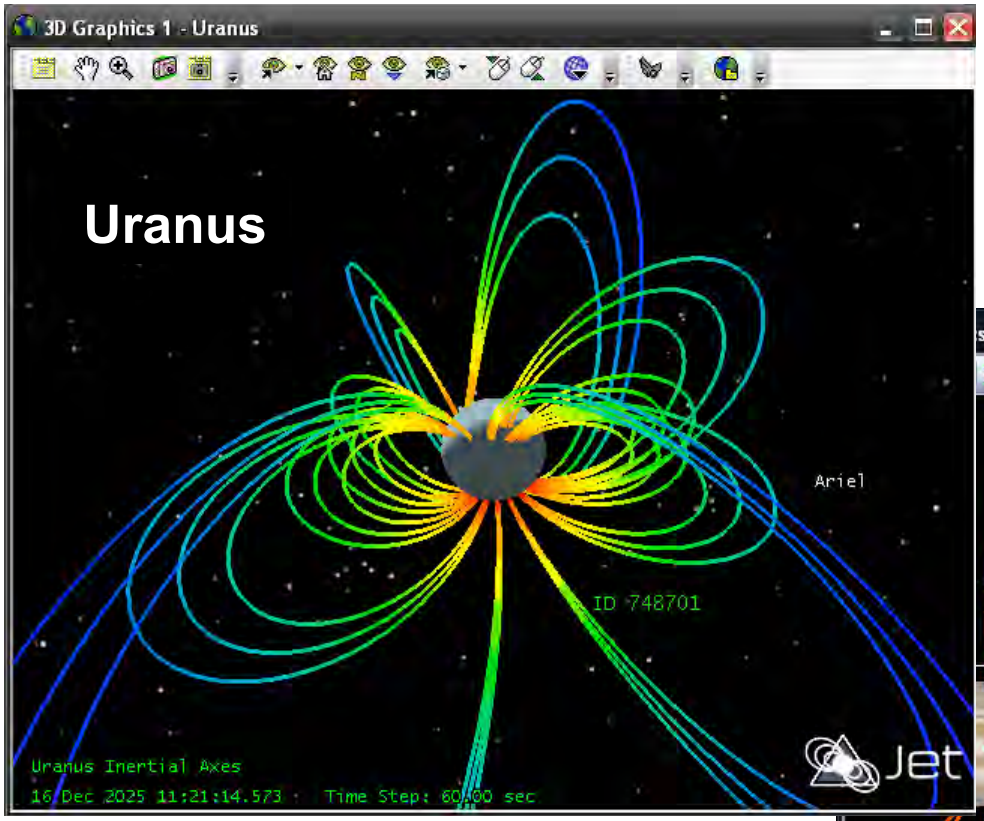
Scenario Directory

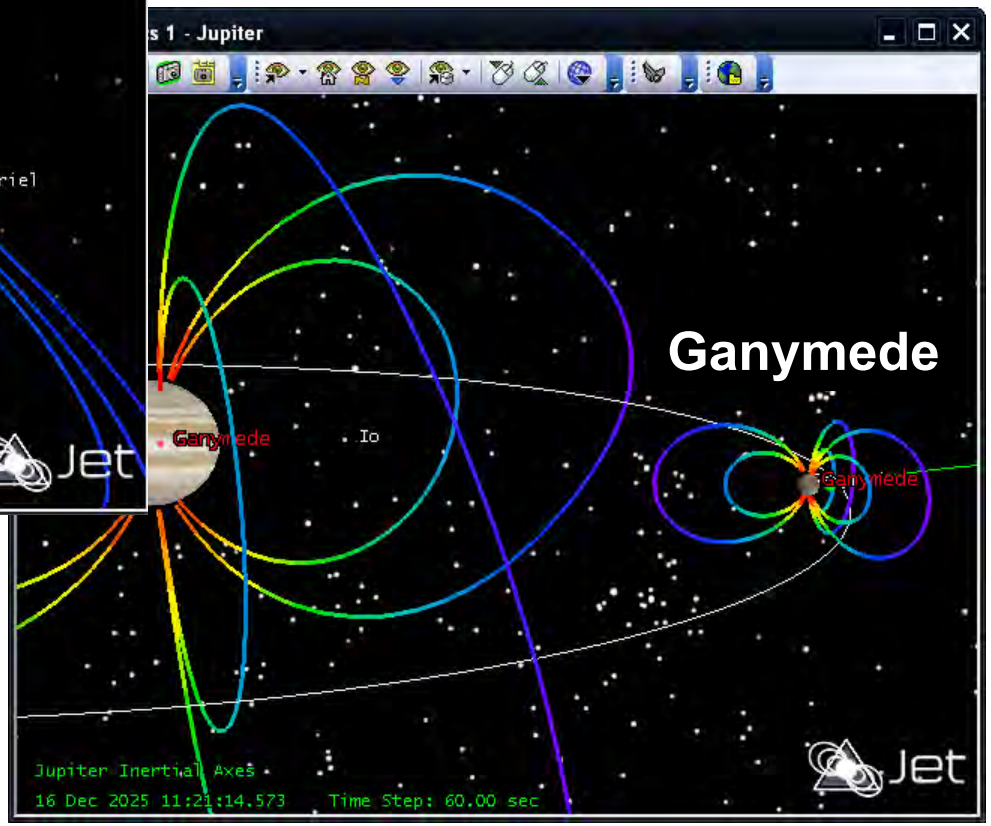


Installation Package



Beyond Jupiter





Future Work

- **Extend to other environment models**
  - Radiation Field
  - Plasma & Neutral Tori
  - Rings / Dust / Small Bodies
  - Satellite Atmospheres
- **Extend to other planets**
- **Clear for public release**
  - Currently releasable on a case-by-case basis
  - For more information on obtaining a copy email: stk.jet@jpl.nasa.gov

Questions?