

IMPEX

→ **Integrated Medium for Planetary Exploration**

FP7 call : Exploitation of science and exploration data

- Submitted in december 2009
- Pending for some time
- Official letter 01/07/2010
- Start = end of 2010 ?
- 4 years

IMPEX

Objectifs

→ Mettre en place un environnement numérique de travail permettant l'inter-connexion, dans le domaine des sciences planétaires, de

- données observationnelles,
- résultats de simulations numériques (codes hybrides et MHD),
- modèles analytiques.

→ Au service de la communauté « science planétaire » :

- Recherche : analyse de données \leftrightarrow simulations
- Planification des missions et instruments futurs

Project structure



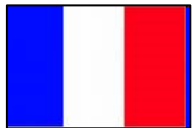
M. Kodachenko, Project Coordinator, IWF, Graz, Austria
Management (project coordinator)



FMI, Finland
Simulation database and runs (WP leader)

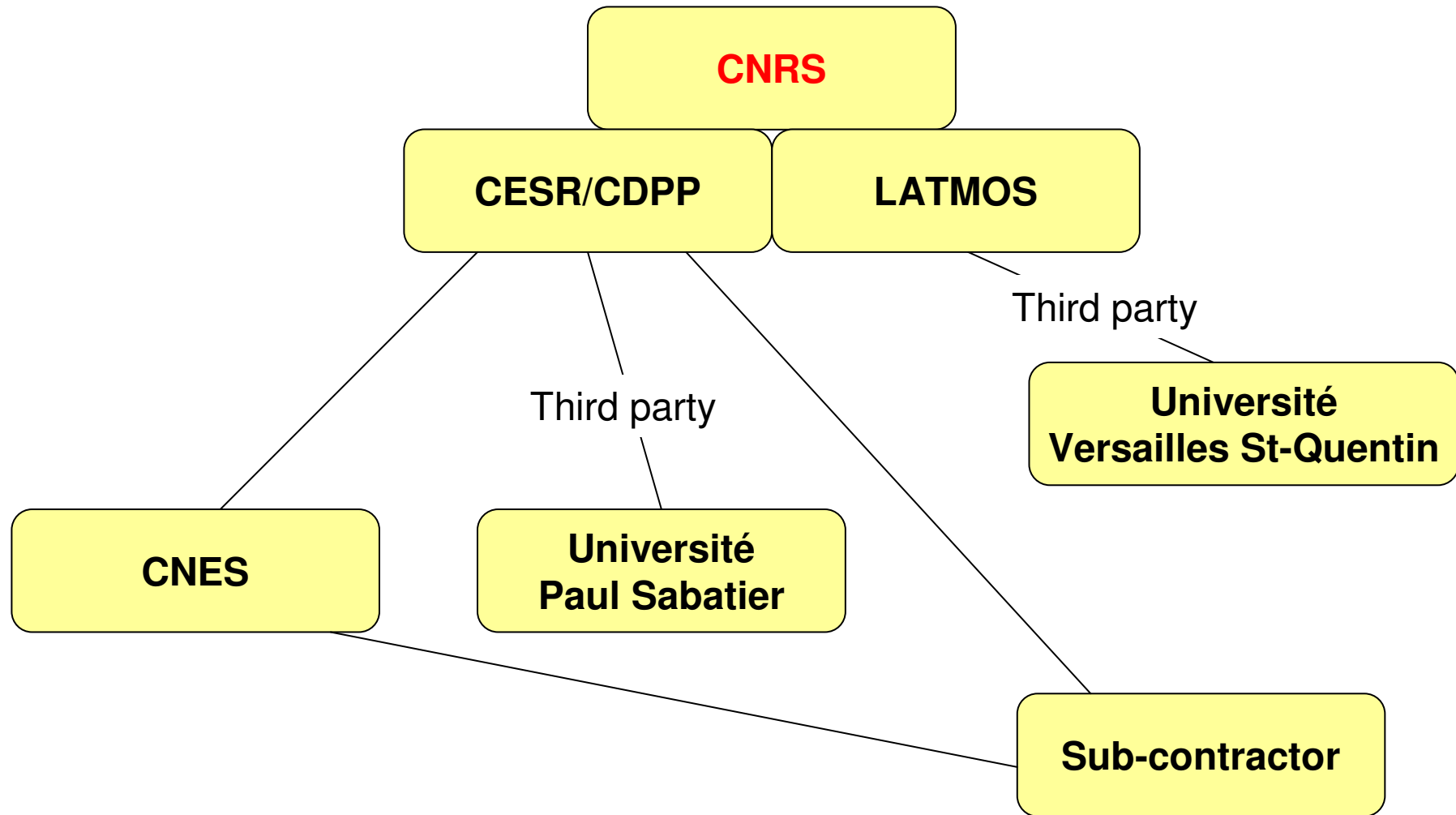


SINP
Paraboloid Magnetospheric Models (WP leader)

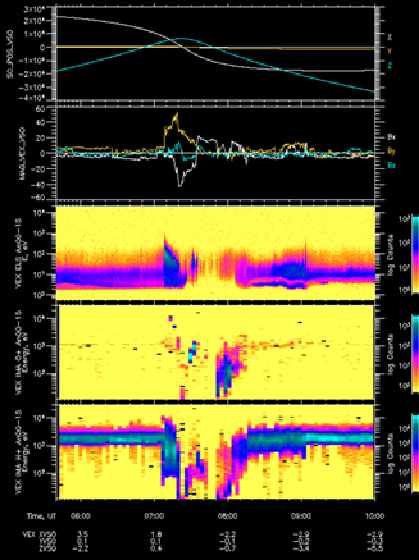


CNRS
Data and Models environment (WP leader, project scientist)

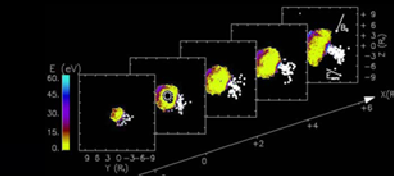
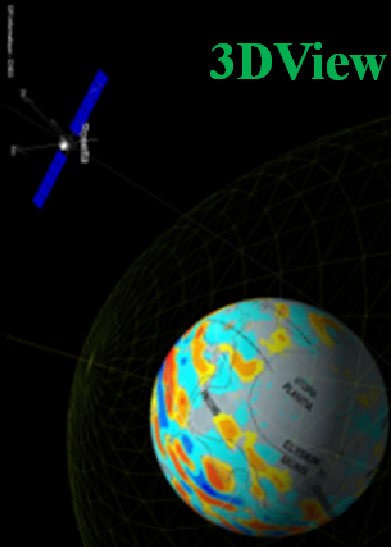
A unique french participant



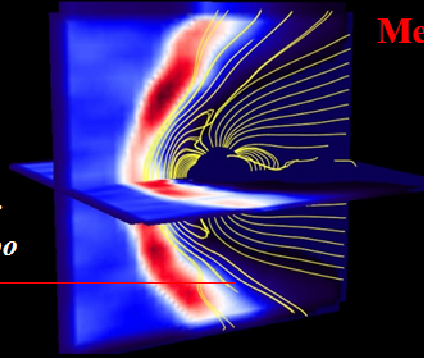
AMDA



IMPEX

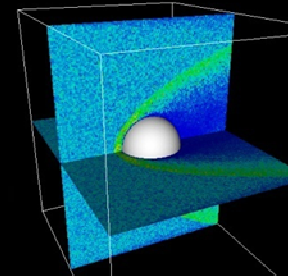


Mercury



Messenger
BepiColombo

HMM



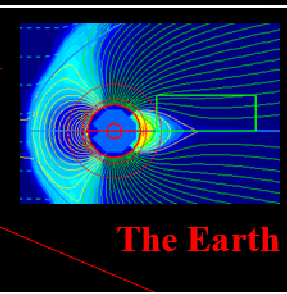
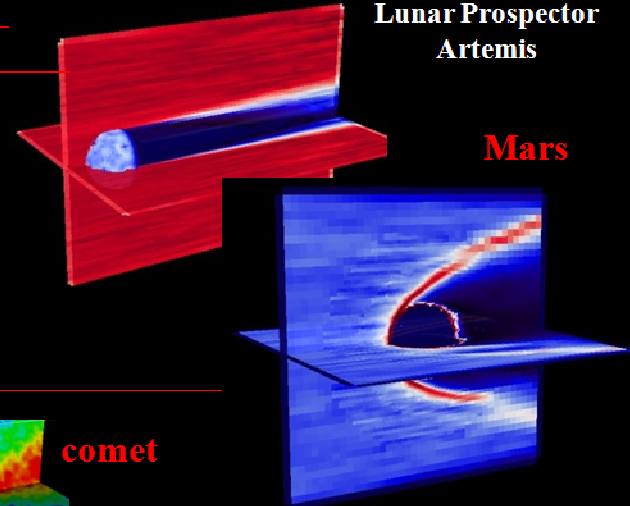
Venus

Pioneer Venus Orbiter
Venus Express

The Moon

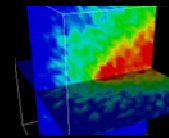
Lunar Prospector
Artemis

Mars



The Earth

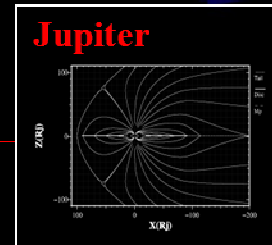
comet



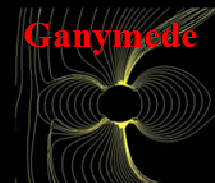
Giotto
Rosetta

Pioneer 10 & 11
Voyager 1 & 2
Ulysses
Galileo
Cassini/Huygens
New Horizons
Juno
EJSM

Jupiter



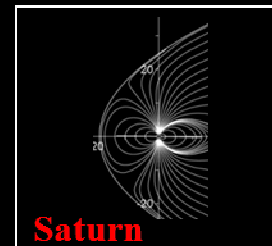
Ganymede



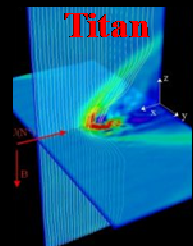
Jupiter & Ganymede

Pioneer 11
Voyager 1 & 2
Cassini/Huygens

Saturn & Titan



Saturn



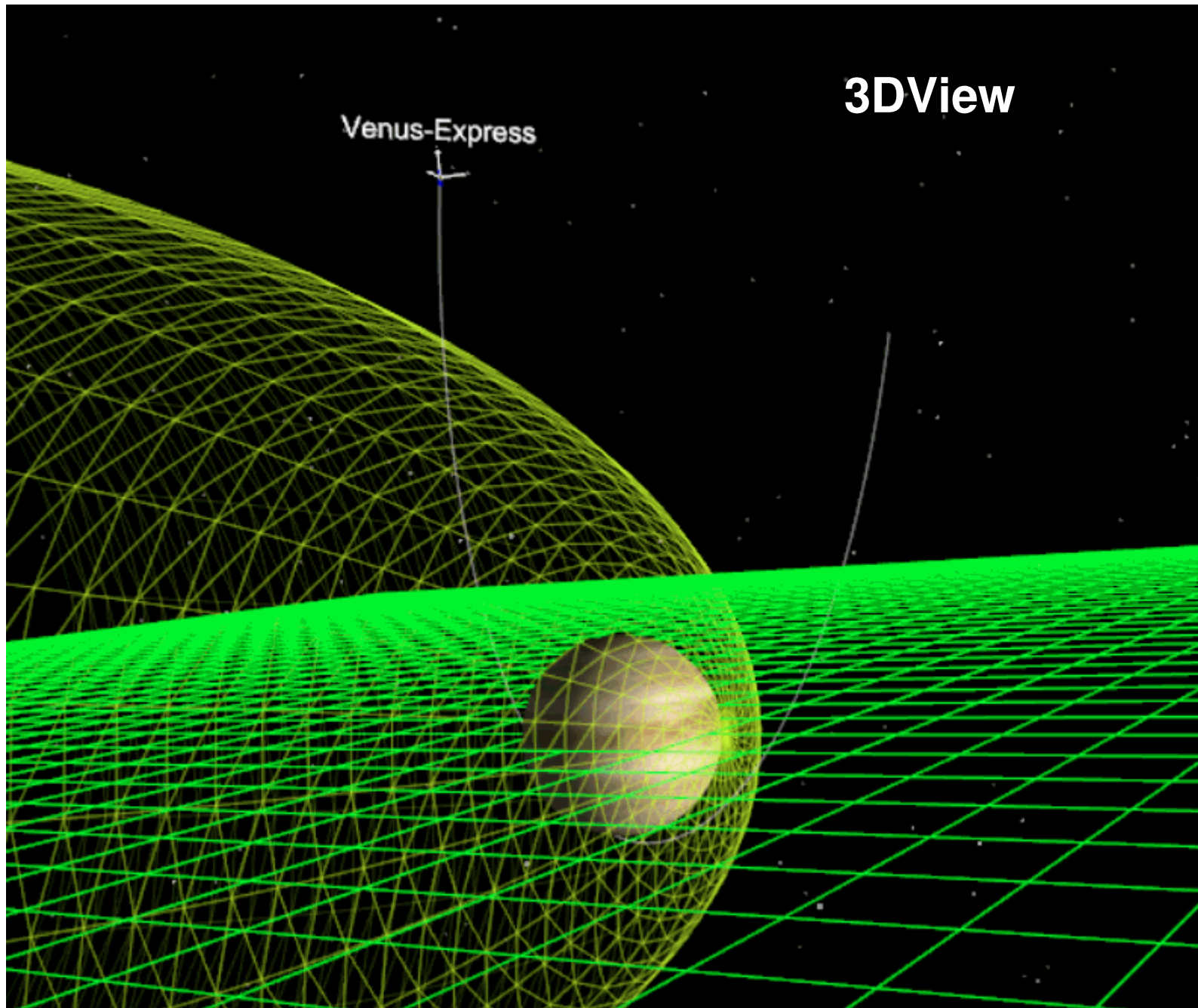
Titan

PMM

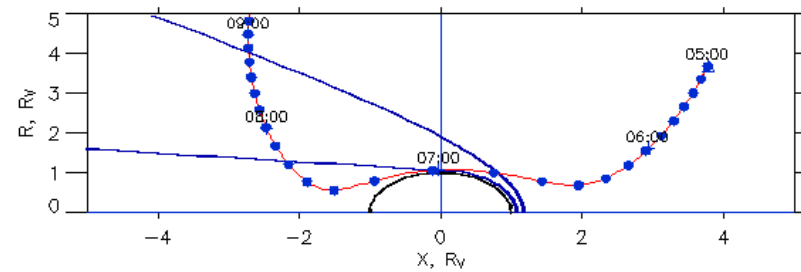
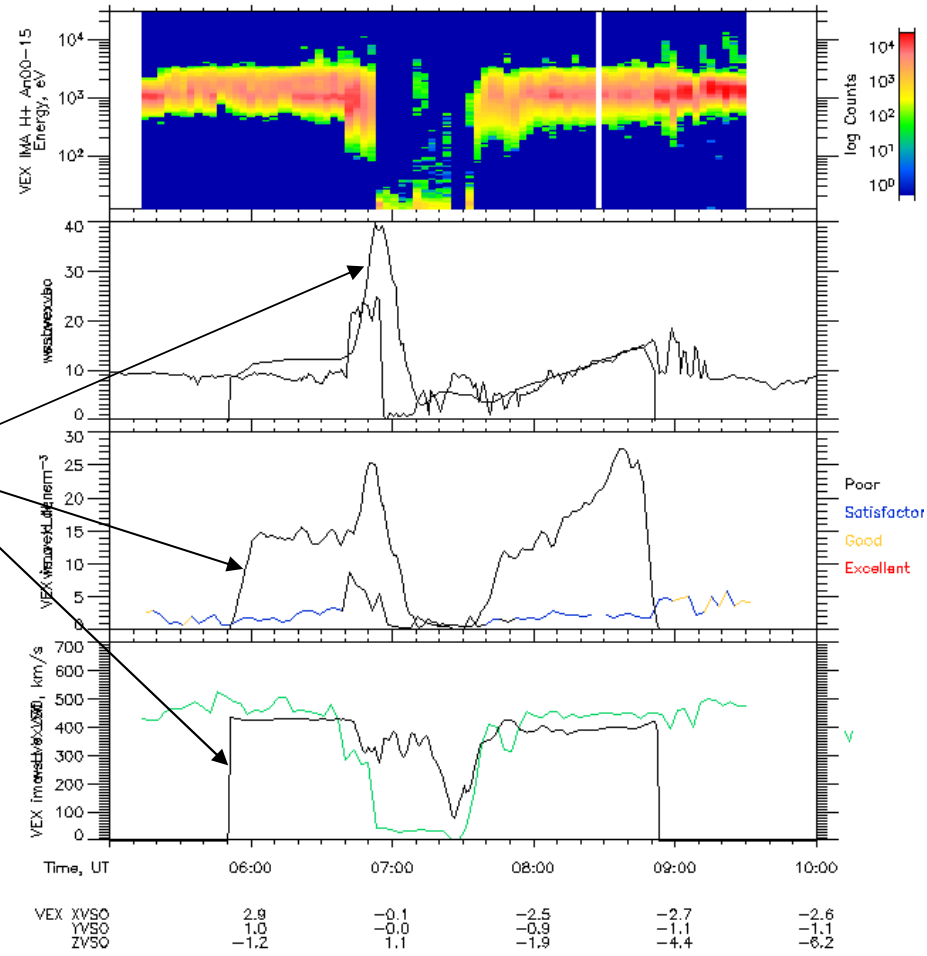
Fig. courtesy of NASA

3DView

Venus-Express

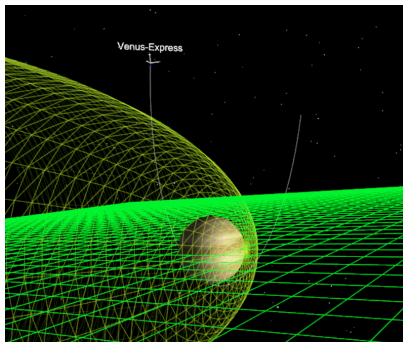


AMDA
observed
.vs.
simulated
data



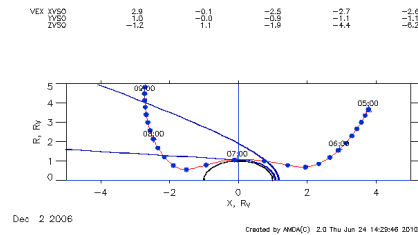
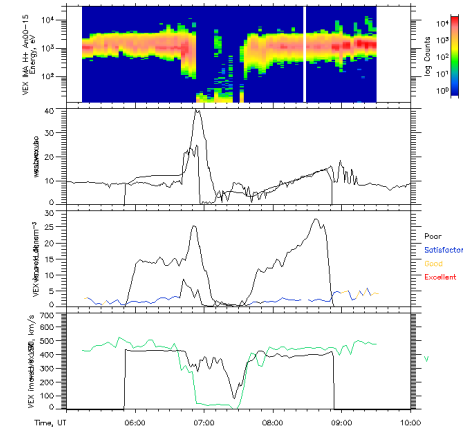
VEX orbit file from AMDA

2.28224e+07 7.20305e+06 -2.10821e+07
 2.27701e+07 7.19066e+06 -2.08811e+07
 2.27162e+07 7.17787e+06 -2.06768e+07
 2.26621e+07 7.16496e+06 -2.04742e+07
 2.26066e+07 7.15162e+06 -2.02683e+07
 2.25508e+07 7.13818e+06 -2.00642e+07
 2.24934e+07 7.12428e+06 -1.98568e+07
 2.24359e+07 7.11028e+06 -1.96512e+07
 2.23767e+07 7.09581e+06 -1.94419e+07
 2.23166e+07 7.08105e+06 -1.92320e+07
 2.22563e+07 7.06618e+06 -1.90241e+07
 2.21943e+07 7.05082e+06 -1.88126e+07
 2.21321e+07 7.03536e+06 -1.86029e+07
 2.20681e+07 7.01938e+06 -1.83897e+07
 2.20040e+07 7.00330e+06 -1.81785e+07
 2.19380e+07 6.98668e+06 -1.79636e+07
 2.18718e+07 6.96995e+06 -1.77506e+07
 2.18037e+07 6.95266e+06 -1.75339e+07
 2.17345e+07 6.93505e+06 -1.73166e+07
 2.16652e+07 6.91732e+06 -1.71010e+07
 2.15938e+07 6.89901e+06 -1.68819e+07
 2.15222e+07 6.88058e+06 -1.66646e+07
 2.14487e+07 6.86155e+06 -1.64437e+07
 2.13748e+07 6.84241e+06 -1.62247e+07
 2.12988e+07 6.82263e+06 -1.60020e+07



Base de simulations

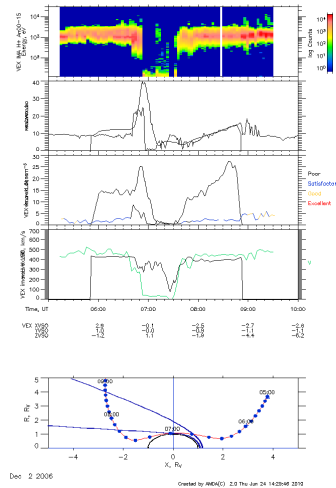
- Upload on HWA
- Choose simulation run
- Fly virtual S/C
- Obtain interpolated parameters
- Upload in AMDA



AMDA

Les challenges « VO »

Connexion : AMDA (outil de d'analyse de données) → bases de données de simulation



AMDA

Web services

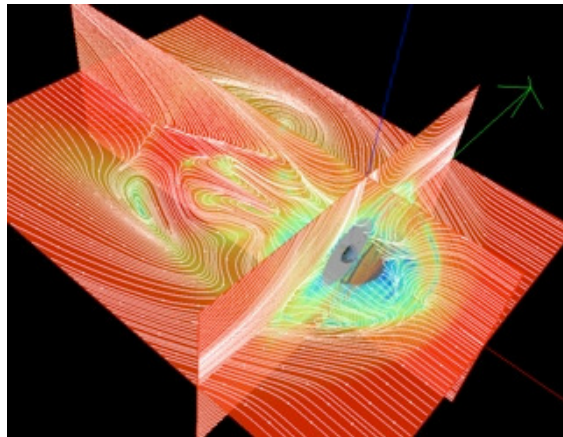
Volume de données :
faible/moyen

The Hybrid Web Archive interface is a web-based tool for accessing simulation data. It features a navigation menu with 'Plot Download', 'Home', and 'Logout'. The main content area is divided into several sections: 'Simulation File' with dropdown menus for 'Object' (Venus), 'Plane' (nominal_d4035km), and 'Data File' (Hydstat_00300000 hc); 'Simulation Info' with tabs for 'Physical Parameters' and 'Numerical Parameters'; 'Physical Parameters' showing values for planet radius, magnetic field, and particle populations; 'Plot Options' for selecting variables and scales; and 'Data Options' for specifying plot files and formats. At the bottom, there are 'Plot Data' and 'Download Data' buttons.

Base de simulations

Les challenges « VO »

Connexions : 3DView → AMDA + bases de données de simulation



Web services

Hybrid Web Archive

Simulation File:

Object: Venus
 Rnac: nominal_0x05km
 Data File: [+_hybstate_00300000.hc]

Simulation Info:

Physical Parameters | Numerical Parameters

Planet radius: 0.051800000e+06 Venus radius [m] (read)
 Intermagnetic Magnetic Field: (-8.09e-4, 5.99e-4, 0.0) (R, θ , ϕ)

Particle Population:	Radius [m]	Charge [C]	Density [1/m ³]	Velocity [m/s]	Temp [K]	Yem [km/s]	Emission rate
solarwind	1.8726e-27 m _{pl}	1.6022e-19	1466	43043	145	---	---
ionospheric	2.6588e-26 m _{pl}	1.6022e-19	---	---	2000	---	1.0e25
exospheric	1.8726e-27 m _{pl}	1.6022e-19	---	---	111 385 + 27	---	8.23e24
exospheric	1.8726e-27 m _{pl}	1.6022e-19	---	---	6000	---	2.0e23
exospheric	2.6588e-26 m _{pl}	1.6022e-19	---	---	6400 4847 + 27	---	4.09e24

Plot Options:

Variable to Plot: [Number density (1/m³), computed from rho as normalho (m-proton mass)]
 Max value: [] Min value: [] Unit length: [5051800] m
 Logarithmic scale: Plot all components:

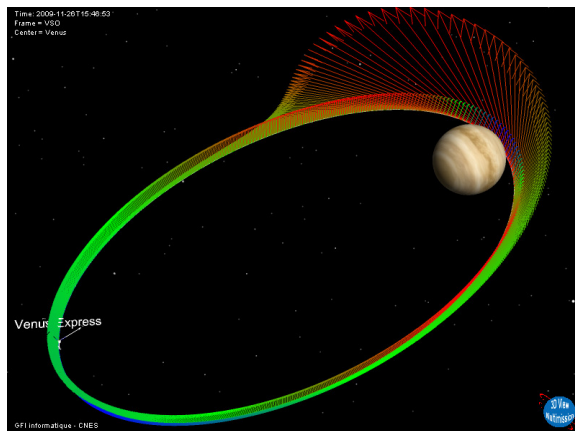
Data Options:

Plane: [] Line: [] Point file: []
 Specify point file:
 Folder: [Venus] Sub folder: [Exo] Point file: [point2.txt]
[Upload / Manage point files](#)

Plot Data | Download Data

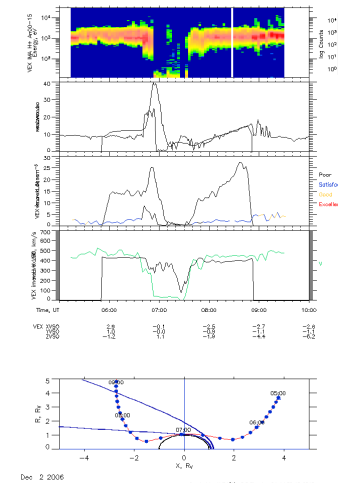
(Hybrid version: 0.5.1, Fimind Meteorologic al Institut)

Base de simulations



Web services

Volume de données :
moyen/important

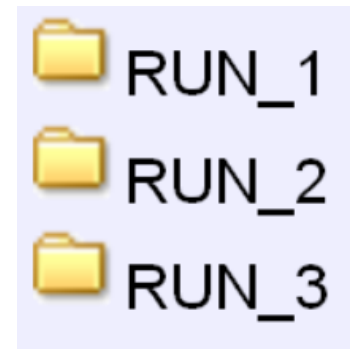
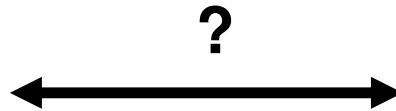
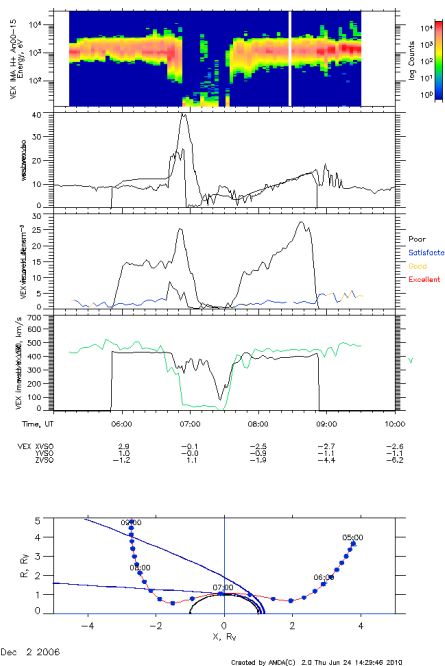


AMDA

Les challenges « VO »

Description standardisée des résultats de simulation

→ Faciliter la conception des outils de recherche (sur AMDA, 3DView, autres)



Contexte observationnel :

- vent solaire
- conditions ionosphériques/exosphériques

Les challenges « VO »

Description standardisée des résultats de simulation

→ Faciliter la conception des outils de recherche (sur AMDA, 3DView, autres)

```
# Object: Venus
# Run: nominal_dx605km
# Data file: H+_hybstate_00300000.hc
#
# Simulation Info; Physical Parameters:
#
# R_P 6.051800000e+06, Venus radius [m] (real), R_V
# dx_R_P 10.0 /
# dt dx 15129.5e3 /
# SW_Bx -8.09e-9
# SW_By 5.88e-9
# SW_Bz 0.0
#
# population
# type uniform
# 1.6726217160e-27, Proton mass [kg] (real), m_p
# 1.6021765300e-19, Electron charge magnitude [C] (real), e
# n 1.5e6
# T 1e5
# V 0
#
# population
# type solarwind
# 1.6726217160e-27, Proton mass [kg] (real), m_p
# 1.6021765300e-19, Electron charge magnitude [C] (real), e
# n 14e6
# V 430e3
# T 1e5
#
# population
# type ionospheric
# 2.6567625437e-26, Atomic oxygen mass [kg] (real), m_O
# 1.6021765300e-19, Electron charge magnitude [C] (real), e
# T 2000
# totalRate 1.0e25
#
# population
# type exospheric
# 1.6726217160e-27, Proton mass [kg] (real), m_p
# 1.6021765300e-19, Electron charge magnitude [C] (real), e
# T 111 285 + 2 /
# totalRate 6.22e24
#
# x y z n vx vy vz v Bx By Bz B
```

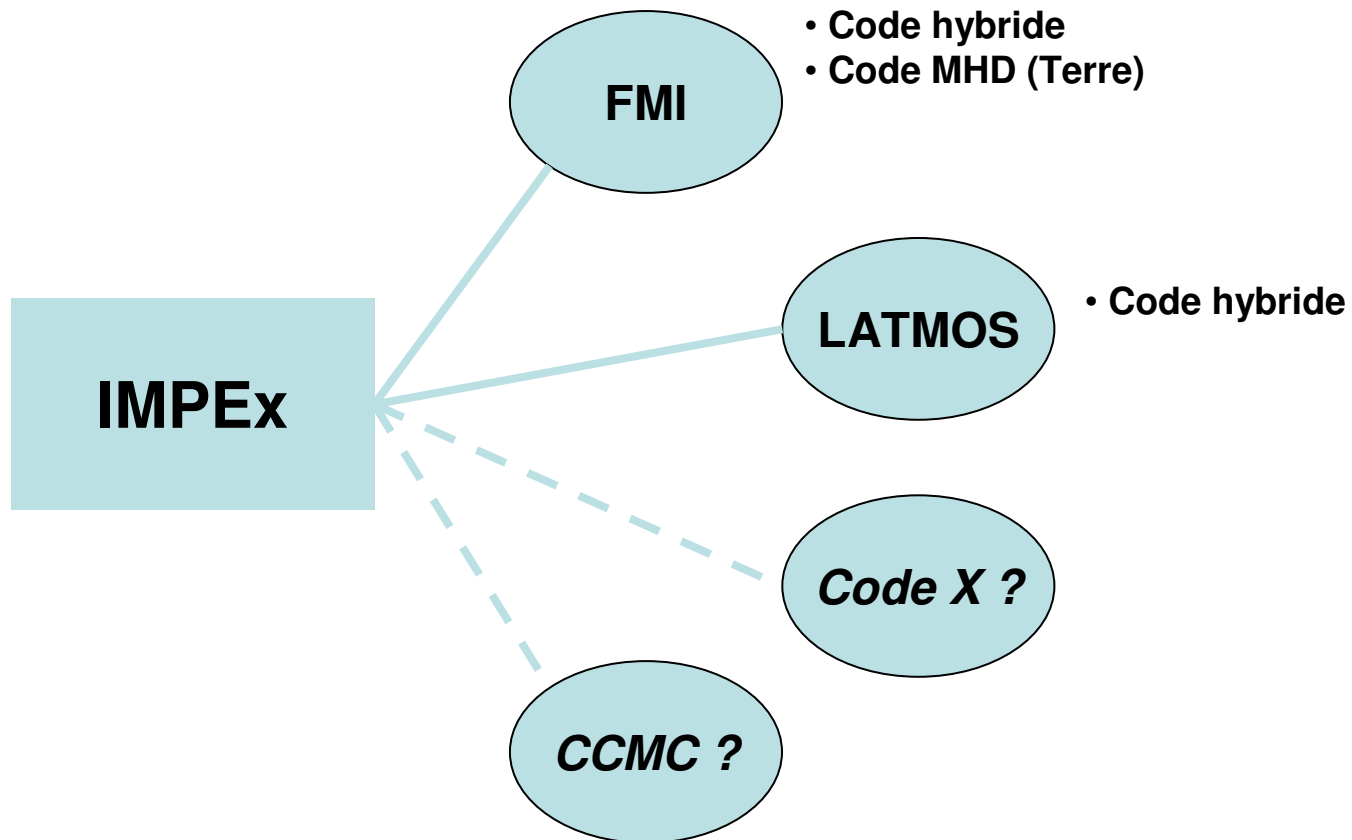
Description à définir (SPASE ?) pour

- Le code
- Les paramètres physiques (Input)
- Les paramètres numériques

Les challenges « VO »

Diffusion du « standard »

→ Faciliter/encourager l'intégration de nouvelles bases / nouveaux code dans IMPEX



Autre contexte / problématique équivalente (données – simulations/modèles)

- spectres stellaires : Pollux (calculés) / Castor (observés @Narval)
- Cassis

Retour d'expérience ?

Quel niveau de détails dans la description des paramètres des codes ?

Utilisation de SDM (Spectrum Data Model) ?