Realization of each task

Main steps – Task 1

Need to hire an IR/Post-doc for parallelization, spherical coordinates? 6 months?

Do we need to include electron energy equation? Two populations of electron?

When hybrid code validated may be of some help for the parallelization of exospheric models

Some preliminary simulations with simple ionosphere

Evaluation of the final spatial scale → Tasks 2 and 3

Can we think of a PhD on that Task?

Validation – Task 1

- capacity of the hybrid code to run with scale of 30 km, even lower scale? If not what can be done for coupling with ionosphere, which assumptions...

- capacity of the code to integrate the crustal fields, which scale, do we need to model the whole system?

- comparison with MEX for ion and MGS for boundary structures, plasma waves, PEB positions and intensity

- solar cycle dependency...

Main steps – Task 2

- Need to hire a post-doc
- Cross section of collision implementation
- Implementation of GCM inputs even if preliminary
  - easy for the oxygen model
  - for C needs introduction of photo-chemical reactions
- Model of the thermal part of the corona
  - parallelization?
  - decrease the threshold in energy on the test-particles (2x thermal speed in Valeille et al. 2009),
  - models for all main constituents (CO_2, O),
  - simulation of the hydrogen and oxygen emissions to compare with SPICAM UV measurements

PhD student yes as an example on H exosphere

Validation – Task 2

- capacity to describe both non-thermal and thermal components

- capacity to describe seasonal variations

- comparison with SPICAM observation of the hydrogen and prediction for O profiles, can we detect a non-thermal component by UV spectroscopy?

- comparison with MEX ion measurements and Valeille et al. (2009) results

Main steps – Task 3

Ionospheric developments already done but without transport (same as Valeille et al.):

- **module solving the equation of motion of electron along the magnetic field line using GCM bakcground**
- **ion production by secondary → GCM for full chemistry**
- **module solving the equation of ion motion for the ion (5 moments) → ion density**
- **problem of time scale?**

How to couple the GCM with the hybrid code? May depend on hybrid scale resolution.

Implementation of magnetic and electric field of convection from hybrid code into ion and electron transports, how to do so?

What are we looking for when including the crustal field?

Validation – Task 3

- comparison with previous simulation, as an example with Gonzalez-Galindo et al. or Valeille et al. models, where the ion and ion transports are important, heating effect?

- capacity to reproduce the ion profiles measured by Viking

- capacity to describe the ion loss rates and composition observed by MEX

- the doubly ionized production

- role of the crustal field, do we see an increase of the electron temperature?

Main steps – Task 4

Comparative study of magnetospheric boundaries from MEX/VEX → PEB

Characterization of the PEB, its variability, analysis from data of the main boundaries of the Martian boundaries (combination of MEX/MGS data set)

definition of simulation tools for each instrument to compare with measurement (already partially done)

definition of test cases for magnetospheric model, ion escape rate, composition and spatial distribution, plasma waves signature

Validation – Task 4

- simulation tools for all instruments of MEX and MGS (what are doing exactly these instruments, what physical parameters to extract from the models?)

- determination of the main structures of the magnetosphere (ISSI workshop on induced magnetosphere)

- case-tests with good sample of measurements (parts of orbit, statistical characterization of Mars' magnetosphere boundaries...)

- this task will be prepared during the first and half year of this project

Main steps – Task 5

selection of four Martian periods of the year

- **calculation of the 3D thermospheric/ionospheric structure**
- **calculation of the 3D exospheric structure**
- **calculation of the 3D magnetospheric structure, ion loss rate…**
- **New thermospheric/ionospheric structure**

determination of the feedback relations, does the magnetosphere have a great influence on Mars' thermosphere and ionosphere?

Extreme solar conditions

- **high solar pressure dynamic, where goes the solar wind?**
- **high EUV flux, how does change the ionosphere and as a consequence the rest of Mars' environment?**

Validation – Task 5

first attempt to understand the relations between thermosphere/ionosphere and magnetosphere and vice versa

how the solar forcing impacts the atmosphere, the escape rates, its composition, its evolution along a solar cycle?

Open questions

Potential new axis of development: does a Titan and Venus application need specific choices to be done now?

Relations with MAVEN team:

which collaboration with MAVEN? Developments of tools predicting the observation? Integration to our global model of the tools specifically developed at Berkeley, others?

schedule, launch end of 2013, insertion 16 september 2014, one Earth year of operation

DELIVERABLES

Congress, workshop, scientific meeting participation:

- **MAVEN meeting: C. Mazelle will attend next 1-2/11/2009 and present HELIOSARES**
- **Set of ISSI meetings on Mars and related questions: R. Modolo/C. Mazelle participate to them**
- **Priority to post-doc and PhD (if any) for conferences?**

Publication policy:

Each task is reponsible of its own budget and plans

Stage and thesis: any plan?

Tasks 1 and 2: we are thinking to propose a stage/PhD

Progress report every month due to coordinator

Useful for report due to ANR every year (TBC)

THANK YOU FOR YOUR PARTICIPATION TO THIS KICK-OFF MEETING

NEXT MEETING WITHIN 6 – 12 MONTHS?