
Transitioning AMPS to the CCMC

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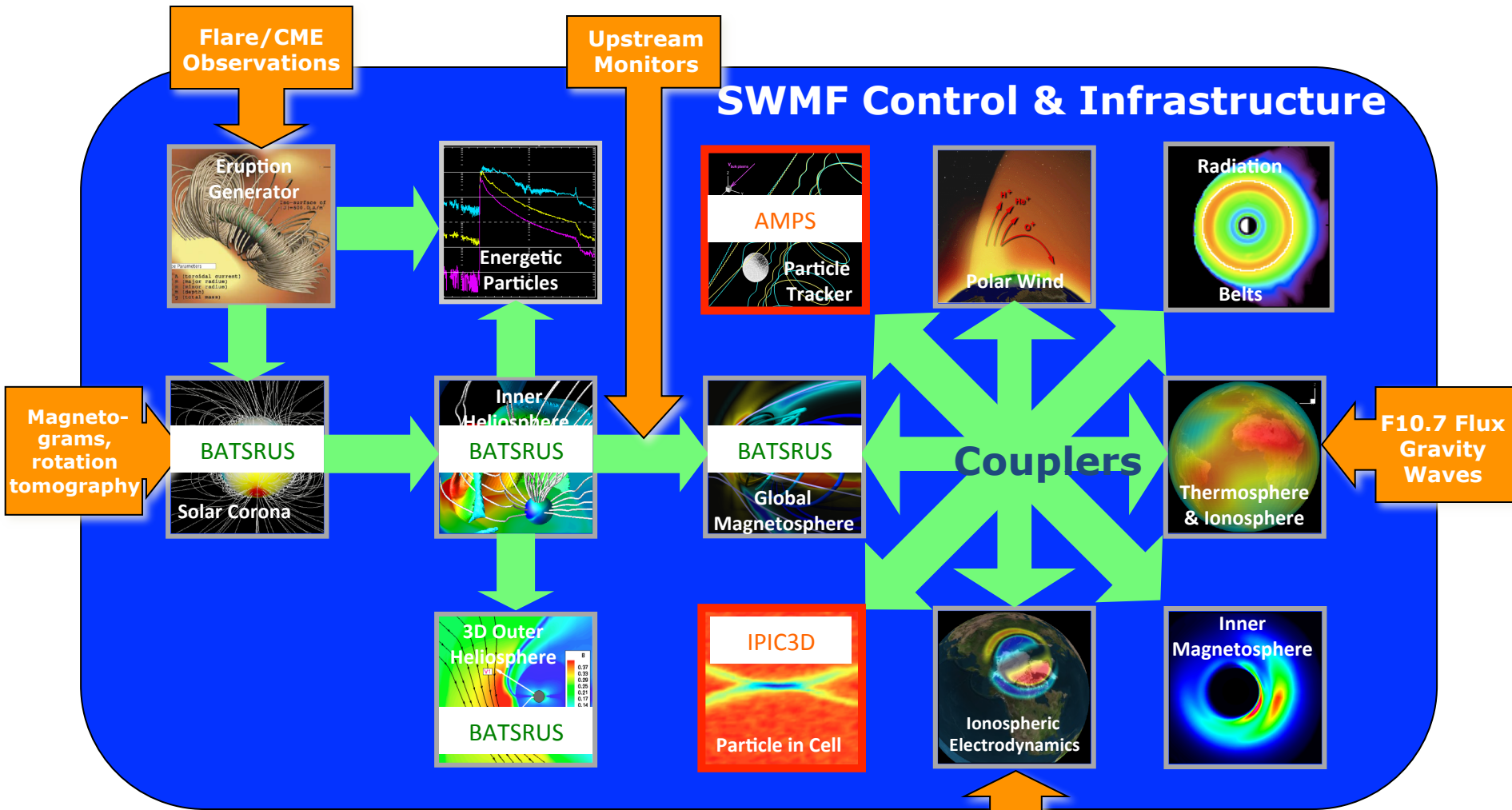


Particle Based Modeling

1. Non thermal component of the simulated environment
 - Energetic particle radiation environment in Earth's magnetosphere
 - Charged dust, etc...
2. Illustration of the particle dynamics on a kinetic level



AMPS in the SWMF

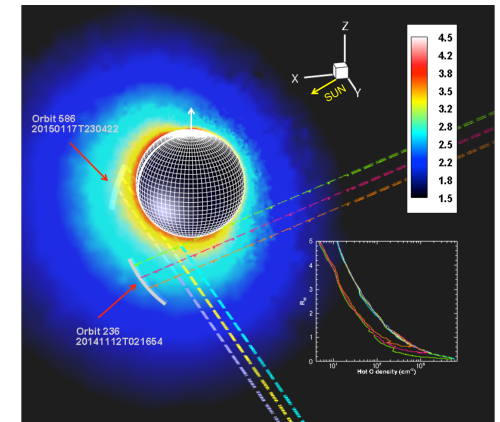
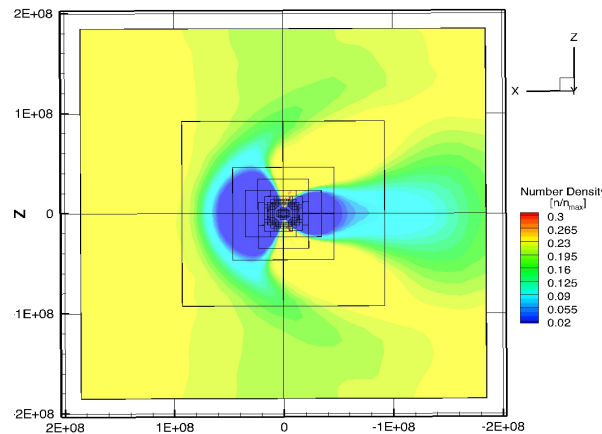
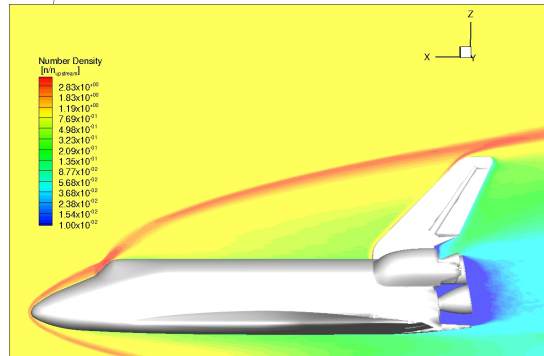
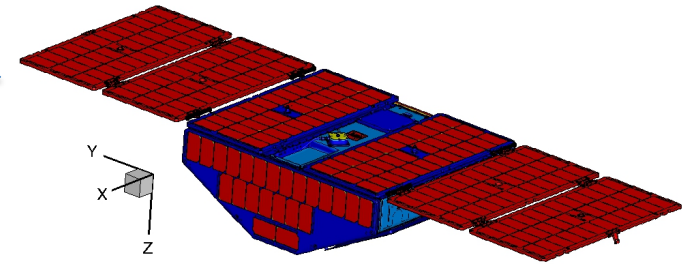
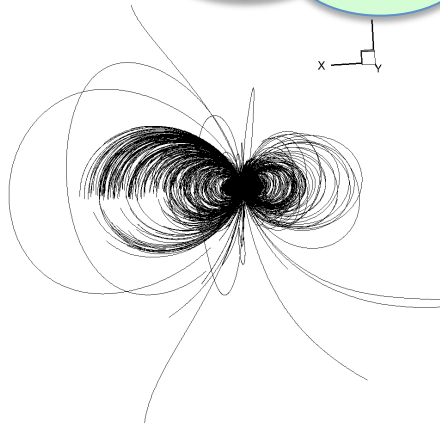


Adaptive Mesh Particle Simulator (AMPS)

SWMF Component

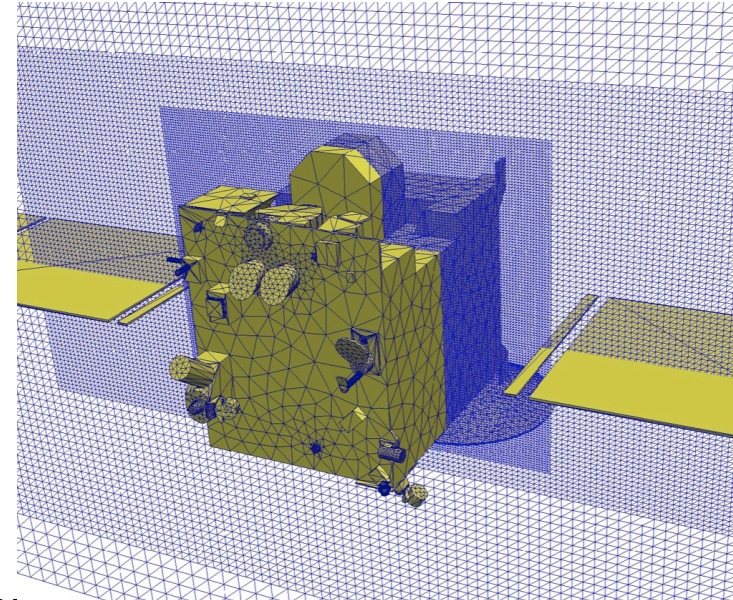
Stand along code

AMPS



Adaptive Mesh Particle Simulator (AMPS)

- Applications
 - Comets, planetary satellites and exospheres
 - Tracking of the ions and charged dust
- Integrated with SPICE and SWMF
- Optimizations
 - Local time step and particle weight
 - Individual particle weight correction
- Adaptive Mesh Refinement (AMR) with cut-cells
- Parallel implementation
 - Domain decomposition
 - Static (volume, cell number) and dynamic load balancing (particle number, execution time)
 - Hybrid implementation: MPI (between nodes) + OpenMP (within each



Recent Development

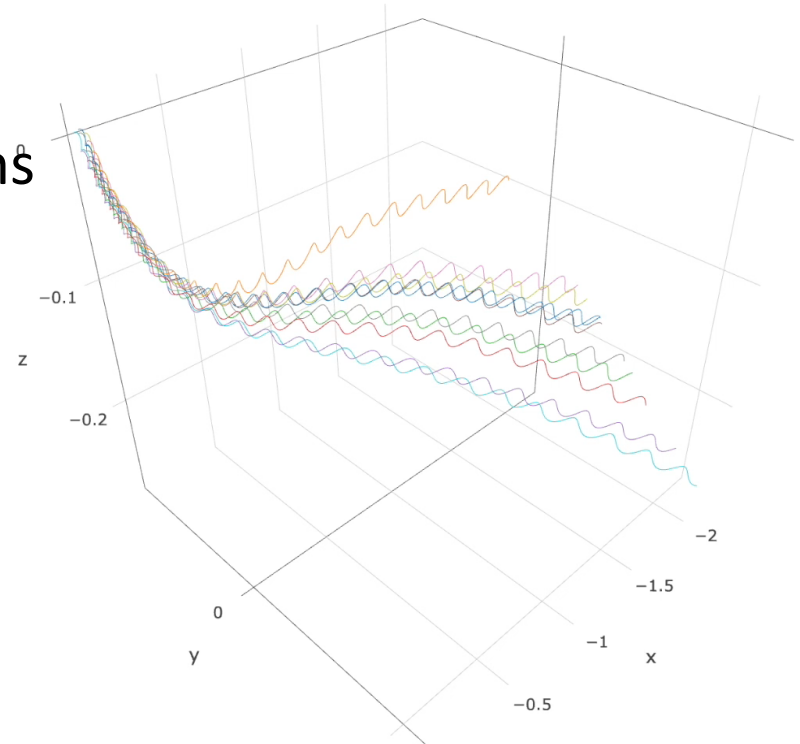
1. Backward particle tracking
2. Calculation of the cutoff rigidity, energy spectra, and flux of the energetic particles

Under construction:

1. Field solver for adding implicit PIC capabilities

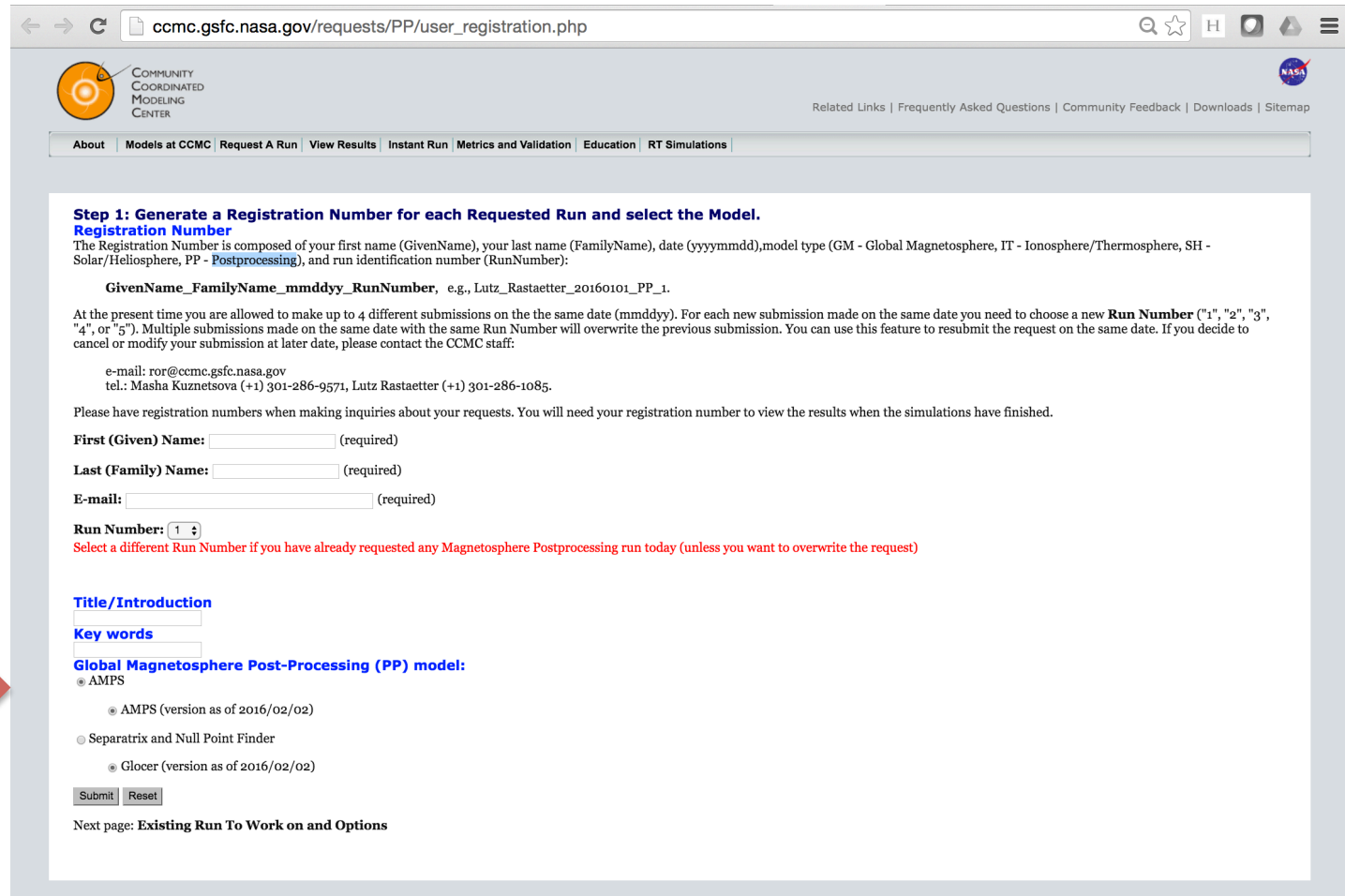
Transitioning to the CCMC

- Analyze charged particle trajectories moving in plasma
 - Post processing tool: use pre-calculated plasma and magnetic field
- Import of the plasma flow simulations into AMPS
 - Time-dependent results of the plasma modeling is saved in files
- Output
 - Individual particle trajectories
 - Samples of the distribution functions
 - Energy spectra
 - Flux



Transitioning to the CCMC

- Web based user interface is under testing





The screenshot shows a web browser window with the URL `ccmc.gsfc.nasa.gov/requests/PP/user_registration.php`. The page header includes the CCMC logo and navigation links such as "About", "Models at CCMC", "Request A Run", "View Results", "Instant Run", "Metrics and Validation", "Education", and "RT Simulations". The main content area is titled "Step 1: Generate a Registration Number for each Requested Run and select the Model." and contains a "Registration Number" section. This section explains that the registration number is composed of the user's first name, last name, date, model type, and run identification number. It provides an example: `GivenName_FamilyName_mmddyy_RunNumber`, e.g., `Lutz_Rastaetter_20160101_PP_1`. Below this, there is contact information for the CCMC staff, including an email address and a phone number. A form follows with fields for "First (Given) Name", "Last (Family) Name", "E-mail", and "Run Number" (a dropdown menu). A red warning message states: "Select a different Run Number if you have already requested any Magnetosphere Postprocessing run today (unless you want to overwrite the request)". The "Key words" section is empty. The "Global Magnetosphere Post-Processing (PP) model:" section has radio buttons for "AMPS", "Separatrix and Null Point Finder", and "Glocer (version as of 2016/02/02)". The "AMPS" option is selected. There are "Submit" and "Reset" buttons at the bottom of the form. The page footer indicates the next page is "Existing Run To Work on and Options".

AMPS



Transitioning to the CCMC

- Initial parameters of the simulated trajectories

Related Links | Frequently Asked Questions | Community Feedback | Downloads | Sitemap

About | Models at CCMC | Request A Run | View Results | Instant Run | Metrics and Validation | Education | RT Simulations

Particle start position input

- Single particle position and velocity
 X [R_E] Y [R_E] Z [R_E]
 V_x [km/s] V_y [km/s] V_z [km/s]
 Particle Species
- Upload file with particle position, velocity and species (X Y Z Vx Vy Vz Species) in each line:
 No file chosen
The file size should not exceed 1Mb. Full path name to the particle position input file at your local disk should not contain any blank spaces or quotation marks. On DOS/Windows systems the recommended extension for the input file name is ".txt". Please read the detailed [instructions on particle input file format](#)

Initial particle data should be in GSM for SWMF, SM for LFM and GSE for GUMICS and OpenGGCM model runs to process

- Spherical start region.
 X_{center} [R_E] Y_{center} [R_E] Z_{center} [R_E]
 Sphere Radius R [R_E]
 Bulk velocity V_x [km/s] (V=sqrt(VX²+VY²+VZ²)<298000) V_y [km/s] V_z [km/s]
 Temperature [eV] (<1 MeV)
 Number of particles N (≤ 1000)
- Rectangular start region and particle distribution:
 X_o [R_E] Y_o [R_E] Z_o [R_E]
 X₁ [R_E] Y₁ [R_E] Z₁ [R_E]
 V_x [km/s] V_y [km/s] V_z [km/s]
 Temperature T [eV] (<1MeV)
 Number of particles N (≤ 1000)

Select run to work on

- Magnetosphere run name: ([search for runs](#); GUMICS runs are not supported yet)

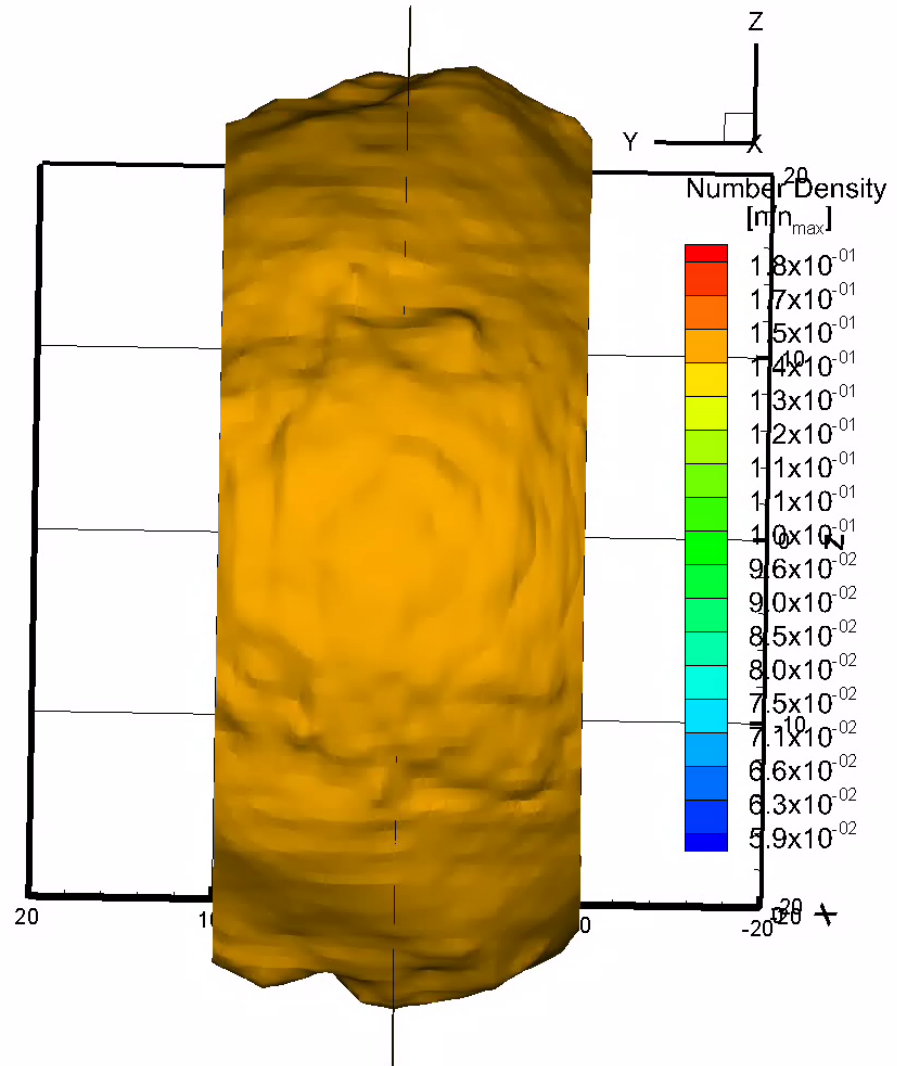
The Registration Number For This Run Is: Val_T_20160410_PP_1

Please have the registration number when making inquiries about the run.



GCRs in Earth's Magnetosphere

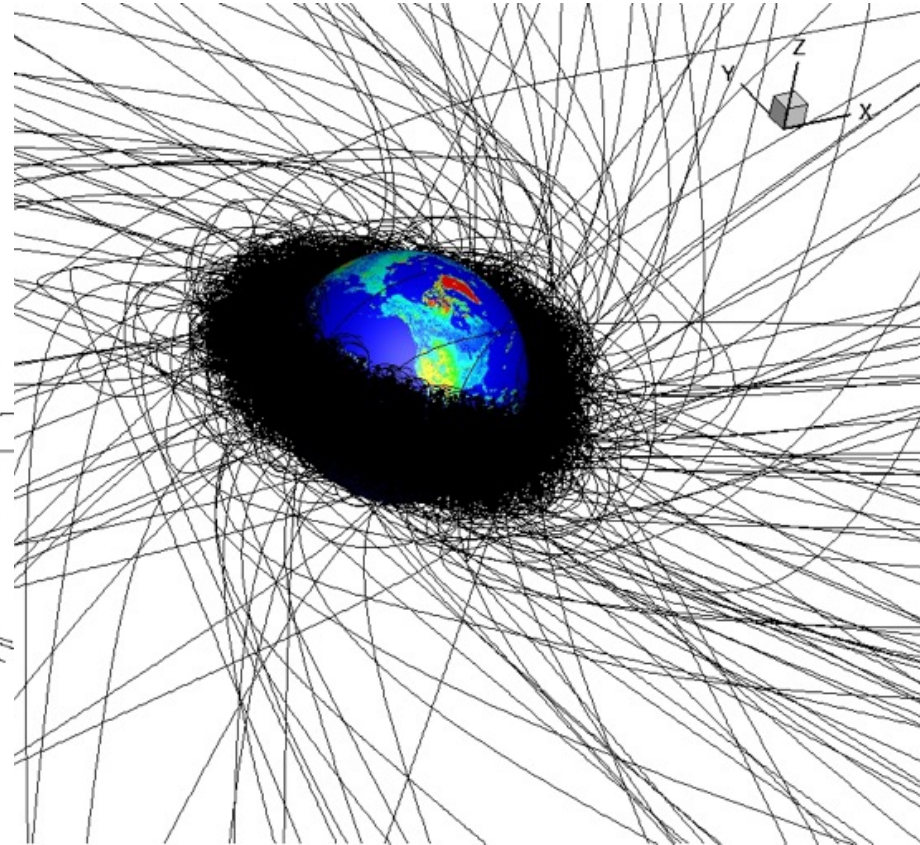
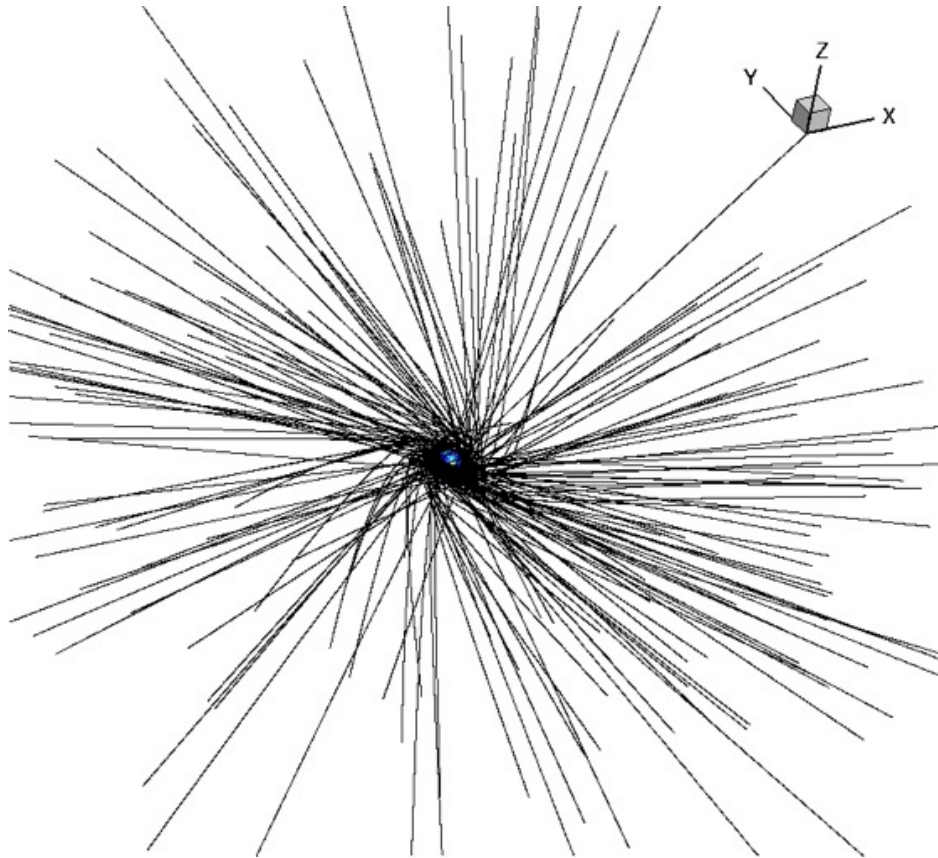
- Energy dependence:
 - Cutoff at low latitudes
 - Shielding by the magnetosphere
- Local time dependence
 - Becomes significant with an increase of the geocentric distance
- Modeling
 - Global modeling of the entire magnetosphere is important



Backward Particle Tracking

Small and Large scale energetic particle trajectory integration

- Radiation environment in the entire Earth's magnetosphere



Modeling Geospace Radiation Environment

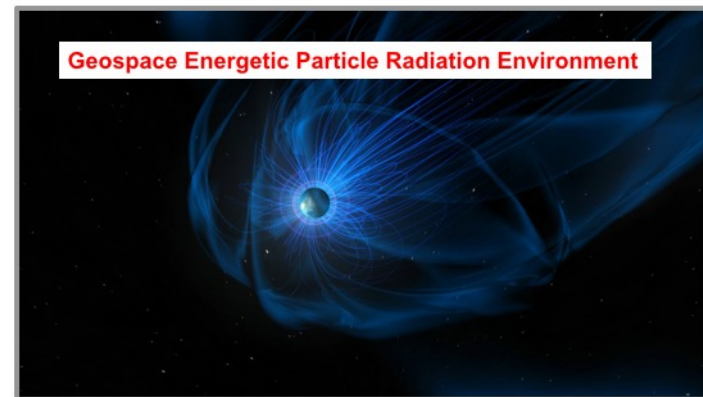
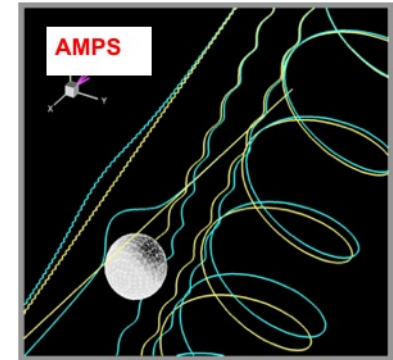
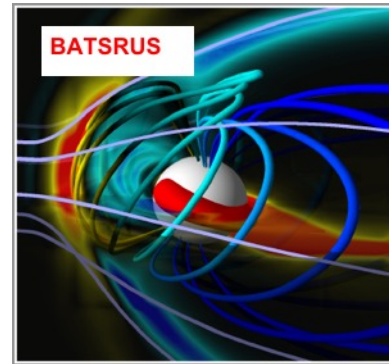
1. Transport of the energetic particles in a realistic geomagnetic field

2. Results at the top of the atmosphere

- Cutoff rigidity
- Energy spectrum
- Flux

3. Practical applications

- Radiation environment in Earth's atmosphere, at LEO, MEO, and GEO



Conclusion

- Adaptive Mesh Particle Simulator
 - Self-sufficient Direct Simulation Monte Carlo model
 - A component of SWMF
 - A particle tracking tool in CCMC
- Application
 - Tracking of the charged particle trajectories, and sampling of distribution functions
 - Kinetic modeling of the charge particle dynamics moving in ambient plasma
 - Geospace radiation environment
- Available in the CCMC in a test mode