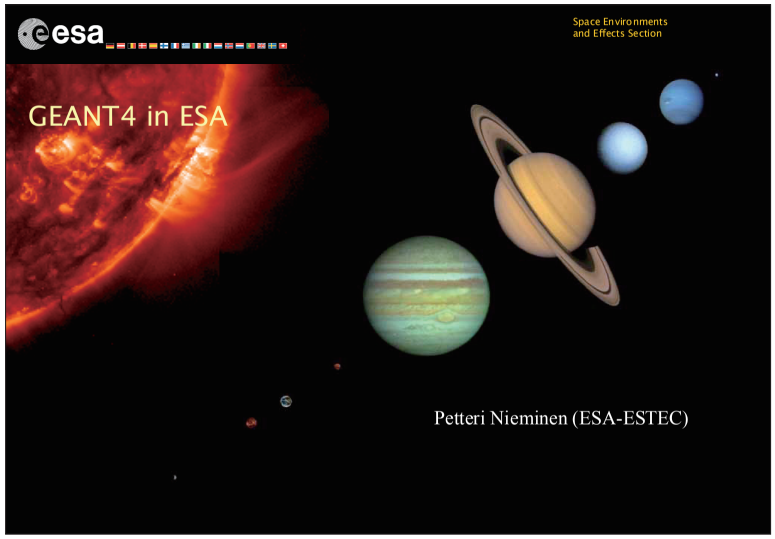

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GEANT4 in ESA

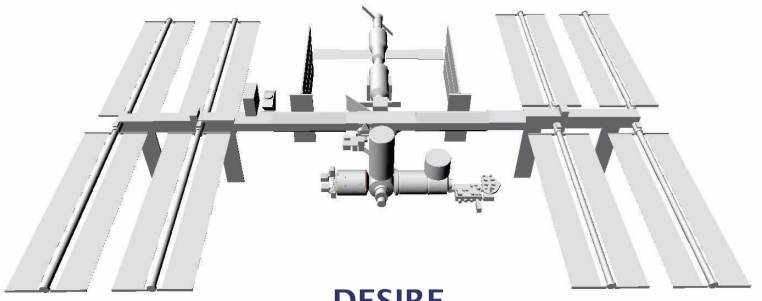
- General comments
- ISS Columbus: DESIRE project
- Tool and application developments
- Radiation monitoring
- Mars radiation environment modelling
- L2 Science Missions
- Ongoing and planned R&D activities

esa Space Environments and Effects Section

GEANT4 in ESA: General Comments

- ESA has been a member of the GEANT4 Collaboration since 1998, and a formal Signatory of the GEANT4 Collaboration Agreement since end of 2005
- GEANT4 and its auxiliary space tools are used extensively for ESA mission support in various application domains (Science, Exploration, Telecom, Navigation, component and environment analyses…)
- ESA internal manpower is rather limited for direct GEANT4 kernel developments (see presentation on GRAS and other developments by Giovanni Santin)
- Instead, most of the R&D is carried out via collaborations and contracts with European Academia and Industry: BIRA (B), DH Consultancy (B), CSR (B), Univ. Bern (CH), SpaceIT (CH), Univ. Geneve (CH), eta_max(D), Univ. Cologne (D), Univ. Kiel (D), INTA (E), IN2P3 (F), ONERA (F), TRAD (F), HIP (FIN), INFN (I), Alenia Spazio (I), KTH Stockholm (S), LIP (P), QinetiQ (UK), Imperial College (UK), Univ. Southampton (UK), CERN,…
- GEANT4 Space Users' Workshops are an important venue for exchange of ideas and information on the latest developments in the space domain worldwide

esa Space Environments and Effects Section



DESIRE

Dose Estimation by Simulation of the ISS Radiation Environment

Courtesy Tore Ersmark

http://www.particle.kth.se/desire/

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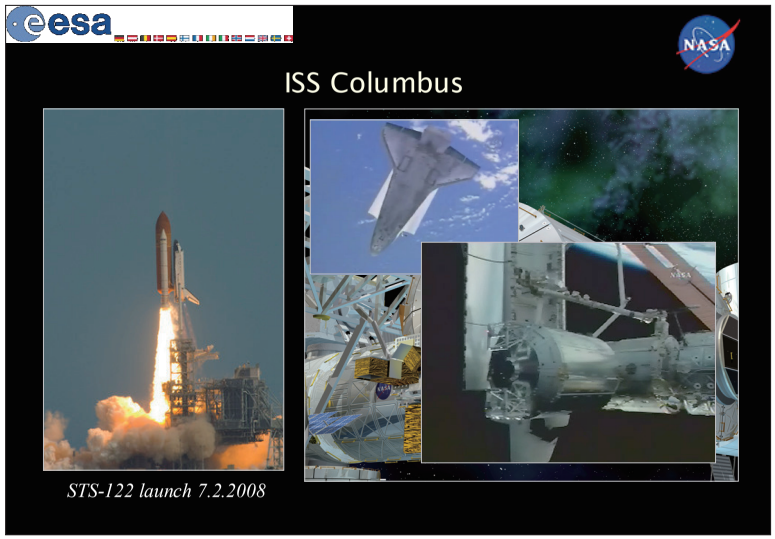

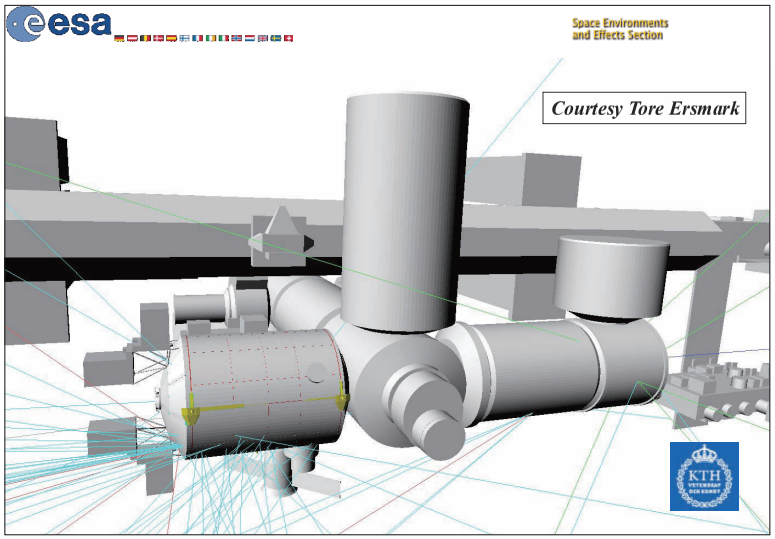

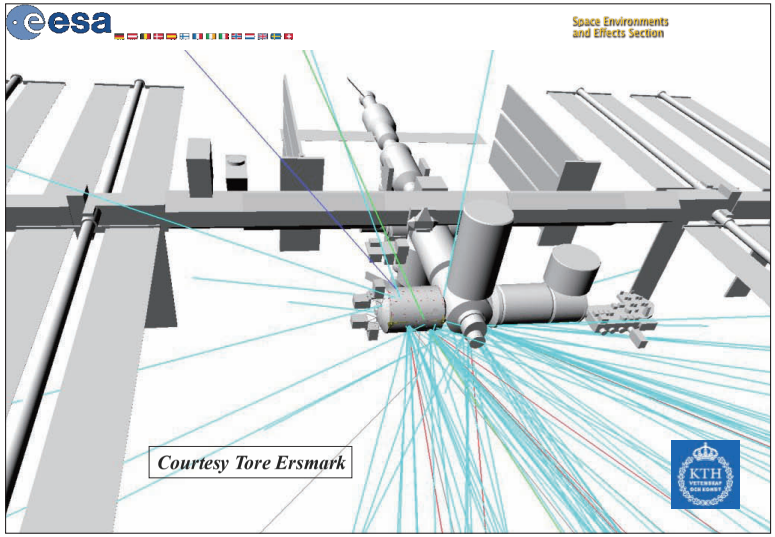

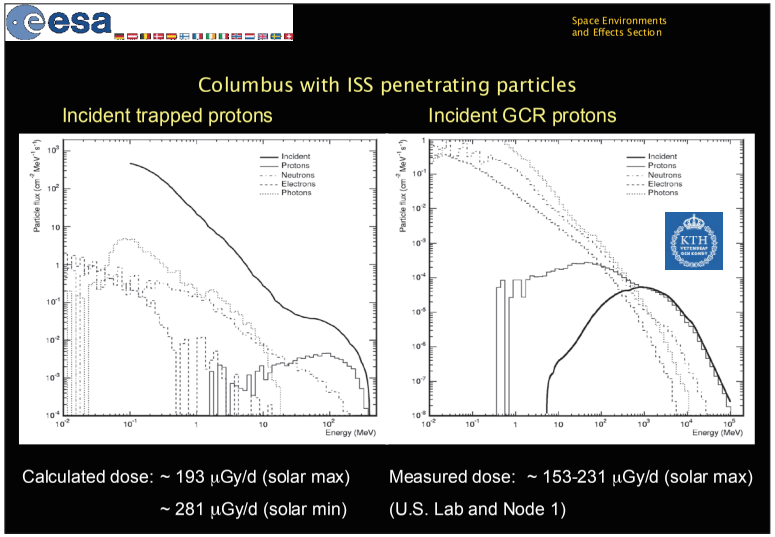

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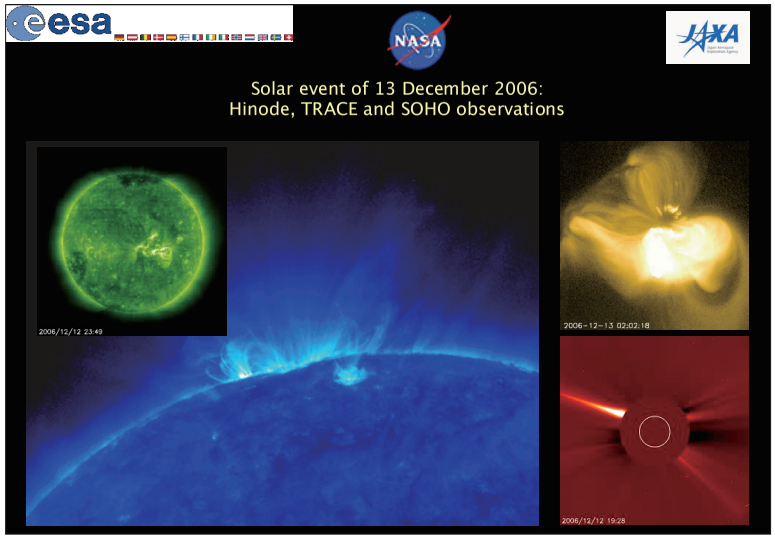

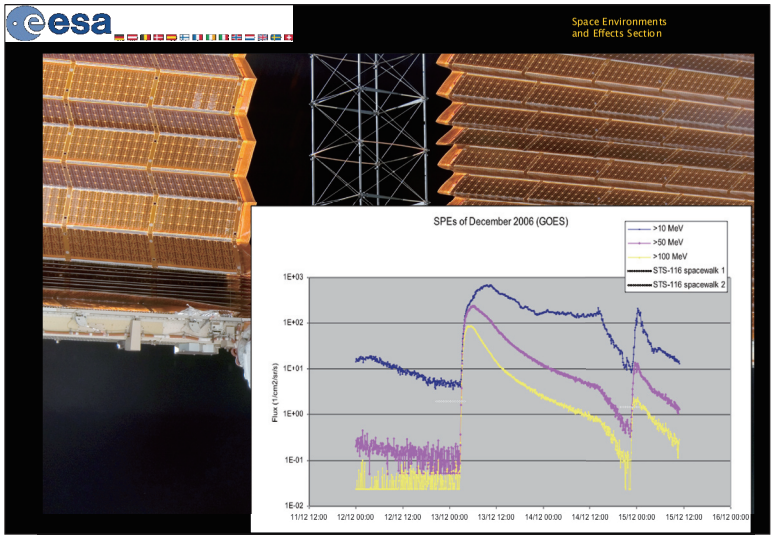

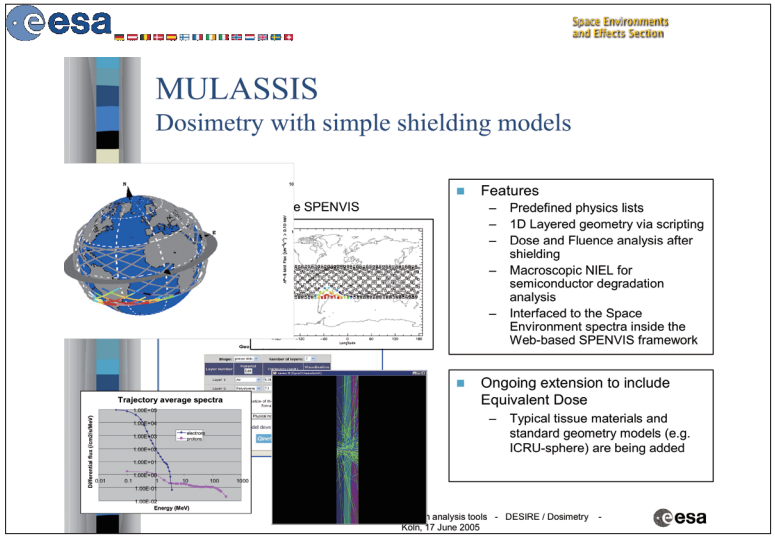

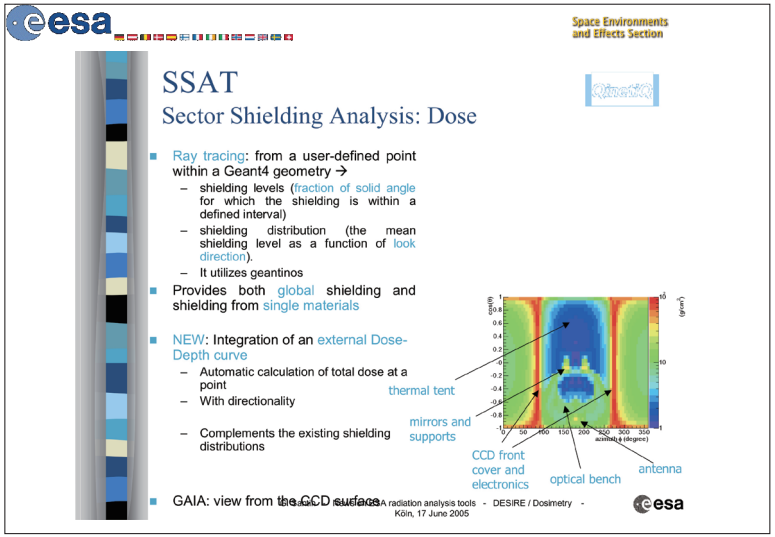

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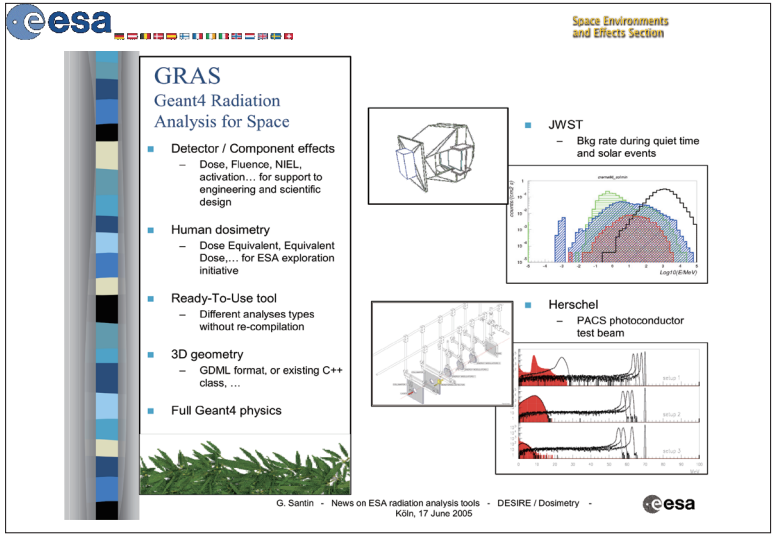

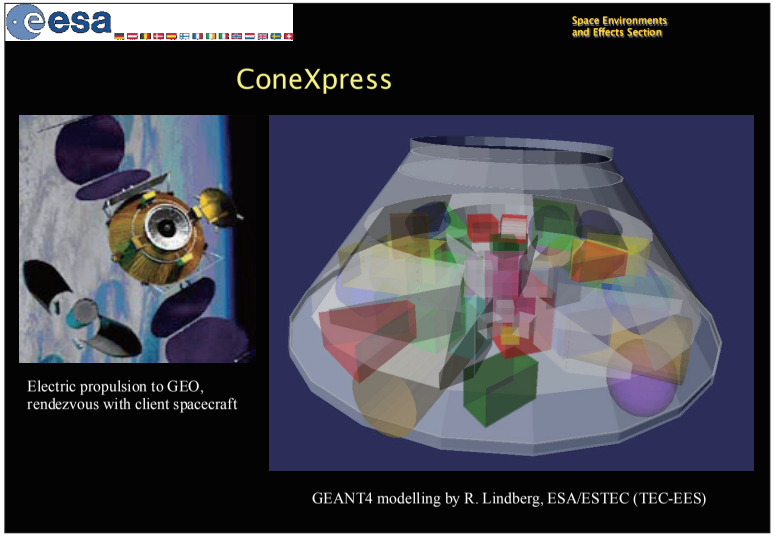

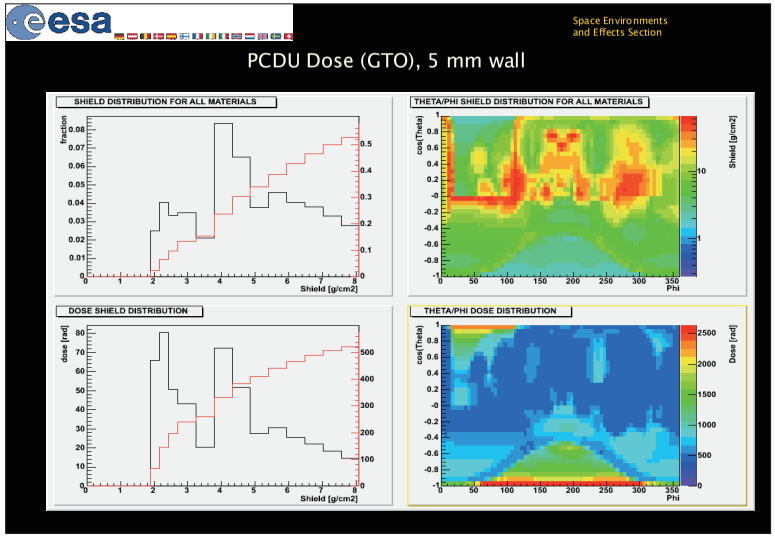

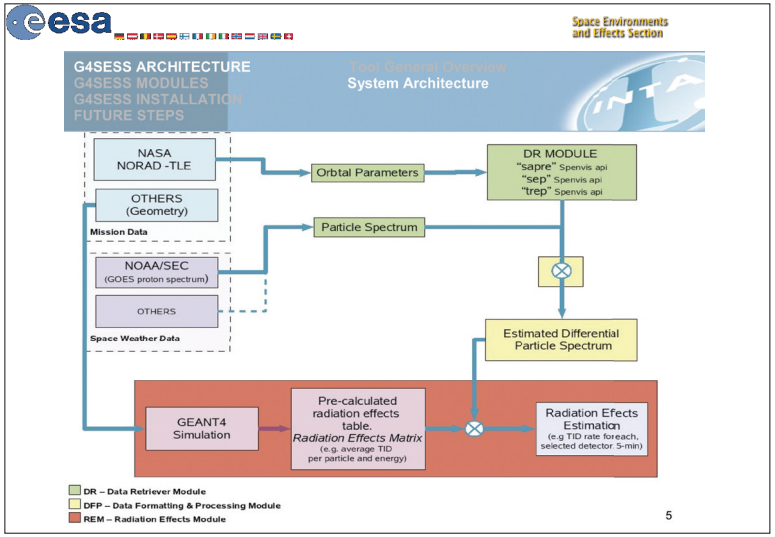

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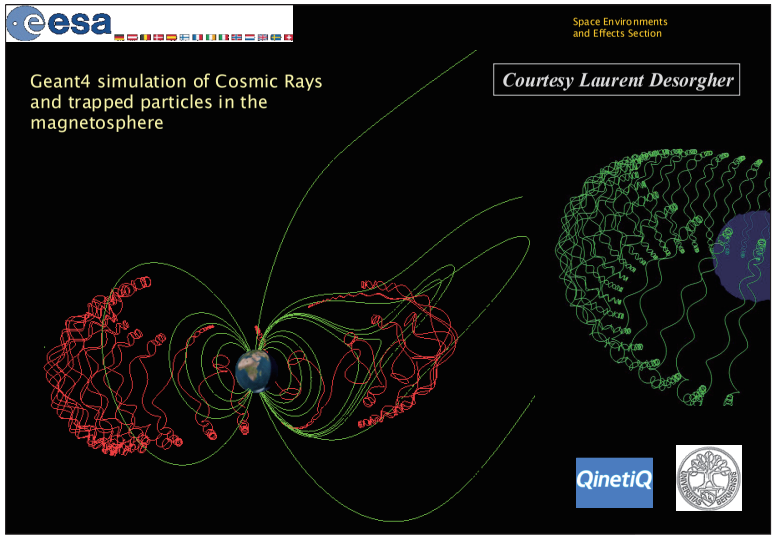

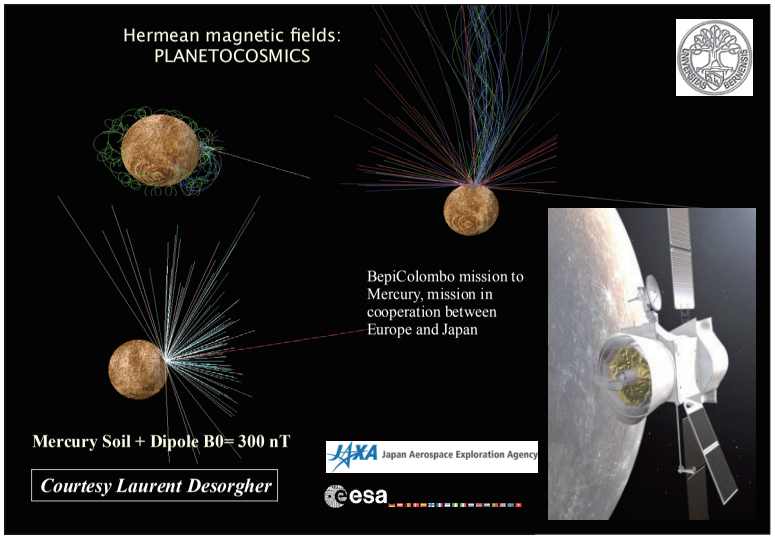

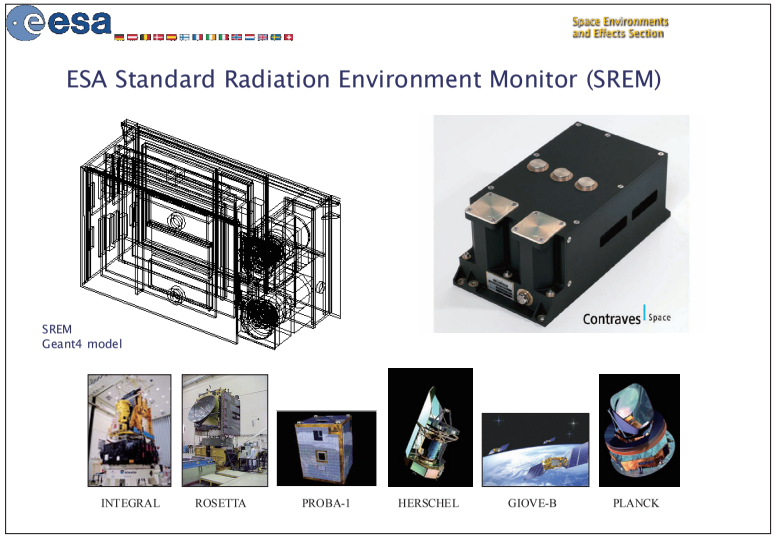

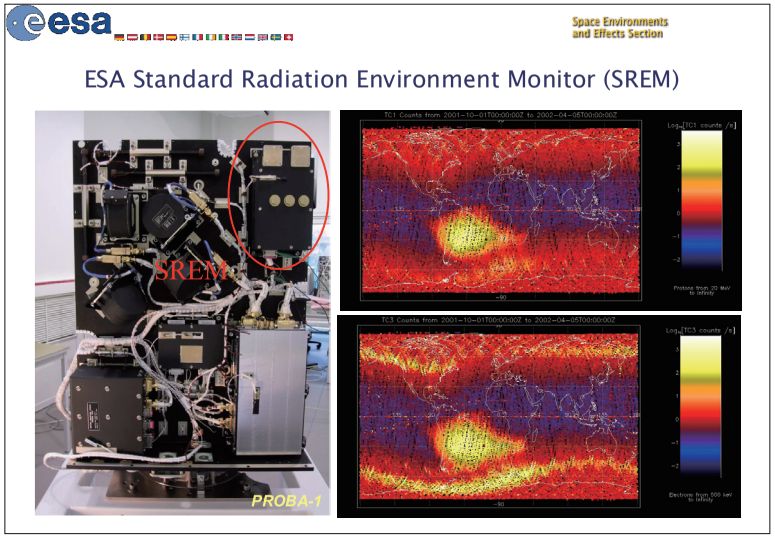

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Issues for Mars:

- SPE and GCR fluxes at 1.5 AU
- Broad range of altitudes
- Seasonal, diurnal and local variations of atmospheric pressure
- For UV and X rays: dust storms
- Surface backscattering and neutrons ⇒ local geology
- Local magnetic fields in the southern hemisphere

Terby crater as seen by Mars Express

© ESA/DLR/FU Berlin (G. Neukum)

Altitude → Surface pressure variations

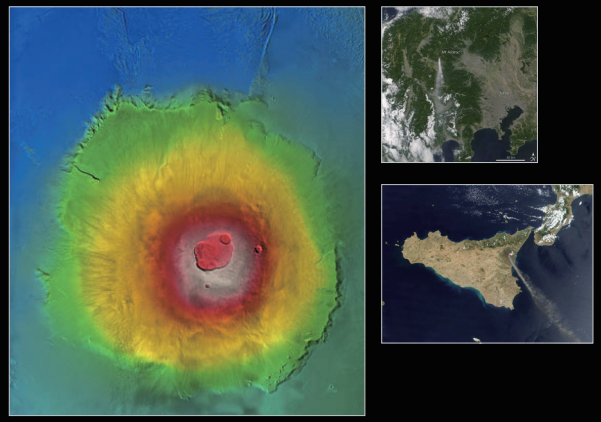


Image credit G. Neukum, FU Berlin, Germany

MEREM

DCH

LIP

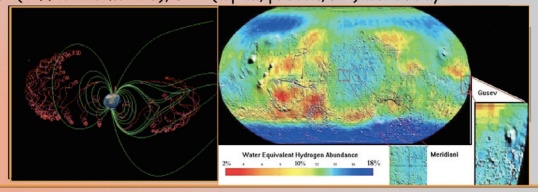
QinetiQ

Spacell

Aim

Courtesy Ana Keating

- Merge and extending MarsREC & Mars-Planetocosmic models for the Mars, Phobos and Deimos, including treatment of surface topology and composition, subsurface, atmospheric composition and density (including diurnal and annual variations), and local magnetic fields.
- Create a user-friendly engineering tool [based on QARM]
- Interface with SPENVIS
- New ion physics
- SEP (differetn models), GCR (alpha, proton, HI) and X-ray



MEREM

DCH

LIP

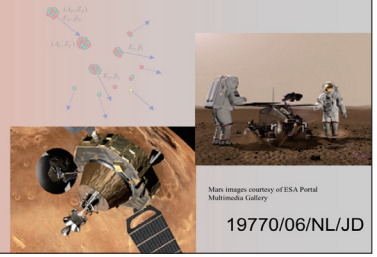
QinetiQ

Spacell

Courtesy Ana Keating

Mars Energetic Radiation Environment Model

A. Keating
S. Valente
P. Gonçalves
M. Pimenta
P. Nieminen
L. Desorgher
P. Truscott
F. Lei
D. Heynderickx
N. Crosby
H. De Witte
G. Degreef



Mars images courtesy of ESA Portal Multimedia Gallery

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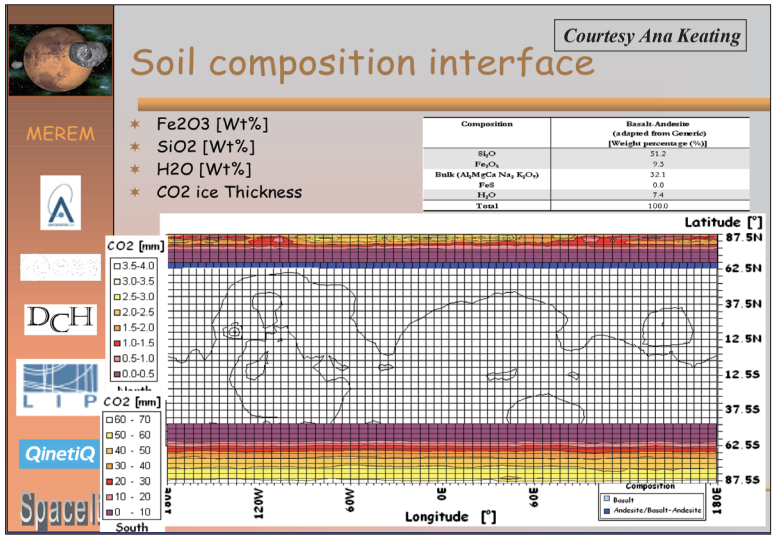

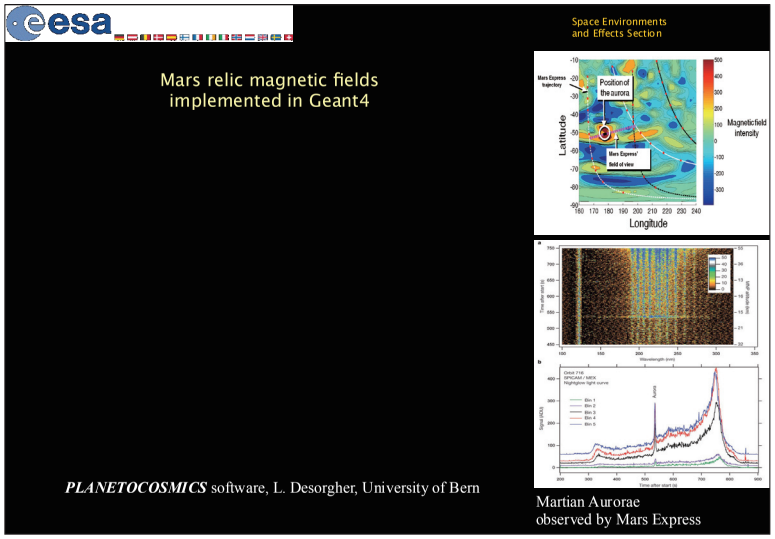

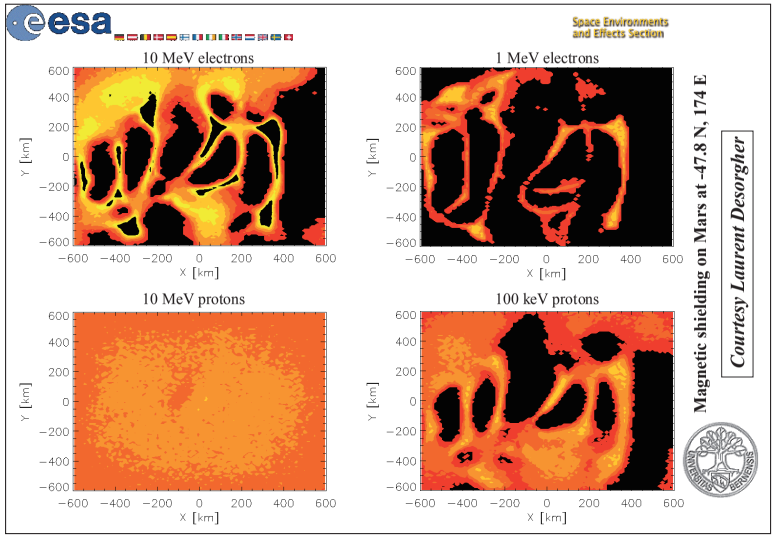

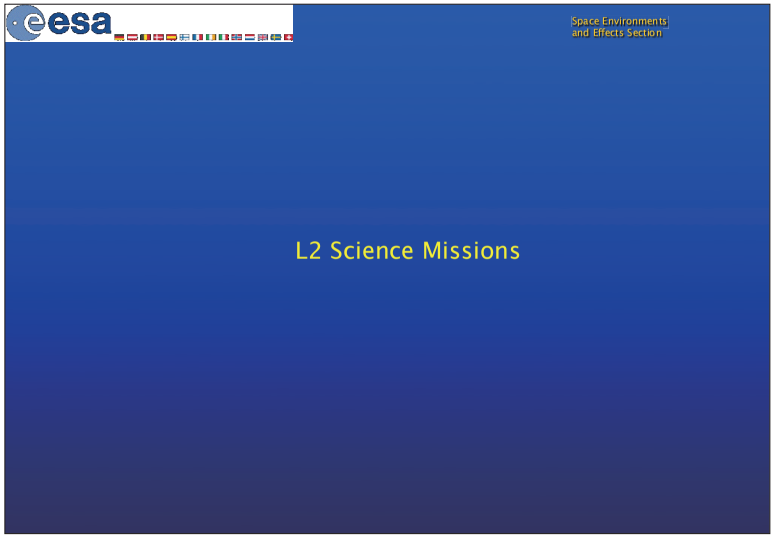

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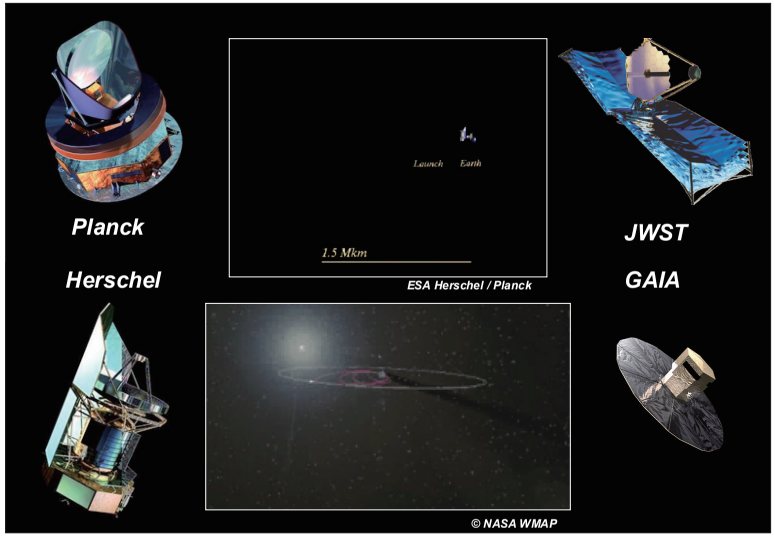

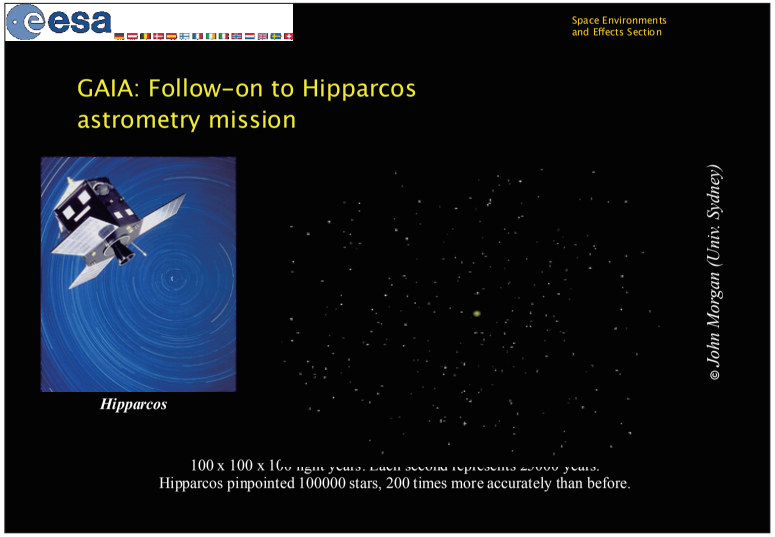

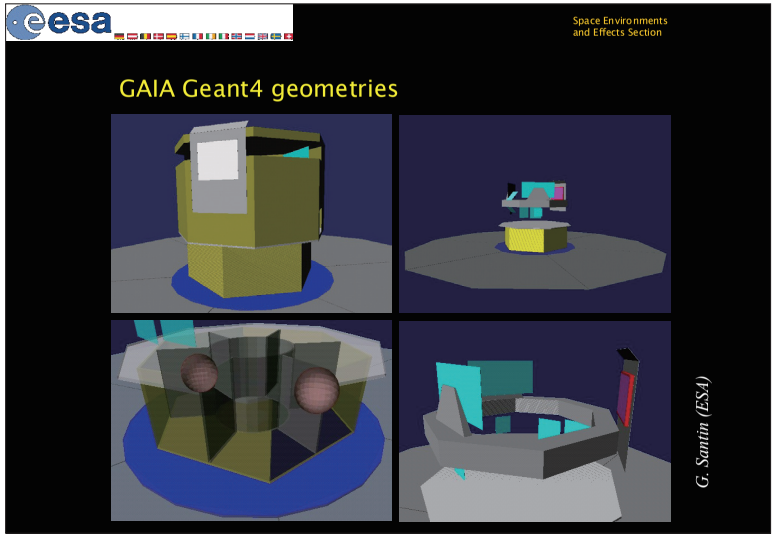

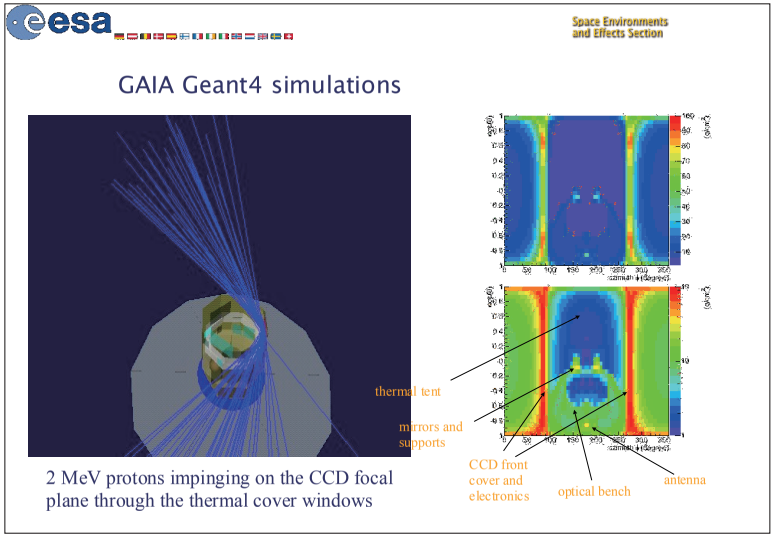

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Ongoing and Planned R&D Activities

- MARSREM: DPMJET 2.5 implementation ongoing; active shielding methods studied
- REAT-MS: Geant4 interface to industrial radiation tools; prototype of Reverse MC
- Rapid Reverse Monte Carlo and Ion Physics for Dose and SEE, KO imminent
- Jupiter Radiation Environment and Effects Tools, KO imminent
- Investigation and Analysis of Very High Energy Accelerators for Radiation Simulation, AO 1st quarter of 2008
- Energetic Electron Shielding, Charging and Radiation Effects, AO 1st half of 2008
- Physics Models for Biological Effects of Radiation and Shielding, AO 2nd half of 2008
- Dose Enhancement in High Electron Environment as a Source of Underprediction, AO 1st half of 2008
- Internal call for ESA Cosmic Vision 2015-2025 R&D proposals, 1st quarter of 2008
- ESA General Studies Programme internal call for proposals, 1st half of 2008

- And, continued support to new missions => Source of new R&D

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