SupraThermal Electrons and Protons (STEP) on Solar Orbiter

Christoph Terasa, Lauri Panitzsch

Institut für Experimentelle und Angewandte Physik
Christian-Albrechts-Universität zu Kiel

May 20, 2014

Outline

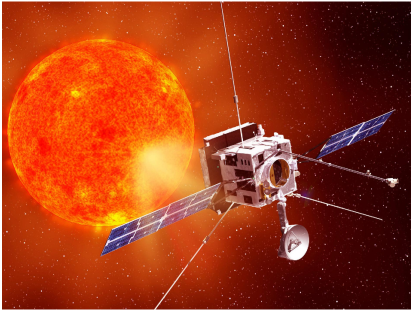
The past: STEIN

The present: STEP

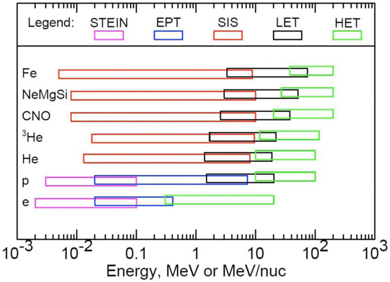
The very present: EM model and calibrations

Solar Orbiter (Launch Jan. 2017?)

- ESA mission to study the Sun and corona, with payload of remote sensing and in-situ instruments
- Perihelion at up to 0.28 AU
- Phases of co-rotation allow observation of fixed points on the Sun's surface
- Increasing inclination at later stages to observe solar pole regions

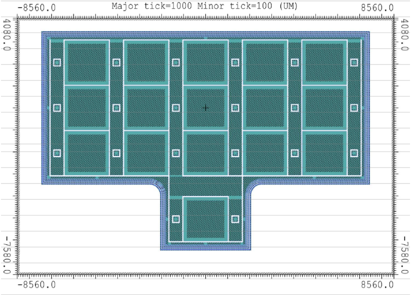


SupraThermal Electrons, Ions and Neutrals (STEIN)



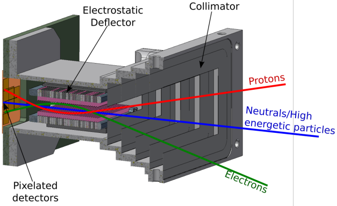
- Energy range 2 keV to 100 keV for electrons and 4 $\mathrm{keV/nuc}$ to 100 $\mathrm{keV/nuc}$ for ions and neutrals

SupraThermal Electrons, Ions and Neutrals (STEIN)



- Energy range 2 keV to 100 keV for electrons and 4 $\mathrm{keV/nuc}$ to 100 $\mathrm{keV/nuc}$ for ions and neutrals
- Reasonably large Field of View of $66^\circ \times 30^\circ$ per telescope

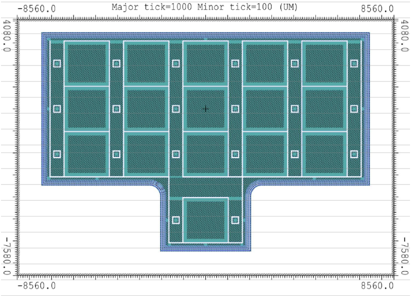
SupraThermal Electrons, Ions and Neutrals (STEIN)



- Energy range 2 keV to 100 keV for electrons and 4 $\mathrm{keV/nuc}$ to 100 $\mathrm{keV/nuc}$ for ions and neutrals
- Reasonably large Field of View of $66^\circ \times 30^\circ$ per telescope
- 32 SSD pixels per telescope head $\Rightarrow$ pitch-angle resolution
- Electrostatic deflection allows separation by particle charge

Detector pixel layout

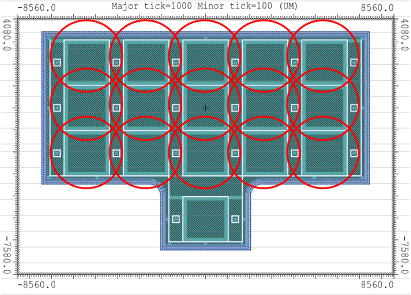
Adaptive geometry factor, optimized for high-flux low-energy electron events:



Detector pixel layout

Adaptive geometry factor, optimized for high-flux low-energy electron events:

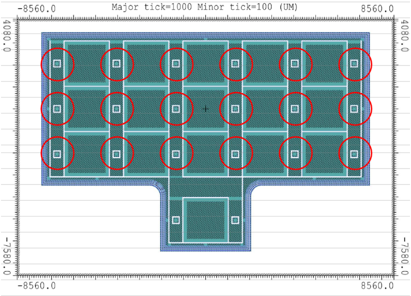
- "large" 2 x 2 mm pixels (about 0.002 $\mathrm{cm}^2\ \mathrm{sr}$)



Detector pixel layout

Adaptive geometry factor, optimized for high-flux low-energy electron events:

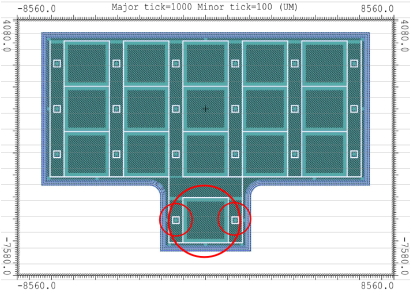
- "large" 2 x 2 mm pixels (about 0.002 cm^2 sr)
- "small" 0.3 x 0.3 mm pixels (about 0.00005 cm^2 sr)



Detector pixel layout

Adaptive geometry factor, optimized for high-flux low-energy electron events:

- "large" 2 x 2 mm pixels (about 0.002 cm^2 sr)
- "small" 0.3 x 0.3 mm pixels (about 0.00005 cm^2 sr)
- "shadow" pixels measure electron/gamma background



The past: STEIN

The present: STEP

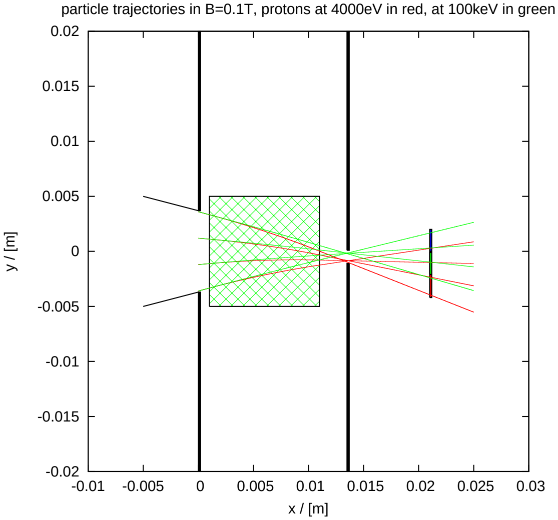
The very present: EM model and calibrations

Problems with HVPS lead us to redesign particle separation:

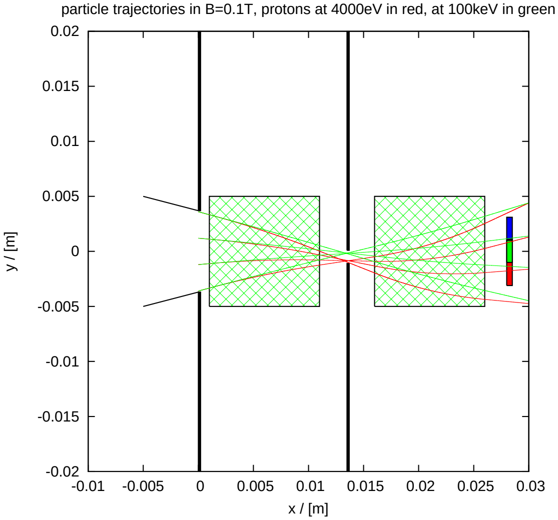
- Idea from (S)EPT: Use permanent magnets to get rid of electrons
- Separation of protons and neutral atoms no longer possible: STEIN $\Rightarrow$ STEP
- Previously antiparallel FoVs are coaligned, one head measures protons and ions, the other electrons, protons and ions

This approach is only possible since STEIN moved from the boom to the S/C body, thus facing the same EMC requirements as EPD/HET or LET

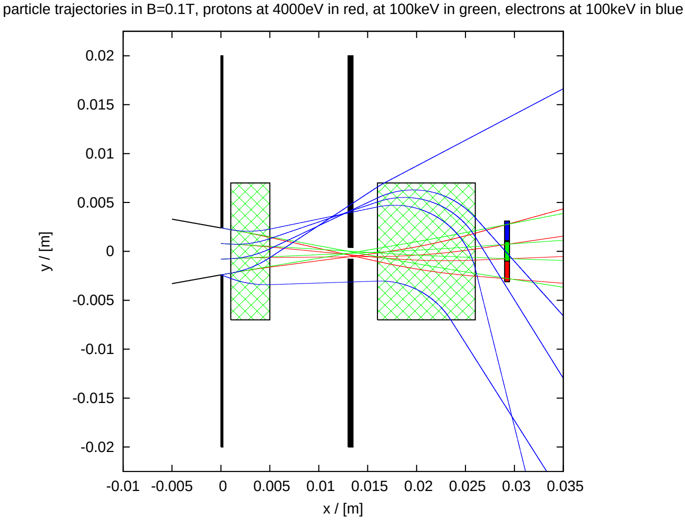
Magnet system simulations



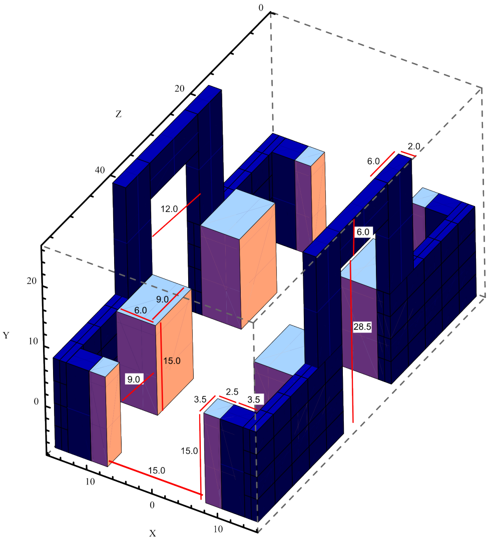
Magnet system simulations



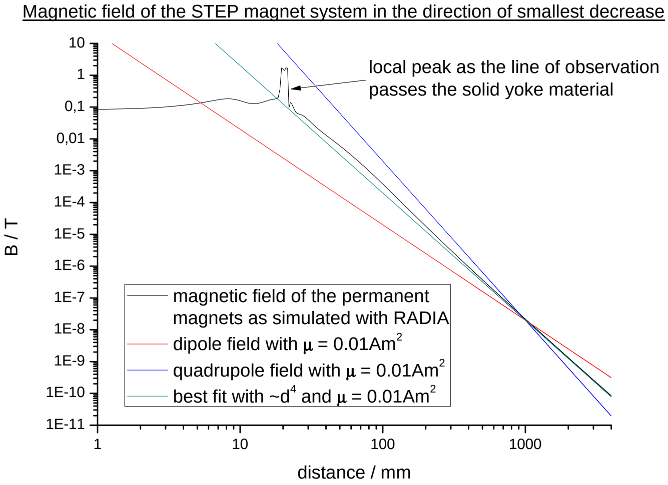
Magnet system simulations



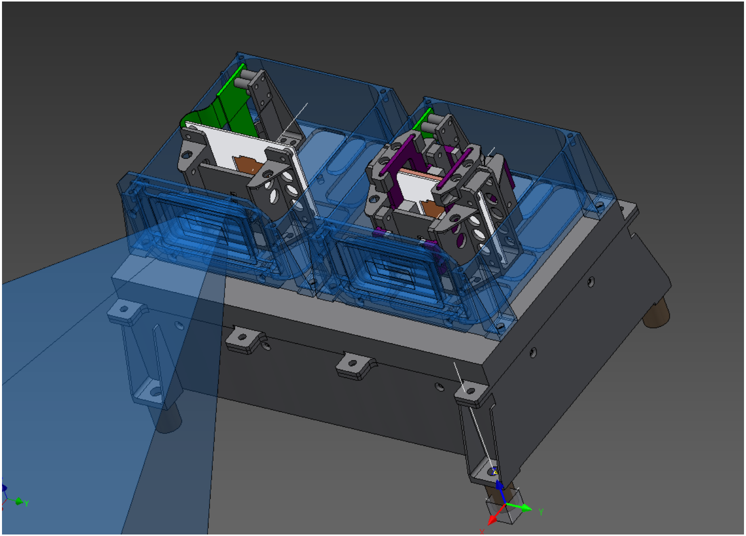
Magnet system design



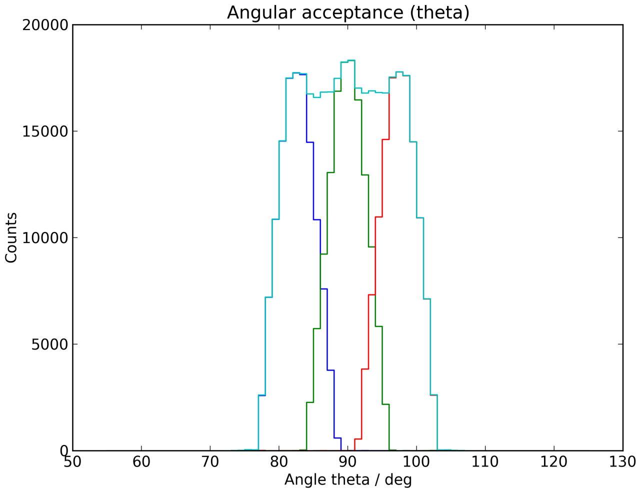
Magnet system far field



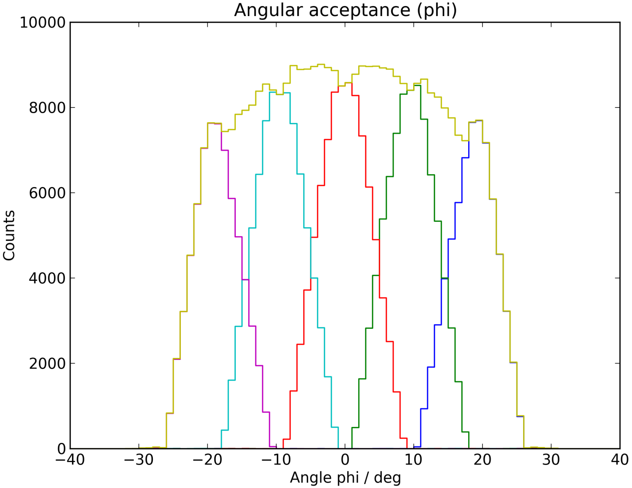
STEP model



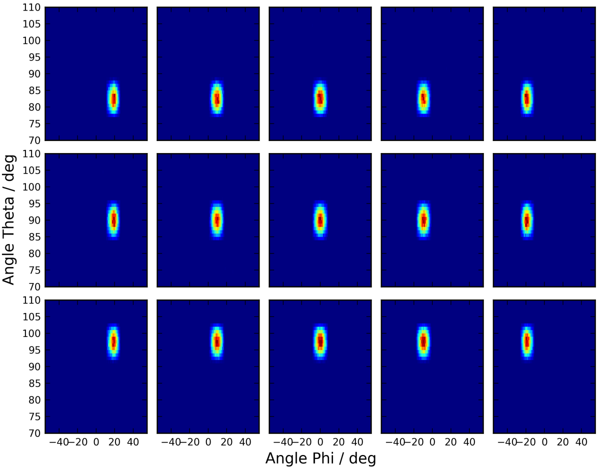
GEANT4 simulations - Protons/electrons in electron head



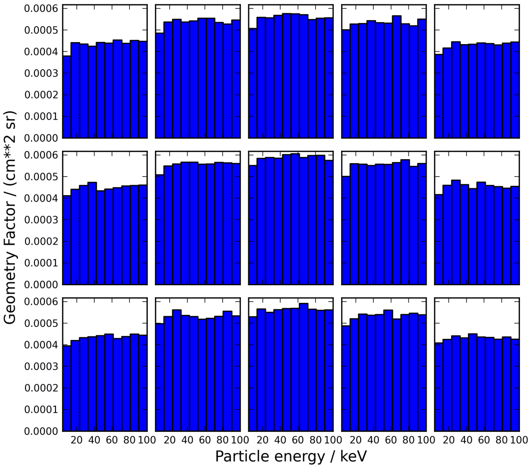
GEANT4 simulations - Protons/electrons in electron head



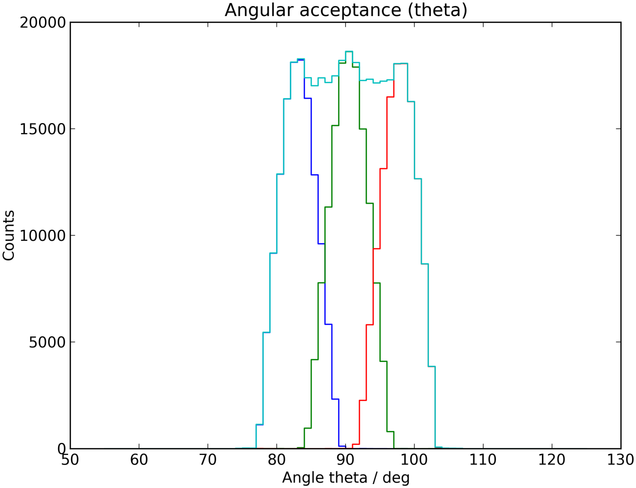
GEANT4 simulations - Protons/electrons in electron head



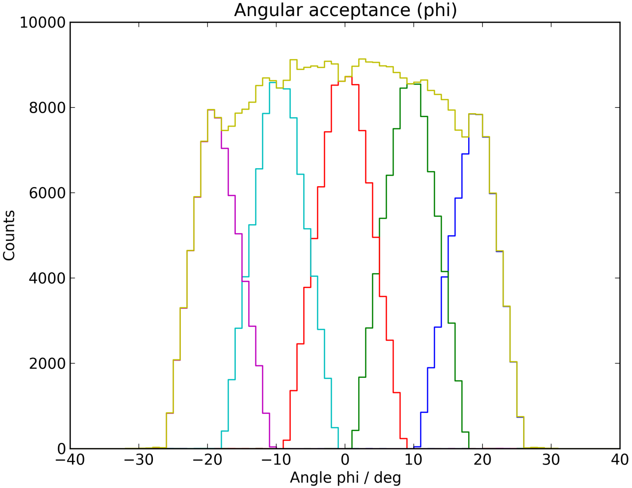
GEANT4 simulations - Protons/electrons in electron head



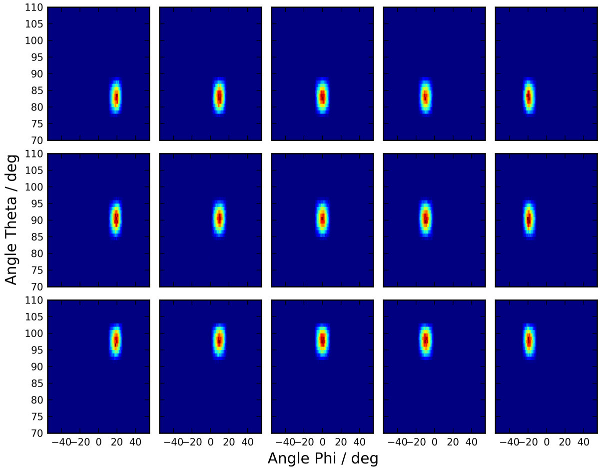
GEANT4 simulations - Protons in proton head



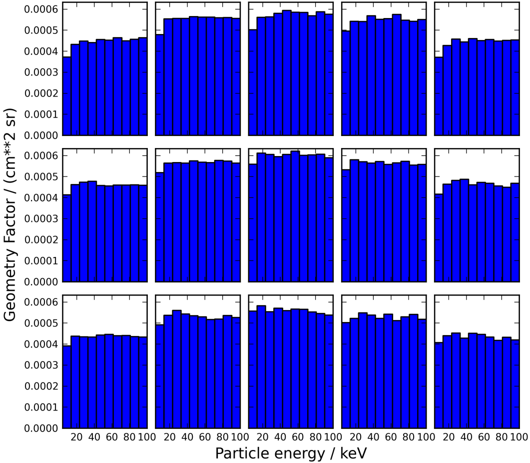
GEANT4 simulations - Protons in proton head



GEANT4 simulations - Protons in proton head



GEANT4 simulations - Protons in proton head



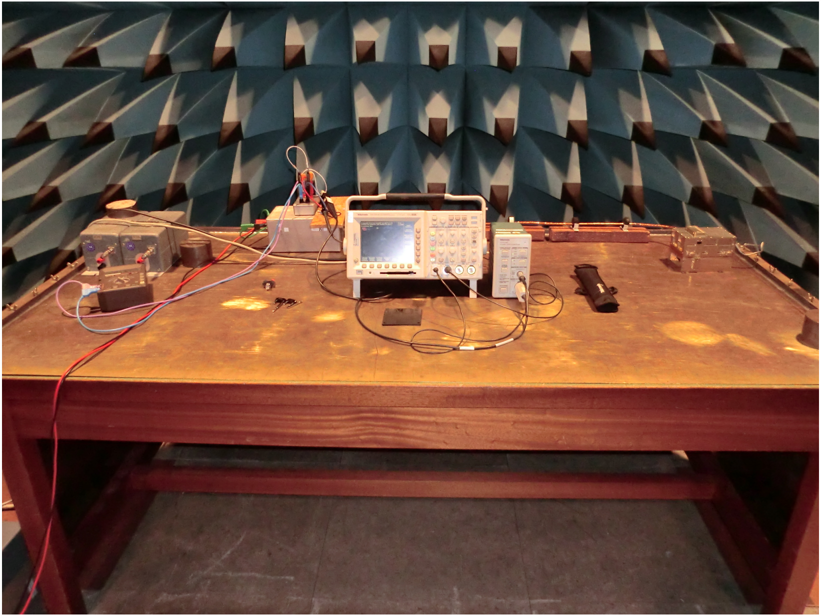
Magnet systems arrived at Kiel

STEP EM

STEP EM

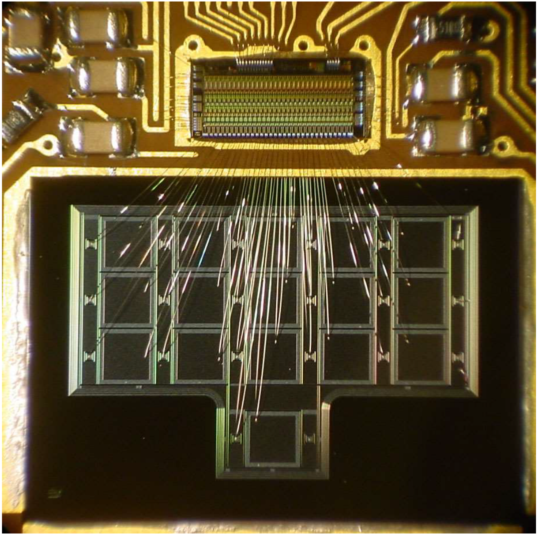
STEP EMC tests at TREO

STEP EMC tests at TREO - Inrush current tests

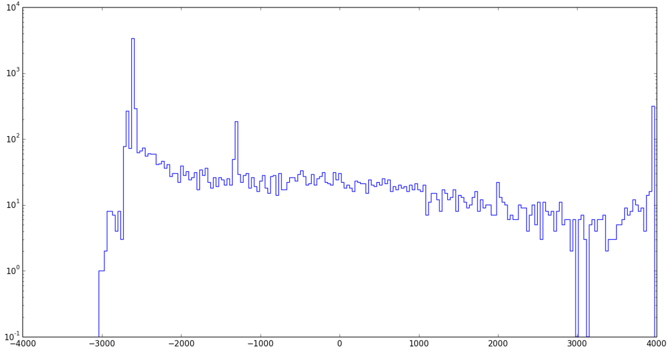


STEP EMC tests at TREO - Team

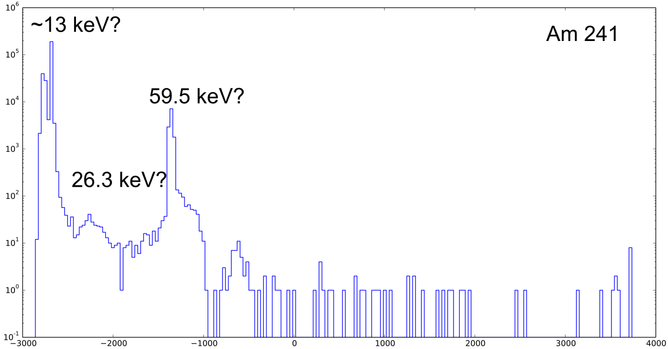
Detectors + IDE-Fx



First spectra - muons?

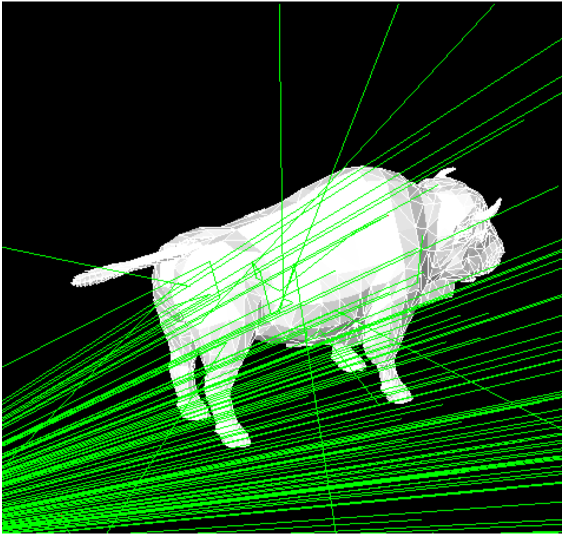


First spectra - Am241

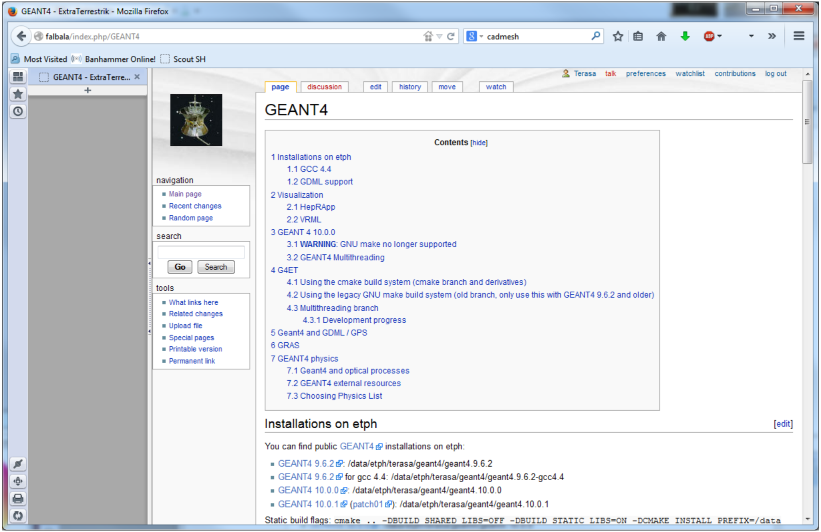


Now for something completely different

GEANT4 CADMesh



GEANT4 wiki


GEANT4 - ExtraTerrestrik - Mozilla Firefox
falbala/index.php/GEANT4
cadmesh
Most Visited
Banhammer Online!
Scout SH
GEANT4 - ExtraTerre...
Terasa
talk
preferences
watchlist
contributions
log out
page
discussion
edit
history
move
watch
GEANT4
Contents [hide]
1 Installations on etph
1.1 GCC 4.4
1.2 GDML support
2 Visualization
2.1 HepRApp
2.2 VRML
3 GEANT 4 10.0.0
3.1 WARNING: GNU make no longer supported
3.2 GEANT4 Multithreading
4 G4ET
4.1 Using the cmake build system (cmake branch and derivatives)
4.2 Using the legacy GNU make build system (old branch, only use this with GEANT4 9.6.2 and older)
4.3 Multithreading branch
4.3.1 Development progress
5 Geant4 and GDML / GPS
6 GRAS
7 GEANT4 physics
7.1 Geant4 and optical processes
7.2 GEANT4 external resources
7.3 Choosing Physics List
navigation
Main page
Recent changes
Random page
search
Go
Search
tools
What links here
Related changes
Upload file
Special pages
Printable version
Permanent link
Installations on etph
[edit]
You can find public GEANT4 installations on etph:
GEANT4 9.6.2: /data/etph/terasa/geant4/geant4.9.6.2
GEANT4 9.6.2 for gcc 4.4: /data/etph/terasa/geant4/geant4.9.6.2-gcc4.4
GEANT4 10.0.0: /data/etph/terasa/geant4/geant4.10.0.0
GEANT4 10.0.1 (patch01): /data/etph/terasa/geant4/geant4.10.0.1
Static build flags: cmake .. -DBUILD_SHARED_LIBS=OFF -DBUILD_STATIC_LIBS=ON -DCMAKE_INSTALL_PREFIX=/data

Lin, R. (1998).
WIND observations of suprathermal electrons in the interplanetary medium.
Space science reviews, pages 61–78.

Lin, R. P., Curtis, D. W., Larson, D. E., Luhmann, J. G., McBride, S. E., Maier, M. R., Moreau, T., Tindall, C. S., Turin, P., and Wang, L. (2008).
The STEREO IMPACT Suprathermal Electron (STE) Instrument.
Space Science Reviews, 136(1-4):241–255.

Tindall, C., Palaio, N., and Ludewigt, B. (2008).
Silicon detectors for low energy particle detection.
Nuclear Science, 55(2):797–801.