

How to parametrize a CME with the Graduated Cylindrical Shell Model



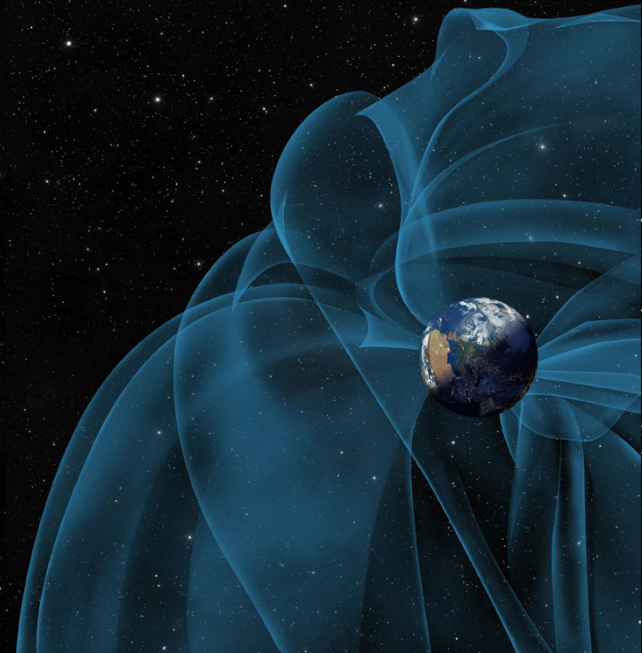
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Overview



1. Software Requirements
Software Installation
2. CME Detection
Data Acquisition
Data processing / IDL-Scripting
3. GCS Modeling Tool
Modeling step by step
with science data
with beacon data
4. Getting Results for CME Forecast

Software Requirements



1. OS: Linux 32/64bit
2. IDL: www.exelisvis.com
3. SolarSoft (SSW, SSWDB) with additional packages
www.lmsal.com/solarsoft/



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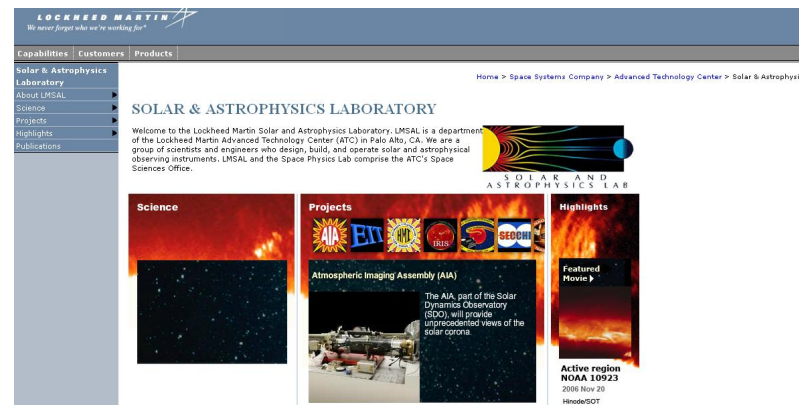
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LIVE SEMINARS:



Software Installation



1. IDL Installation on Linux

2. Installation of SSW:

(described on www.lmsal.com/solarsoft/ssw_install_howto.html)

a) SSW INSTALLATION FORM

SSW Mission, Instruments and databases

Packages: SECCHI, SSC ...

b) -> returns Installation Script `csh -f scriptname`

c) SSW System Environment and IDL Setup (within csh):

```
setenv SSW ../ssw
```

```
setenv SSW_INSTR "stereo secchi ..."
```

```
source $ssw/gen/setup/setup.ssw
```



3. Start (IDL 6.3, 8.2):

a) (csh) setting SSW System Environment

b) `sswidl`

c) `rtsccloud, /demo`

Software Installation



4. Installation of SSWDB:

(described on www.lmsal.com/solarsoft/sswdb_install.html)

a) SSWDB INSTALLATION FORM

SSW Mission, Instruments and databases

SECCHI Background cal (Standard) stereo/secchi/backgrounds/a/monthly_min

SECCHI Background cal (Standard) stereo/secchi/backgrounds/b/monthly_min

each about 10 GB ?

b) -> returns Installation Script `csh -f scriptname`

c) consider to keep SSWDB up to date (upgrade script)

5. local data repository (suggested)

(same as on NRL-Server)

`/.../database/stereo/secchi/lz/L0/a/seq/cor2/yyyymmdd/`

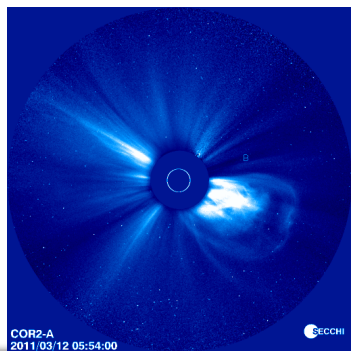
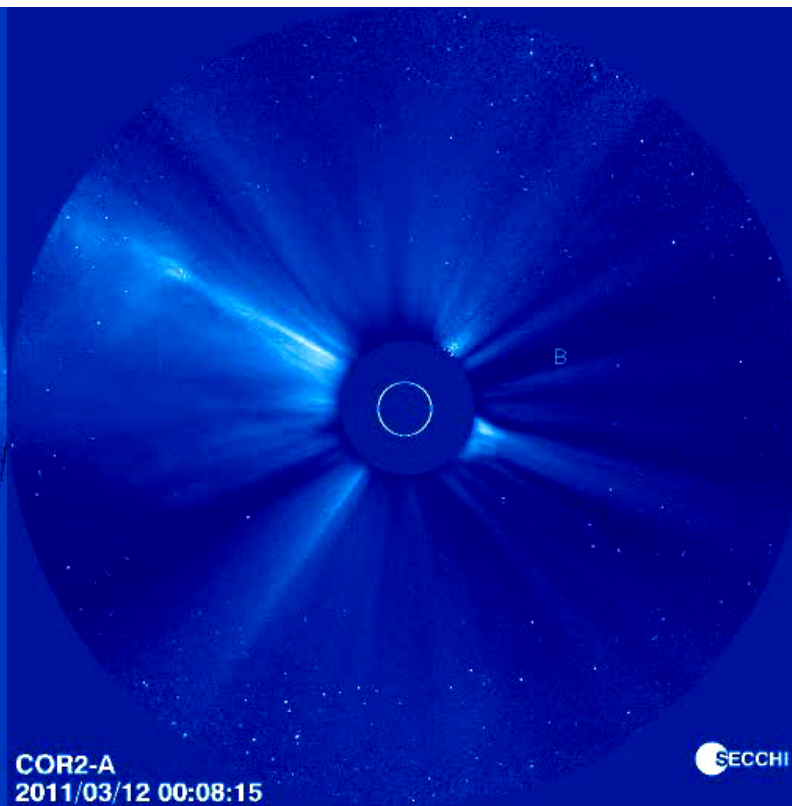
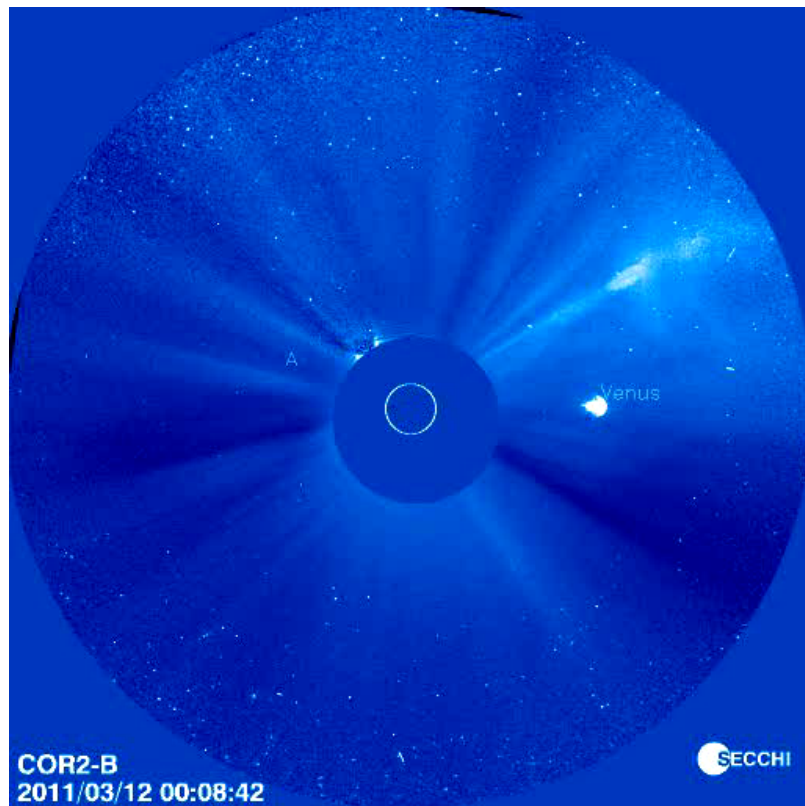
`/.../database/stereo/secchi/lz/L0/a/img/euvi/yyyymmdd/`

CME Detection

(CME #651 on 12.03.2011)



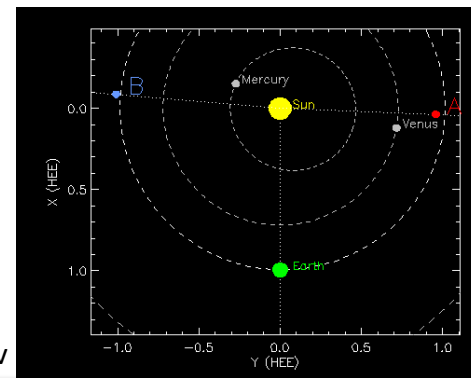
secchi.nrl.navy.mil



STEREO/SECCHI/COR2 Synoptic Movie

(12.03.2011 – 25.03.2011)

sep. Angle (A-E-B) = 182°



stereo-ssc.nascom.nasa.gov

Data Acquisition for CME #426 on 12.03.2011



Modeling with Science data:

(depends on data availability)

t_0 (time without CME):

12.03.2011 @ 00:08:15 UTC

6x COR2 FTS

t_1 (time CME is best visible for fitting):

12.03.2011 @ 06:08:15 UTC

6x COR2, 2x EUVI FTS

Modeling with Beacon data:

(data gap)

t_0 (time without CME):

11.03.2011 @ 20:08:15 UTC

6x COR2 FTS

t_1 (time CME is best visible for fitting):

12.03.2011 @ 05:08:15 UTC

6x COR2, 2x EUVI FTS

Websites: SCC: http://stereo-ssc.nascom.nasa.gov/data/ins_data/secchi/L0/a/seq/cor2/

Science Data

SCC: <http://stereo-ssc.nascom.nasa.gov/data/beacon/ahead/secchi/cor2/>

Beacon Data

NRL: http://sharpp.nrl.navy.mil/cgi-bin/swdbi/secchi_flight/img_short/form

Beacon & Science Data

STEREO SCIENCE CENTER
SSC
HOME CONTACT SITE MAP

Index of /data/ins_data/secchi/L0/a/seq/cor2/20110312

Name	Last modified	Size
Parent Directory		-
20110312_000815_n4c2A.fta	14-Mar-2011 10:07	8.0M
20110312_000845_n4c2A.fta	14-Mar-2011 10:08	8.0M
20110312_000915_n4c2A.fta	14-Mar-2011 10:08	8.0M
20110312_010815_n4c2A.fta	14-Mar-2011 10:11	8.0M
20110312_010845_n4c2A.fta	14-Mar-2011 10:12	8.0M
20110312_010915_n4c2A.fta	14-Mar-2011 10:12	8.0M
20110312_020815_n4c2A.fta	14-Mar-2011 10:15	8.0M
20110312_020845_n4c2A.fta	14-Mar-2011 10:15	8.0M
20110312_020915_n4c2A.fta	14-Mar-2011 10:16	8.0M

SECCHI Flight (S/C A and B) Images Query Form

As of 2013-02-19 02:04:53 EST, database contains 18803161 shutter flips and 8077437 downloadable images (excluding SWs).

Observation Range: 2006-10-27 08:25:06 - 2013-02-15 23:59:01

Please enter qualifiers in the fields below (Date Obs is required) and press the Search button.

For more detailed queries use our [long query form](#).

Start Date Obs: 02/15/2013 00:00:00 HH/DD/YYYY hh:mm:ss

End Date Obs: 02/15/2013 23:59:59 HH/DD/YYYY hh:mm:ss

Image Cadence: All (Cadences are anchored to the Start Date Obs)

Detector: ☐ EUVI ☐ COR1 ☐ COR2 ☐ HI-1 ☐ HI-2 ☒ All
Wavelength/Polarizer: All Filter: All

☒ Observatory: A&B

Data Level: Level-0.5

Download: SSR1

☐ Use full-page output, even if more than one row is returned (not downloadable).

Return a maximum of 150 records from this query.

Search Reset

Data Processing

IDL-Scripting

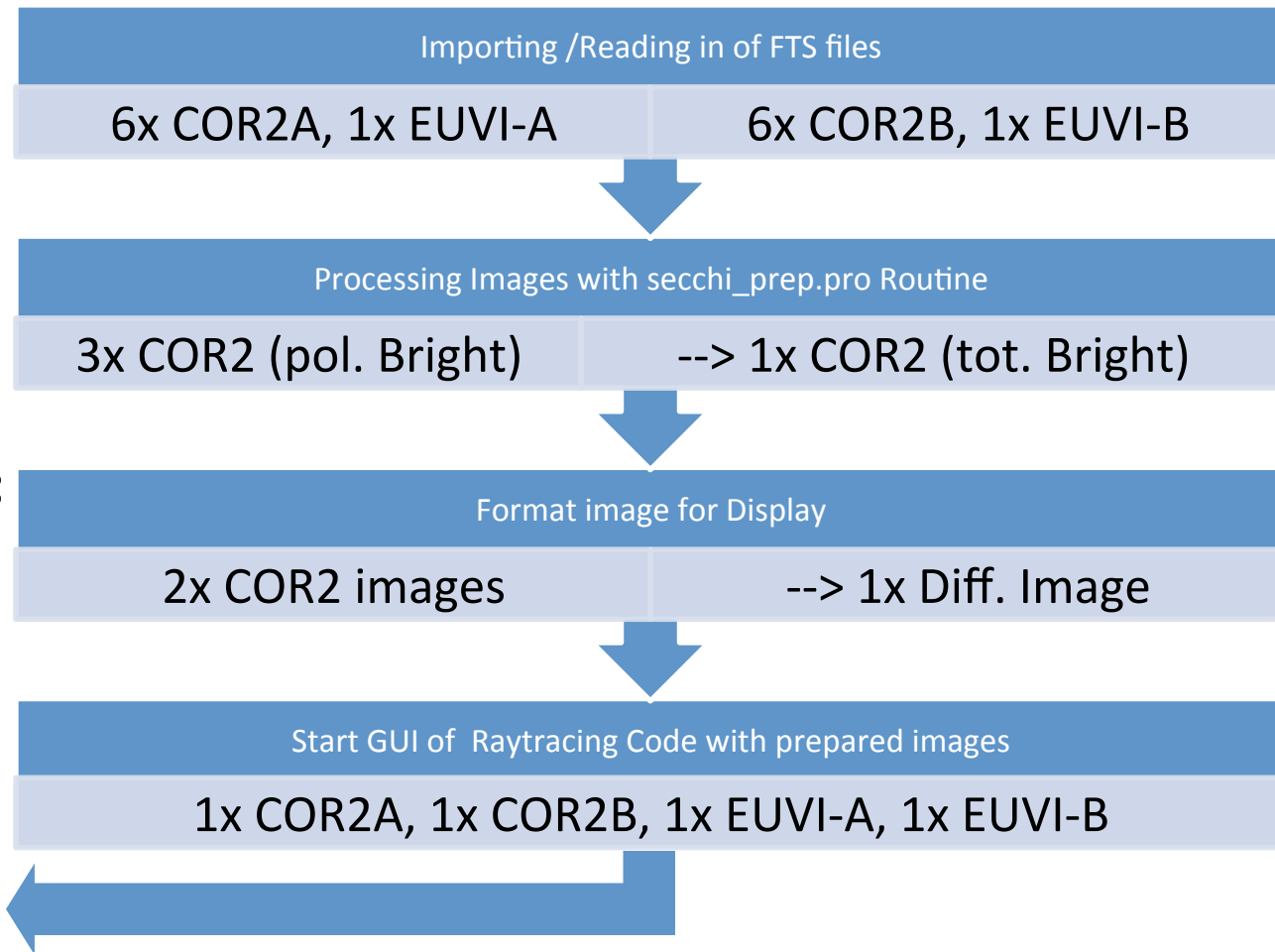


For Modeling with Science and/or Beacon data Tutorial available on:

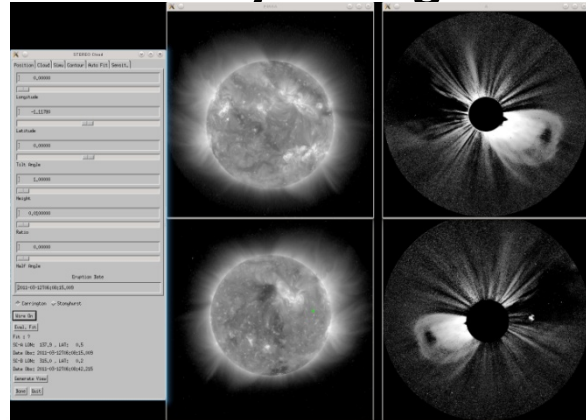
<http://secchi.nrl.navy.mil/synomaps/scraytrace/dobo/examples.html#tutrtscgcloud>

(with IDL Code example)

Overview:



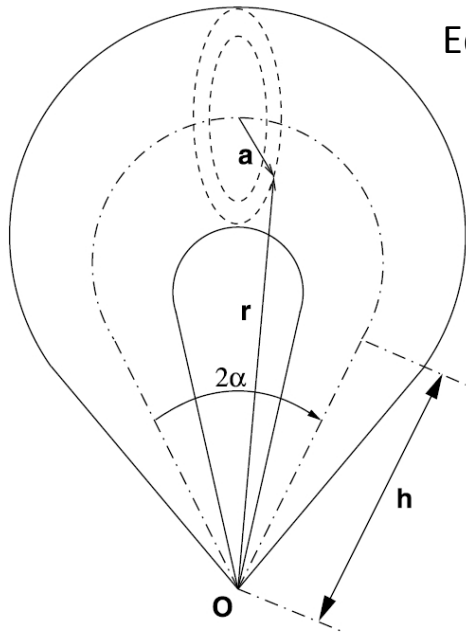
GUI of Raytracing Code:



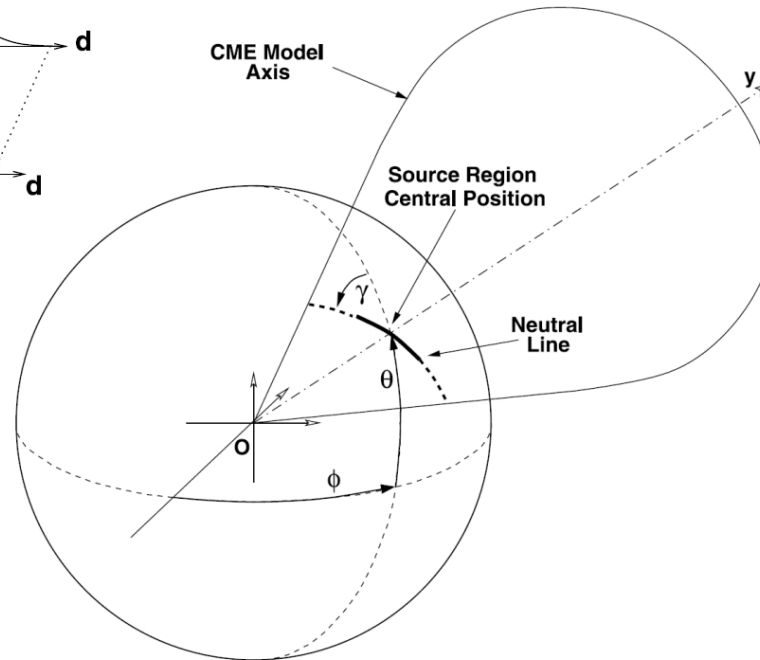
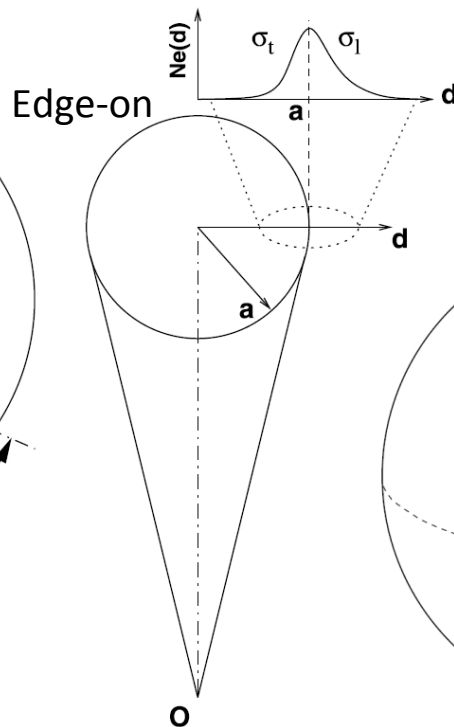
Reminder: GCS Model



Face-on



Edge-on



Howard, Thernissien
and Vourlidas, 2006

Model-Parameter and electron density distribution

2α	angle between both legs
h	height of the legs
h_{front}	distance between O (sun center) & leading edge
a	radius of cross-section
r	distance between sun center & boundary point of GCS
$\kappa = a/r$	aspect ratio
N_e	electron density

Φ	longitude
θ	latitude
γ	tilt angle
σ_t	Gaussian width of density profile inside GCS
σ_l	Gaussian width of density profile outside GCS

GCS Modeling Tool

Modeling - Step by Step



For Modeling with Science or Beacon data Guide available in:

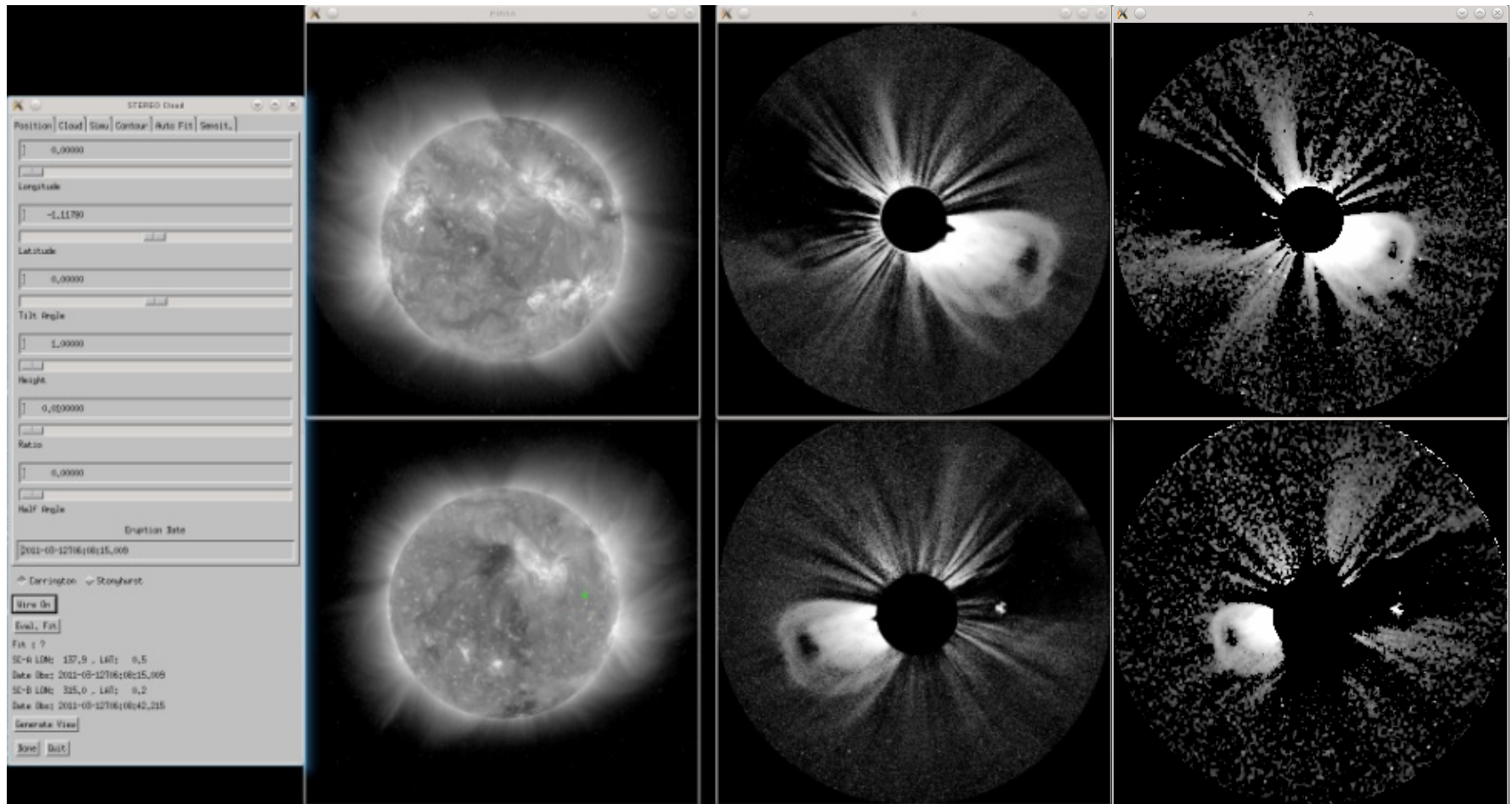
Thernisien,Vourlidis,Howard: **Forward Modeling of CMEs using STEREO/SECCHI data**, *Solar Phys.* (2009), 111-130

Control Panel

EUVI @ 195 Å

COR2 Science Data

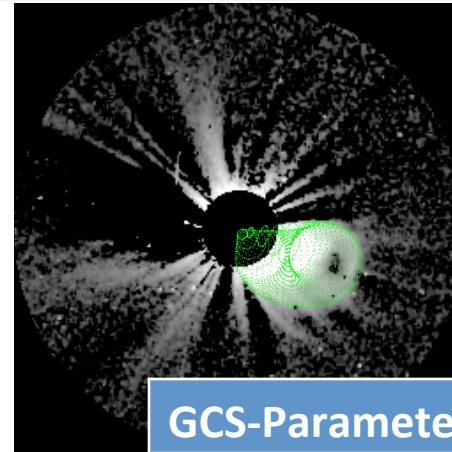
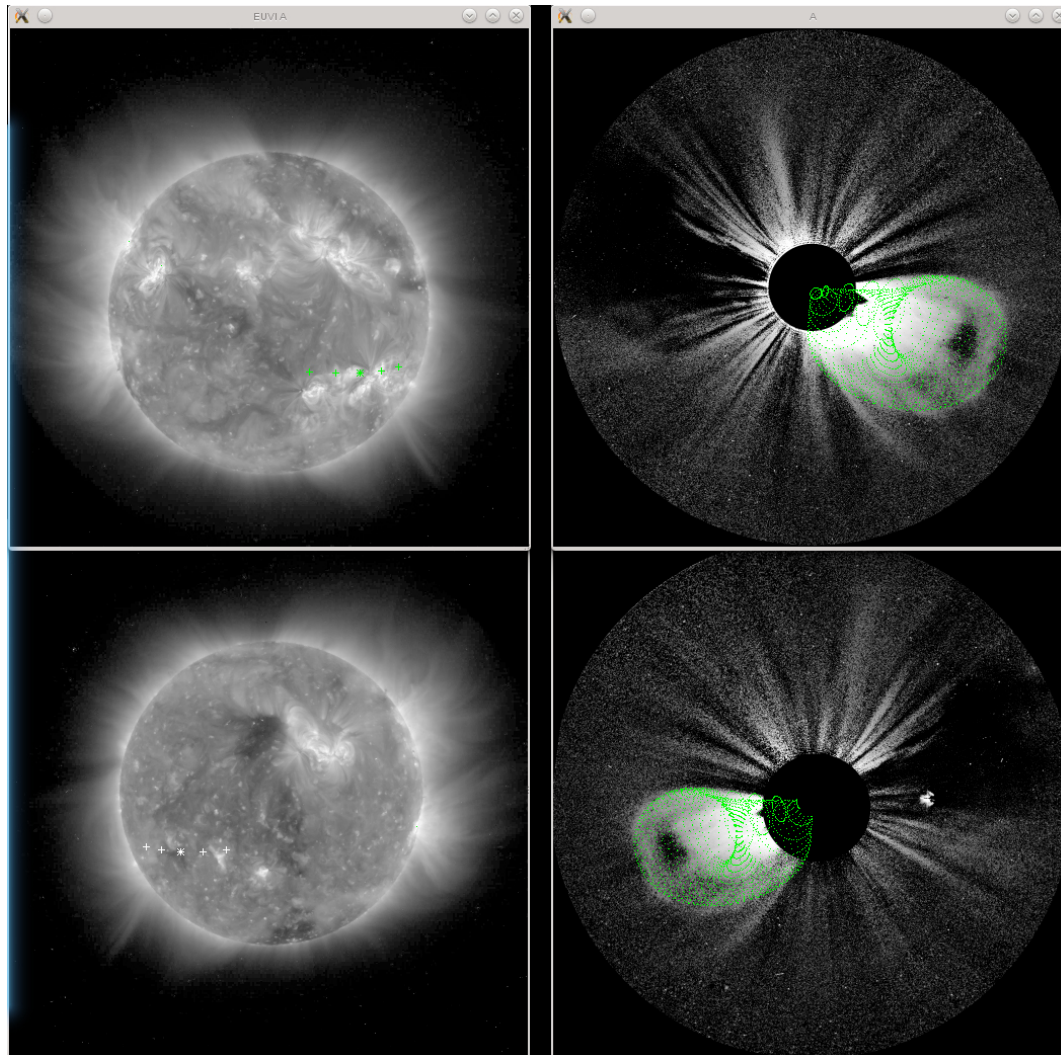
COR2 Beacon Data



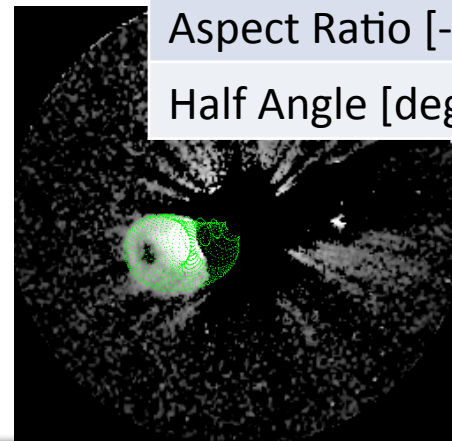
Getting Results



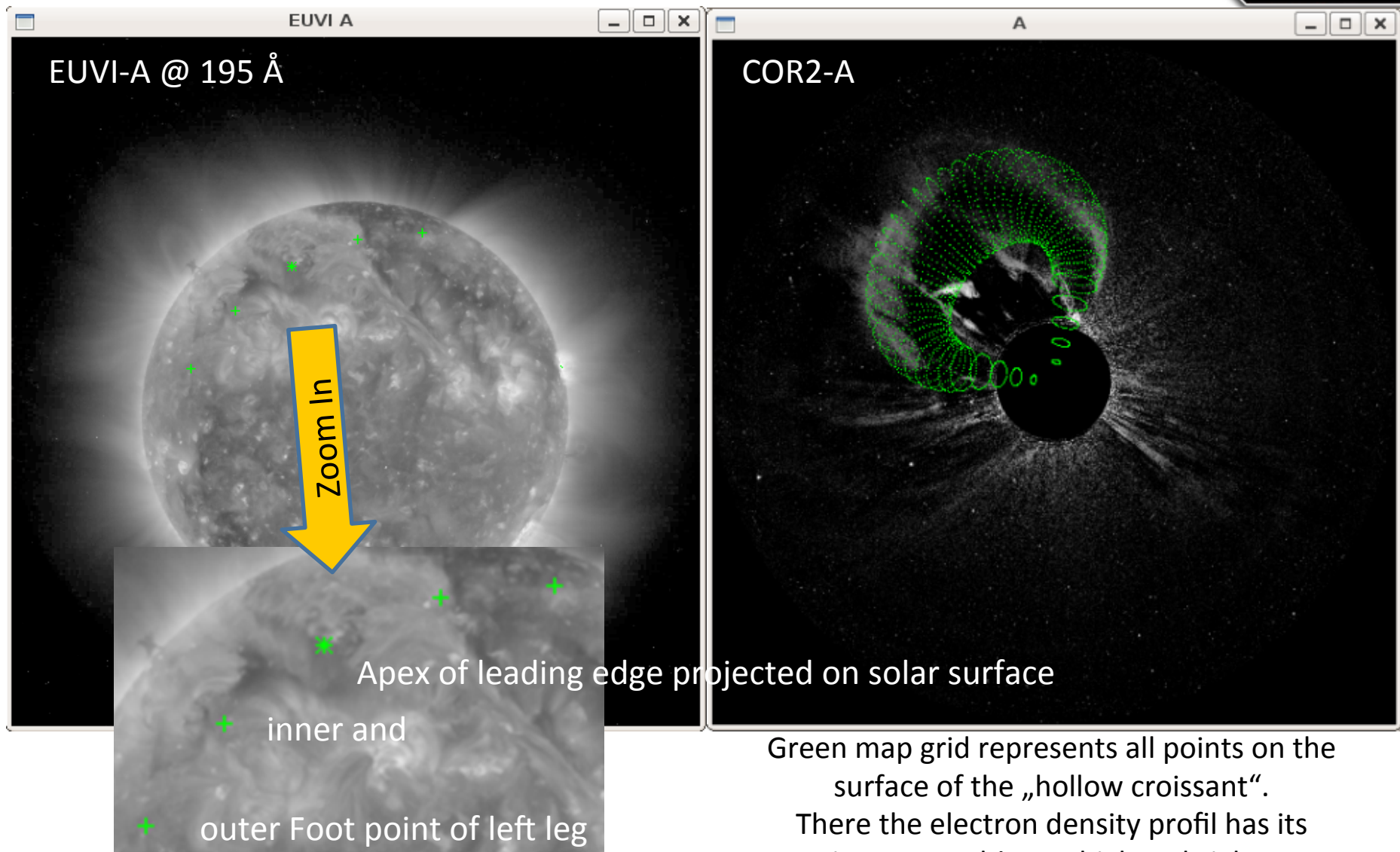
...



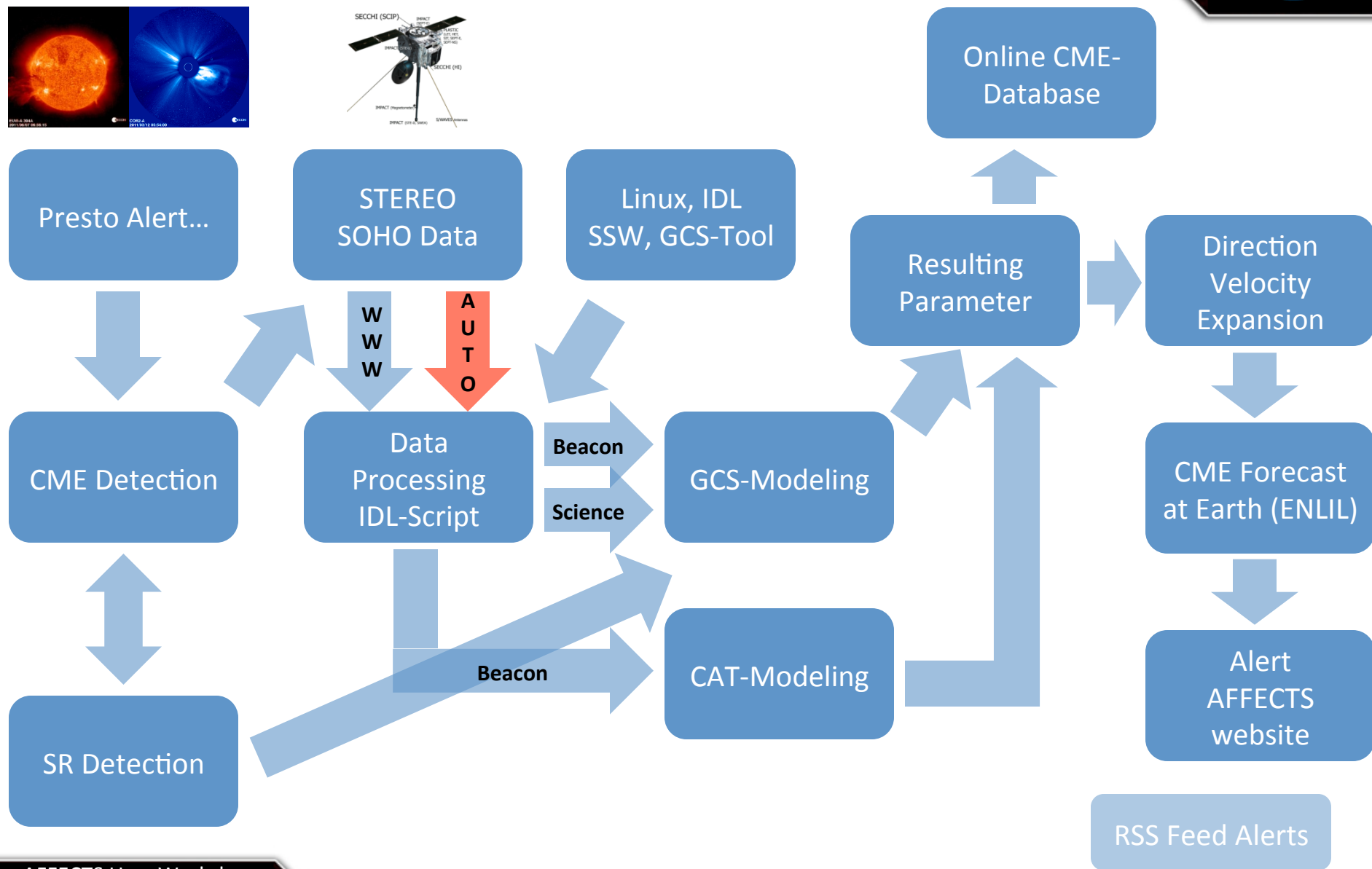
GCS-Parameter	Value
Carrington Lon. [deg]	177.8
Heliosph. Lat. [deg]	-17.3
Tilt Angle [deg]	8.4
Height [r_sun]	14.4
Aspect Ratio [--]	0.3
Half Angle [deg]	20.4



Footpoint line (in EUVI)



Summary



Demo at Workshop



- Live CME Fitting with GCS Modeling Technique for several CMEs with STEREO/SECCHI/COR2 Science and Beacon Data
- Workshop Poster
- Handout of Poster for your information

Acknowledgement



Thanks for your Attention!

Thanks for support to:

Volker Bothmer
Jonas Hesemann
Malte Venzmer

References and further information:

- IDL: www.exelisvis.com
- SSW: www.lmsal.com/solarsoft/ssw_install_howto.html
- NRL: http://sharp.nrl.navy.mil/cgi-bin/swdbi/secchi_flight/img_short/form
- GCS-Tutorial:
<http://secchi.nrl.navy.mil/synomaps/scraytrace/dobo/examples.html#tutrtsccloud>
- Thernisien, Vourlidas, Howard: **Forward Modeling of CMEs using STEREO/SECCHI Data**, *Solar Phys.* (2009), 256: 111-130

Synthetic Coronagraph Images



Based on the electron density distribution & the GCS-Model a synthetic Coronagraph image is generated with the Thomson Scattering Ray-Tracing Code developed by Thernisien et al.

