What happened at ESA's Meteor Research Group in 2010/11?

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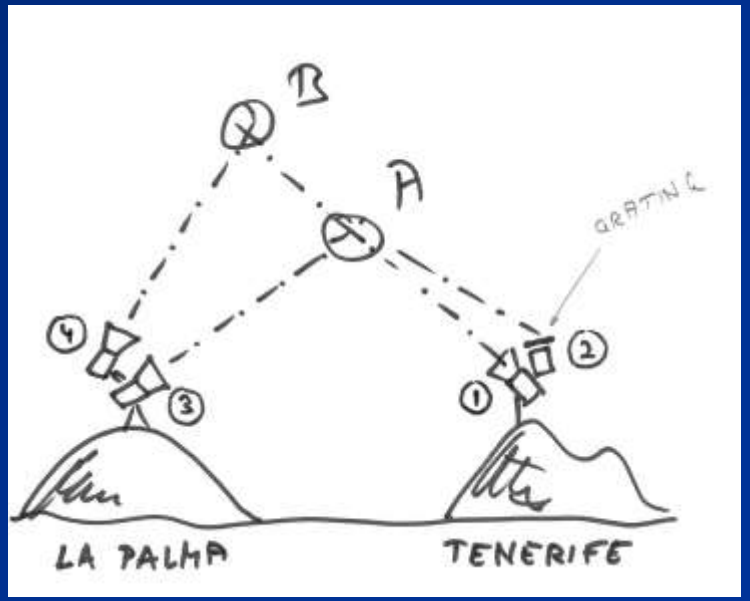
CILBO
Spectra
Flux
Meteoroid model
VMO
Theoretical work
Geminids 2010
The future

Presented at the IMC 2011, Sibiu, Romania

- CILBO = Double-station setup on the Canary islands
- Status:
  - First roll-off roof on Tenerife
  - But: Intensifiers kept breaking
  - Are being fixed by manufacturer
  - Weather report coming in every morning from Tenerife via email
  - Setup on La Palma still to be done

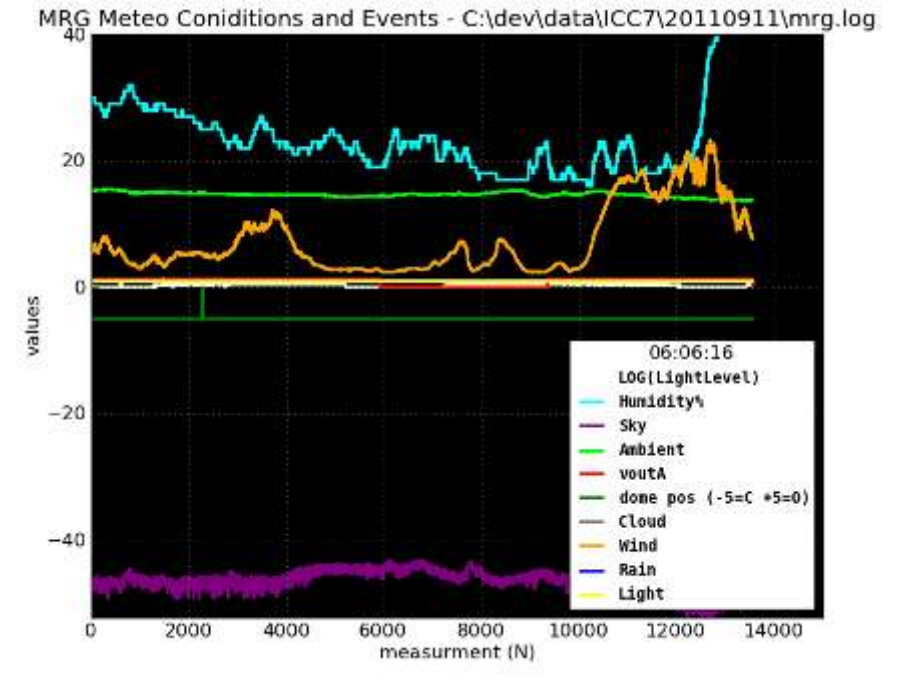
CILBO
CANARY ISLANDS LONG BASELINE OBSERVATORY




IAC
OBS
GONG

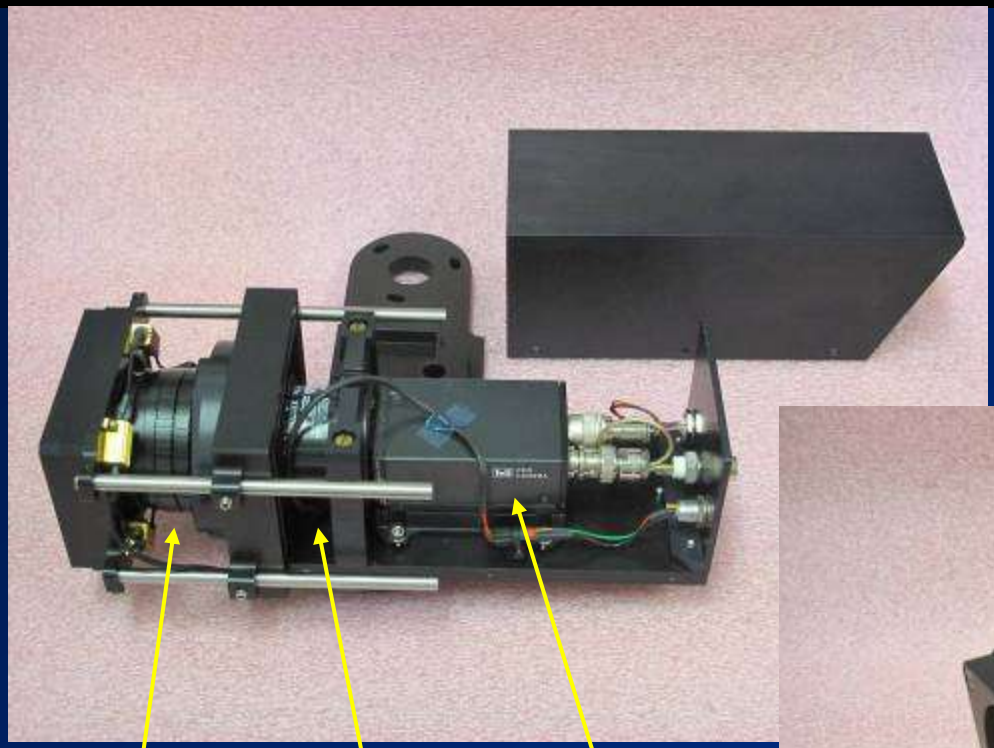
CILBO – Software work

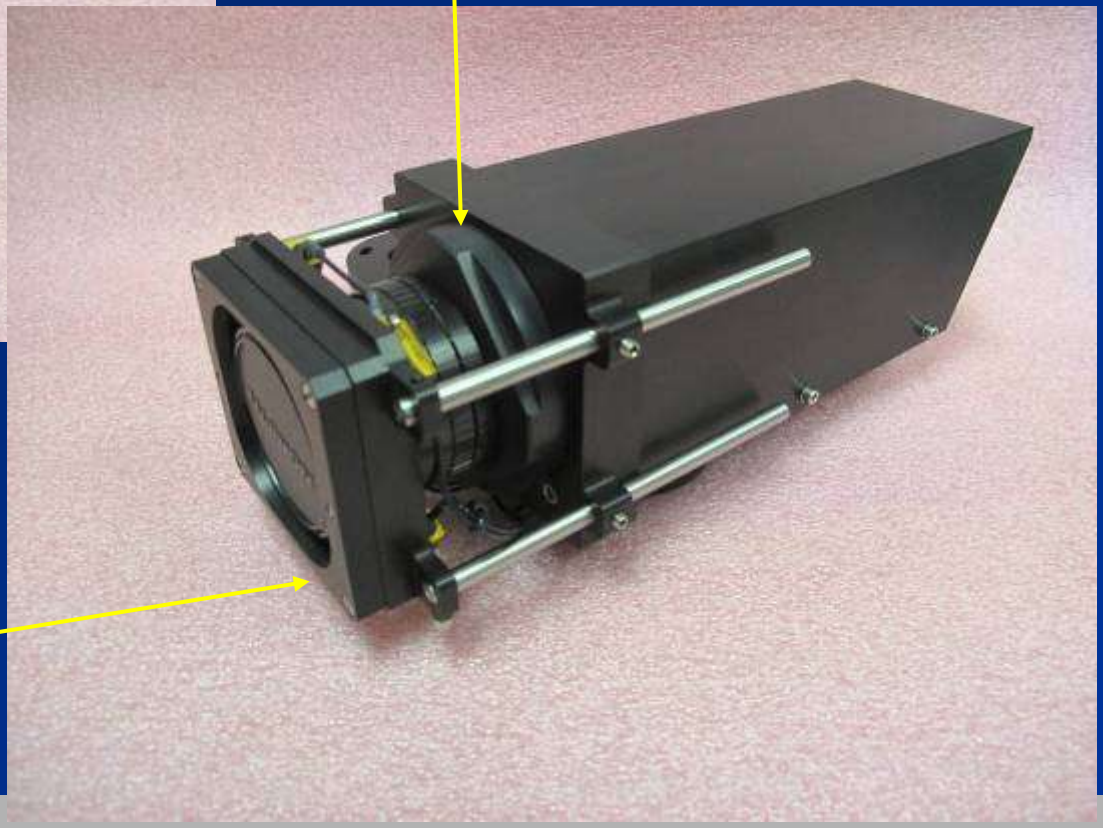
- Support to Sirko for MetRec on Windows
- Generation of an automation software to
  - Check weather data
  - Check sun elevation and lunar distance to the field of view
  - Open/close a motorized roof
  - Switch on/off camera and intensifiers
  - Send data to ftp server every morning
  - Send email with summary info and link to data every morning
- Remote login via logmein.com



```
Message: Successfully transferred data file
File: ftp://www.rssd.esa.int/pub/hsmit/mrg_data_20110911.tar.gz
Size: 7264800 bytes
Application: autoarchive v2.8 Aug  5 2011
Monitor Image: ftp://www.rssd.esa.int/pub/hsmit/mrg.png
Ephemeris: ftp://www.rssd.esa.int/pub/hsmit/fov.html
This email has been automatically generated. Please, do not respond.

Regards, SpcRec application

Archive contents
================
<snip>
====== end of contents ========

MRG Events
==========
2011-09-11 06:06:39.369          STAT: Recording from 2011-09-11T19:59:21 to 2011-09-12T06:06:10
2011-09-11 06:06:39.369          STAT: Moon  FOV from 2011-09-12T00:29:21 to 2011-09-12T03:00:21
2011-09-11 06:06:39.728          WARN: last ping time exceed 9000ms. Ping time dif = 53953ms.
2011-09-11 06:06:39.744          STAT: autocloud:on;
2011-09-11 06:26:22.759          STAT: light:on;
2011-09-11 19:41:22.446          STAT: light:off;
2011-09-11 19:59:23.008          STAT: observing:on;
2011-09-11 19:59:32.899          STAT: metrec:on;camera:on;intensifiers:on;
<snip>
2011-09-12 00:29:22.155          STAT: moon_fov:on;
2011-09-12 00:29:22.155          FAIL: Moon FOV warning. Turning off camera.
2011-09-12 00:29:24.889          STAT: camera:off;intensifiers:off;
2011-09-12 03:00:22.067          STAT: moon_fov:off;
2011-09-12 03:00:22.067          SAFE: Moon is leaving FOV. Turning on camera. Opening dome.
2011-09-12 03:00:36.692          STAT: autocloud:off;camera:on;intensifiers:on;auto_cloud_reset:triggered;
2011-09-12 03:00:44.942          WARN: dome fault. Initiating comm cycle
2011-09-12 03:00:45.099          ERROR: Unitronics interface first command empty!
2011-09-12 03:00:48.817          STAT: autocloud:on;
2011-09-12 06:00:04.730          STAT: metrec:off;
2011-09-12 06:06:11.667          STAT: observing:off;
2011-09-12 06:06:16.433          STAT: autocloud:off;camera:off;intensifiers:off;
====== end of events ========
```

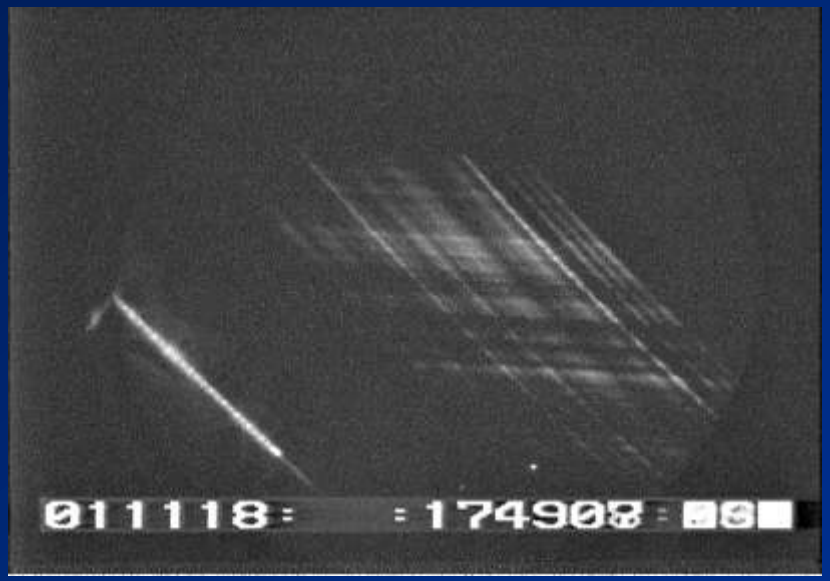
The camera

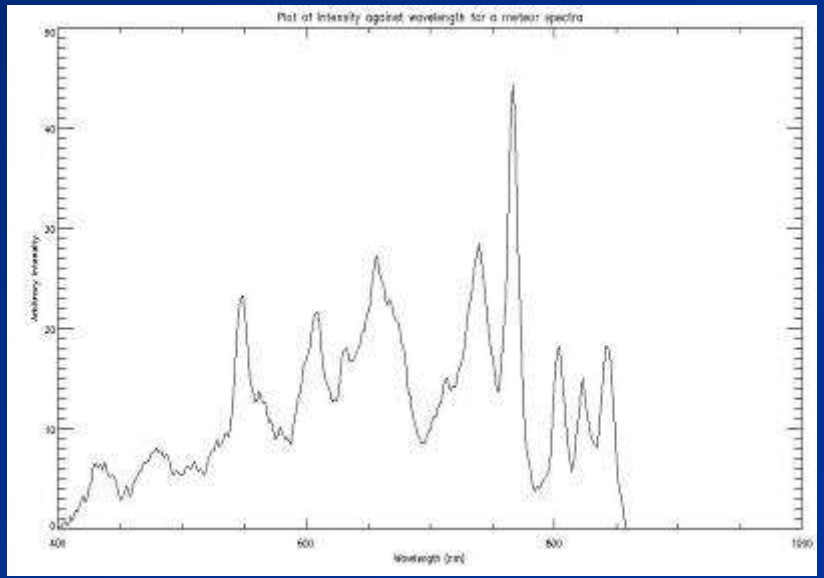

lens
Intensifier
Video camera


Adapter for different lenses
Holder for grating

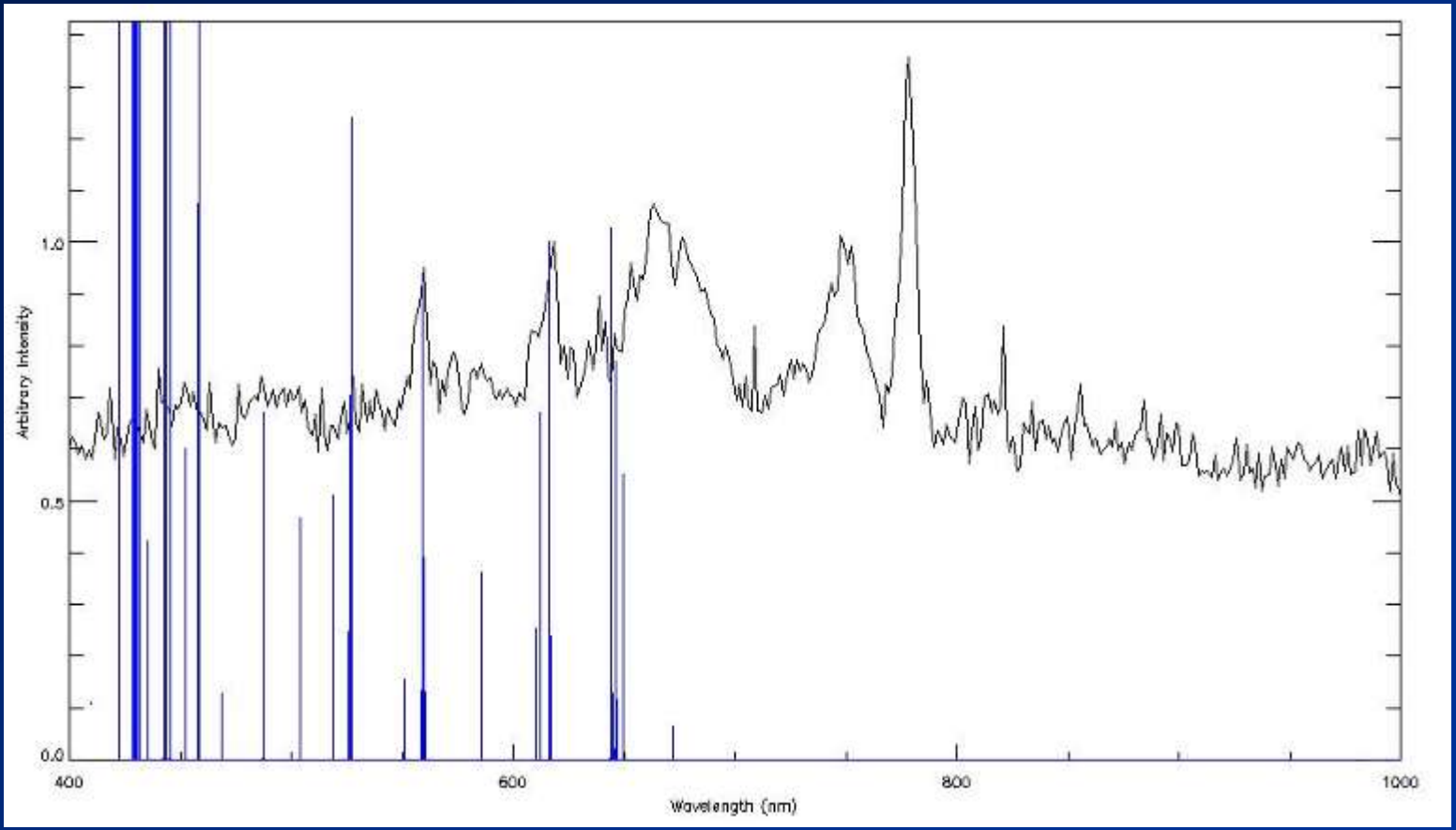
Spectra

- Two summer students helping us to understand analysis of spectra
- We use a software called PARADE to simulate spectra
  - Input chemical element(s), temperature
  - Output: simulated spectrum
  - Compare to existing spectra

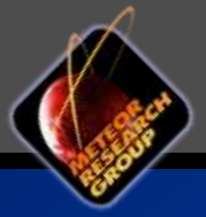




- A measured spectrum (spectrally calibrated), with simulated Ca-spectrum in blue



Current assessment



- PARADE was written for modelling the entry of spacecraft under ESA contract
- It's database does not yet contain relevant elements for meteor spectrum analysis
- It only runs on Unix
- Not user-friendly at all, needs a steep learning curve
- We'll continue working with it – but need more work to actually be able to use it properly
- Current spectral fits show two temperature regimes for the one analyzed meteor (~6000 K and ~10000 K)

Flux – see IMC 2010, Paco's work

- Paco Ocana's code presented at the IMC 2010 was validated
- Code reproduces both the Brown 1999 and the Bello-Rubio 2002 data
- Validation of MetRec flux determination to come

flux_v0r93.py - C:\Documents and Settings\Detlef Koschny\My Documents\Python_pro...

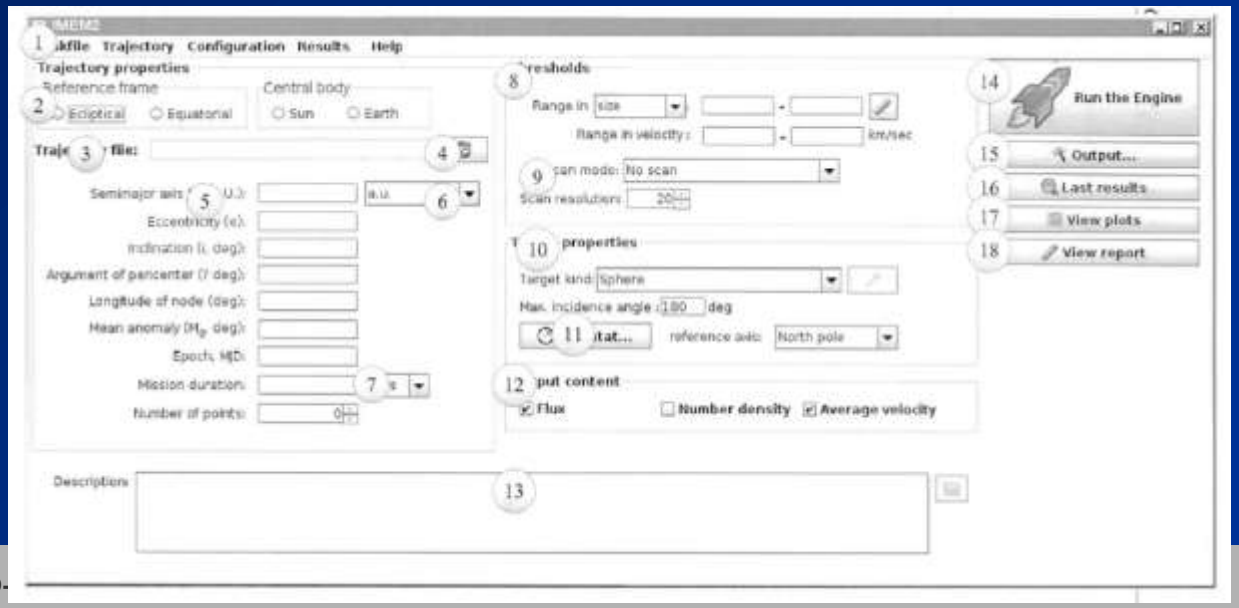
File Edit Format Run Options Windows Help

```
            beta = atan (tanb / cosh)
            cosbeta = cos (beta)
            h_altitude = abs (atan (tanh * cosbeta))    # could become negativ
            h_altitudedeg = degrees (h_altitude)

            # Now save the x, y, z positions in arrays
            xarr.append (x)
            yarr.append (y)
            zarr.append (z)
            harr.append (h_altitudedeg)

            cntr = cntr + 1
        #endfor k
    #endfor j

    # Now we compute the areas:
    cntr = 0
    cntrarea = 0

    # Python-specific: range (a, n) returns an array starting at a, with
    # n elements.
    for j in range (0, ns):
        # Only ns - 1 steps since there are only ns - 1 spaces between j <= n
        # rows
        #print "j = ", j
        for k in range (0, nw+1):
            if (cntr % (nw+1) != nw):    # Excludes the right-most points
                l1 = xarr [cntr] - xarr [cntr + 1]                # Top
                l2 = xarr [cntr + nw + 1] - xarr [cntr + nw + 2] # Bottom
                l3 = yarr [cntr] - yarr [cntr + nw + 1]           # Left
                l4 = yarr [cntr + 1] - yarr [cntr + nw + 2]       # Right

                areaj [0] = l1 * l3
                areaj [1] = l2 * l4
                areaj [2] = l1 * l4
                areaj [3] = l2 * l3

                areaavg = (areaj [0] + areaj [1] + areaj [2] + areaj [3])/4
                areai.append (areaavg)

                # Using the distance we compute a 'reduced' area taking the
                # extinction into account.
                # airmass comes from Pickering, K. A. 2002, The Southern Limi
                # of the Ancient Star Catalog, DIO 12:1, p. 22 (footnote).
```

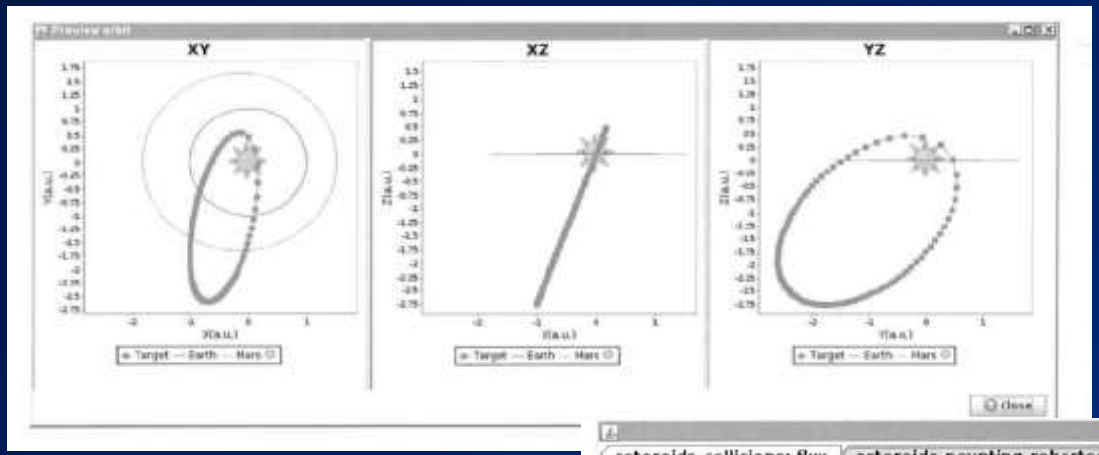
Ln: 1 Col: 0

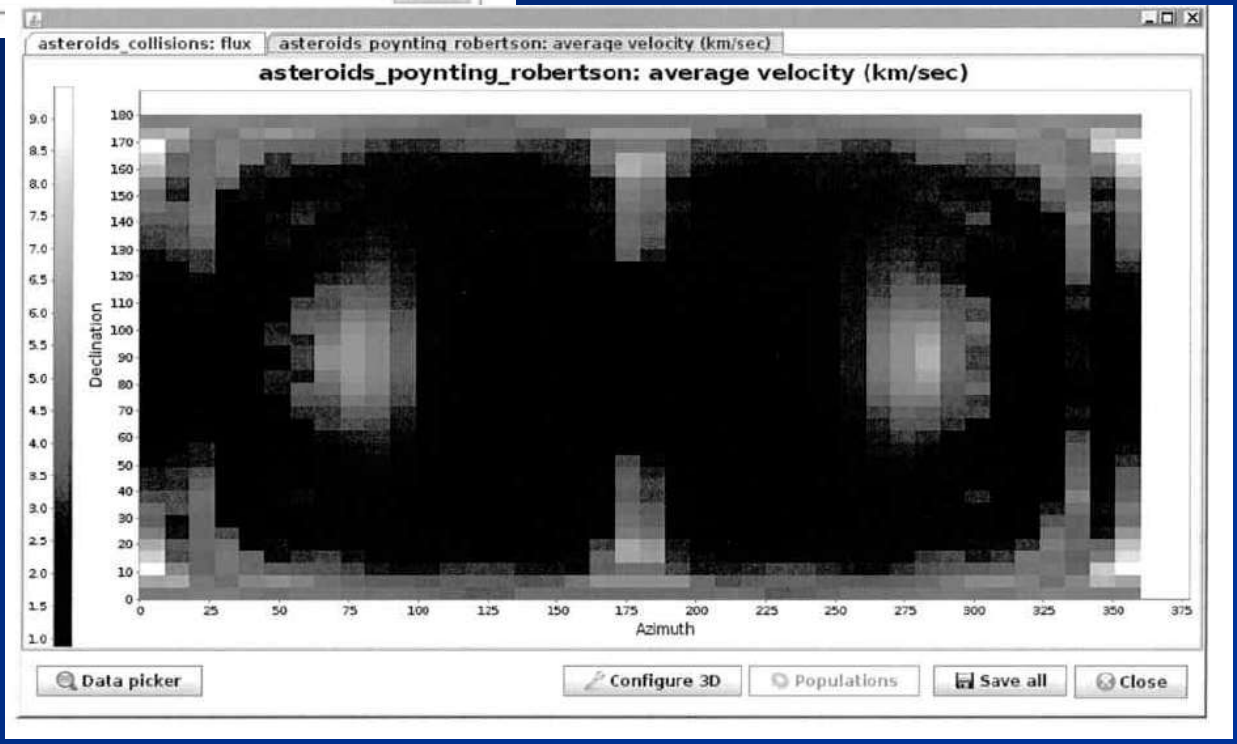
Meteoroid modelling

- Update of the ESA Interplanetary Meteoroid Engineering Model (IMEM) last year – more user-friendly!
- As announced last year (Drolshagen): Preparing for a new contract - Interplanetary Micrometeoroid Environment for (human) eXploration (IMEX)
- Incorporating optical data is planned
- Invitation to Tender before end 2011
- Another project coming up: Mitigation measures and impact effects



Some IMEM visualisations





Virtual Meteor Observatory

- Maintenance of the server
- Outcome of MOD WS #04:
  Start a “VMO developer” group to push further in making the VMO a functioning meteor data archive.

Theoretical work

- With M. Gritsevich (Moskau) + T. Kohout (Finland)
- Fitting dynamical model to deceleration data
- Trying to link with photometrical models to better constrain small objects
- See Icarus 212/2 (2011), 877-884

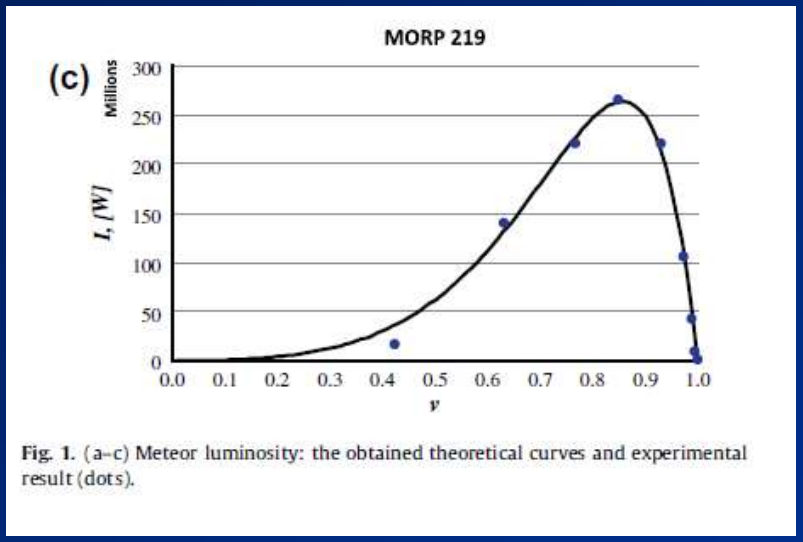


Fig. 1. (a–c) Meteor luminosity: the obtained theoretical curves and experimental result (dots).

$$I = -\tau \cdot \frac{d(MV^2/2)}{dt} = -\tau \cdot \left(\frac{V^2}{2}\frac{dM}{dt} + MV\frac{dV}{dt}\right)$$

$$= -\tau \cdot \left(M_e V_e \frac{\beta v^3}{1-\mu} + M_e V_e v\right) \exp\left(-\beta\frac{1-v^2}{1-\mu}\right)\frac{dV}{dt}$$

$$= \tau \cdot \frac{M_e V_e^3 \sin\gamma}{2h_0} v^3 \cdot (\overline{E}i(\beta) - \overline{E}i(\beta v^2)) \cdot \left(\frac{\beta v^2}{1-\mu} + 1\right)$$

$$\cdot \exp\left(\beta\frac{(\mu v^2 - 1)}{1-\mu}\right)$$

$$= \tau \cdot \frac{M_e V_e^3 \sin\gamma}{2h_0} f(v) \qquad (13)$$

where

$$f(v) = v^3 \cdot (\overline{E}i(\beta) - \overline{E}i(\beta v^2)) \cdot \left(\frac{\beta v^2}{1-\mu} + 1\right)$$

$$\cdot \exp\left(\beta\frac{(\mu v^2 - 1)}{1-\mu}\right) \qquad (14)$$

Geminids 2010

- Observing campaign parallel to a rocket launch campaign in Andoya, Norway
- Combining cameras with radar for flux measurement
- Optical meteor observations + radar head echo observations
- Observations compromised by aurorae

Image: A. Knofel


SPOSH_20101212
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2010-12-13T05:28:10
ESA/DLR-PF/University of Utrecht


SPOSH_20101212
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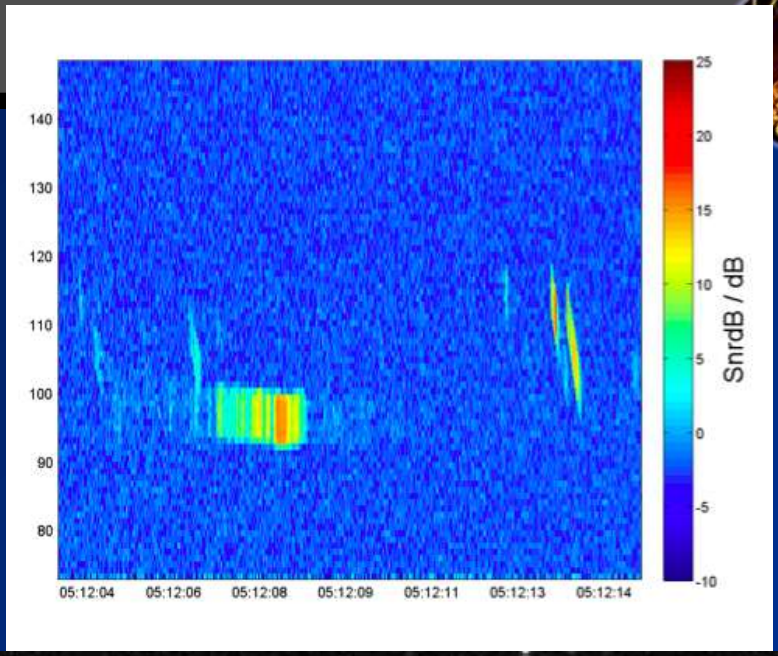
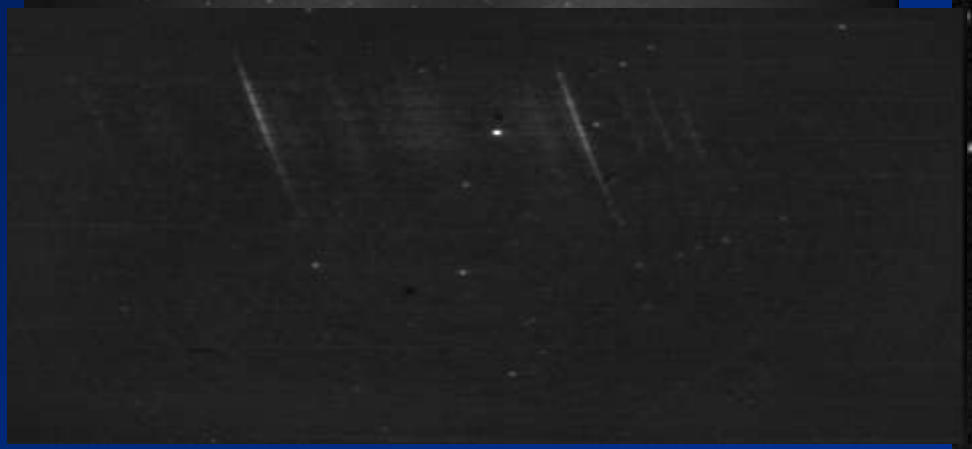
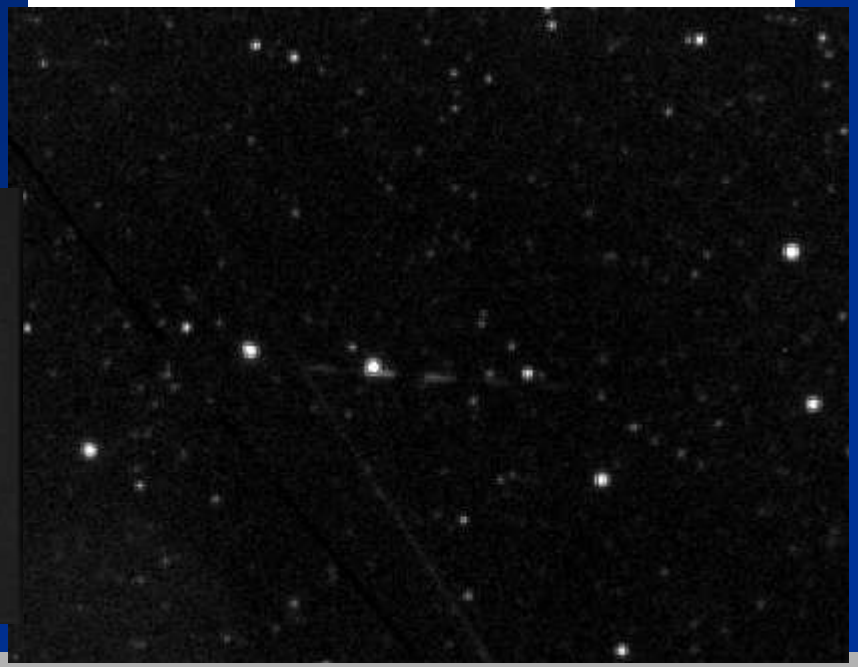
2010-12-13T00:54:33
ESA/DLR-PF/University of Utrecht
00:08:33

- Double-station meteor with head-echo and spectrum







The future

- Finish CILBO
- Get back to the VMO
- Participation in Draconid airplane campaigns