

# The Airborne Imaging Spectrometer APEX (Airborne Prism EXperiment)

*The APEX Team:* Klaus Itten, Michael Schaepman, Daniel Schläpfer, Johannes W. Kaiser, Jason Brazile (RSL)

Walter Debruyn, Koen Meuleman, IIs Reusen, Pieter Kempeneers, Bart Deronde (VITO)

Andreas Neukom, Hans Feusi, Peter Adolph, Renzo Moser, Thomas Schilliger (HTS)

Lieve De Vos, Guido Brandt (OIP)

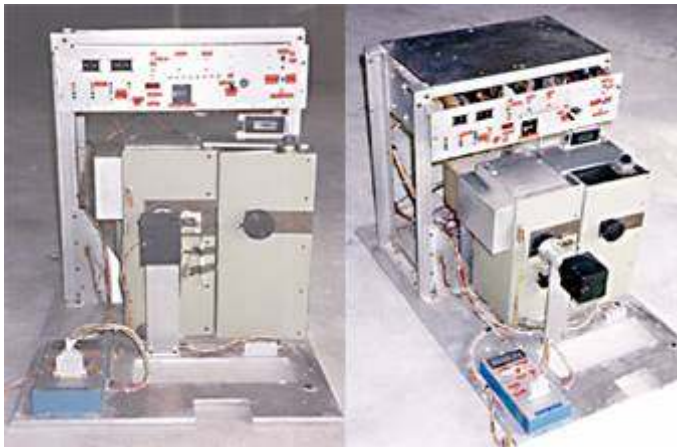
Peter Kohler, Markus Meng, Jens Piesbergen (Netcetera)  
Peter Strobl (DLR)

Jose Gavira, Gerd Ulbrich and Roland Meynart (ESA)



# Historical Development

- Airborne **Imaging Spectrometers** / Hyperspectral sensors
  - GER Mark II Airborne Infrared Spectroradiometer, **HYDICE**
  - Arizona Imager Spectrograph, MIVIS, **CASI, SASI, ROSIS**
  - NASA AIS-1, AIS-2 and **AVIRIS**; DAIS 7915, SFSI, **HyMap**
- Spaceborne **Imaging Spectrometers** / Hyperspectral sensors
  - **Warfighter/OrbView4, Hyperion/EO-1, COIS/ NEMO, CHRIS/PROBA**



## Scope of APEX

- APEX is an airborne instrument to support the development of ESA's future spaceborne imaging spectrometer missions → **testbed function**.

- APEX will be able to

- Simulate,
- Calibrate, and
- Validate

the planned and active European imaging spectrometer and hyperspectral missions (SPECTRA, MERIS, ...) → **logistic function**.

- APEX will foster the use of imaging spectrometer data in Europe and will support the application development of imaging spectroscopy products → **scientific function**.

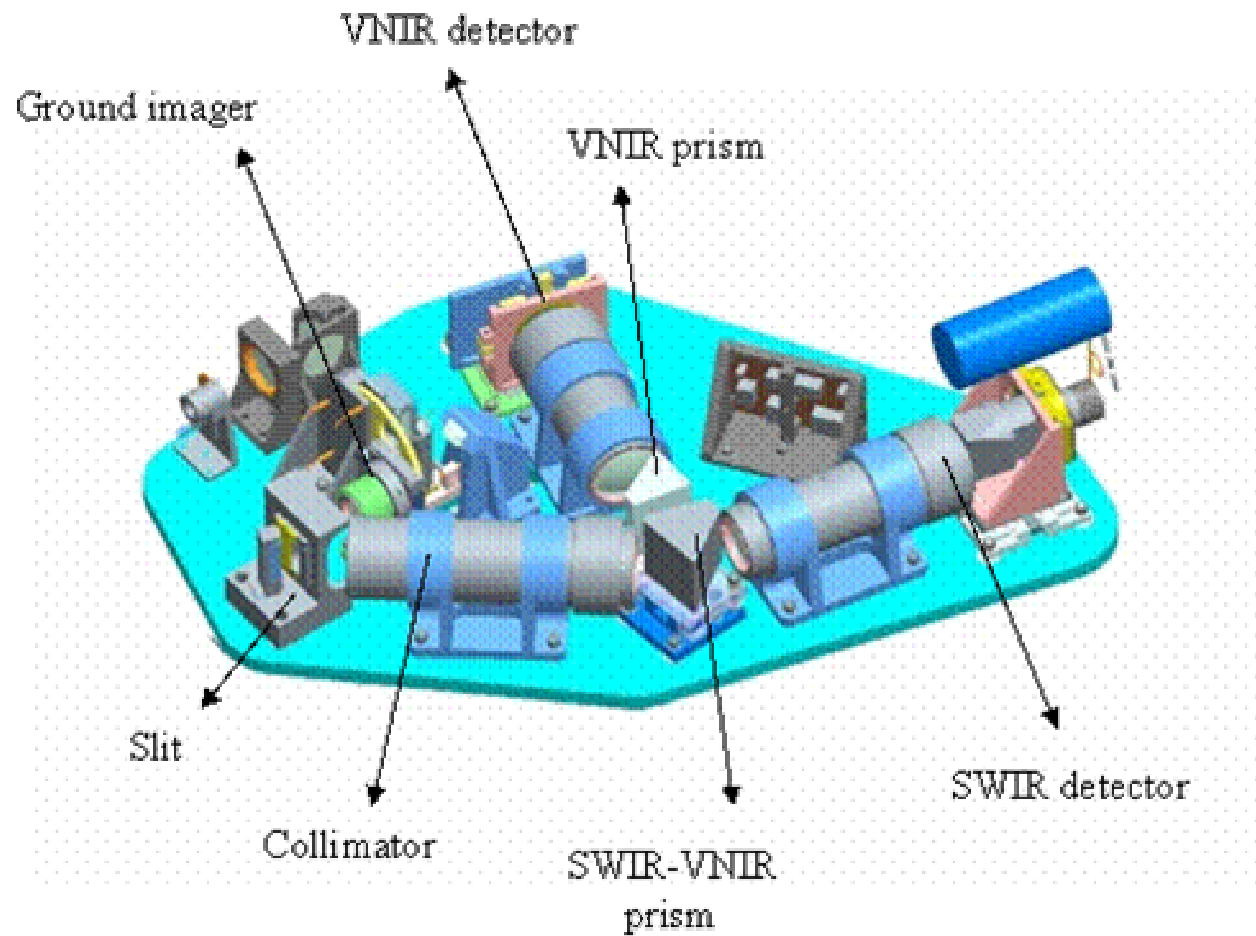


## APEX Selected Specifications

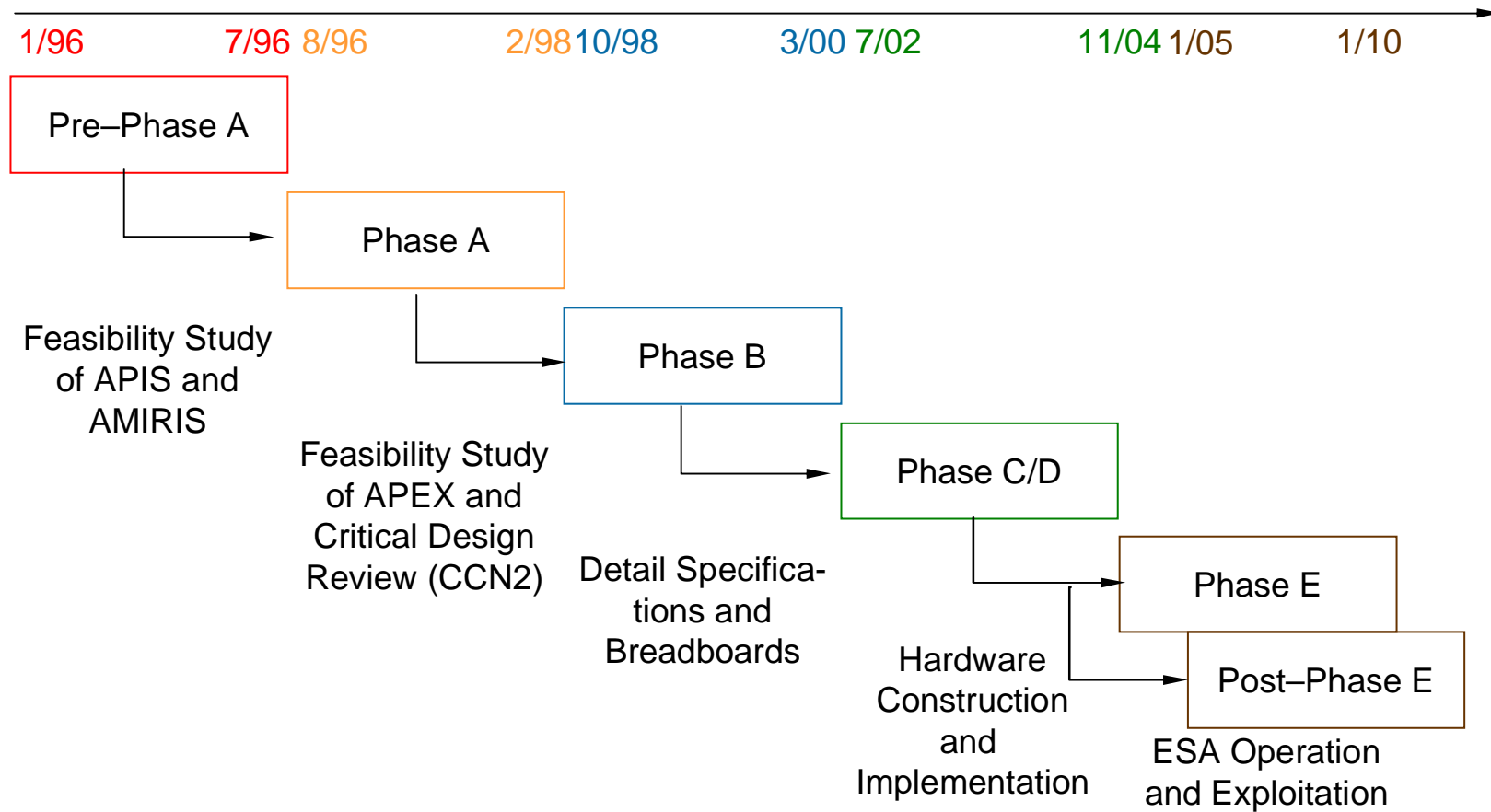
- Pushbroom design; total FOV 28° deg
- IFOV 0.49 mrad (spatial resolution across slit)
- Operating altitudes between 3-10 km a.s.l.; spatial resolution 2-5 m
  
- Total of across-track pixels  $\leq 1024$  for both detectors
  
- Spectral range 400-2500 nm
- Total spectral pixels on chip, prior to binning 312 (VNIR) + 195 (SWIR)
- Total spectral bands supported by the electronics  $\leq 300$ , resulting in a spectral sampling interval of  $\leq 5$  (10) nm in VNIR and  $\leq 10$  nm in SWIR
- Reprogrammable on-chip binning of spectral bands (using software upload)
  
- The system will be optimized for coregistration (and smile, frown), polarization (MERIS scrambler inheritance), stray light and ghost images.
















# APEX : Spectrometer Design



# APEX Timeline




# APEX Programmatics Phase C/D

|  <b>esa</b> Observing the Earth<br><small>European Space Agency</small> |   |   |  |
|--|---|---|--|
| ESA Team   | Science Team  | Operations Team   | Industrial Team  |
| <b>PRODEX</b><br>Technical Officer<br>José Gavira Izquierdo  | <b>Principal Investigator</b><br>Klaus Itten<br>  | <b>Co-Investigator</b><br>Walter Debruyn<br> | <b>Industrial Prime</b><br>HTS AG<br>          |
| <b>EO Instrument</b><br>Pre-Development Office<br>Instrument Manager<br>Gerd Ulbrich   | <b>Instrument Scientist</b><br>Michael Schaeppman   | <b>Instrument Operations</b><br>Koen Meuleman   | <b>Optical Subsystem</b><br>OIP Sensor Systems<br>  |
| <b>EO Instrument</b><br>Pre-Development Office<br>Detector Development<br>Roland Meynart   | <b>Processing Scientist</b><br>Daniel Schläpfer   | <b>Processing Operations</b><br>Pieter Kempeneers   | <b>Electronic Subsystem</b><br>Netcera AG<br>  |
| <b>ESA</b><br>Contracts Officer<br>Ulrich Sterzl   | <b>Calibration Scientist</b><br>Johannes Kaiser   | <b>Flight Operations</b><br>Bart Deronde  | <b>SWIR Detectors</b><br>Sofradir<br>      |
|  | <b>IT Scientist</b><br>Jason Brazile  |   | <b>Calibration Home Base</b><br>DLR<br>    |



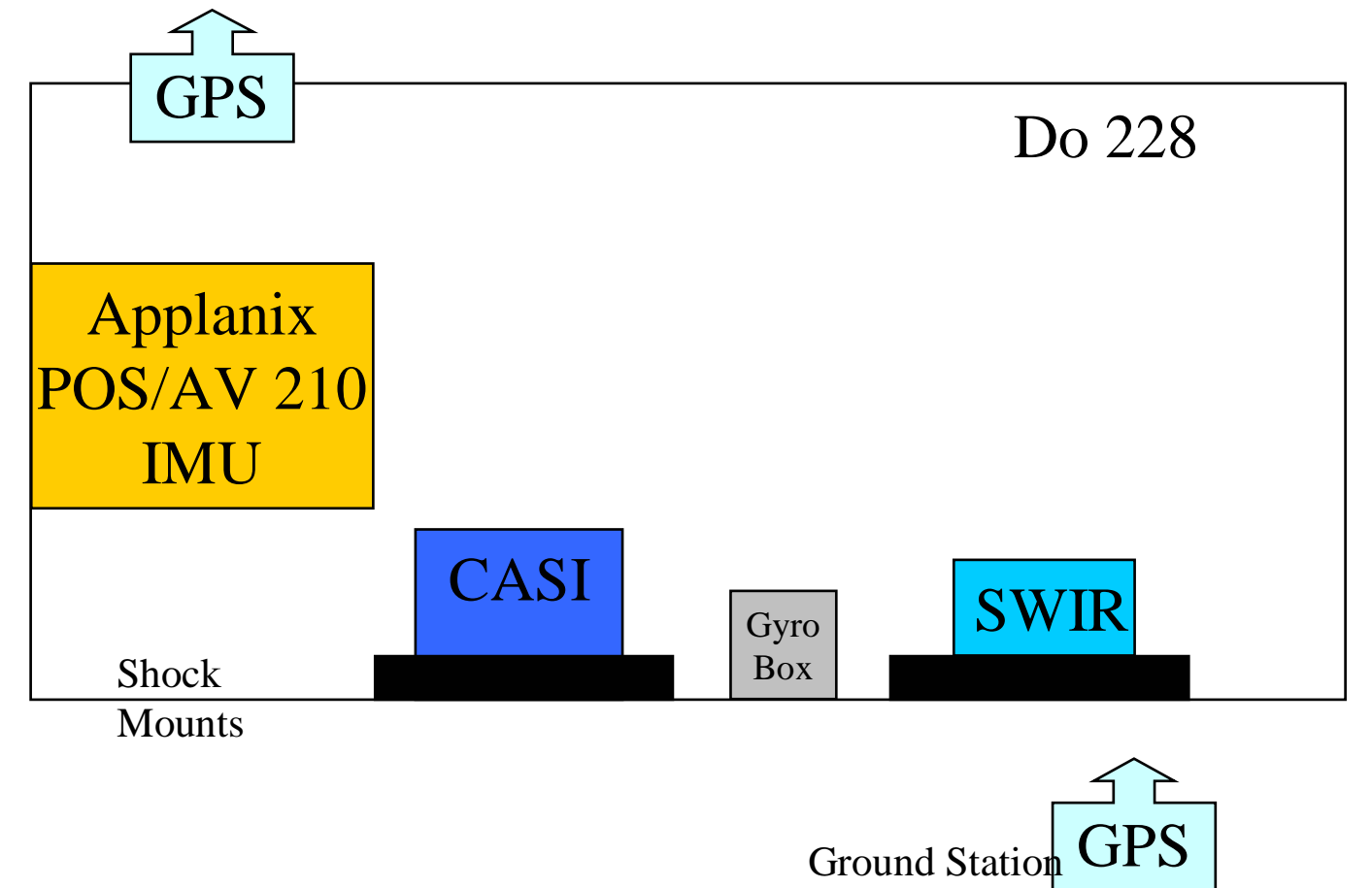
## Vito & Airborne IS deployments

- 1998 DAIS 7915-campaign
- 1999 *et sed* APEX conception and construction for 
- 2000 CASI campaigns (APEX vicarious calibration site)
- 2001 CASI campaigns (APEX vicarious calibration site)
- 2002 CASI-SASI campaigns to support Belgian Universities and Scientific User Groups
- 2003 CASI-TIR campaigns to support Belgian Universities and Scientific User Groups
- 2004 CASI-xyz (?) campaigns throughout abc (?)
- 2005 *et sed* APEX exploitation



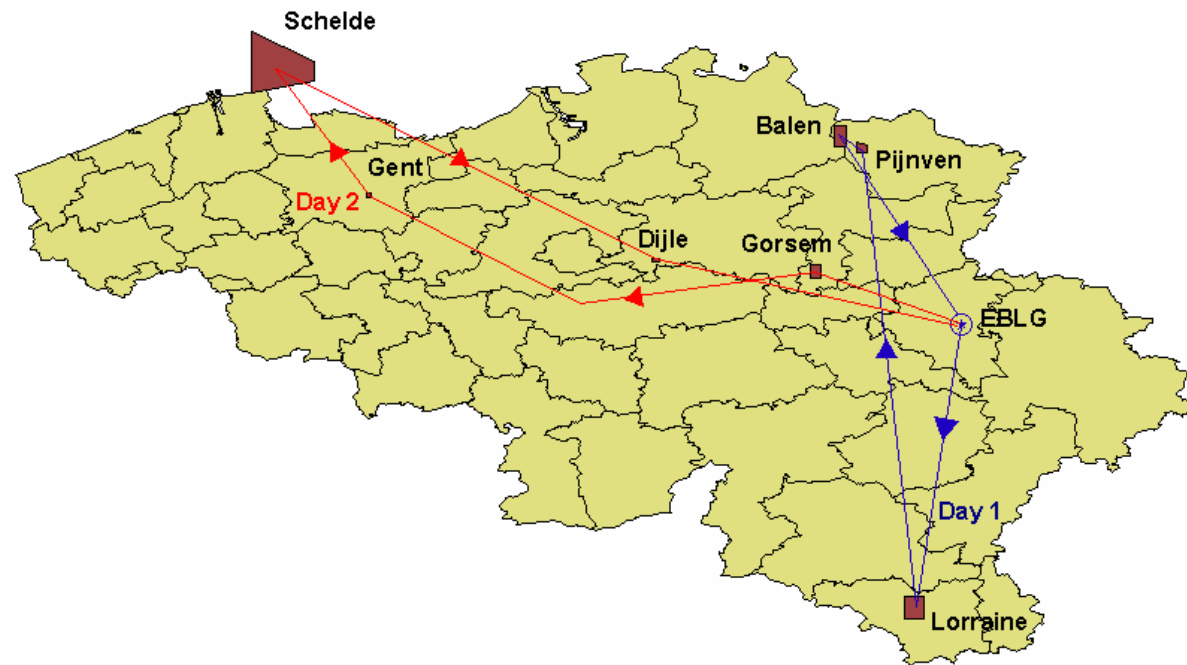


# Airborne Hardware 2002 Deployment



# CASI/SWIR Campaign 2002

Flight plan of the CASI-SWIR 2002 campaign  
(day 1 = sept 12, day 2 = sept 13)



# CASI/SWIR Campaign 2002

## Belgian Site details

CS1 / Balen (*Heavy metals stress in plants*)  
dr Piet Seuntjens

CS2 / Lorraine (*Soil surface organic matter estimation / Grassland canopy characterisation*)  
prof Bernard Tychon / prof Robert Oger

CS4 / Gent (*Spatial information extraction, Urban areas*)  
prof Rudi Goossens

CS5 / Dijle (*Moisture gradients*)  
prof Okke Batelaan

CS7 / Pijnven (*Plant vitality*) / Gorseme (*Plant stress in horticulture*)  
prof Pol Coppin

CS8 / Schelde (*Coastal biogeochemistry*)  
prof Marc Acheroy



# CASI/SWIR Campaign 2002

## Data delivery

- 12 February 2003 : radiometrically & geometrically corrected CASI data sent to all User Groups
- 14 March 2003 : fully corrected CASI data sent to all User Groups
- 27 May 2003 : fully corrected SASI data sent to the Users (except SE data)
- 7 June 2003 : fully corrected SASI data sent to the Schelde team



## Aim of this CASI/SWIR Workshop

- Give feed-back to campaign organizers (OSTC and Vito)
- Stimulate interaction between UK/B User Groups
- Discuss / interchange experiences & results
- Exchange data cubes
- Form alliances for future campaigns, calls for proposal, ...

News on CASI/TIR 2003 Campaign

