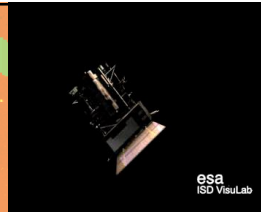


# Space Instrumentation



Lectures for the IMPRS 23. 6. to 27.6. 2003 at MP Ae Lindau  
presented/ compiled/ organized by Rainer Schwenn, MP Ae,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Pardowitz, Richter, Schühle

- Mon, 23.6. 14:00 Introduction into the techniques of space research (RS)  
15:00 An illustration: the „Ozonometer“. From the idea to the publication of results (RS)  
16:00 Plasma detectors. Electrostatic analyzers: Helios, Giotto IMS, TAUS (RS)
- Tue, 24.6. 14:00 Seminar extern. Dr. Jon Rotvig: *Dynamos and convection: mean flow generation*  
15:00 Modern particle analyzers in planetary research: TOF, ENA (RS)  
16:00 Energetic particles. Detection of interstellar gas (RS)
- Wed, 25.6. 14:00 Measuring magnetic fields in space (Richter, TU Bs)  
15:00 Radioastronomy from space (RS)  
16:00 Optical instruments, an overview (RS)
- Thu, 26.6. 14:00 Solar EUV spectroscopes (Curdt)  
15:00 Imaging detectors in various spectral regimes (Pardowitz, Gandorfer, Schühle)  
16:00 Planetary and cometary exploration: cameras, landers (Hoekzema)
- Fri, 27.6. 14:00 In-situ instrumentation for planetary surface exploration (Hilchenbach)  
15:00 How to do experimental research in space (RS).

IMPRS June 2003



# Space Research?

„Space“: the region outside the bound of the Earth's atmosphere and gravity

There are several kinds of space activities:

1. Exploration **of** space: astronomy, astrophysics, cosmology have always been done from the ground, now also from space.
2. Exploration **from** space („extraterrestrial research“)
  - a) The Earth from above: geodesy, geophysics, meteorology, environmental research, top-side-sounding of the atmosphere etc.,
  - b) astronomy in IR, UV, X-rays, gamma-rays, neutrons.
  - c) in-situ exploration of the Earth's uppermost atmosphere, magnetosphere, the interplanetary medium, cosmic rays, interstellar gas,
3. Exploration **in** space (astronautics)
  - a) visit of man in near-Earth space, at the moon, at other bodies...,
  - b) studies of biological and biomedical problems at zero-g,
  - c) material research at zero-g,
  - d) space tourism.
4. Exploration **for** space applications:  
commercial satellites, TV, Galileo, military, etc.
5. Political show-business...

IMPRS June 2003



# Space Research!

Space missions are usually (1)

## Precious:

- they offer discoveries of new frontiers,
- they have an outstanding visibility to the public,
- data are often spectacular,
- data are often unique.

## Risky:

- some missions are lost too early, (some even BEFORE launch!)
- instruments can fail, there are no possibilities for repair,

## Expensive:

- in order to minimize risk, everything has to be designed more carefully than usual,
- proper tests have to be conducted,
- the agencies require considerable management efforts,
- safety aspects are major cost drivers, especially for manned missions,

## Rare:

- because of the cost, they are carefully selected and often delayed,
- other disciplines are in competition.



IMPRS June 2003



# Space Research!

Space missions are usually (2)

## Long-term efforts, because of

- long approval procedures, Helios: 1965 to 1969
- long development phases, 1966 to 1976
- long mission durations, 1974 to 1986
- long travel times to their research goals n.a.
- Long scientific evaluation and re-evaluation 1974 to 2003...

## Ambitious:

- They are conquering new frontiers with unknown environment,
- They require most advanced high-tech developments,

## Extremely conservative:

- No avoidable risk must be taken,
- Only space-proven techniques may be applied,
- In most cases, the PISs are experienced and, thus, old...



IMPRS June 2003



# Space Research!

Basic rules for developing instruments and missions:

**No mass,  
No power,  
No cost.**

Further advice for potential space researchers:

- be young, and live long,
- be experienced,
- select your CoIs carefully,
- build up a good team of scientific and technical coworkers at home,
- have creative ideas,
- stop having creative ideas in time,
- have an demo-instrument ready in time,
- develop good contact to your bosses, space agencies and funding agencies,
- be communicative,
- be patient and stress-resistant...
- do not forget to keep up-to-date in science!

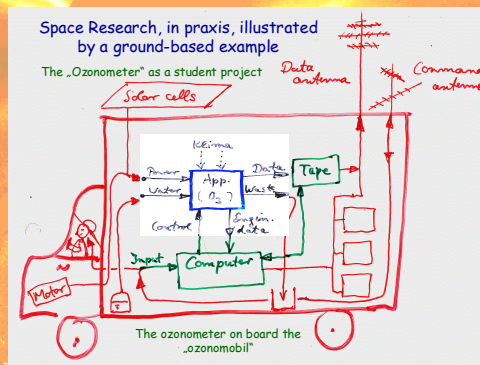


IMPRS June 2003

## Space Instrumentation (2)

Lectures for the IMPRS June 23 to June 27 at MPAe Lindau  
Compiled/organized by Rainer Schwenn, MPAe,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Mon, 23.6. 15:00 An illustration: the „Ozonometer“. From the idea to the publication of results (R5)

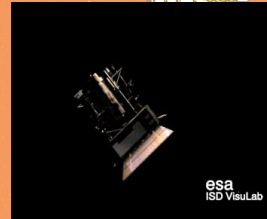
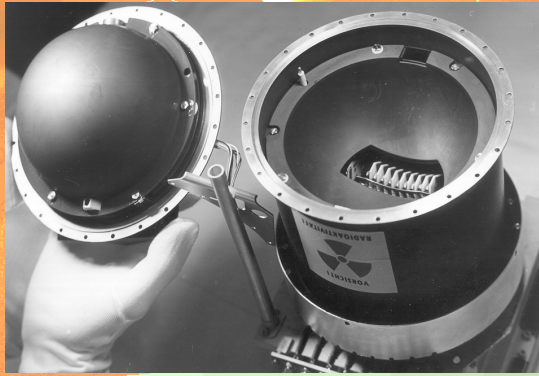


IMPRS June 2003

## Space Instrumentation (3)

Lectures for the IMPRS June 23 to June 27 at MPAe Lindau  
Compiled/organized by Rainer Schwenn, MPAe,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Mon, 23.6., 16:00 Plasma detectors. Electrostatic analyzers: From particle counting to moments of distribution function. Helios, Giotto IMS, TAUS (RS)



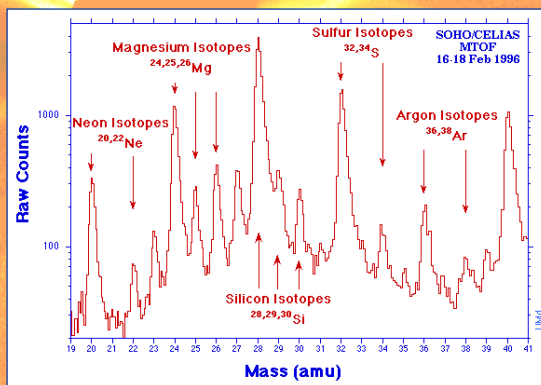
IMPRS June 2003



## Space Instrumentation (4)

Lectures for the IMPRS June 23 to June 27 at MPAe Lindau  
Compiled/organized by Rainer Schwenn, MPAe,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Tue, 24.6., 15:00 Modern particle analyzers in planetary research: TOF, ENA (RS)



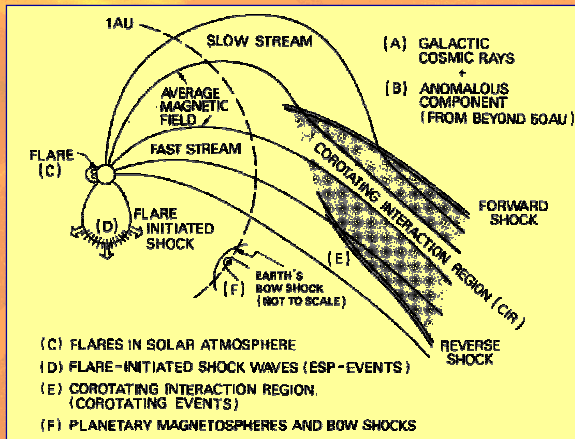
IMPRS June 2003



## Space Instrumentation (5)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
Compiled/organized by Rainer Schwenn, MP Ae,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Tue, 24.6., 16:00 Energetic particles. Detection of interstellar gas. (RS)



IMPRS June 2003



## Space Instrumentation (6)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
Compiled/organized by Rainer Schwenn, MP Ae,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Wed, 25.6., 14:00 Measuring magnetic fields in space (Richter, TU Bs)



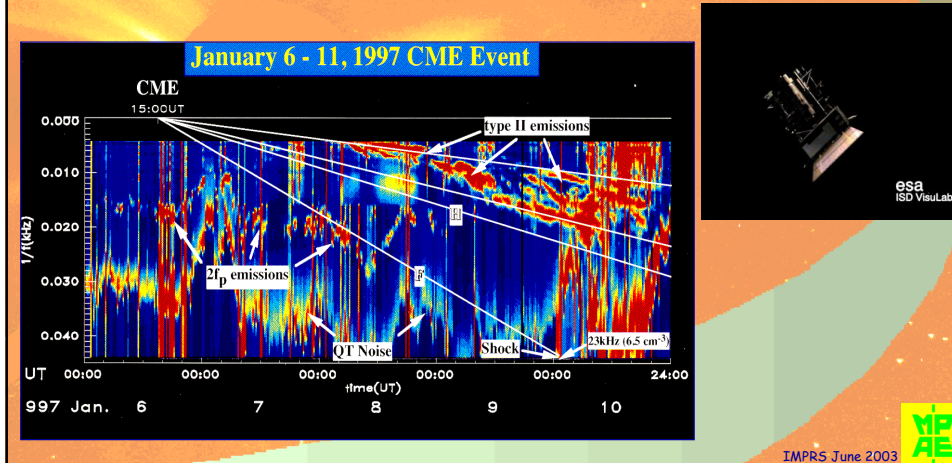
IMPRS June 2003



## Space Instrumentation (7)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
 Compiled/organized by Rainer Schwenn, MP Ae,  
 supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Wed, 25.6., 15:00 Radioastronomy from space (RS)



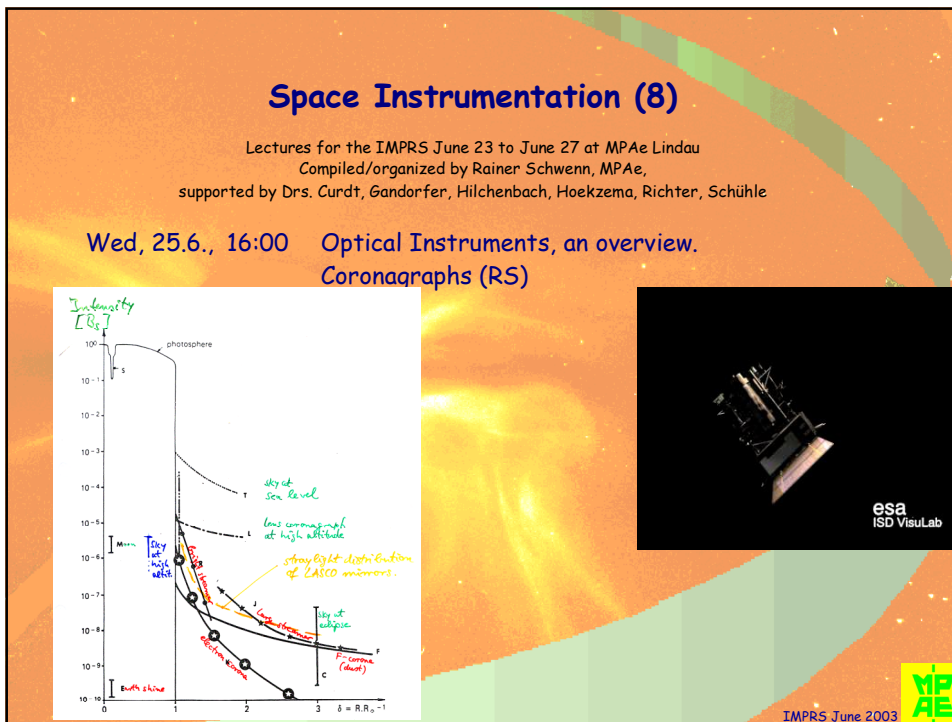
IMPRS June 2003



## Space Instrumentation (8)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
 Compiled/organized by Rainer Schwenn, MP Ae,  
 supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Wed, 25.6., 16:00 Optical Instruments, an overview.  
 Coronaagraphs (RS)



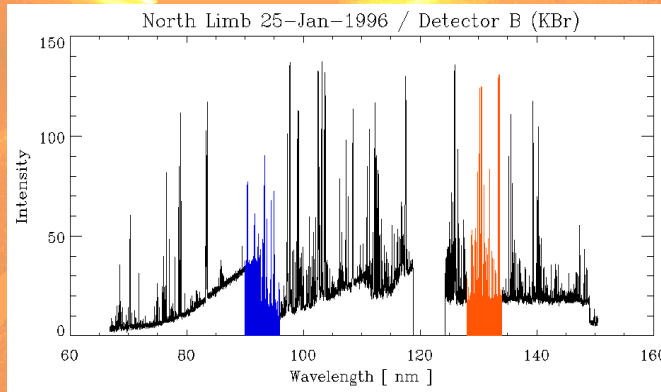
IMPRS June 2003



## Space Instrumentation (9)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
Compiled/organized by Rainer Schwenn, MP Ae,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Thu, 26.6., 14:00 Solar EUV spectroscopy (Curdt)



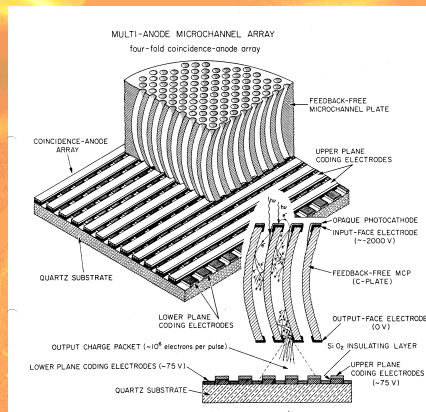
IMPRS June 2003



## Space Instrumentation (10)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
Compiled/organized by Rainer Schwenn, MP Ae,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Thu, 26.6., 15:00 Imaging detectors in various spectral regimes (Pardowitz, Gandorfer, Schühle)



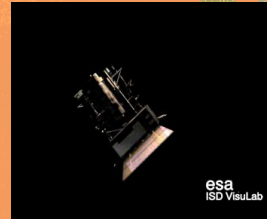
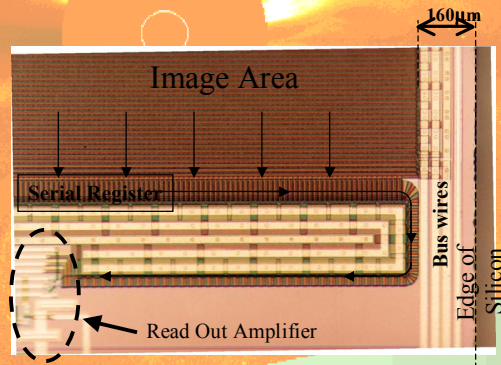
IMPRS June 2003



## Space Instrumentation (10a)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
 Compiled/organized by Rainer Schwenn, MP Ae,  
 supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Thu, 26.6., 15:00 CCD and APS principles (Pardowitz)



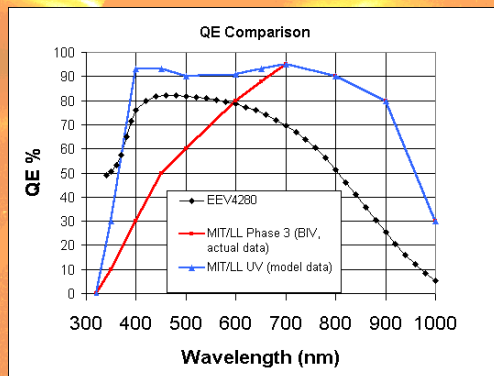
IMPRS June 2003



## Space Instrumentation (10b)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
 Compiled/organized by Rainer Schwenn, MP Ae,  
 supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Thu, 26.6., 15:20 Spectral properties of array sensors  
 (Gandorfer)



IMPRS June 2003

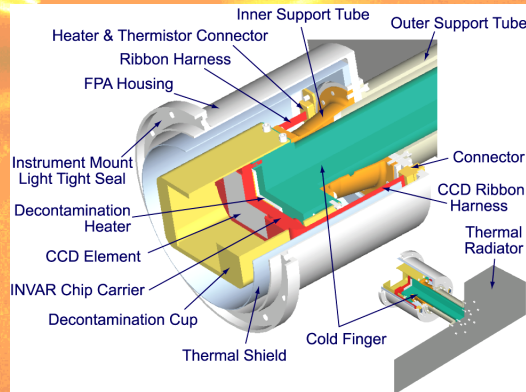




## Space Instrumentation (10c)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
Compiled/organized by Rainer Schwenn, MP Ae,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Thu, 26.6., 15:40 UV detectors fore solar observations (Schühle)



IMPRS June 2003



## Space Instrumentation (11)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
Compiled/organized by Rainer Schwenn, MP Ae,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Thu, 26.6. 16:00 Planetary and cometary exploration: cameras, landers (Hoekzema)

ESA  
ISD VisuLab

## Space Instrumentation (12)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
Compiled/organized by Rainer Schwenn, MP Ae,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Fri, 27.6., 14:00 In-situ instrumentation for planetary surface exploration (Hilchenbach)



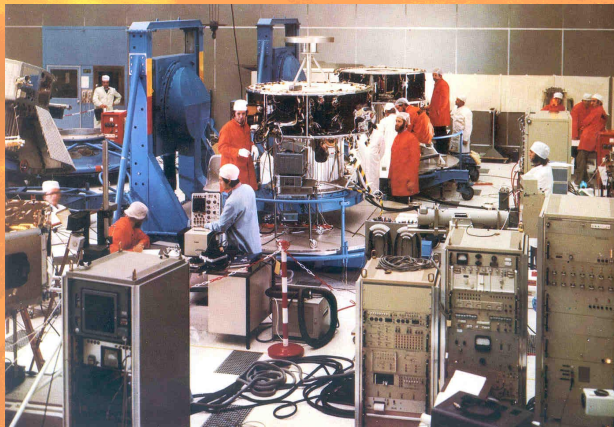
IMPRS June 2003



## Space Instrumentation (13)

Lectures for the IMPRS June 23 to June 27 at MP Ae Lindau  
Compiled/organized by Rainer Schwenn, MP Ae,  
supported by Drs. Curdt, Gandorfer, Hilchenbach, Hoekzema, Richter, Schühle

Fri, 27.6., 15:00 How to do experimental research in space (RS)



IMPRS June 2003

