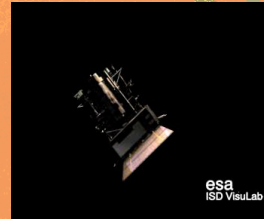
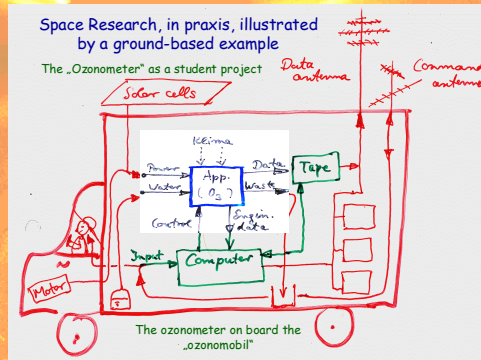


## Space Instrumentation (2)

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

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

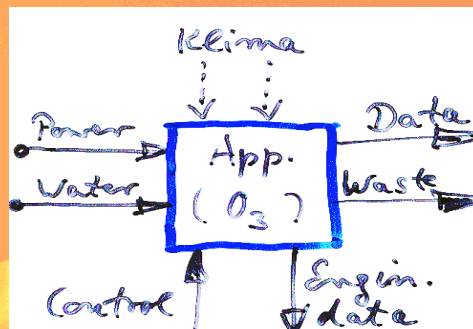


IMPRS June 2003



## Space Research, in praxis, illustrated by a ground-based example

The „Ozonometer“ as a student project



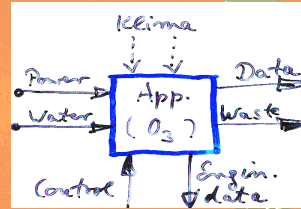
IMPRS June 2003



## The heart of the Ozonometer is the proper measuring device („instrument“)

The instrument needs supplies from the laboratory:

- electrical power,
- cooling water,
- control by the experimenter,
- clock pulses,
- air condition.



The instrument returns to the laboratory:

- measured scientific data,
- engineering data,
- waste,

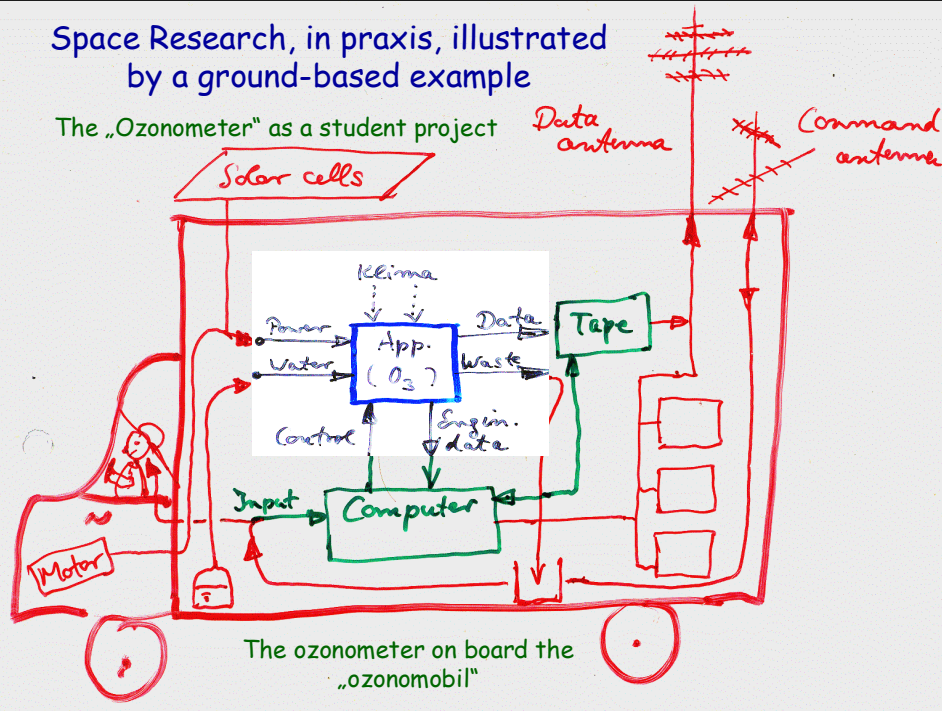
In space research, the terms „experiment“ and „instrument“ are often confused. Note the difference, though: an **instrument** is a measurement device, usually a piece of hardware. It is built by a clever scientist to allow him to perform **experiments**.

IMPRS June 2003



## Space Research, in praxis, illustrated by a ground-based example

The „Ozonometer“ as a student project



## The student now plans to move his instrument through town, on a mobile platform, the „Ozonomobile“

The ozonobile has to perform the same services as the laboratory had done before. That requires several provisions:

- An engine for driving plus sufficient fuel,
- a dynamo (or solar cells) for generating electric power,
- a data storage for saving scientific and engineering data,
- a command antenna for receiving instructions on where to go and what to do,
- a data antenna for transmitting data to the experimenter,
- a dump for collecting waste.

The ozonobile can carry other instruments sharing the same resources, provided they do not interfere with each other.

In order to survive rides on bad streets, the instruments have to be built with a certain robustness.

The mission is expensive. Thus, risk has to be minimized by proper testing.

IMPRS June 2003



## Experiments in space: from ideas to scientific results. 1.

- An idea is created in a researcher's brain, leading to calculations, discussions.
- Functional models of instrument are designed, built and tested in laboratory.
- Development phase. Testing of critical items.
- Interface definitions.  
Detailed design. Electrical layouts.
- Build SM and EM, deliver to agency.

*Institute gets interested.*

*Search for PI, CoIs,  
proposal written,  
application for funding.*

*Proposal accepted by agency,  
find funding, find contractors.*

*Preliminary design review (PDR).*

*Mechanical SM tests and  
EM system tests.  
Critical design review (CDR).*

IMPRS June 2003



## Experiments in space: from ideas to scientific results. 2.

- Build prototype (PM).
- Instrument performance tests.
- Qualification tests with enhanced levels.

*Final design review (FDR).*

- Build flight units (FM and FS).
- Acceptance tests.
- Final calibrations.

*Delivery to agency.*

- Integration into S/C, adjustments, fits, connections
- Electrical system tests: functional, EMC, software.
- Environmental tests: vibration, TV, solar simulation...
- Transport to launch pad.
- Final tests.

*Flight readiness review (FRR).*

- Preparations for launch.
- Launch.
- Launchparty...

IMPRS June 2003



## Experiments in space: from ideas to scientific results. 3.

### Mission operation phase

- Commissioning:
  - switch on of all subsystems,
  - EMC tests,
  - calibrations,
  - software patches and uploads etc.,
  - data distribution to PIs, networks, Internet.
- Routine operations:
  - daily /weekly/monthly planning,
  - preparing of joint operation programs (JOPS),
  - observatory mode, guest investigator programs.
- Distribution of NRT data to PIs at mission control center.
- Data distribution of NRT and final data to CoIs (CD, Internet).
- Data archiving on tapes, CD, DVD.
- Routine processing to Level 2 (calibrated).
- Scientific evaluations.
- Thinking, discussing, writing, presenting...

**New ideas in researchers' brains...**

IMPRS June 2003

