

The Jungfraujoch suntracker camera



Goal and Requirements

The camera must provide a real-time picture of the sky around the sun.

- Albeit we are interested in the “cleanliness” of the solar disk, it is difficult and not desirable to detect clouds only in front of the sun.
- It is more useful to know the status of the sky around it in order to provide a global picture or a movie of the sky evolution.

The camera must be able to withstand the Jungfraujoch weather conditions.

- Must easily cope with -35°C to 20°C temperatures
- Must be water-ice-snow tight
- Must be flying snow/ice & wind compatible
- Must survive lightning strikes

It must be remote controlled by
TCP/IP.

- Since TCP/IP is a routed communication protocol. The camera may be accessed from outside of the laboratory LAN
- TCP/IP is the most often implemented protocol in the PCs. No additional protocol installation would usually be required
- It will require some access protection

The camera must be compatible with proprietary software developments.

- Proprietary applications should be able to make use of the camera derived pictures or movies
- A software development kit must be available to access the API of the camera device driver

If possible, the camera should not require any add-in PC card.

- Specific add-in cards use proprietary control lines that may be difficult to extend and protect against lightning
- Use 1 PCI slot, usually for a single camera
- Multiple cameras are not often supported by the drivers
- The card is camera specific. If the camera model changes, the card changes. Same for the specific cable-interface adaptations and software developed

Working principle

- Attach the camera to the suntracker
- Hide the solar disk to the camera
- The suntracker must use the astronomic solar position equations

First crude simulation test on a window



Problems

- The camera must be able to cope with extended periods of direct sunlight when the suntracker is not aligned
- The amount of light received from the scenery (mostly snow) under normal operation must not saturate the CCD



Choice of the camera

Logitech cameras have the advantage of having the following properties :

- USB interface
- Free Software Development Kit available and common to all camera models
- Good quality / robustness
- Good resolution (640x480 pixels)

Final choice : Quickcam traveler

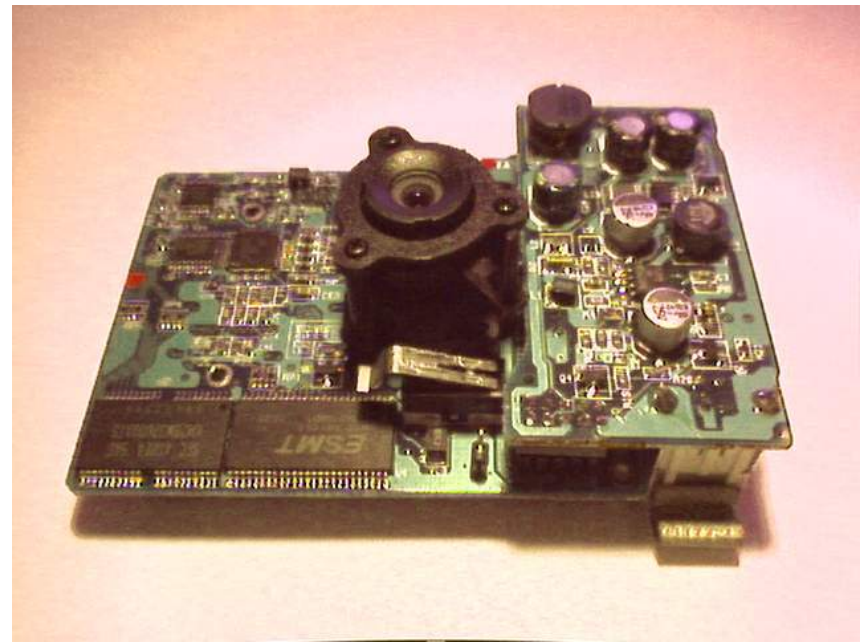
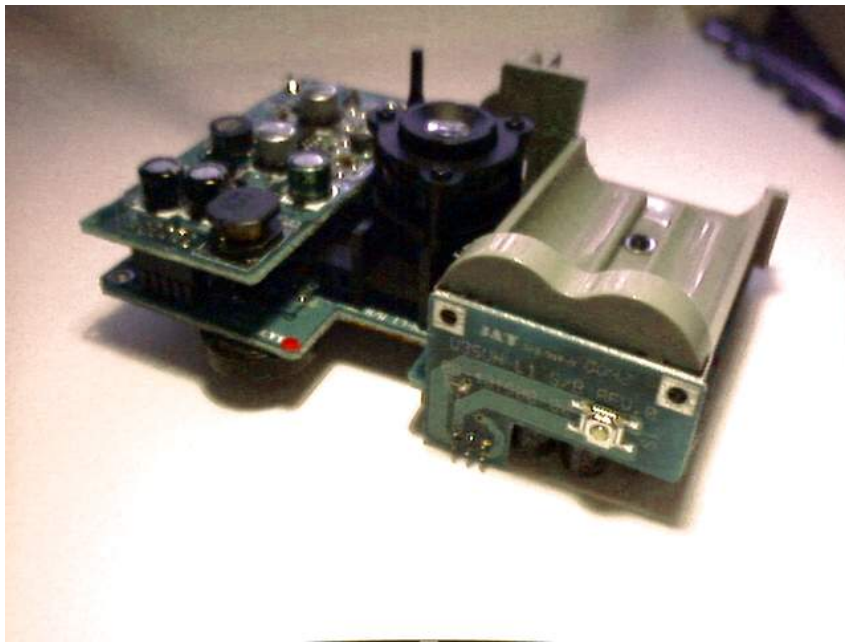
- Increased robustness towards saturation compared to model 3000 pro
- Better image quality – color and sharpness
- Good compatibility versus low temperatures
- Larger size than model 3000 pro and unnecessary features (permanent memory, batteries, LCD display)

Choice of the filter

- Use a neutral filter to keep normal colors
- Tests showed that $<10\%$ transmittance was sufficient to avoid saturation
- Somewhat lower transmittance would better protect the CCD against direct sun

Final choice : 1% transmittance

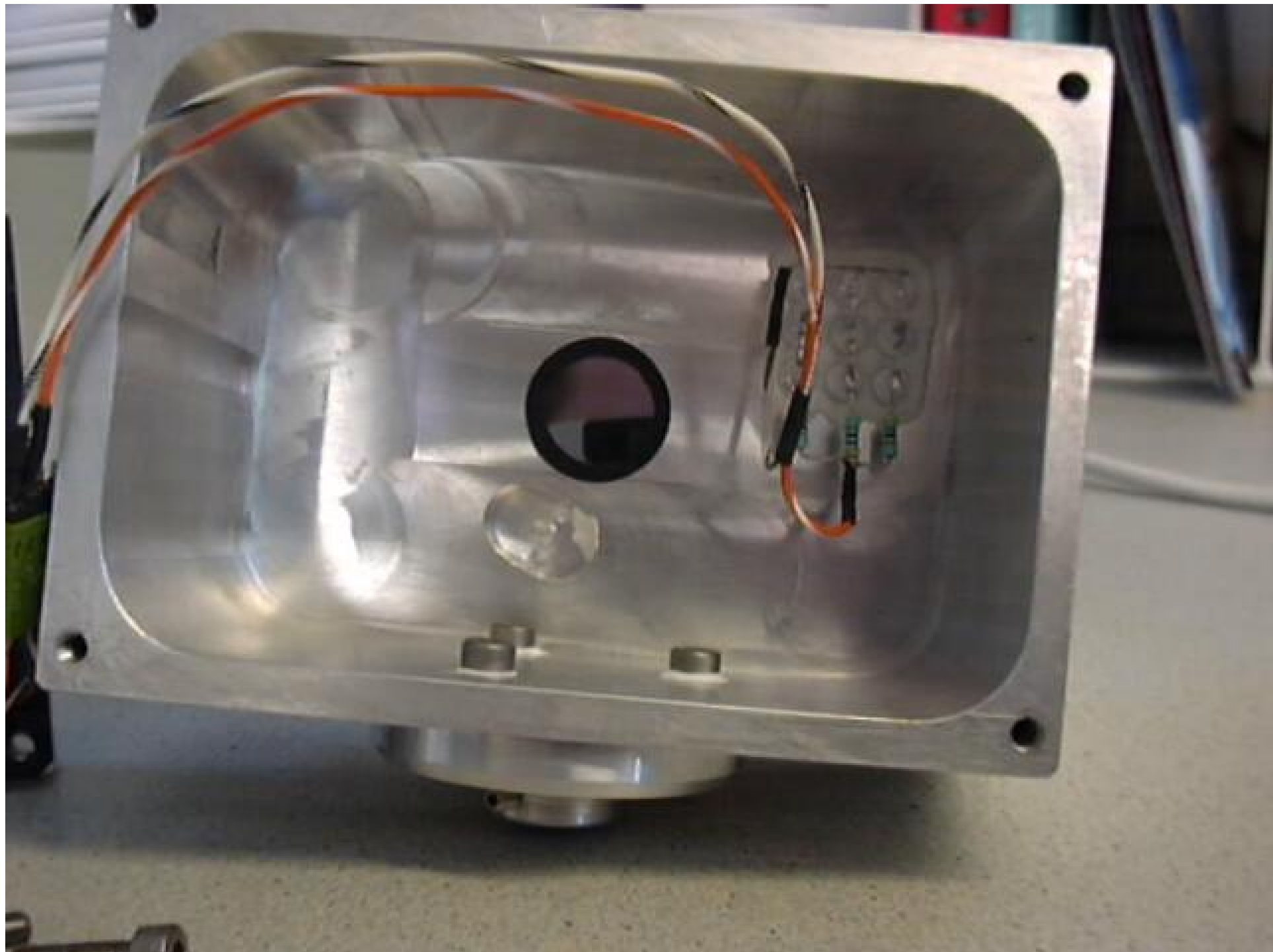
Reduce Traveler model to stripped-down version

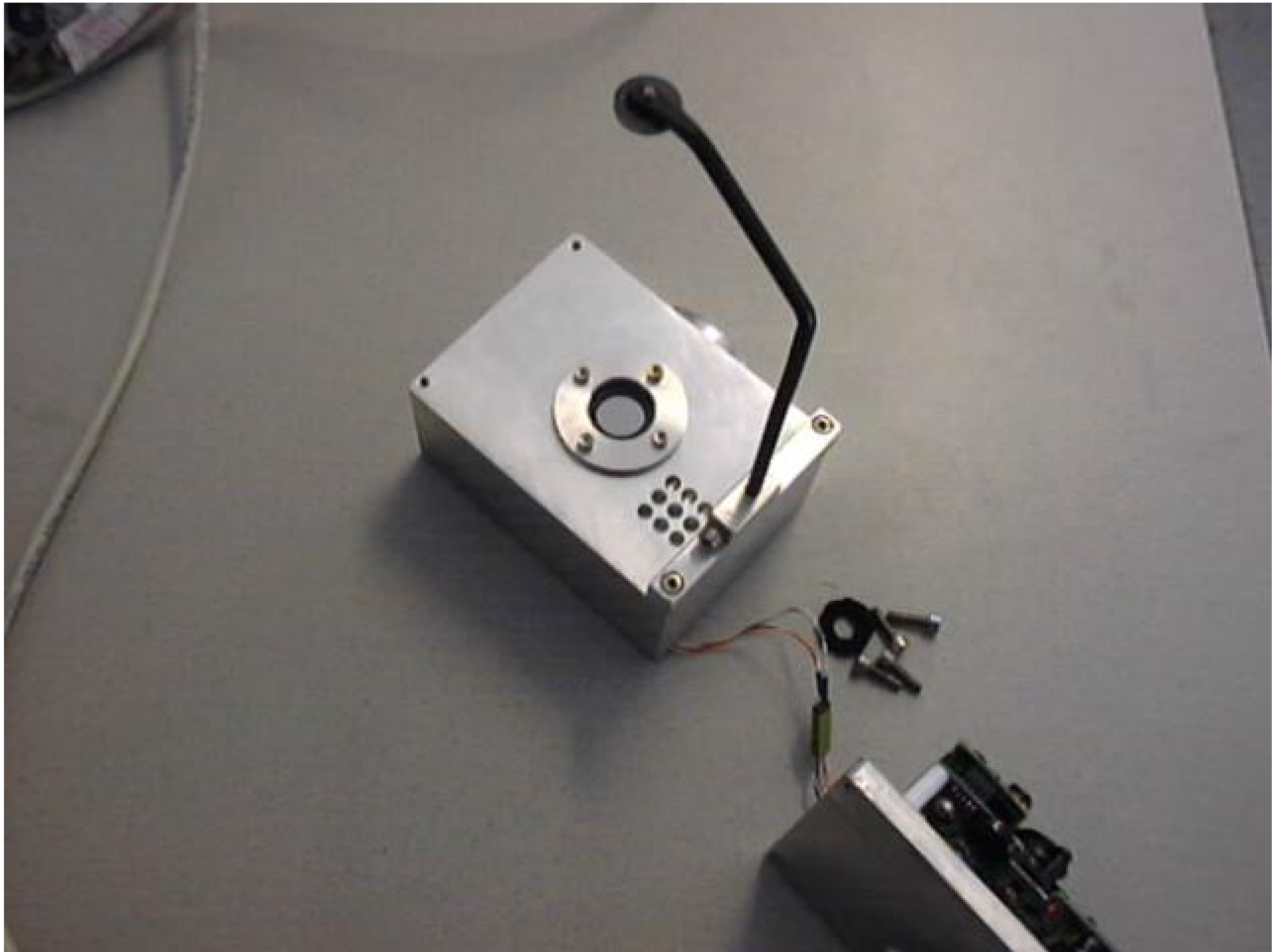


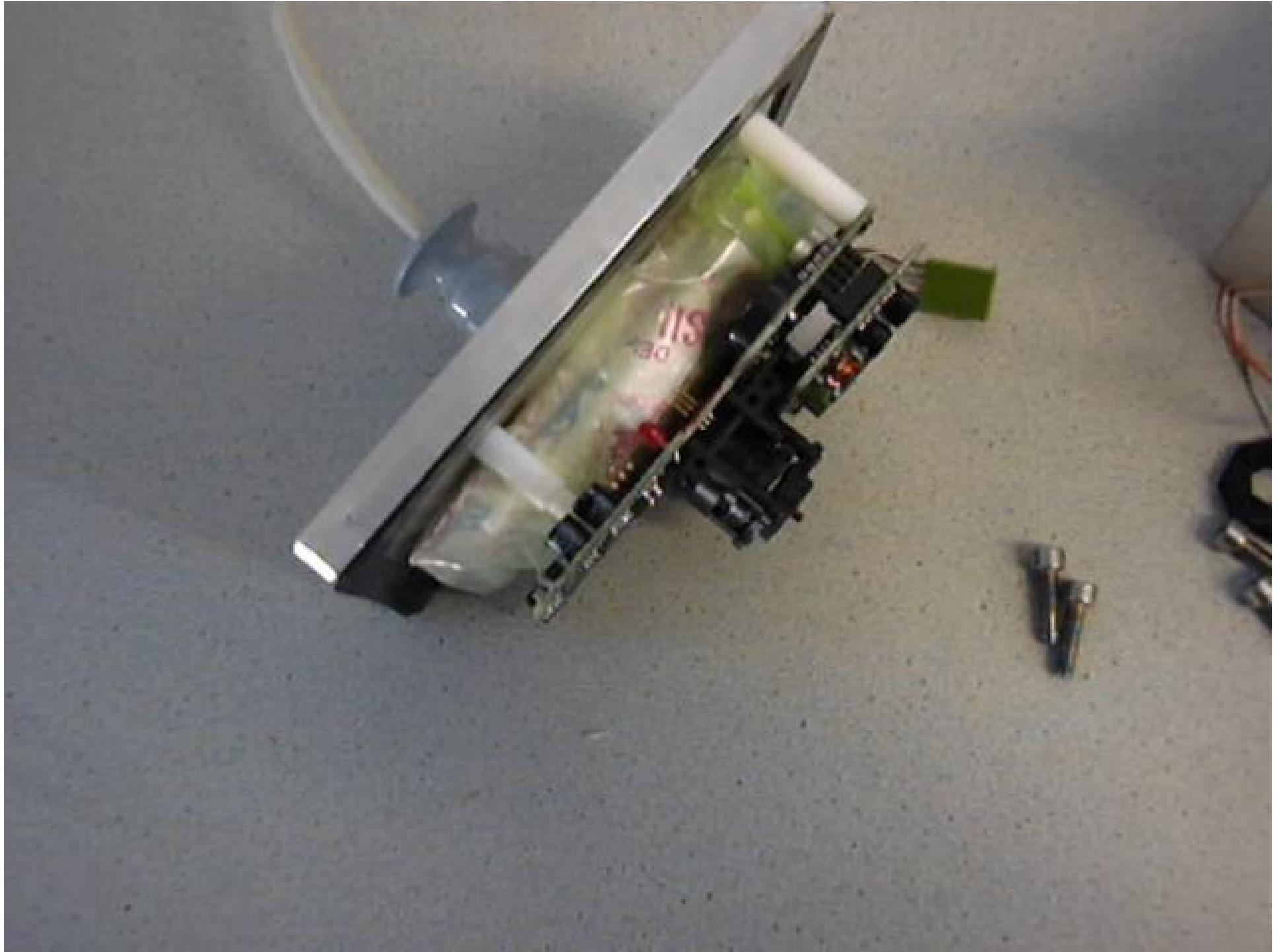
Adapt cabling and enclose it in air-tight protective housing

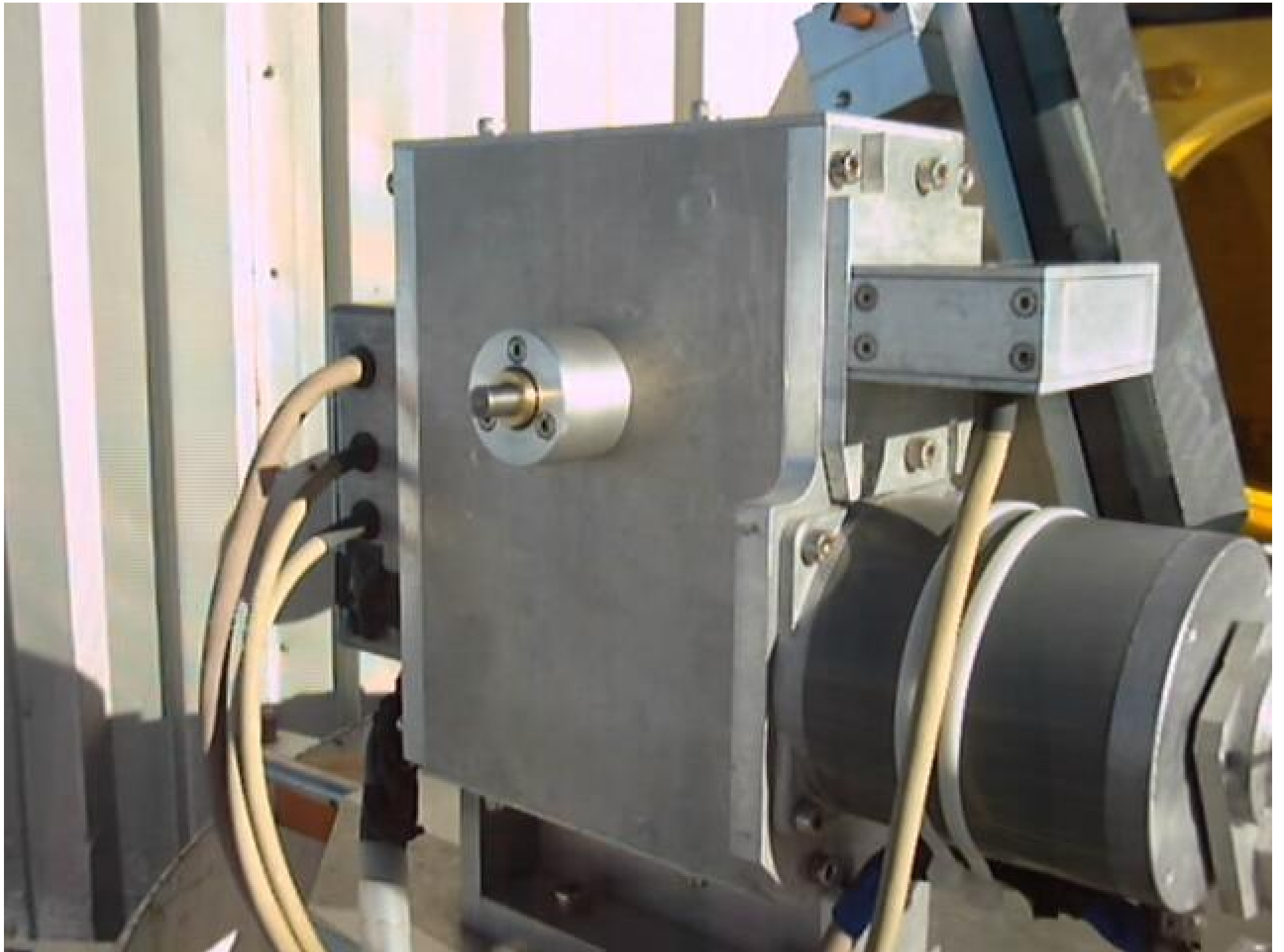
- Use RJ 45 cables to include optional heating and lamp/LED power
- Include Silicagel to avoid condensation on filter or electronics at low temperatures
- Keep the microphone operational
- Avoid stray reflections inside the box

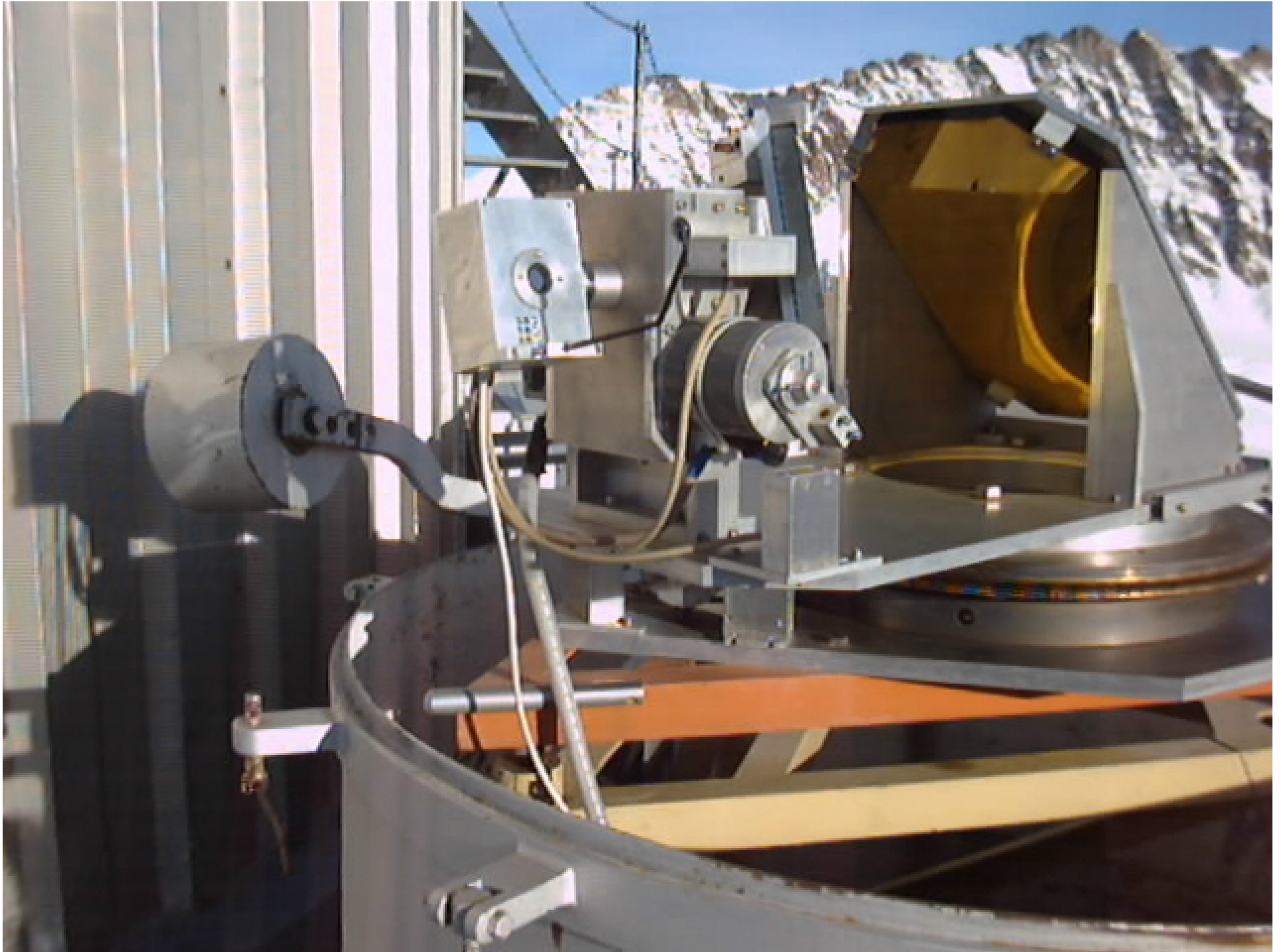














Some results

Pictures...



Clear Sky



Light Cirrus

Flying snow
and clouds



Some time-lapse movies...