Austrian Space Forum

High altitude Mars analog research

Results from the AMADEE-15 glacier Mars simulation

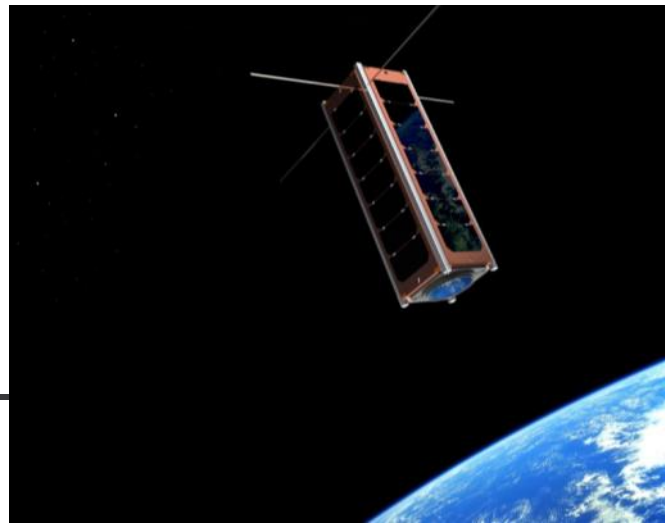
G. Groemer and R. Albrecht,
Austrian Space Forum

Österreichisches Weltraum Forum

- Citizen science organisation since 1998, led by professionals
- 180 team members
- High public visibility & space outreach & academic involvements
- Level-of-effort methodology

OeWF Research Focus

- **Hardware development:**
  - Aouda.X spacesuit simulator
  - Mars analog rovers
  - Stratospheric balloons & Cubesats
  - 3 operational ground stations by 2017
- **Research focus**
  - Planetary surface operations
  - Planetary protection
  - Optimizing remote science support
- **11 major field campaigns**
  - E.g. Rio Tinto 2011, Dachstein 2012 (NASA/JPL, Exomars-h/w, Morocco 2013)



Analog astronaut class of 2015 (from 100 candidates, 5 months basic training)

(Orgel, C. et al. (2013) Geological trainings for analogue astronauts: Lessons learned from the MARS2013 expedition, Morocco, EPSC conf proc) and Groemer et al., 2012, The Aouda.X space suit simulator and its applications Astrobiology. February 2012, 12(2): 125-134.)

Mission rationale

- Mission operations on planetary surfaces is different from e.g. ISS operations and needs new concepts (time-delay, long duration autonomy,…)
- OeWF and its partners have identified “doable niches”, where a significant contribution can be made → (almost) open-source body-of-knowledge on human Mars mission operations

Mission objectives

- **Investigate** the limitations and opportunities of studying a Martian (rock) glacier
- **Test** mission support strategies, decision making workflows and near-real time data analysis for flight planning.
- **Serve** as a high-visibility showcase of analog field research

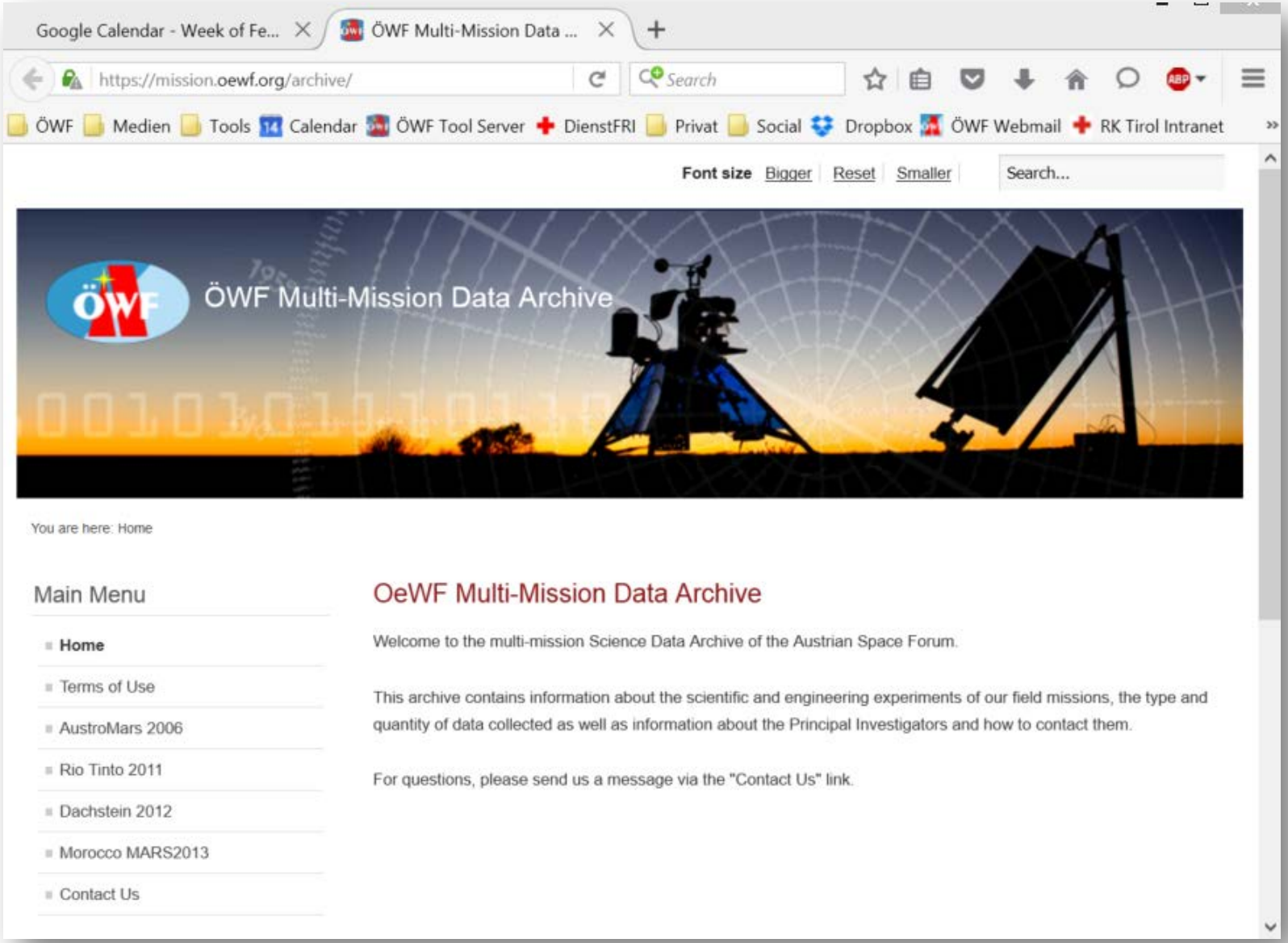
- NASA DRA 5.0 – 19 matches

*Orgel, C., et al. „**SCIENTIFIC RESULTS AND LESSONS LEARNED FROM AN INTEGRATED CREWED MARS EXPLORATION SIMULATION AT THE RIO TINTO MARS ANALOGUE SITE**, Acta Astronautica 94/2 (2014)*

Mission Support Center Innsbruck/Austria

+ Support Rooms (Flight Planning, Ground Support, IT/Sci. Archive, Rem. Sci. Support)
+ ext. Rover control room(Budapest/Hungary)

Sans Fuentes, S.A. (2012) "Human-robotic Mars science operations: target selection optimization via traverse and science planning". MSc thesis, University of Innsbruck, Innsbruck, Austria.



https://mission.oewf.org/archive

Experiments

- **Surveillance / Recon**
  - Cliffbot / Aerostat
  - PULI ROCKS: GLXP rover terrain tests
  - Ground Penetrating Radar
- **Astrobiology**
  - L.I.F.E.: Biomarker fluourescence instrument
  - Glacier-MASE: glacial extremophile inventory
  - WORIS: Lichenometry
  - Morraine Dating
- **Human Factors & Operations**
  - VEMES Pilot-A: Virtual & Blended reality tests
  - FOG: aerosol shower for low water usage
  - Aouda Suit monitoring
  - Dental procedures: 3d manufacturing

Losiak, A et al. (2014) "Design and utility optimization of maps for long duration planetary missions", Astrobiology 14:6


XPRIZE

VERAS/VEMES PILOT-A Study

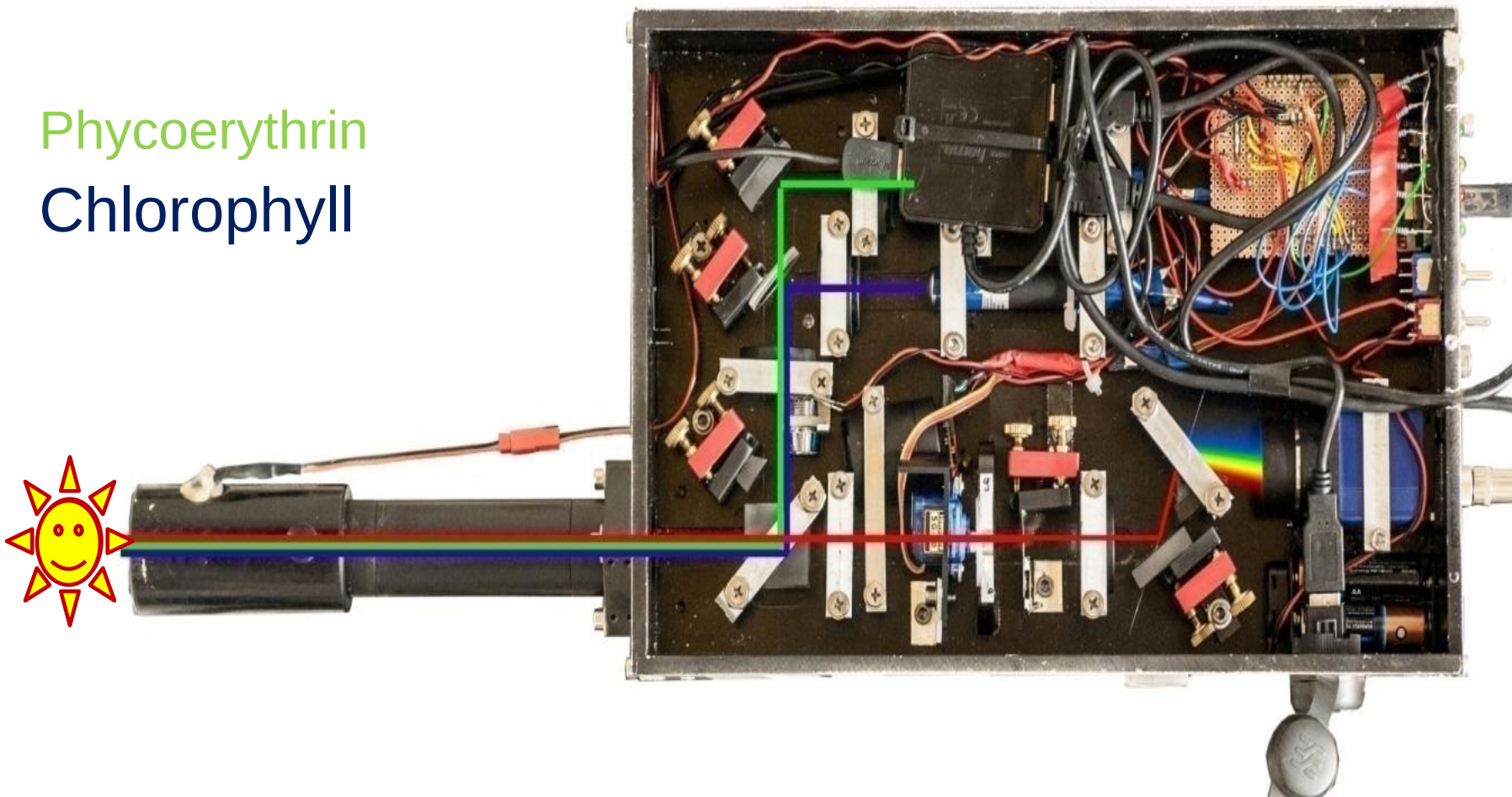

Aldebran
Virtual Space Systems

PROTOTYPE 1.0 | L.I.F.E.

G. Groemer, et. al (2014),„**Robotic Field-Validation of Laser Induced Fluorescent Emission (L.I.F.E-Instrument) during the Mars2013 Analog Mission**”, Astrobiology 14:5

Phycoerythrin

Chlorophyll



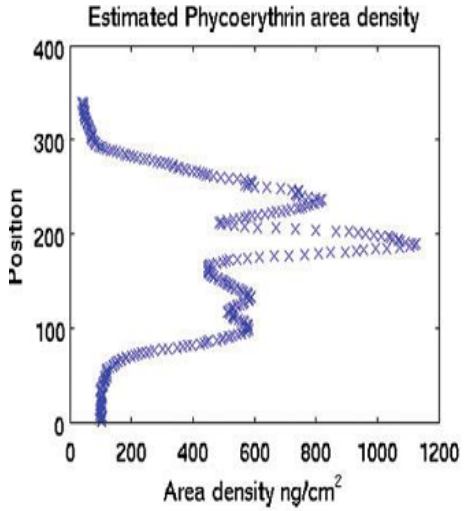
APPLICABILITY | L.I.F.E.

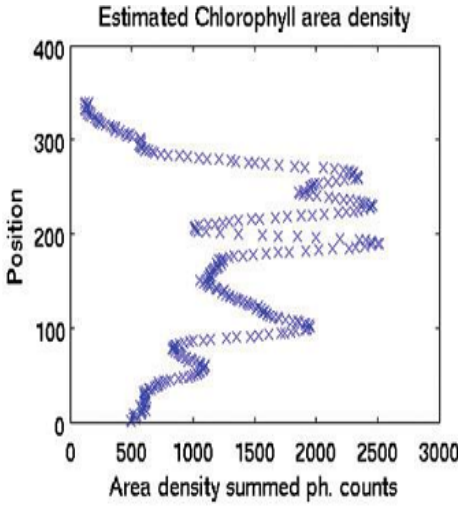
- Chlorophyll gradient
- Standard approach impossible

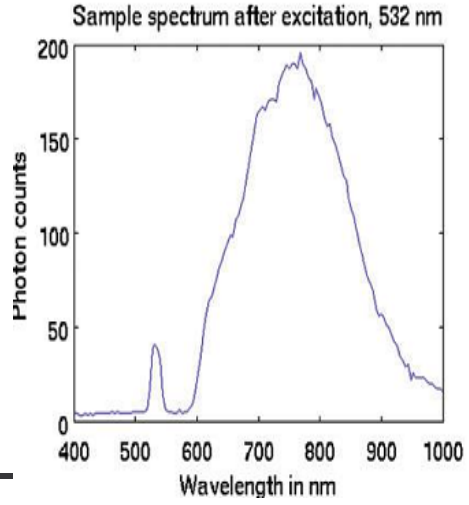
High spatial resolution measuerement with L.I.F.E. instrument!

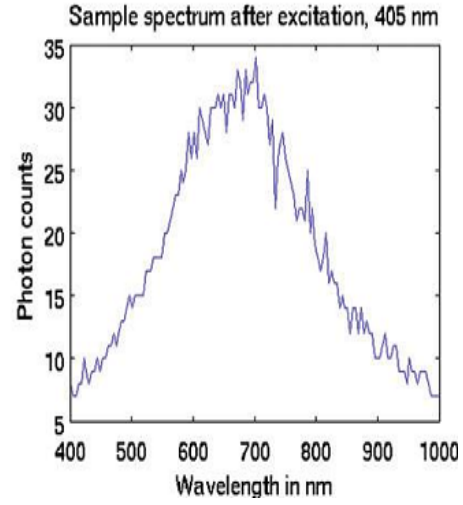
- Spatial resolution: 30µm px^{-1}
- Spectral resolution: 5nm px^{-1}
- Detection limit chl_a: 500pg ml^{-1}
- Detection limit PE: 10ng ml^{-1}

L.I.F.E. FIELD DATA



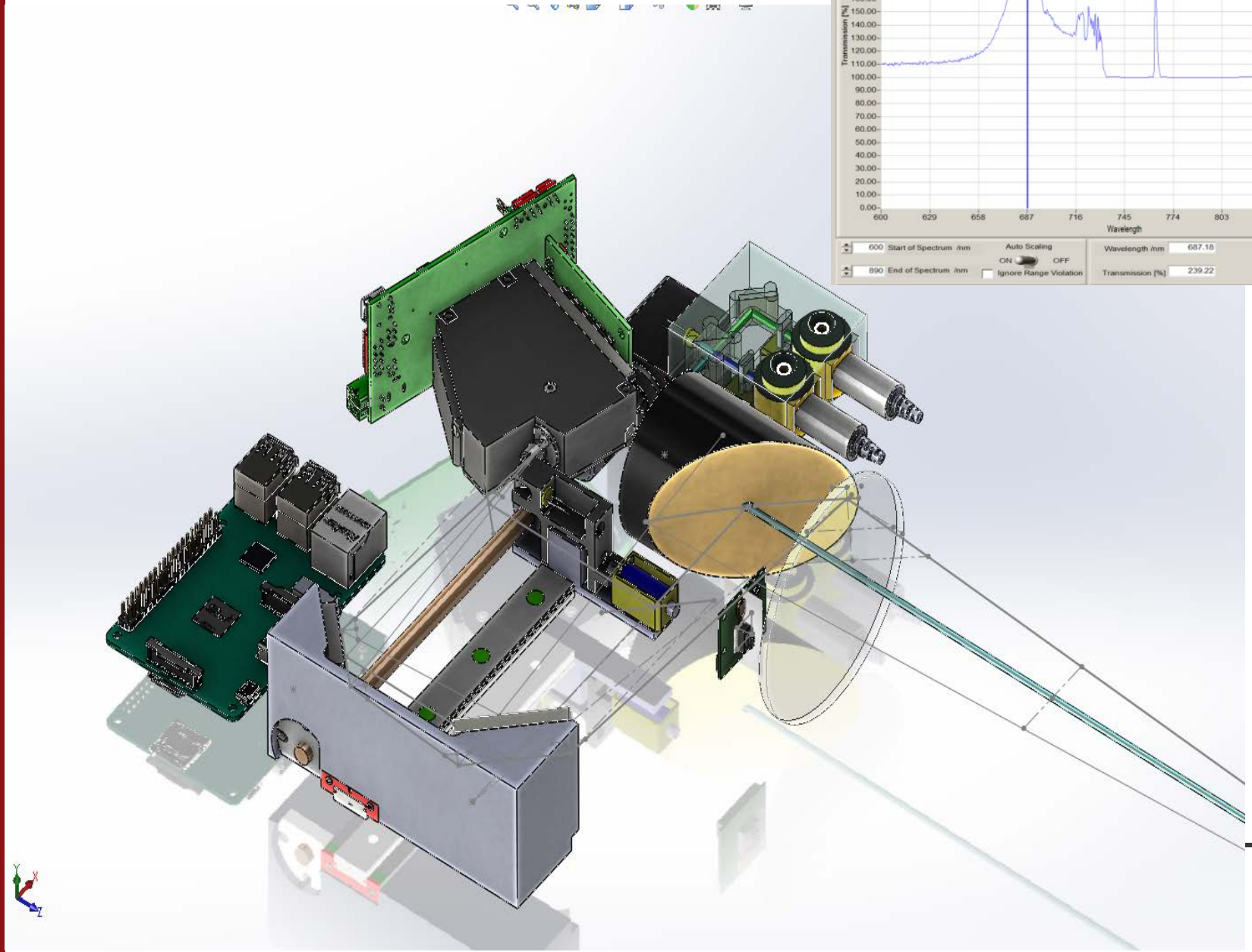






Groemer et al., 2014

L.I.F.E. @ AMADEE-15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Wavelength
600 Start of Spectrum /nm
890 End of Spectrum /nm
Auto Scaling
ON
OFF
Ignore Range Violation
Wavelength /nm 687.18
Transmission [%] 239.22


MILLET
36V


PROXIMA


PROXIMA

glacierMASE - extremophile inventory

(EU/FP7 project, ongoing)

Challenges

- **Single-gateway of communication**
- **Experimental readiness**
  (traditional field science vs spaceflight operations)
- **Safety:** significant effort in high alpine environments

Upsides

- Science/Exp-driven
- **AA selection & training +++**
- **Workflows/SOP's**
- **Communication pathways**
- **Base station**

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