PLANETARY PROBE DESIGN WORKSHOP: COLLABORATIVE HANDS-ON SMALL SATELLITE TRAINING FOR ENGINEERING STUDENTS

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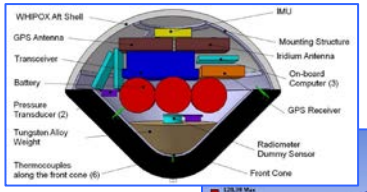
Motivation

- **Adapt to changes in university-level engineering education**
  - Hands-on projects on undergraduate and graduate level
  - Offering research experience for undergraduates in addition to theses
  - Building on the institute's existing, positive experience with workshop format (graduate/post-graduate level) in a concurrent design environment
- **Using CubeSat nano satellite format as a proven tool for education**
  - Platform to perform research in dedicated fields (e.g. atmospheric entry, electric propulsion)
  - Student small satellite projects as a supplement - not a replacement to the institute's academic small satellite research program
  - Using low-cost and fast-schedule opportunities for sub-projects within the overall format to provide sense of achievement
  - Applying *"Do One Thing Well"* (mission complexity) and *"Virtual Exploration is NOT an Option"* (hands-on) approach

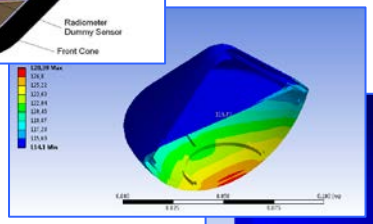
Student Involvement

The Planetary Probe Design Workshop provides an educational framework for additional surrounding activities.

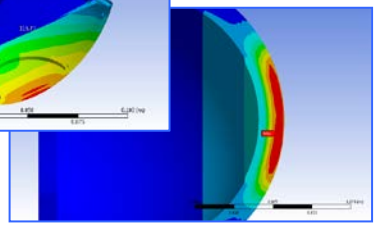
- Annual iteration of the one week *Planetary Probe Design Workshop* since 2012 with increasing number of participants – international and from various years of study.
- Numerous student theses and project/internship work
- Student small satellite interest group **KSat e.V.**:
  - Currently >25 highly motivated active members – and growing!



2015

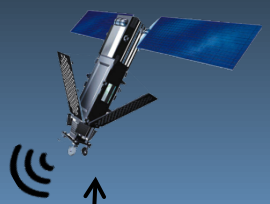


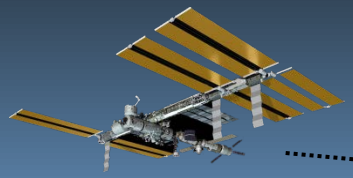
2014

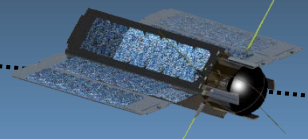


2012

1st PPDW Project: CAPE Mission





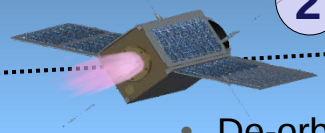


PPDW phase 0/A reports
DLR Rexus 19/20 participation
Bachelor theses on CAPE

1 Deployment
e.g. from ISS

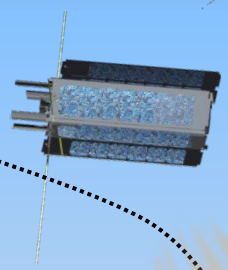
IRS faculty & staff
PhDs (TPS/SEP)
Visiting experts
External theses

2 De-orbit



- De-orbit down to separation altitude
- Atmospheric measurements
- PPT demonstration

3 Separation
at 125 to 150 km altitude



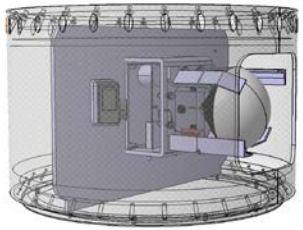
4 Re-entry of MIRKA2

Measurement of the ambient conditions and the re-entry performance of the capsule

5 Transfer of re-entry data via satellite
Transmission of data through Iridium network

6 Demise of SDM, impact of capsule
Potential for monitoring of break-up and demise

MIRKA2-RX Mission (PDR passed 12/2014)



T=140s: apogee at 80-100 km
Ejection

MIRKA2-RX
Capsule

T=26s:
burn-out

REXUS
sounding rocket

MIRKA2-RX
Mirror System

(ESA 2007)

T=0s: launch

T=~800s

KSat

ThalesAlenia Space
A Thales / Finmeccanica Company
Deutschland

IRS

DLR

IRS (G. Herdrich)
- Management and lead, System Design
- Thermochemistry, Instrum.

DLR Stuttgart (H. Hald)
- Integration of capsule

NASA Goddard (J. Esper)
- Potential flight opportunity

Space Science Lab (R. Laufer, CASPER, Baylor University)
- Systems Engineering Support
- Small Satellite Design

KSat
- IRS Student team

Gradel (D. Petkow)
- Modelling + simulation of capsule's dynamic motion during initial reentry phase

University of Adelaide (M. Kim)
- Blackout assessment

ISA (Ph. Reynier)
- Assessment of laminar/ turbulent transition
- Trajectory simulation

ÖWF (N. Frischauf)
- International outreach

CE (R. Gabrielli)
- National outreach and regulations (CE)

ASA (M. Auweter-Kurtz)
- System and mission analysis support

OHB Sweden (A. Demairé)
- PPU for deorbit electric propulsion

Thales Alenia Space Deutschland
- Facilities and logistical support of student activities

Summary and Outlook

- **PPDW is an educational element in (especially) undergraduate aerospace engineering education**
  - offering an intense, mission-focused, goal-oriented workshop-type course utilizing a concurrent design environment
  - Utilizing highly cost-effective CubeSat standard as a platform for education, science and engineering research
  - Enables highly motivating, inspiring and challenging types of missions
  - Network of partners provide opportunities for students
  - PPDW 2016 in the March/April 2016 timeframe
  - Possible growth into two workshops per year (spring & fall)
- **Like to know more?**

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