



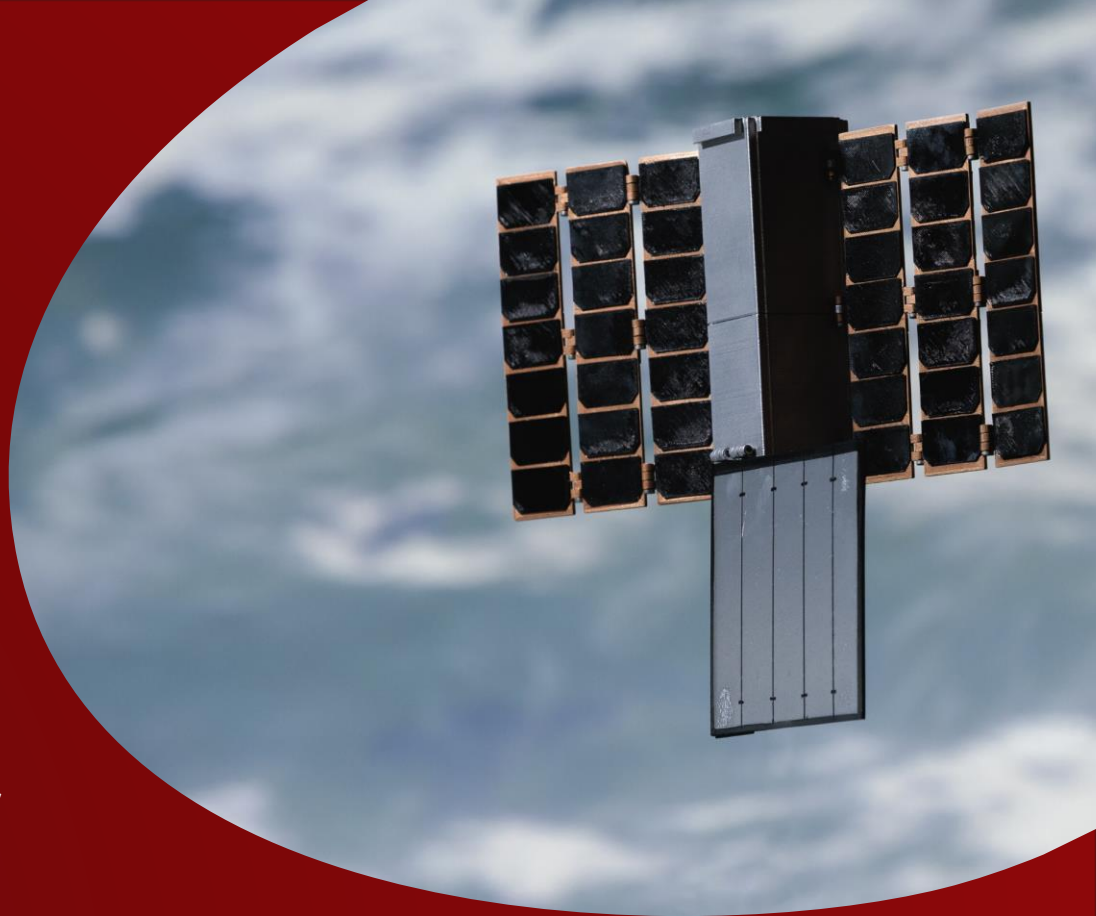
ADLER-1

Austrian Debris Detection Low Earth
(orbit) Reconnoiter

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ADLER-1 Overview

- Mission profile
 - Structural design
 - Electronics & Mechatronics
- Projected Detection Frequency

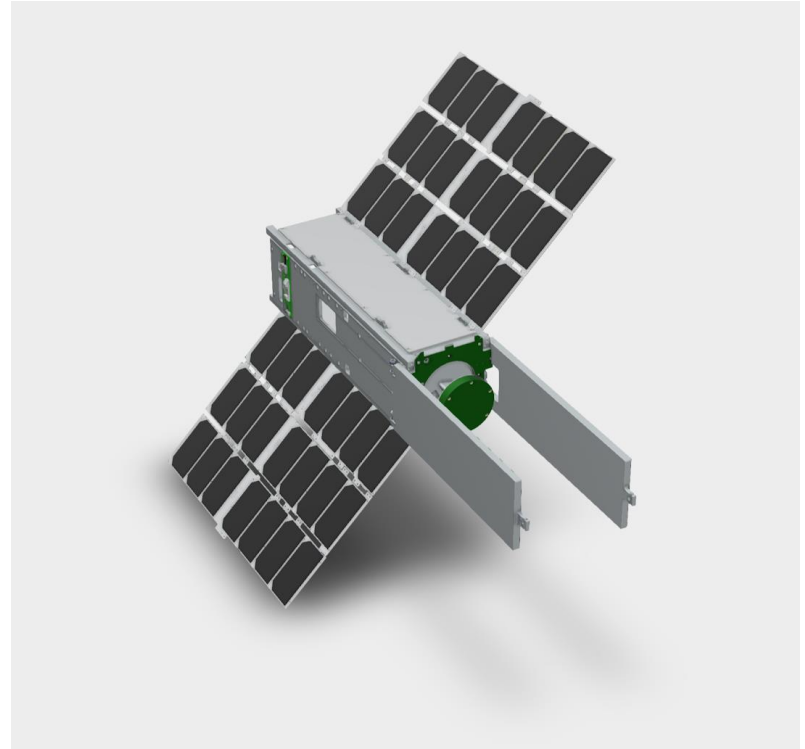
Aims:

- In-Orbit Demonstration of space debris detection from a 3U CubeSat using multiple sensors
- Showcase Orbit-as-a-Service, Austrian mission



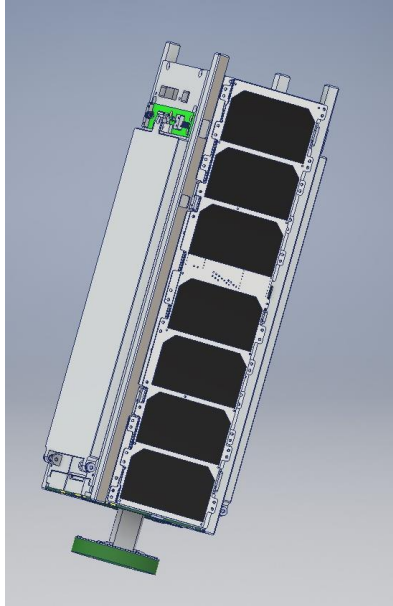
ADLER-1 Mission profile

- 3U (30x10x10cm launch config) cubesat, built by SPIRE and Austrian Space Forum in partnership with FINDUS Venture GmbH
- Ca 6 kg (1,5 kg p/l); 3-axis stabilized
- Comm: X-Band (up to 25 MB/s down), S-Band, UHF
- Launch: Sep2021+ (ca 1 year from idea to orbit !)
- Target Orbit: LEO @ 500 km
- Nominal lifetime: 1 year
- **2 Instruments**
 - APID/Austrian Particle Impact Detector
 - PL2/CW Radar (on a 3U CubeSat)

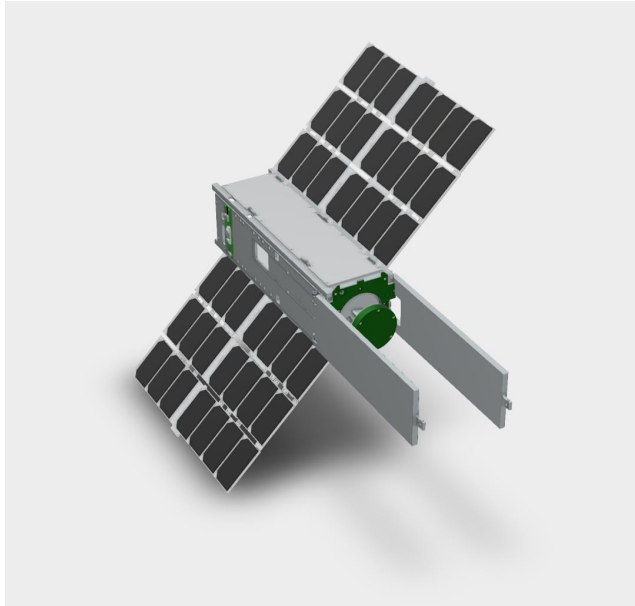


ADLER-1/APID Design

launch config



semi-deployed



Piezoelectric Sensor Wings

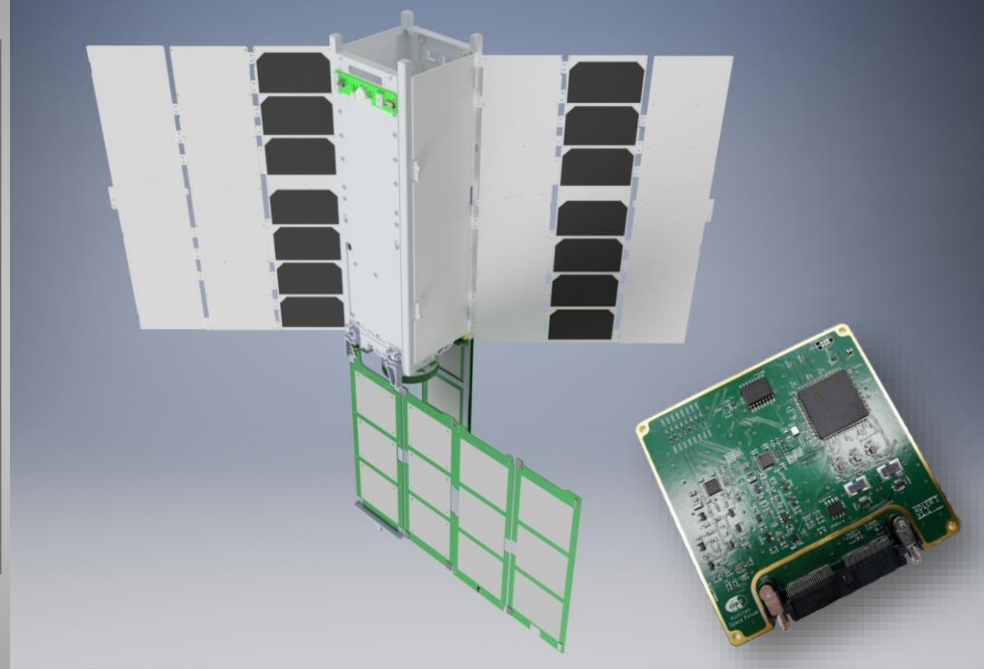
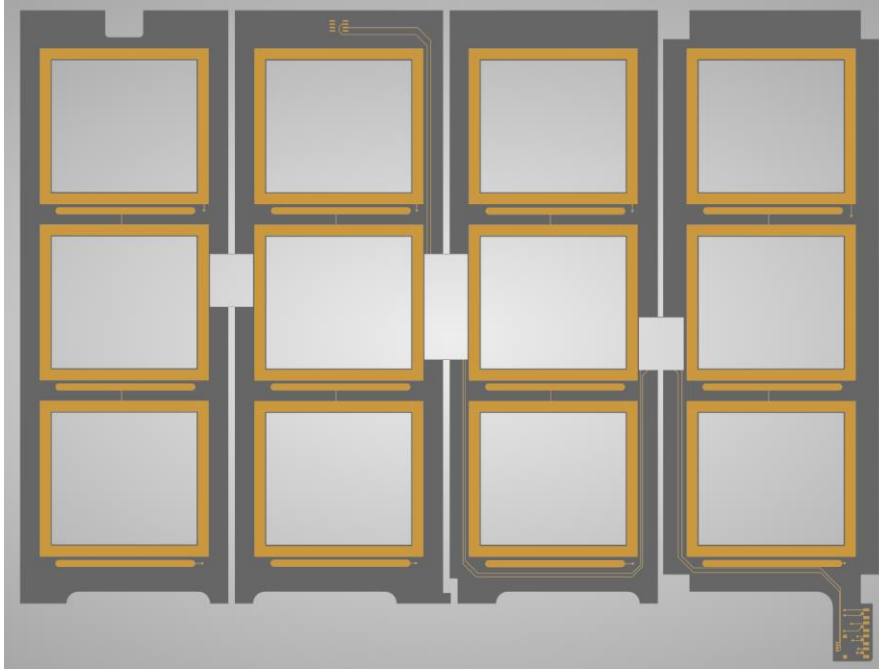
- Mechanical-electrical conversion: 12 mV/microstrain, 400 mV/ μm
- Particle target range: <100 μm @ 10 km/s

Config

- 2 wings, with 12 units of ca. 60 x 65 mm each
- Total sensor surface: ca **865 cm²**

ADLER-1/APID Sensor PCBs

P1 (+X)



ADLER-1/RADAR Design

Config

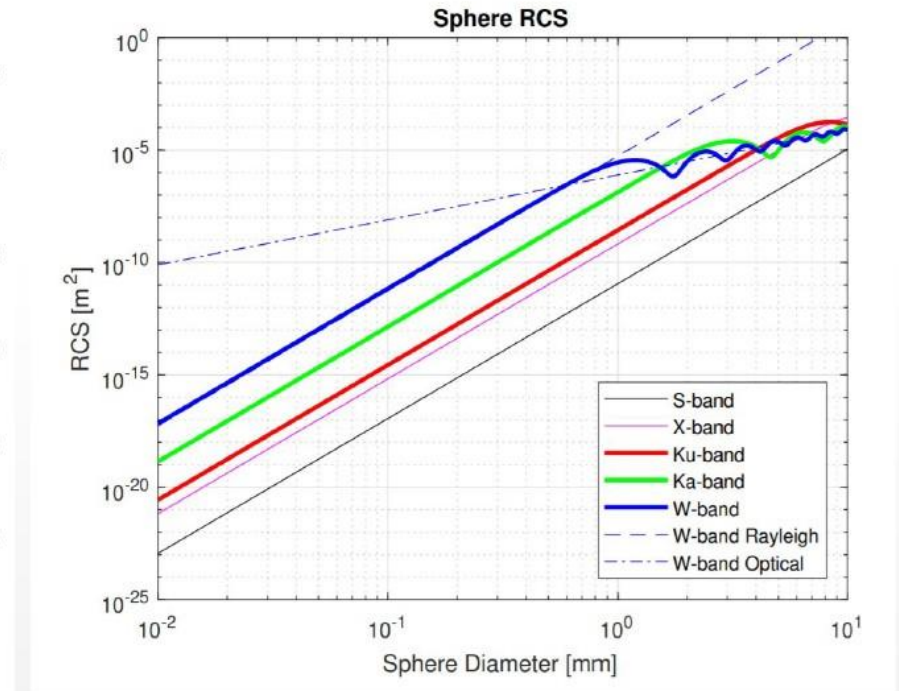
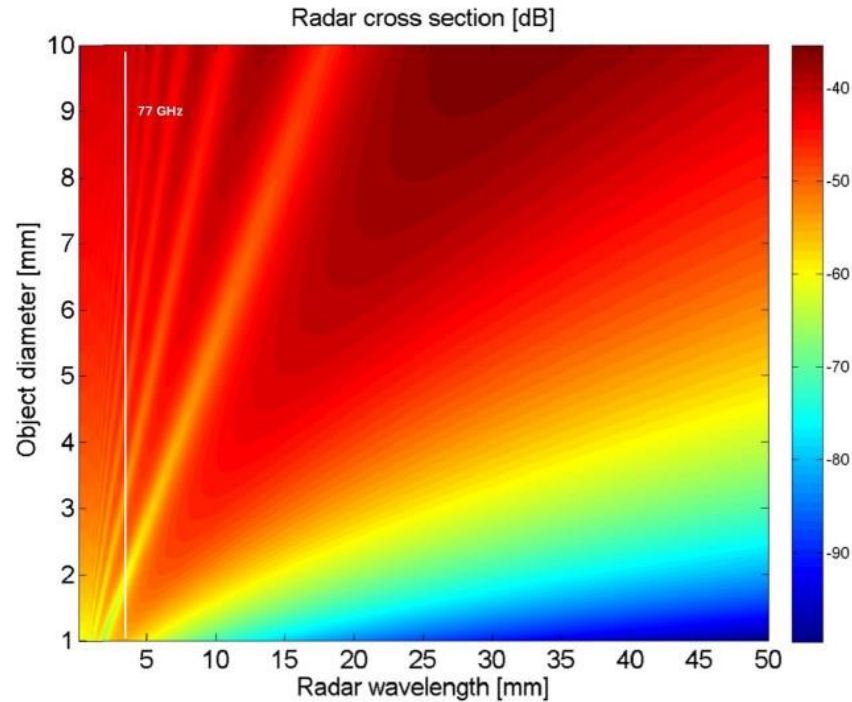
- **1 Watt CW Radar @ 78 GHz**, automotive-heritage radar chip
- Processing based upon Xilinx Zynq Ultrascale+-Architecture
- Fully programable on-orbit
- 1,6mm thin antenna configuration

Debris Detection - Target particles

- 1mm+ @ 15 km/s
- Range: ca 50m (depending e.g. on radar cross section) in a ca 5° cone
- Measures RCS and Doppler
- Equivalent cross section: 150 m²



ADLER-1/Radar Cross Section (RCS) vs debris size



Projected Detection Frequency

- Modelling based upon ESA-MASTER v8.0.2
- @ 500 km, $i < 50^\circ$
- **APID/piezoelectric sensor: ca 1/day**
- **RADAR: ca 0,5 / months**
- → Detection of flux spikes possible? (eg meteor streams? Collision events?)
- → On-Orbit Demonstration
- → Risk of APID sensor destruction with slow impacts >1 mm

