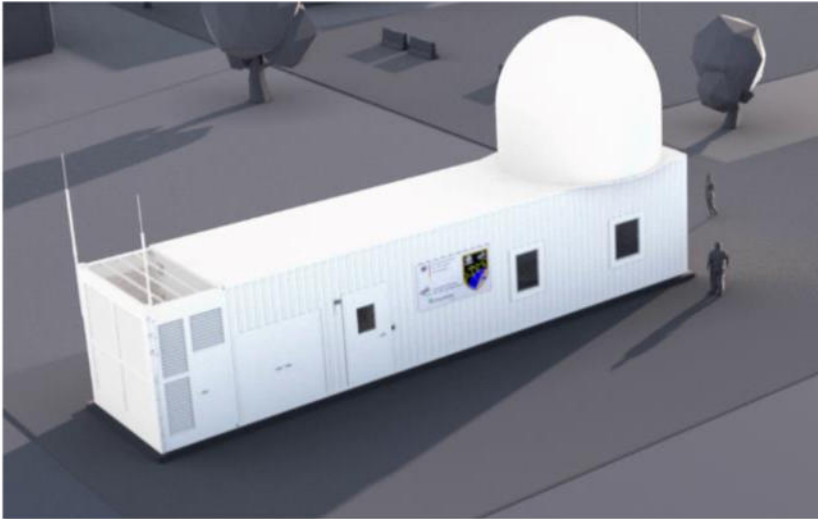


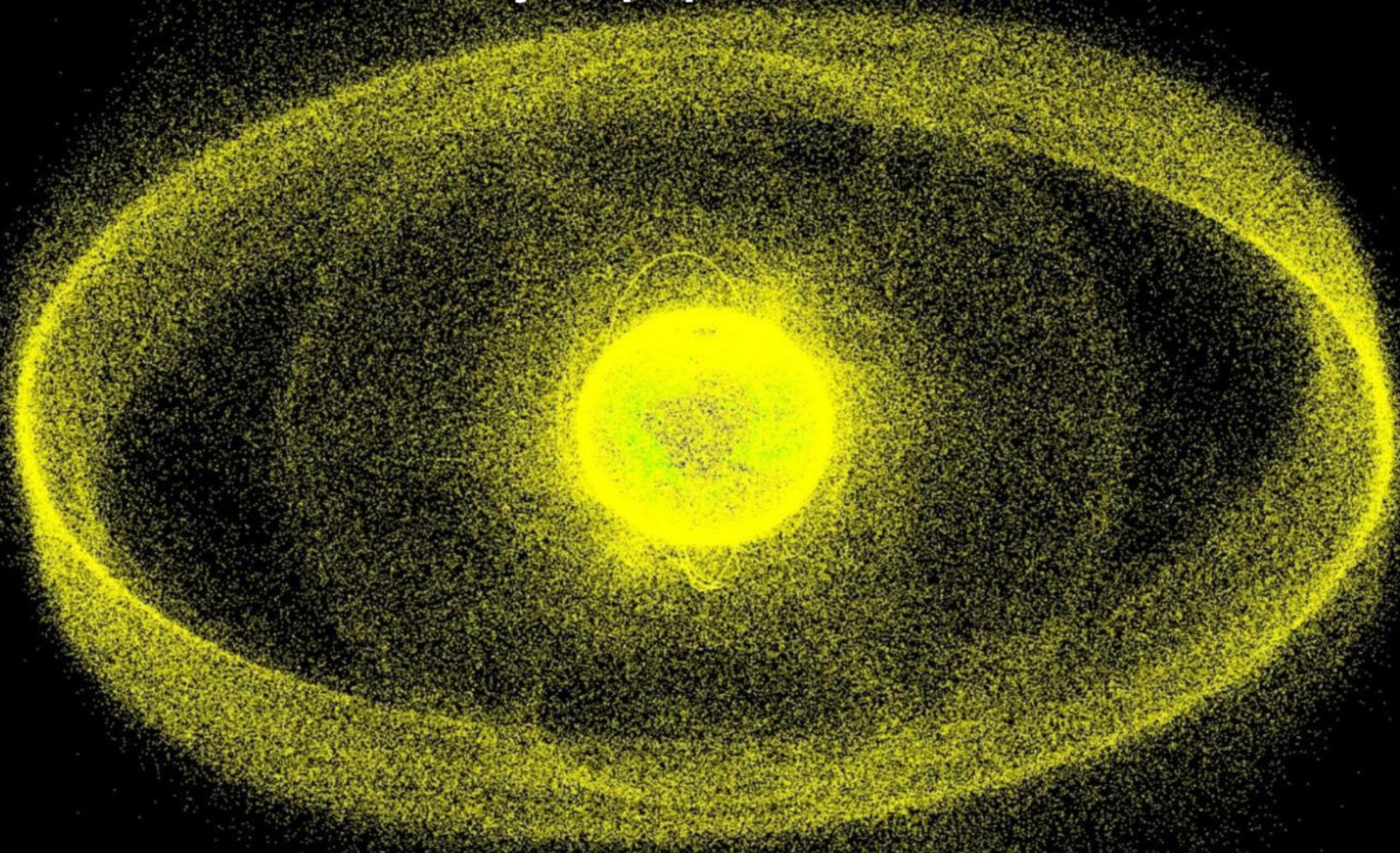
GESTRA – German Experimental Space Surveillance and Tracking Radar

A high-performance experimental radar for space surveillance



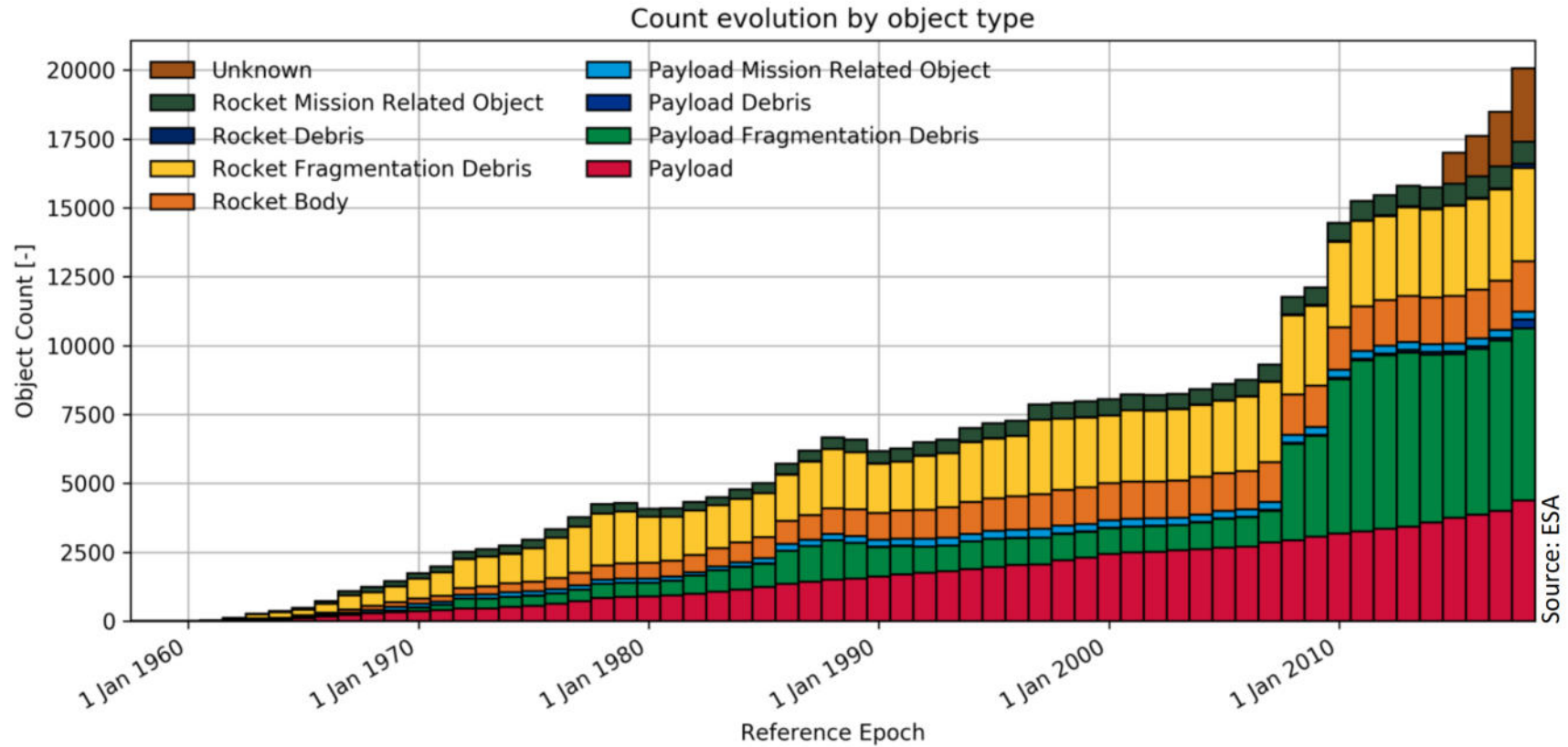
Knowledge for Tomorrow

Situation in the earth orbit – object population



Distribution of the $\sim 128.000.000$ particles > 1 mm corresponding to the ESA MASTER model

Situation in the earth orbit – increasing population



23.000 objects > 5 - 10 cm cataloged (US-SSN) – upward trend

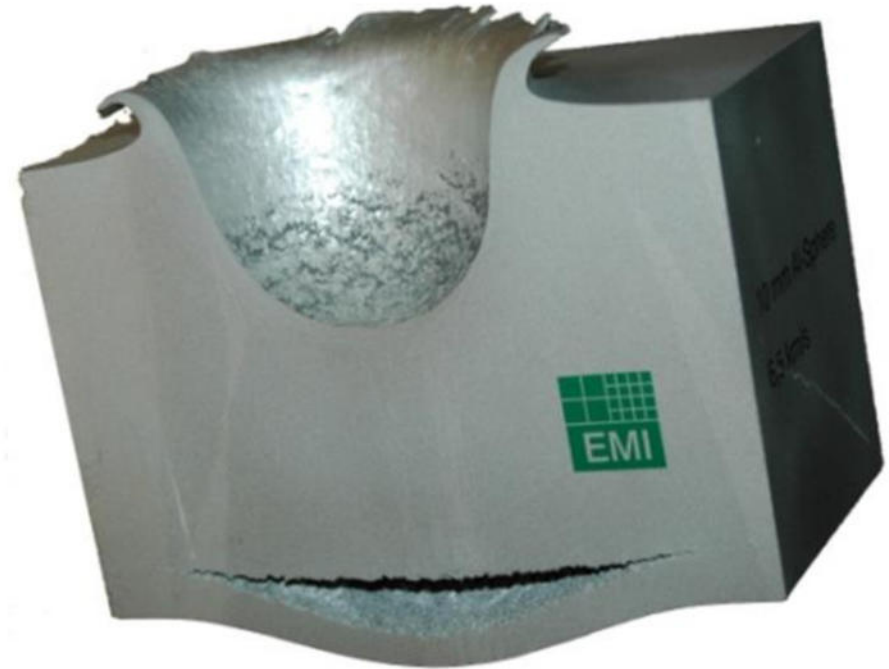


Situation in the earth orbit – object size

Object size	Estimated quantity
≥ 100 cm	5.000
≥ 10 cm	34.000
≥ 1 cm	900.000
≥ 1 mm	128.000.000

Source: ESA

„Lethal size“



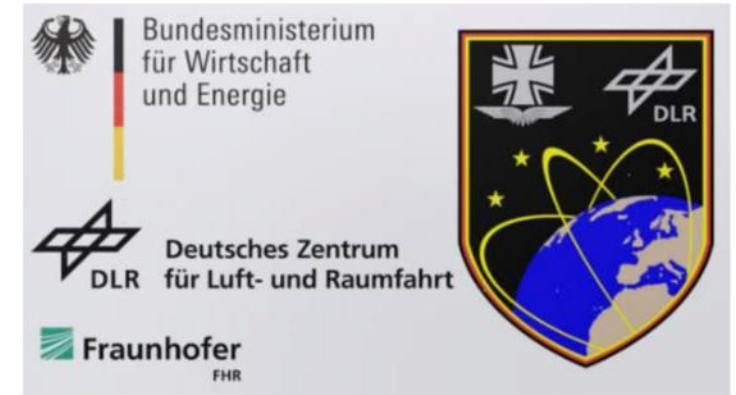
Effect of an impact of a 1 cm aluminum bullet with 6500 m/s onto a 7,5 cm thick aluminum board

Fraunhofer EMI



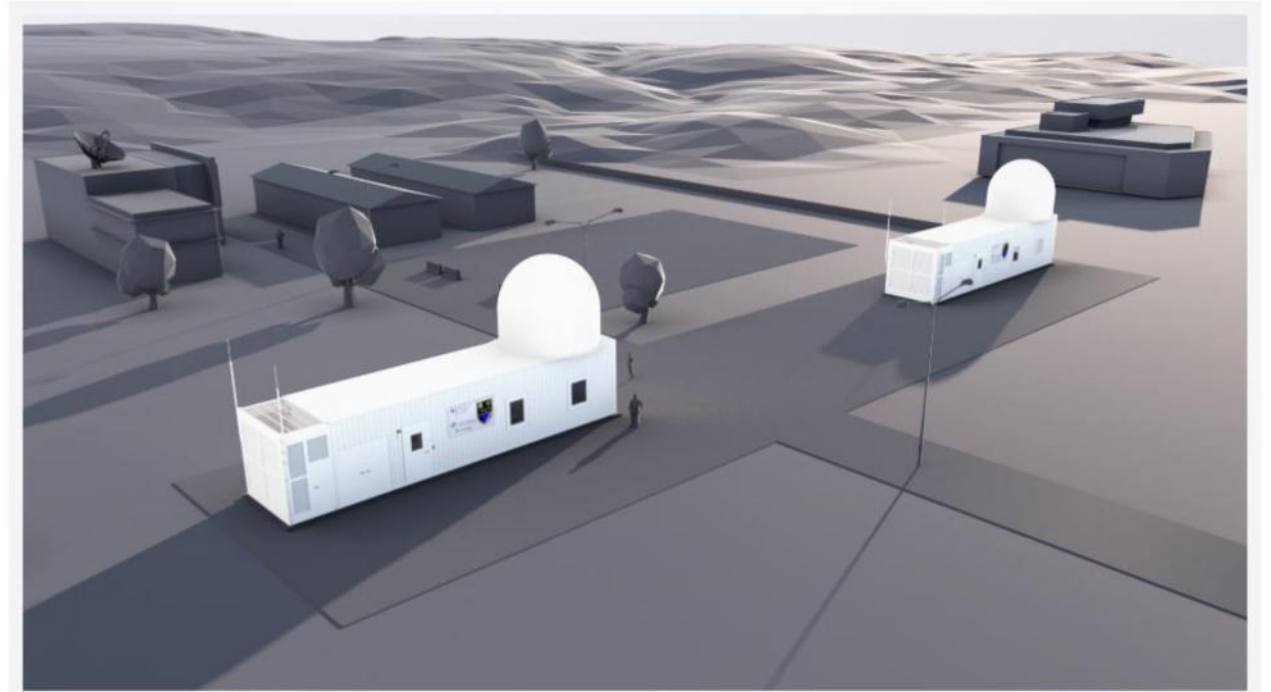
National contribution

- The space strategy of the German federal government outlines the necessity of a national competence for the detection and valuation of the space situation
- Since 2012 the German Situational Awareness Center in Uedem is operational as a joint project of BMVg and BMWi; sovereign, political lead management of the BMWi is perceived by the DLR Space Administration
- In December 2014 the DLR Space Administration assigned the Fraunhofer FHR to develop and build an experimental radar system: GESTRA



GESTRA – High performance radar for space surveillance

- Close monostatic pulsed phased array radar operating in L-band (~ 1.3 GHz)
- Space surveillance of the low Earth orbits (LEO) up to altitudes of 3000 km
- Enhanced surveillance flexibility by mechanical and electronical beam scanning
- Various operational and experimental modes for surveillance and tracking (e.g. Track-while-Scan)
- Product assurance based on ECSS standards
- Partly mobile shelters
- Remotely controlled by the German Space Situational Awareness Centre (GSSAC) in Uedem



GESTRA – receive shelter at its operational site

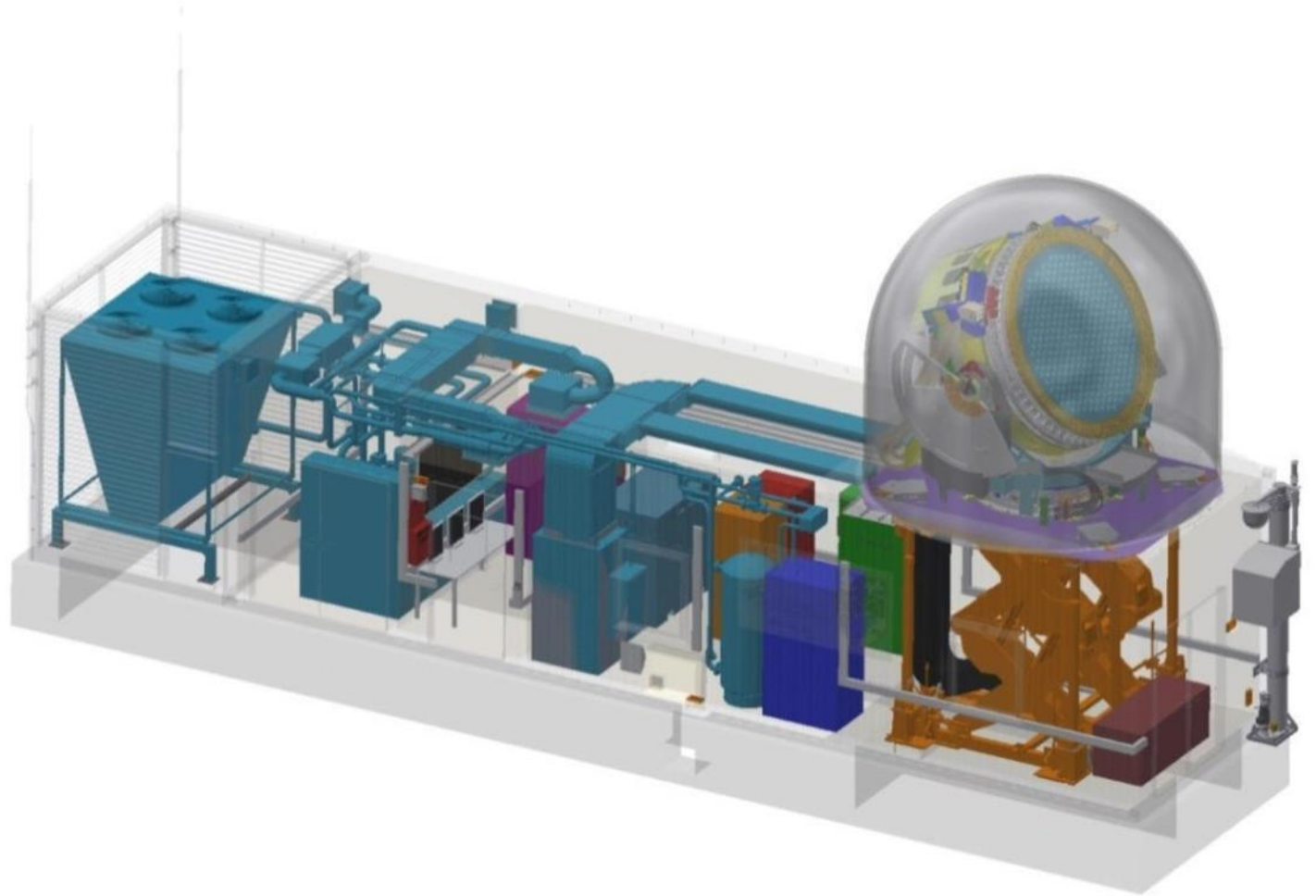


GESTRA – transmit shelter at its operational site

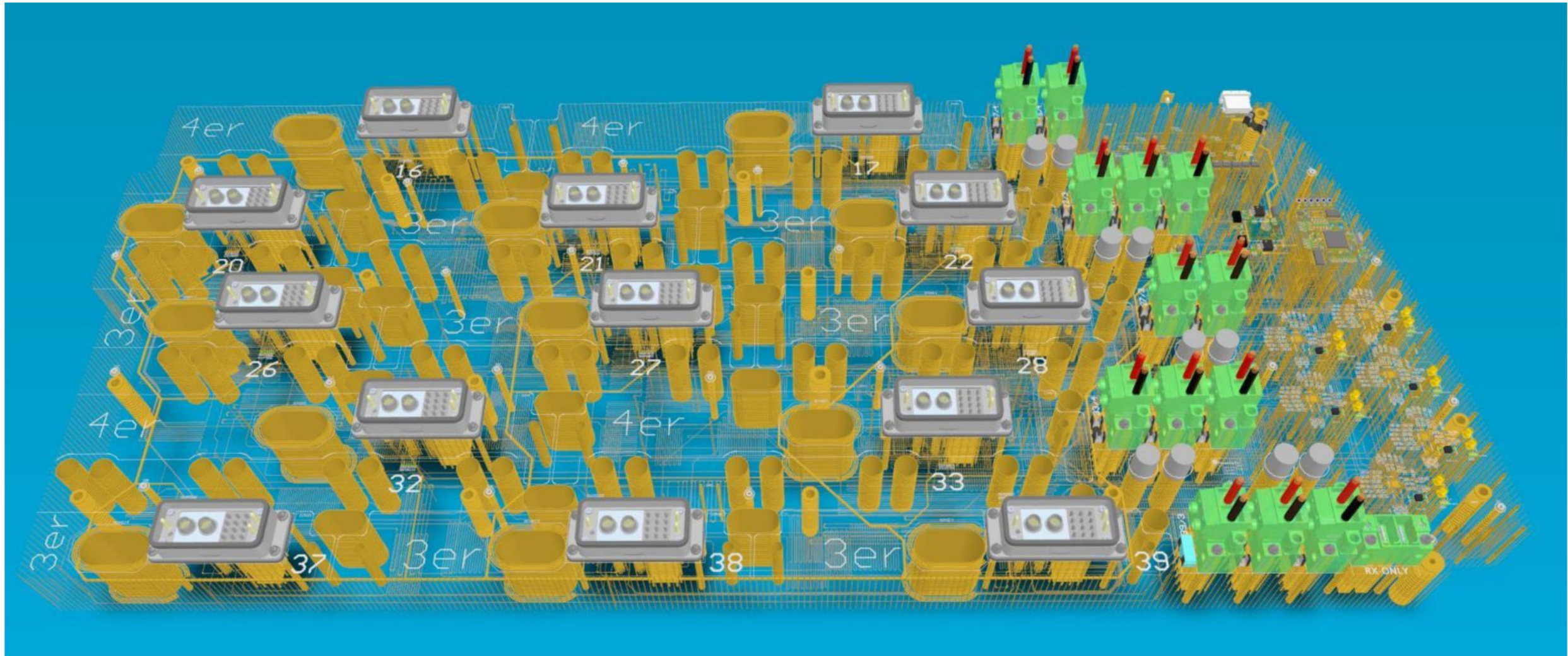


GESTRA - Design

- Shelter dimensions 18 m x 4 m x 4 m
- Weight ~ 90 metric tons
- Separate areas for heat exchanger, cold water unit, operating room and radar system
- Removable radome
- Scissor lift table for maintenance and transport
- 3-axis positioner
- Liquid-cooled antenna
- Highly flexible energy chain



22-layer view of the prototype backplane PCB

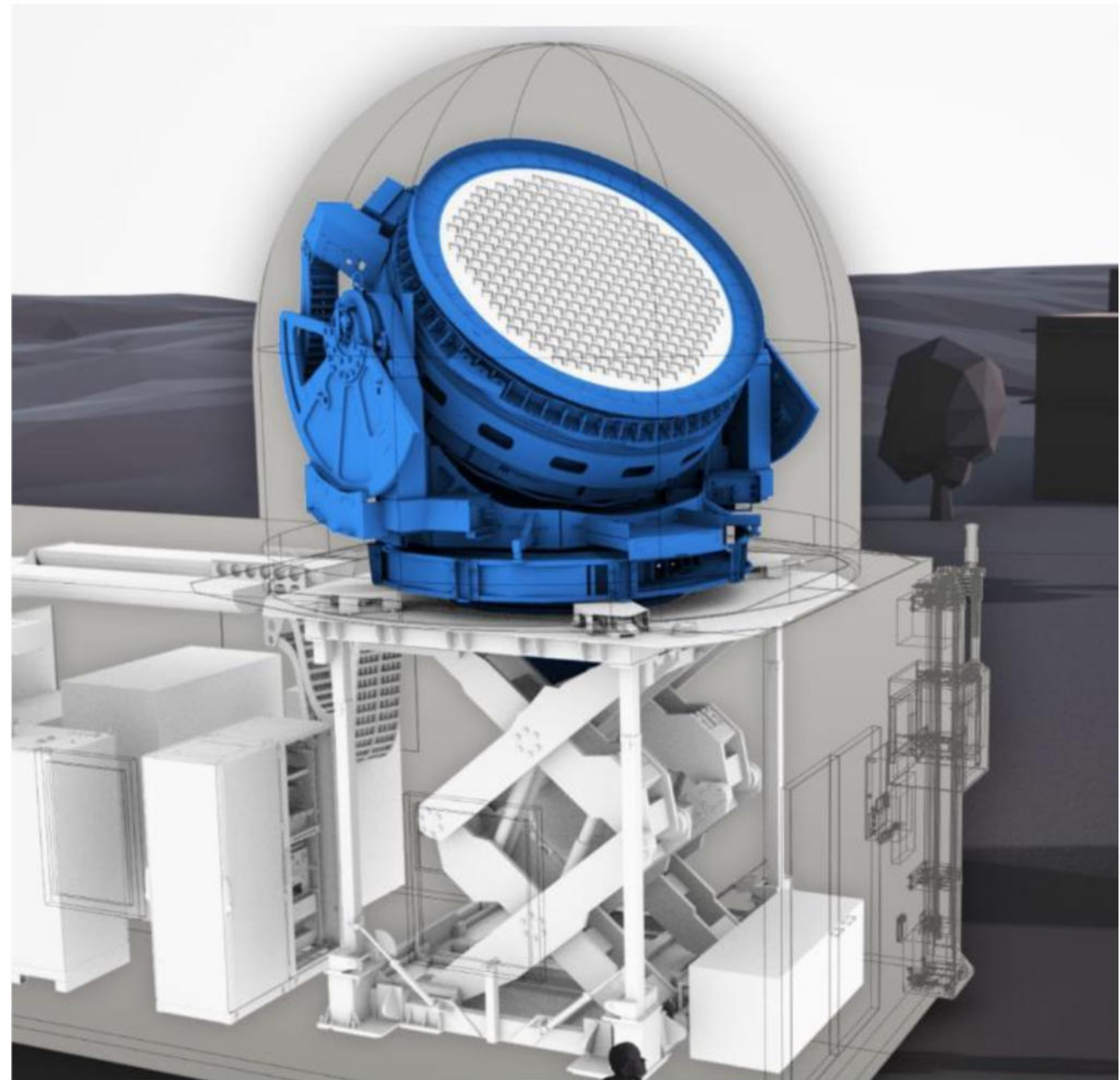


Impression – backplane PCB



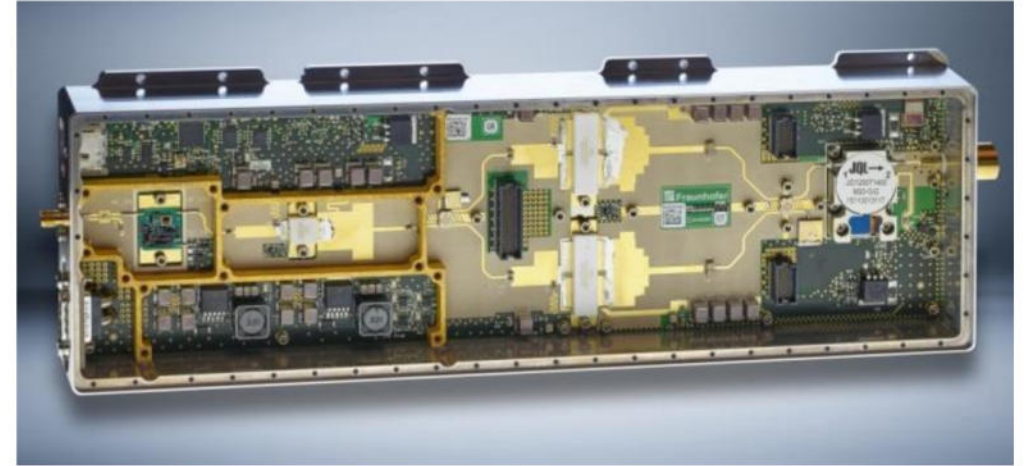
Positioner with antenna

- Planar phased array antenna with **256** active elements and integrated liquid cooling
- 3-axis positioner for selecting the Field of View
- Integration of energy chains



Development of key radar components

- Analogue antenna components:
 - Radiator elements
 - Transmitting amplifier
 - Input stage receiver
- SW defined radar on the single element
- Digital multiple directivity
- Highly stable signal generation
- Low jitter signal distribution
- Radar signal processing
- Radar operation control



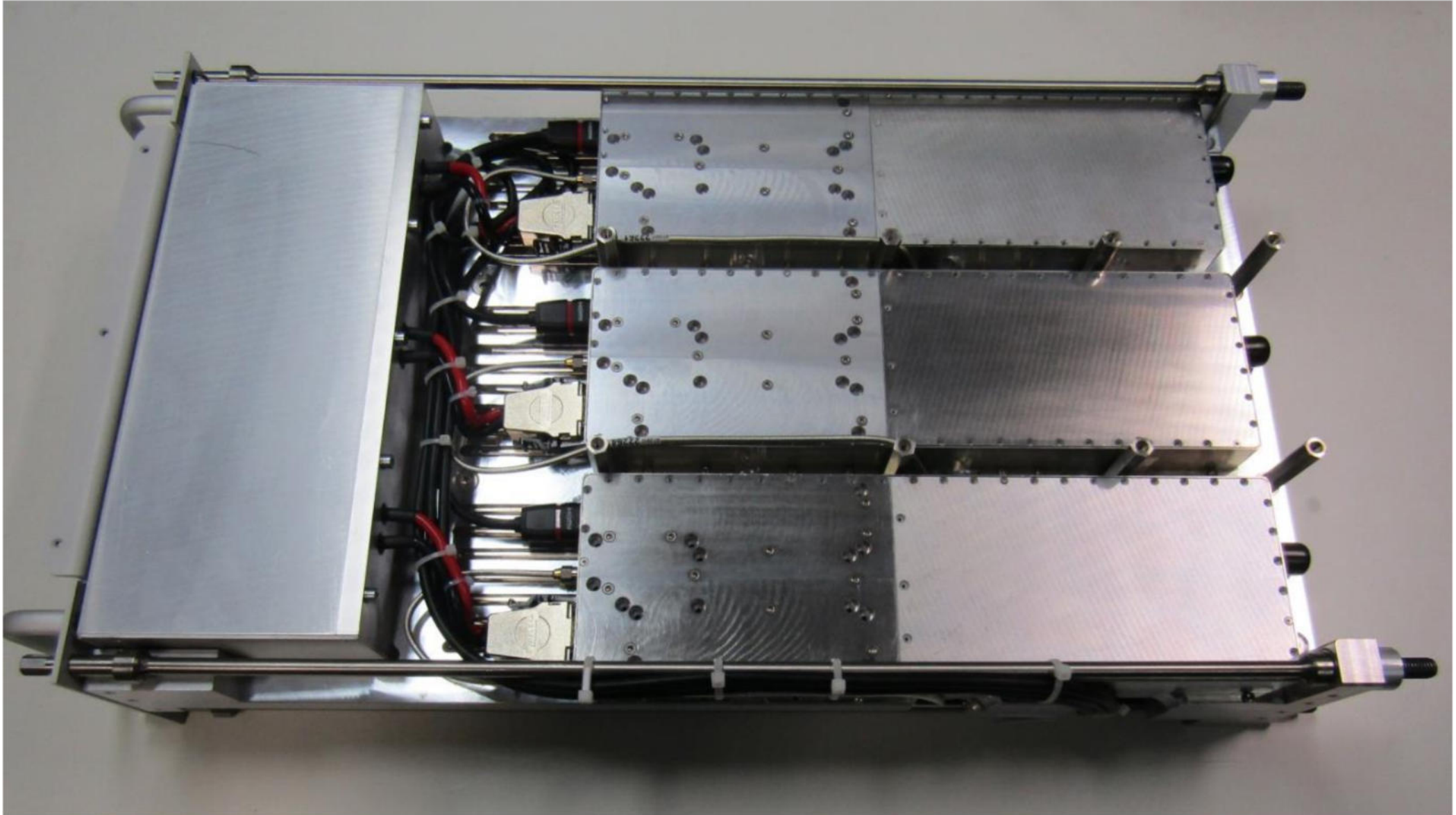
Power amplifier transmitter



Two-channel digital receiving element



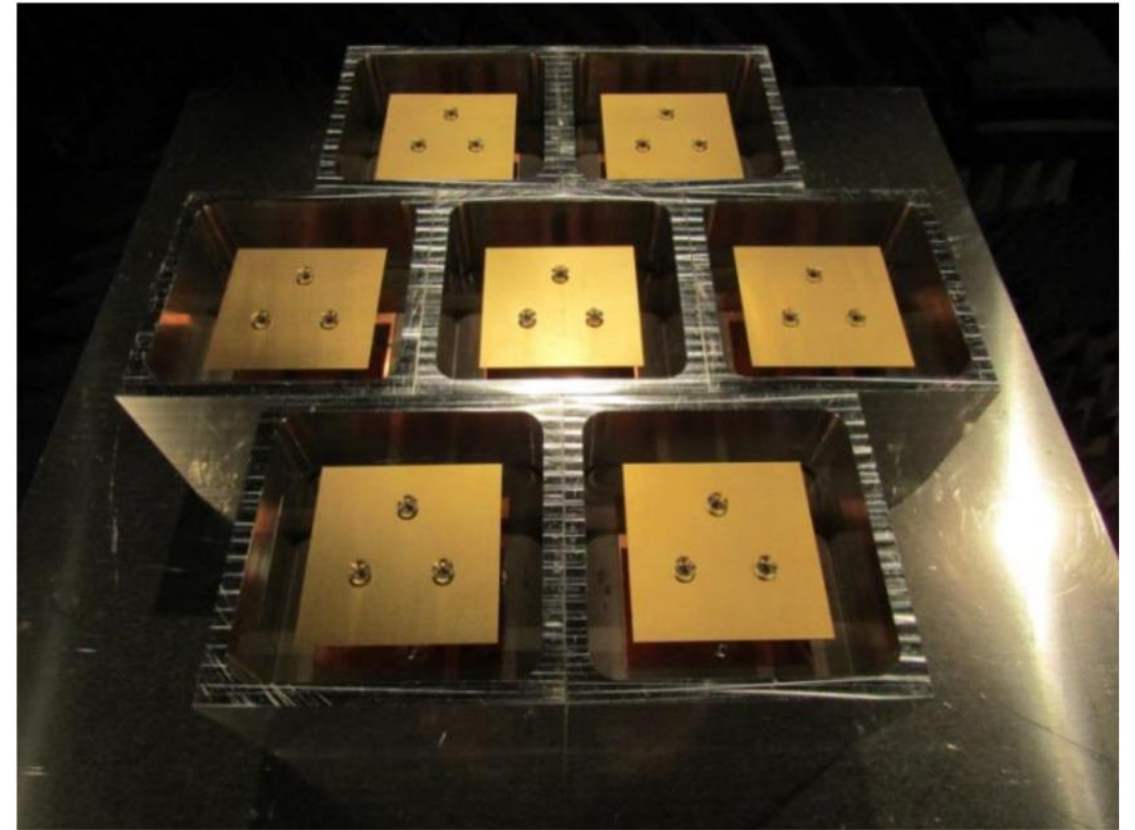
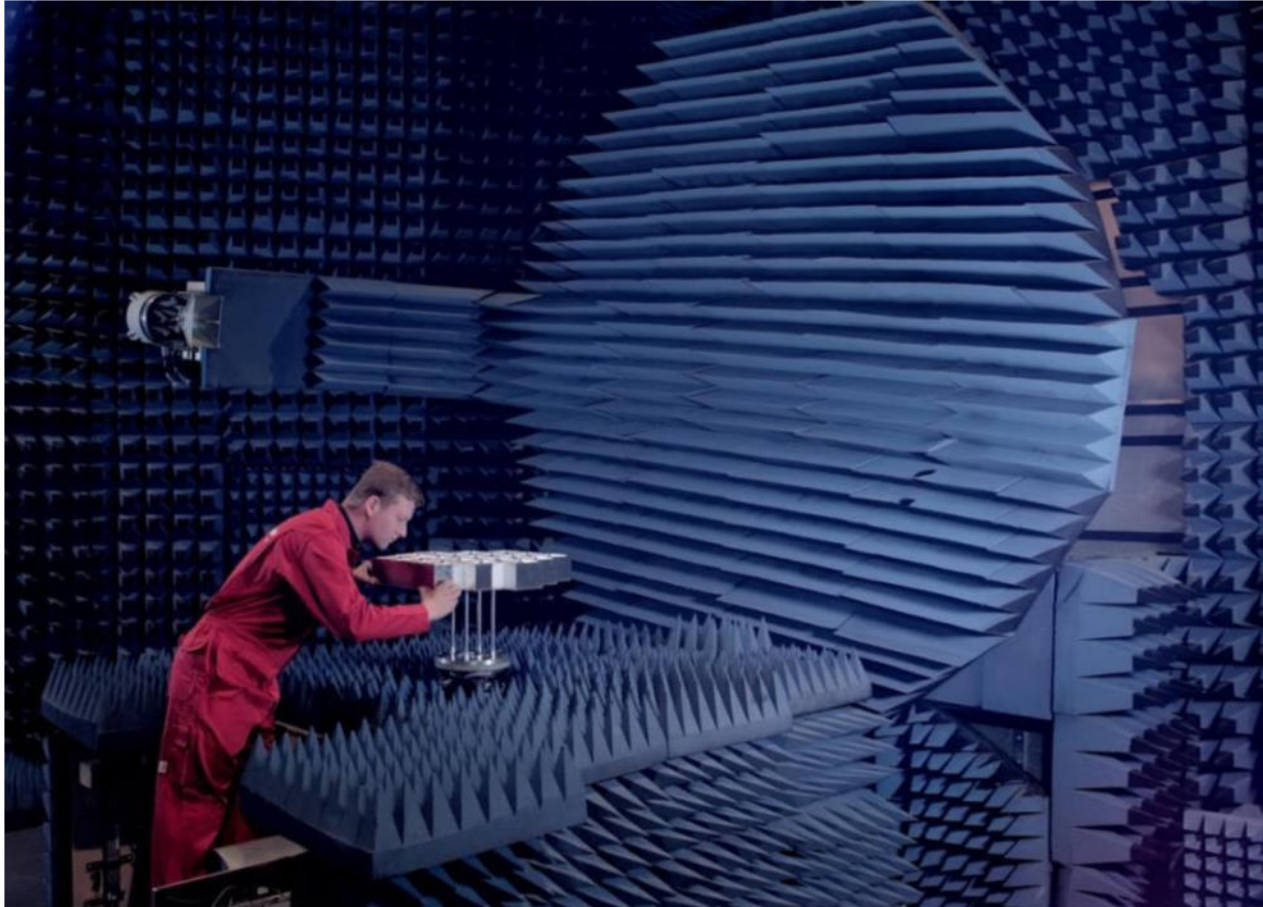
GESTRA – Plank structure



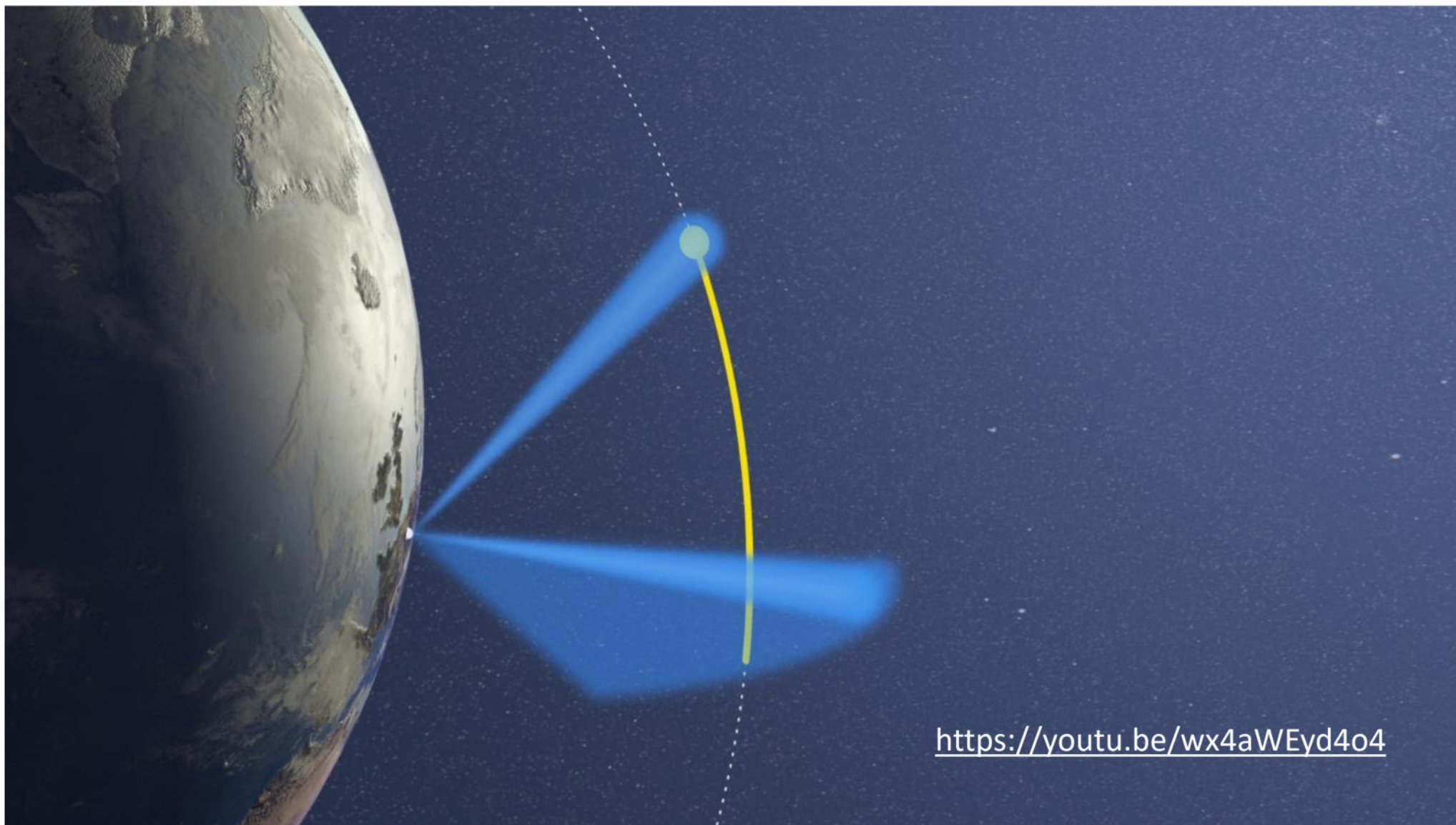
Mounting of a Plank unit



Measurement of the cavity patch antenna elements



Watch „GESTRA in operations“



Acknowledgments

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