Status of the GRACE Follow-on Mission

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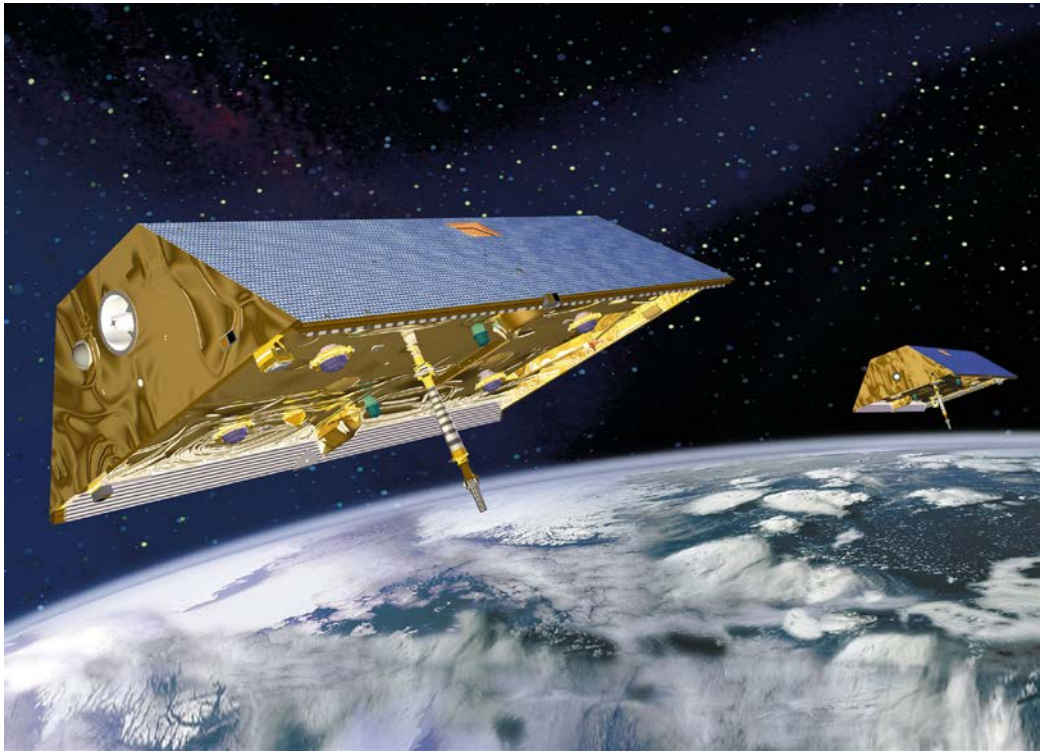
Outline

- Background
- Project Status
  - Implementation Status of Satellites and Instruments
  - Launch Vehicle
  - Mission Operations
  - Science Data System "Grand Simulation"
- Summary/Outlook

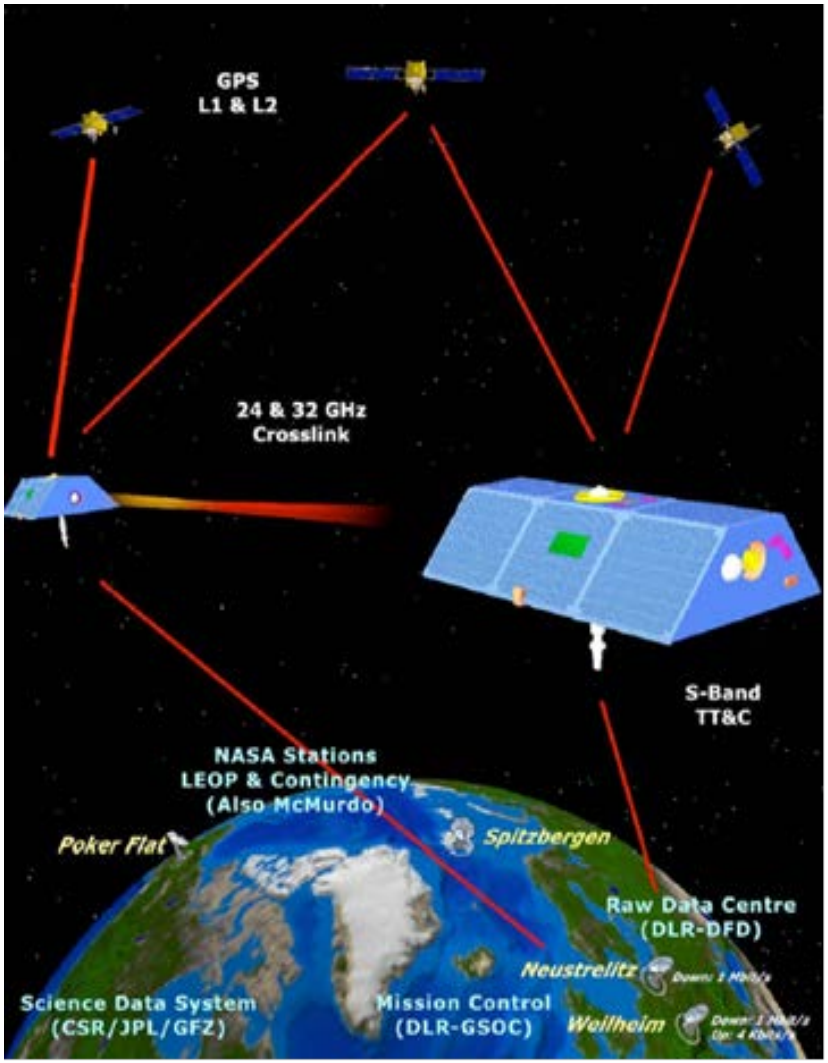


Background (1/2)

- Primary Mission Objective of GRACE FO is to continue to obtain the same extremely high-resolution global models of Earth's gravity field, including how it varies over time, as in the original GRACE mission, launched in 2002 and still operating.

- **GRACE FO follows the original GRACE mission**
  - Continues the recordGap filler between GRACE and GRACE-2
  - GRACE FO will also demonstrate a Laser Ranging technology in support of future GRACE-like missions. this is an important component of interest to NASA

- GRACE FO is a directed mission identified in NASA's 2010 plan



Pre-Decisional Information -- For Planning and Discussion Purposes Only

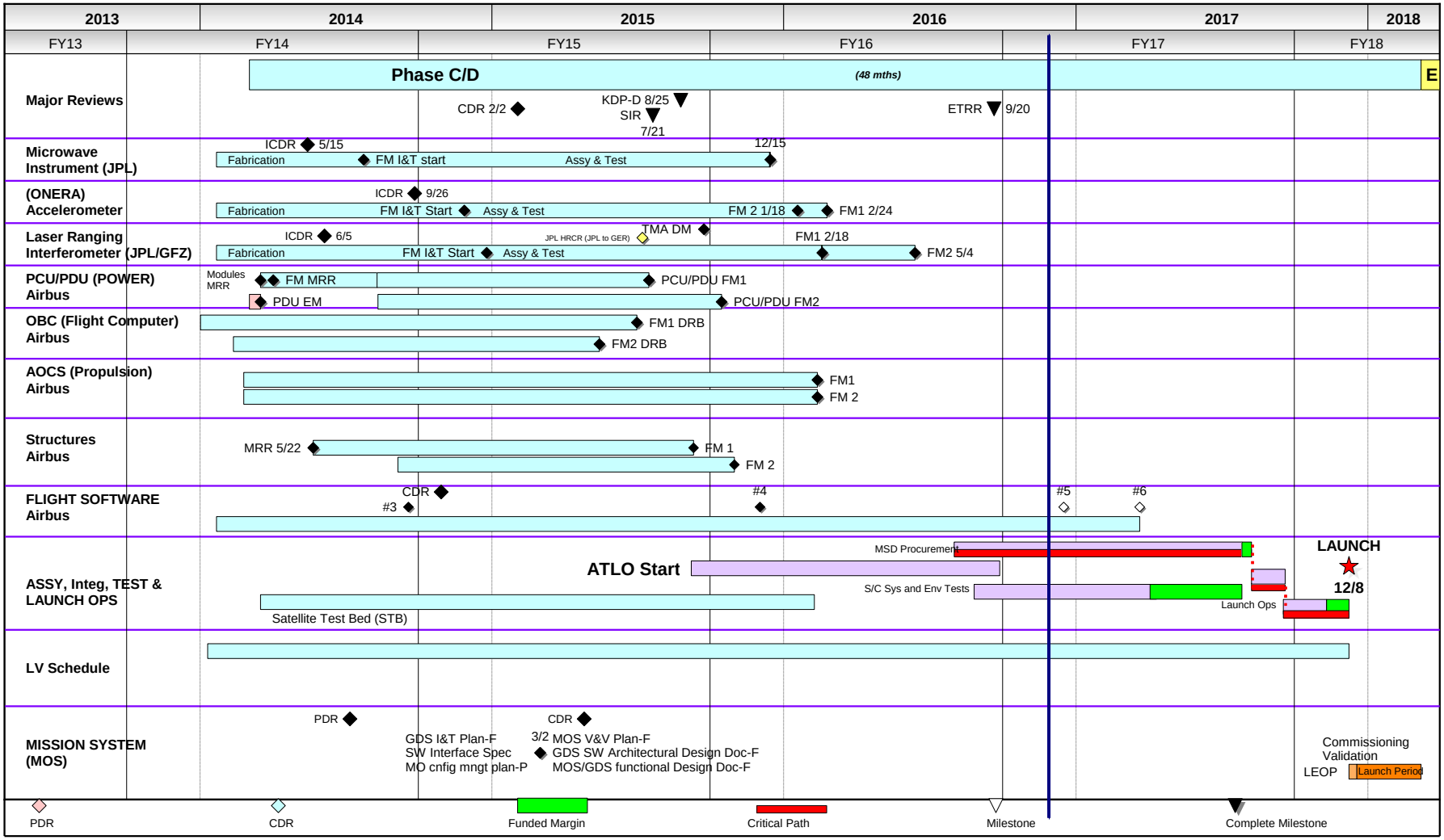
Background (2/2)

- GRACE end-of-mission dependent on solar activity, fuel consumption, instrument and battery status (continues to degrade) – could be (in best case scenario) early ’18, but will likely be much earlier.

- GRACE-FO (Follow-on)
  - Entered Formulation (Phase-A) in early 2012
  - Currently in implementation (Phase-D) with a target launch period from December 2017 through February 2018.

GRACE-FO GFO Phase C/D Schedule

Notional Schedule



Pre-Decisional Information -- For Planning and Discussion Purposes Only

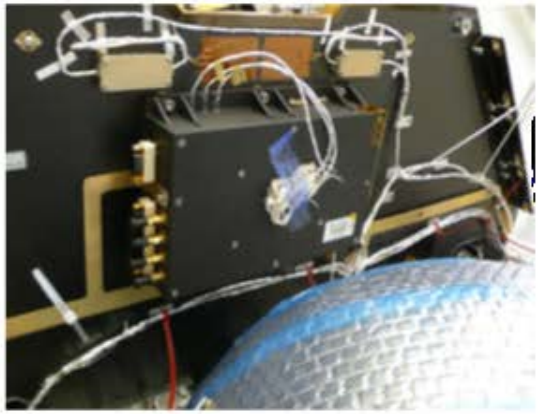
Implementation Status

- Project is currently in ATLO
  - Both flight systems (FM1 and FM2) are fully integrated (i.e., Accelerometer, Star Cameras, MWI, LRI)
  - All spacecraft pre-environmental alignments are completed

Integration Highlights

ACC/STR/TMA Integration
On FM1 with nominal shims

S/C FM1 Status



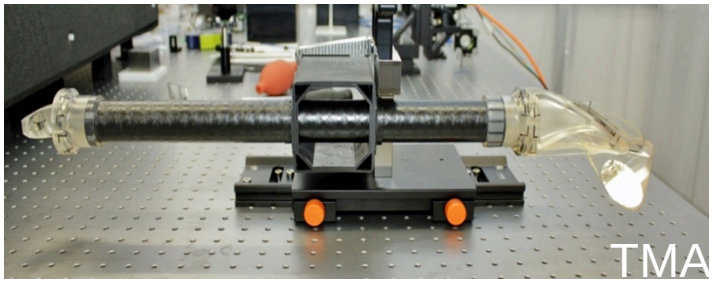
OBE Integration
Mechanical integration on FM1

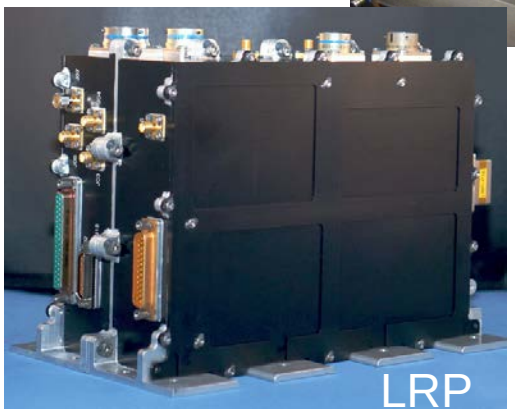
MTE integration
On FM2

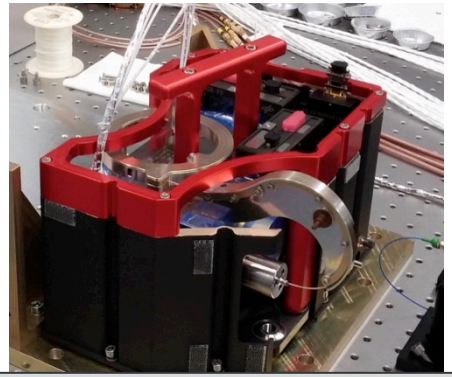
MTQ Electrical Integration
During magnetic field measurement

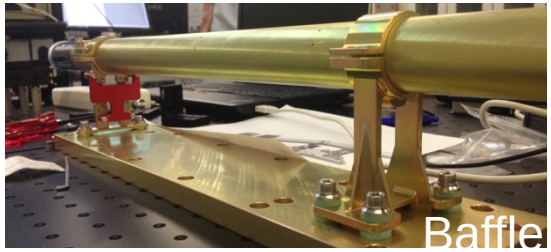
ACC/STR/TMA Integration
Final mounting of LRI TMA on FM1

LRI components





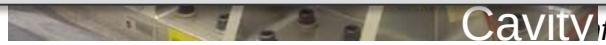


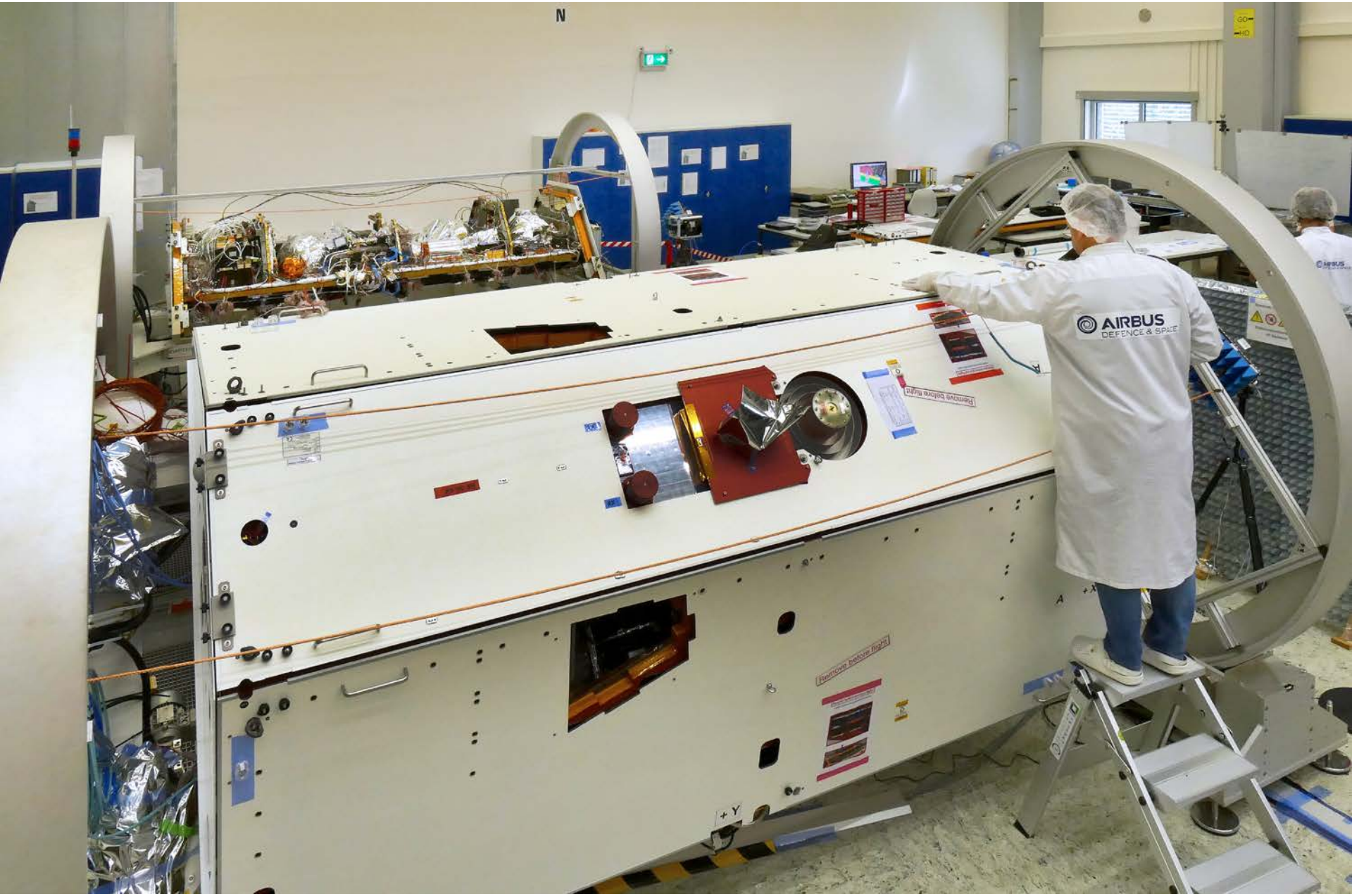


Further information will be provided in the following presentations:

V. Müller et al: Laser Interferometry for GRACE Follow-On & NGGM

B. Christophe et al: Expected performance of GRACE-FO accelerometers and status of MicroSTAR development for future gravity missions

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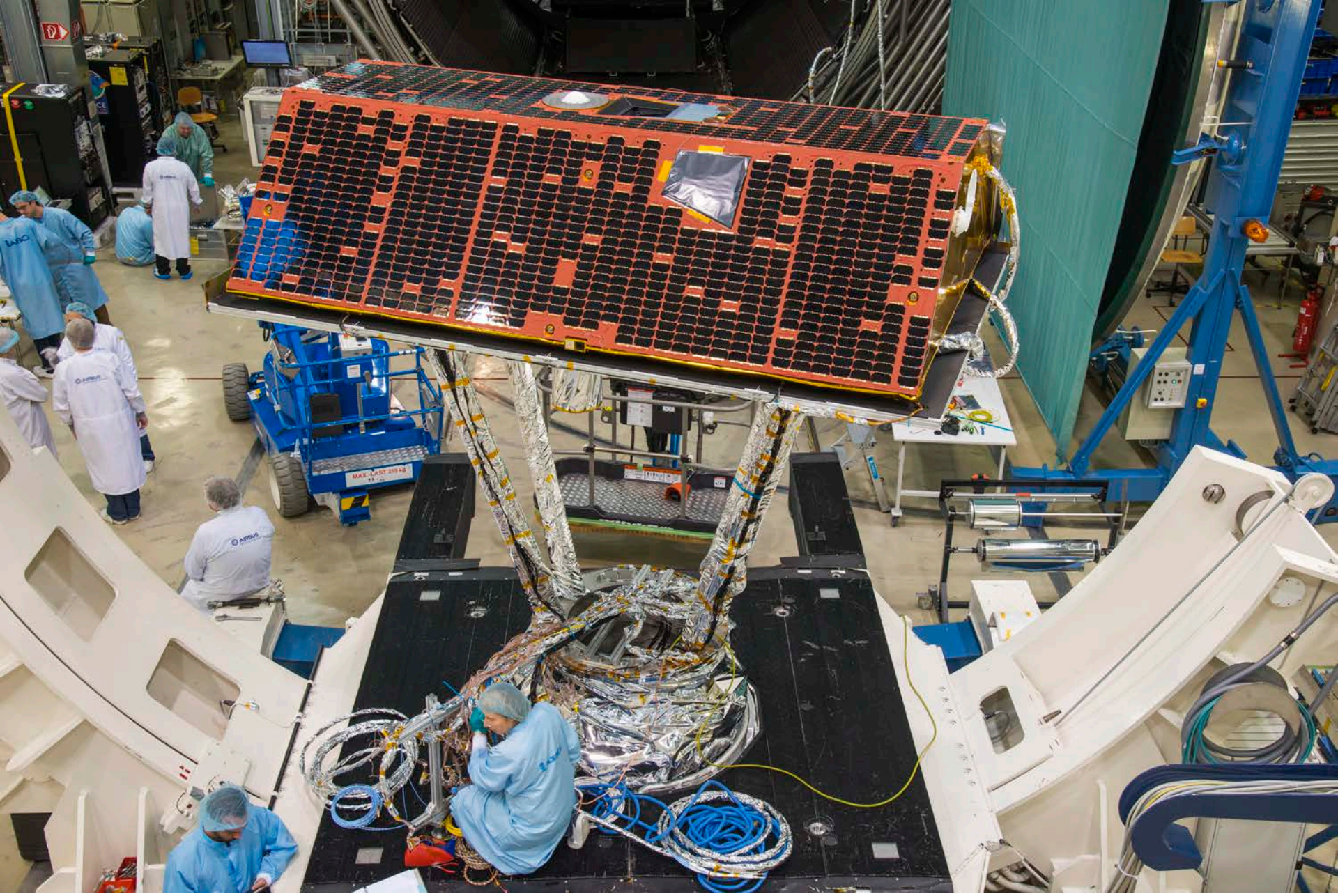
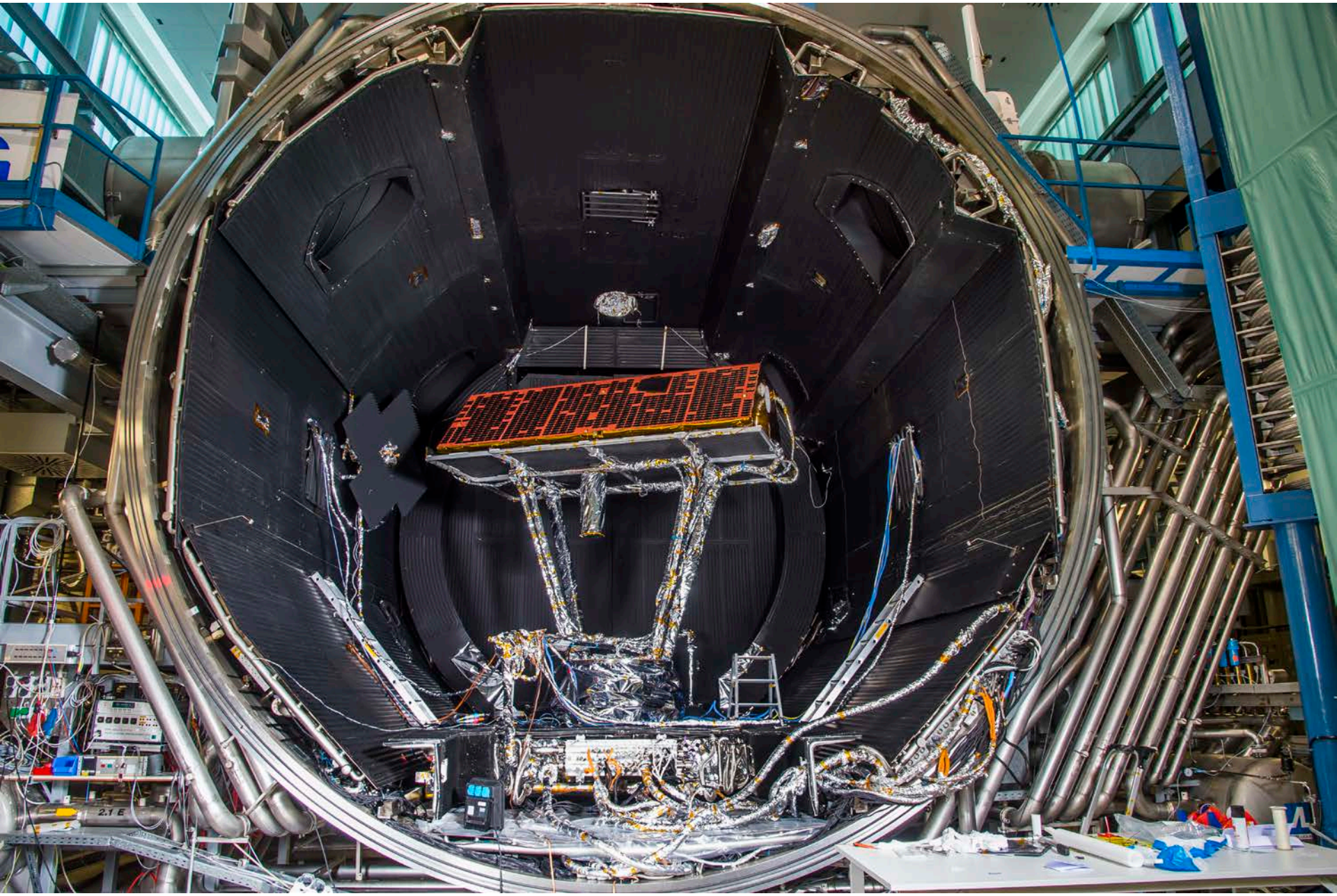
- Both S/C are in Environmental Tests at IABG
  - ETRR
    - Held in Sept at IABG
  - FM1
    - Environmental Test Campaign began in Nov 2016
    - TVAC completed
    - In middle of EMC testing
    - Preparing for dynamics tests in January
  - FM2
    - Enters TVAC in February 2017
    - Environmental tests expected to be completed by March 2017





Launch Vehicle

- GRACE-FO is a collaboration between NASA, leading on the US side, and GFZ, leading on the German side.
  - In the agreed allocations of primary responsibility between the collaborators, GFZ is responsible for providing the launch services and the multi-satellite dispenser.

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- The GRACE-FO Project is currently planning for a ride-share launch with several Iridium NEXT Communications satellites on a SpaceX Falcon 9 rocket from Vandenberg Air Force Base in California in the December 2017 – February 2018 timeframe.

Launch Vehicle

- Multi Satellite Dispenser
  - To be built by CASA, Spain – long & robust history for this MSD heritage design
- Launch Service Management
  - Airbus D&S (under contract of GFZ)

Schedule Summary

- *11/2016*
  - *Environmental Test Campaign starting at IABG*
- 09/2017
  - Pre-ship Review
- 12/2017 – 2/2018
  - Launch Period
- 3 months after launch
  - End of Commissioning/Start of science operations

“Grand Simulation” Content and Schedule

- “Grand simulation” is intended to Verify and Validate the SDS centers software and interfaces using a realistic data set, which includes:
  - Current best estimate of instrument noise for KBR, LRI, ACC, SCA and GPS
  - Timing errors, alignment errors
  - Background models currently used for GRACE processing. Final model selection (including monthly gravity deviation from static field (hydrology, glaciology, GIA) prior to August 2016 based on consensus within the SDS
  - AOD product included but no AOD errors or any other geophysical related errors
  - JPL Conducted “Grand Sim” Test Readiness Review (2016-07-15)

- “Grand simulation” data release to science community:
  - Initial Level-1B release (summer 2017) via PO.DAAC and GFZ archives. This release is only intended for science community software V&V and not gravity recovery science analysis. If time permits, 2nd release will be generated for this purpose.

“Grand Simulation” Content and Schedule

- All Level-1B data will use standard GRACE formats (in Ascii) (LRI1B uses KBR1B format)
- Full disclosure of models used for simulation at time of release

- SDS collaboration with GRACE-FO “Mock Data Challenge” (MDC)
  - Ensure MDC L1B data is in the standard GRACE format
  - SDS intends to participate in gravity recovery science analysis of MDC dataset

Further MDC information will be provided in the following presentation:

M. Naeimi, et al: Data Analysis Challenges for GRACE Follow-On (next presentation)

Summary

- GRACE-FO satellite/instrument implementation status is excellent
  - All science instruments on both satellites fully integrated
  - Environmental Test campaign at IABG starting October 2016
- MOS implementation and testing is on schedule
- Launch Vehicle
  - Baseline switched to Falcon-9 (shared ride with Iridium)
  - MSD development at CASA
  - Launch period is December 2017 – February 2018
- “Grand Simulation”
  - Testing the complete SDS system from science telemetry to science Level-2/3 products and serves as the V&V.
  - Data will also be made available to the user community (~ summer 2017).