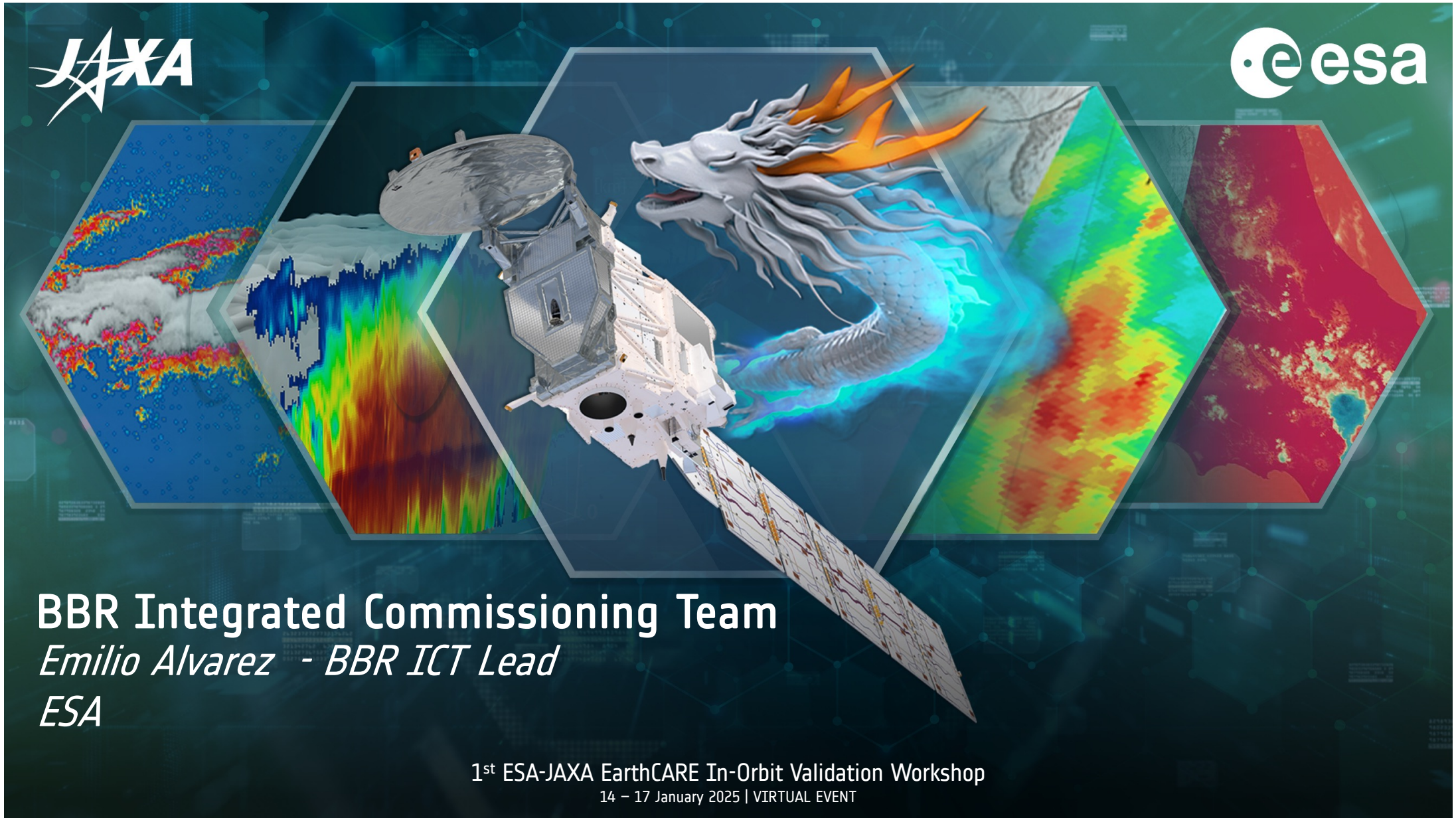


# BBR Integrated Commissioning Team

*Emilio Alvarez - BBR ICT Lead*
*ESA*

1st ESA-JAXA EarthCARE In-Orbit Validation Workshop
14 – 17 January 2025 | VIRTUAL EVENT

# Agenda

- Status of BBR Commissioning Phases:
  - **PHASE 1:** BBR Switch-ON → **COMPLETED**
  - **PHASE 2:** BBR In-orbit Health Status and Characterization → **COMPLETED**
  - **PHASE 3:** BBR In-orbit Health Status and Calibration → **COMPLETED**
  - **PHASE 4:** BBR Instrument and L1 in-orbit Performance Analysis → **COMPLETED**
  - **PHASE 5:** Silent Configuration (Ad-hoc/interim configuration) → **COMPLETED**

# BBR ICT - Phase 1 Definition

**PHASE 1: BBR Switch-ON Activities:**

- Operations:
  - In-orbit
- Starting Condition:
  - Platform IOV activities completed
- General Description:
  - Power ON BBR LCL → Transition to INS-DEC to perform Instrument Decontamination → CDM Speed modification and check (0.6x, 0.75x, 1.0x) → Restore baseline speed (0.75x) → Continue with mode transition up to INS-NOM → Monitor ISP generation.
- Highlights:
  - Several NCRs taken into consideration during Switch-On Activities: NCR- 2534, NCR- 2366, NCR- 0189-1932
  - To avoid FDIR, BBR to be cooled down after decontamination before transition back to IDLE mode (switching-off decont heaters)
  - No commissioning of BBR Redundant configuration planned
- Success Criteria:
  - 1.- Power ON BBR LCL
  - 2.- Decontamination phase executed.
  - 3.- CDM Speed modification functionality confirmed
  - 4.- All mode transitions executed nominally.
  - 5.-Nominal A-side switched-on up to INS-NOM
- Expected duration (aprox. in Nominal case): 18 hours (12 hours for decontamination completion)

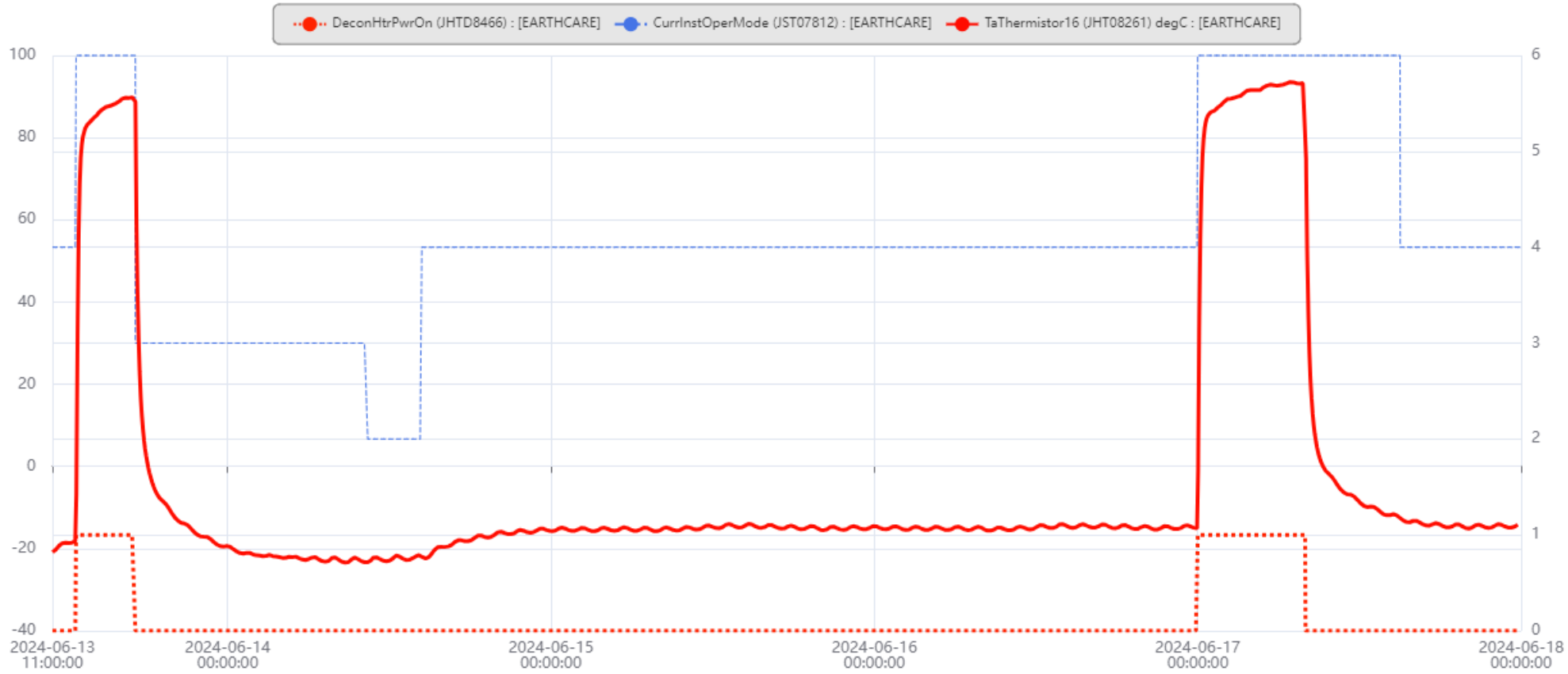
# BBR ICT - Phase 1 Status → COMPLETED

**PHASE 1: BBR Switch-ON → COMPLETED**

- All activities executed successfully → All success criteria defined were achieved → Continuation with the Phase 2 of the BBR IOV Plan.
- All BBR mode transitions (OFF → INS-INI (LCL ON) → INS-SBY → INS-IDL → INS-DEC → INS-IDL → INS-NOM) were executed nominally and as planned.
- Decontamination phase completed successfully on Monday 17 June.
    - **AR EC_SC-10**: "BBR: DEC mode aborted due to high temperature in TaThermistor 16" → Root-cause understood to be an incorrect FDIR setting on-board. Way-forward agreed to modify the FDIR monitor high limit and continue with the DEC mode.
- The **functionality of the CDM Speed modification was confirmed on Tuesday 18 June**. Three velocities were exercised:
    - 75% (196 rpm), 60% (156 rpm) and 100% (261 rpm). Baseline speed of 75% (196 rpm) was restored in preparation for transition to INS-NOM.
    - ***NB.:*** *Additional* ***performance check with respect to the very same different speeds*** *(with BBR in INS-NOM) was executed in CW47 → No significant impact on the performance was reported at the ICT.*
- **BBR transition to INS-NOM performed successfully on Tuesday 18 June.**
    - ISP generation started and L0 data available on the commissioning server.
- All success criteria defi

# BBR ICT - Phase 1 Status → Decontamination

**BBR Decontamination Htrs**



# BBR ICT - Phase 1 Status → CDM Speed Modification

# BBR ICT - Phase 2 Definition

**PHASE 2: BBR In-orbit Health Status and Characterization:**

- Operations:
  - In-orbit / On-ground Processing and Analysis
- Starting Condition:
  - BBR Phase 1 completed.
  - BBR Mode: INS-NOM
- General Description:
  - Detail TM Check generated by while BBR in INS-NOM (Thermal, Mechanism, Power, Datation (PPS correlation))
  - Several checks and procedure to be executed: Telescope Raw Check, SW Calibration Check, Detector Linearity and Temperature Stability, Chopper Drum Speed Stability
- Highlights:
  - Confirm successful BBR Level-0 and Level-1 data provision to TAS-UK in support of BBR Characterization
- Success Criteria:
  - Several Success Criteria defined for the individual sub-tasks in this Phase (more details are provided in JIRA)
- Expected duration (aprox. in Nominal case): 18 hours

# BBR ICT - Phase 2 Status → COMPLETED

**PHASE 2: BBR In-orbit Health Status and Characterization → COMPLETED**

- All activities executed successfully.
- Telescope raw check was performed successfully on Tuesday June 18
- The inversion of the BB heater power settings as part of the detector linearity checks was performed successfully on Tuesday 18 June.
- **Standalone SW calibration execution executed on CW25**.

- **AR EC_SC-12** raised after it was found that the signal in the Telescopes 2 & 3 RED MPDs (2 out of 9 MPDs) was saturated (see plot above by courtesy of Airbus). All other MPDs were in signal range

# BBR ICT - Phase 2 Status → COMPLETED

**PHASE 2: BBR In-orbit Health Status and Characterization → COMPLETED**

Several ARBs in relation to EC_SC-12:

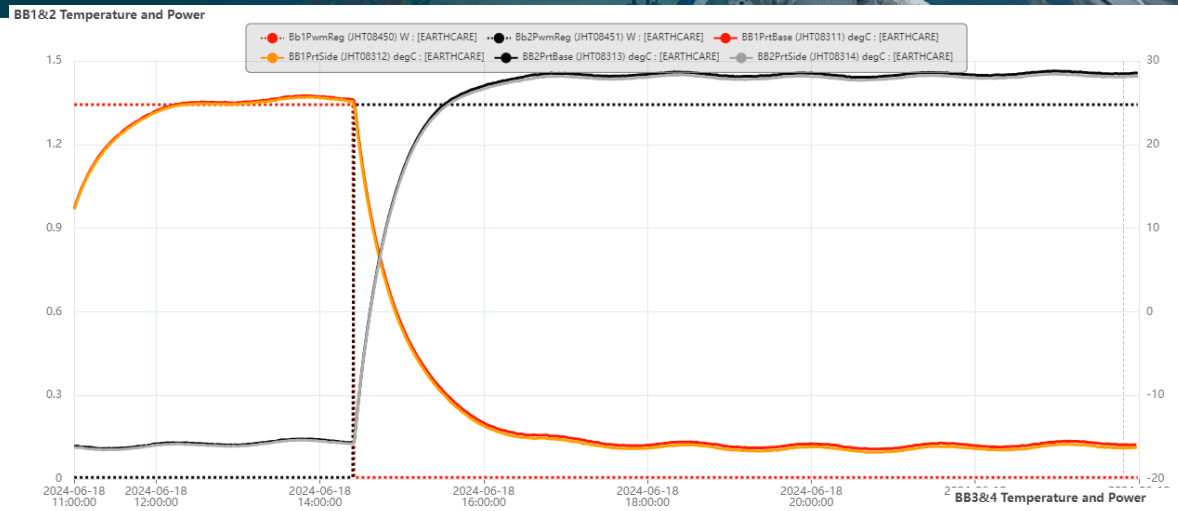
- **ARB#01** (Monday 24 June): Possible scenarios for root-cause presented and discussed:
  - Physical failure of the spectral filter on the red MPDs → Discarded after further investigations by industry.
  - Accidental CDM frame edge reflection due to the 75% operational speed. → Test performed in-orbit with operational speed at 100%. Results were similar than with 75%. Root-cause was discarded
  - Incorrect setting of the MPD gain.

- **ARB#02** (Tuesday 25 June): After a **Confirmation of root-cause as an incorrect setting of the MPD →** no possible correction in-orbit.
- Agreed to continue with the **Reference SW Calibration Campaign that was executed for 30 orbits on the 26-28 Jun → Confirmation of MPF algorithm for planning of SW Campaign**

- **ARB#03** (Tuesday 03 September): A **new operational approach** of the SW Calibration Campaign was agreed:
  - To perform 25 nominal SW calibrations with the same sun elevation angle (6.8deg) and duration (as per current baseline)
  - To perform 5 additional SW calibrations with the same duration as for the nominal 25 nominal SW calibration but time shifted to obtain the information from the slope. New value for the sun elevation is 9.6deg
- **The new Mission Planning algorithm was implemented and tested to cope with the new operational approach!**

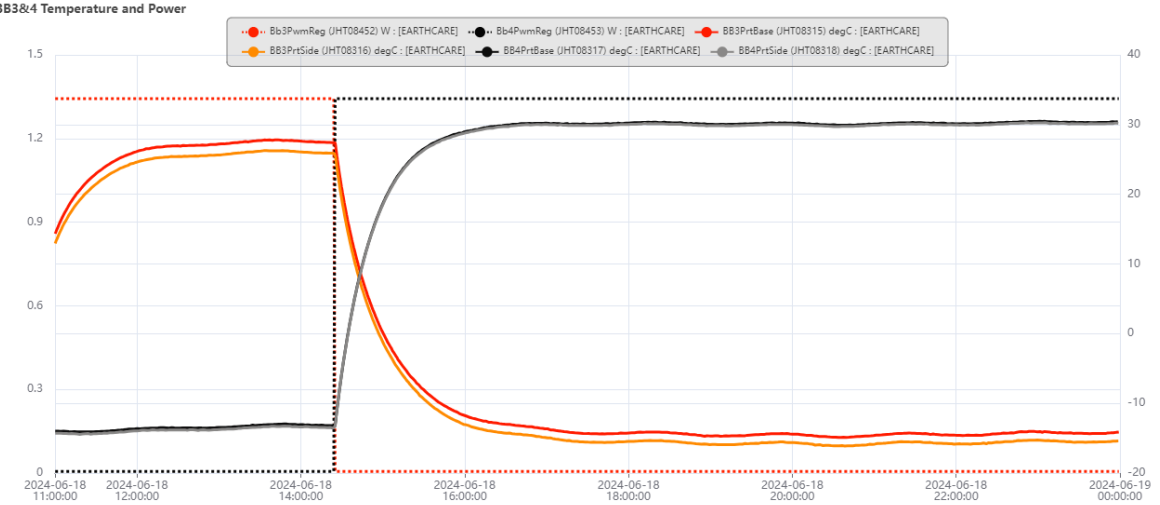
- All success criteria defined for task BBR-02 were successfully achieved and completed. → Authorisation is given to continue with BBR-03 activities of the BBR IOC Plan

# BBR ICT - Phase 2 Status → BB Inversion




**<---- Inversion of BB 1 & 2: Temperature and Power**

**Inversion of BB 3 & 4: Temperature and Power ---->**



# BBR ICT - Phase 5 Definition

**PHASE 5: Silent Configuration:**

- Operations:
  - In-orbit
- Starting Condition:
  - BBR Phase 1, 2, 3 & 4 completed
- General Description:
  - BBR switch to low speed until completion of IOV activities of other instruments.
  - This is done to save CDM rotation (LLI Items)
  - The recovery to the baseline speed will be performed as soon as the other instruments are in their respective Nominal Modes
- Highlights:
  - Speed to be confirmed with ADS / TAS-UK
- Success Criteria:
  - 1.- BBR at low speed or SBY Mode
  - 2.- After all instrument in INS-NOM Observation / Measurement Mode → BBR recovered to baseline speed and stable in INS-NOM
- Expected duration (aprox. in Nominal case): 1 hour

# BBR ICT - Phase 5 Status → COMPLETED

**PHASE 5: Silent Configuration (Ad-hoc/interim configuration) → COMPLETED**

- BBR was successfully commanded to SBY Mode on Friday 28 June after the completion of the reference Solar Calibration Campaign.
- Instrument remained in SBY until all other instrument were in their corresponding operational modes (Measurement Mode).
- **Instrument switched back to INS-NOM in CW30 (23 June) as planned**. Instrument in SBY Mode for almost 1 month.

# BBR ICT - Phase 3 Definition

**PHASE 3: BBR In-orbit Health Status and Calibration:**

- Operations:
  - In-orbit / On-ground Processing and Analysis
  - Mission Planning from MPF required for the periodic Solar Calibration Campaign
- Starting Condition:
  - Platform IOV activities completed
- General Description:
  - Optimization of the BB heater power
  - Update on-board tables in preparation for the reference solar calibration campaign
  - Perform Second Solar Calibration (29 orbits/2 days) and Second Solar Calibration (2 months after reference calibration)
- Highlights:
  - Saturated MPDs during SW Calibration Campaign
- A Success Criteria:
  - Execution of Second SW Calibration Campaign
  - Several other Success Criteria are defined for the individual sub-tasks defined in this Phase (more details provided in JIRA)
- Expected duration (aprox. in Nominal case): 2 months taking into account the Second Solar Calibration.

# BBR ICT - Phase 3 Status → COMPLETED

**PHASE 3: BBR In-orbit Health Status and Calibration → COMPLETED**

- After completion of Phase 5, BBR reached IDLE on Tuesday 23 July. CDM switch to baseline speed was confirmed successful.
- After telescope thermal stabilization was confirmed, the instrument was commanded to INS-NOM on Tuesday 23 July.
- BBR continues nominally in INS-NOM since that day, with no plan to return to the Silent Configuration (SBY) for the time being.
- Optimization activities as part of the Phase 3 were skipped:
  - No need for optimization of the BB heater power
  - No need for any update on-board tables in preparation for the reference solar calibration campaign

- **Second SW Calibration Campaign was executed for 30 orbits on the 26-27 August**. N.B.: Campaign executed still with the old operational approach.
- **Data Analysis from the two different SW Calibration Campaign confirmed OK.**
- NB.: A Third SW Calibration Campaign was executed in in November in CW44

- All success criteria defined for task BBR-03 were successfully achieved and completed. → Authorisation is given to continue with BBR-04 activities of the BBR IOC Plan

# BBR ICT - Phase 4 Definition

**PHASE 4: BBR Instrument and Level-1 In-Orbit Performance Analysis:**

- Operations:
  - On-ground Processing and Analysis
- Starting Condition:
  - Platform IOV activities completed
- General Description:
  - Evaluate performances of the measurements obtained during Phase 1, 2 and 3: Long Wave performance analysis (Gain, radiance noise, stability); Short Wave performance analysis (Filter transmissivity, MDP Noise level);Chopper drum stability:
- Highlights:
  - Performance analysis (based on L1 data) will last for several months.
  - Confirm successful BBR Level-0 and Level-1 data provision to TAS-UK in support of BBR Characterization
- Success Criteria:
  - Several Success Criteria are defined for the individual sub-tasks defined in this Phase (more details provided in JIRA)
    - LW gain: A gain value which differs from prediction by more than 10% is sufficient to highlight non-operating pixels.
    - Radiance Noise: < 2.8 W/m2 sr
    - The long wave gain compared between any neighboring TW calibration <1% will indicate success
    - Filter transmissivity: A value of all three within 10% indicates success.
    - MPD noise levels: Expected variation from the true value is lower than 0.04% indicates success.
    - Chopper drum stability: Variation of <+/-0.5% in the speed equivalent, relative to the commanded speed, will indicate success.
- Expected duration (aprox. in Nominal case): 4 months

# BBR ICT - Phase 4 Status → COMPLETED

**PHASE 4: BBR Instrument and L1 in-orbit Performance Analysis → IN PROGRESS**

- The evaluation of the BBR Performances during several months of the commissioning phase indicates in general **very good results**., with all the requirements assessed as **COMPLIANT**. See assessment of compliance reported by Airbus

- **BBR was the first EarthCARE instrument to release the L1 products to the L1 teams:**
  - Release of the BBR L1 products B-NOM and B-SNG to the the Validation Teams on the 5 September 2024.

- **Outstanding work performed by the BBR ECGP Team during the complete commissioning:**
  - 2 updates released since launch with the latest version to support the Level 1 product public release. The main updates for this BBR ECGP are:
    - Update of CCDB containing the instrument pointing information to improve the geolocation of the products and the correction of the mismatch between the 3 BBR telescopes spatial coverage for one frame
    - Additional information provided to the B-SOL (solar calbration) products needed by the ICMF to cope with the anomaly of the saturation of the MPD
  - Further details on data quality will be presented during the Workshop
  - Final session is scheduled on the 15 January to clarify and close the latest open questions.

**Thank you very much for your attention!!**

**Questions??**