

EarthCARE ATmospheric LiDAR (ATLID) performance status after 3 and half billion shots of successful in-flight operation. Comparison and impact on other ESA LiDAR Missions

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ABSTRACT

ATLID (ATmospheric LiDAR) is the atmospheric backscatter LiDAR (Light Detection and Ranging) on board of the EarthCARE mission. ATLID's purpose is to provide vertical profiles of optically thin cloud and aerosol layers, as well as the cloud altitude. ATLID emits laser pulses (ns) in the UV, at a repetition rate of 50.5 Hz, while pointing in a near-nadir direction along the satellite trajectory. The atmospheric backscatter signal is then collected by its telescope to measure the atmospheric Mie and Rayleigh scattering signals.

EarthCARE satellite was launched on May 24th, 2024. The ATLID laser was switched on for the first time in flight on July 25th, 2024, and, after some setting optimizations, the final UV emitted energy of 37.8mJ was reached, in line with the requirements. A continuous linear decay of 4μJ/day of the UV energy (loss of almost 4% per year) has remained constant from December 2024 till May 2026. In the last months the decay rate has increased to 5μJ/day but with a trend that seems to return to the original one. It could be related to seasonal effects; the new trend reasons are under investigation and are continuously monitored. In any case this change has no impact on the duration of the mission and it is in the margins that could be managed. There are several Tx parameters that could be used to increase energy again and to extend the lifetime of the instrument well beyond the nominal mission duration. After more than two years of operations the laser confirms the enhanced performance stability proved during on ground tests. Until now no Tx parameter has been used to increase the UV energy even: study of a possible approach to restore the initial UV energy is under investigation, and it will be considered in case of necessity of increase data quality.

This paper will provide a summary of the status of the performances of ATLID after more than 2 years of in-flight operations with trend analysis and estimation of long-term performances. A comparison with respect to the performances of the first ESA LiDAR Mission, AEOLUS, particularly Laser performances along the mission, will be presented.

Based on Aladin experience, efforts were put in the ATLID laser design to improve thermo-mechanical stability and robustness against contamination induced LIDT, including dry air pressurization. Moreover, enhanced performance stability has been proven since on ground test at laser and instrument level. For this reason, based on the heritage of laser transmitters already successfully utilized in the Aeolus and EarthCARE missions (with the ALADIN and ATLID instruments respectively), and based on the lessons learned of both missions, an ATLID like design was selected both for the transmitter and for the instrument of the Aeolus-2 mission. This approach was selected to guarantee high confidence in the long-term performance of the Aeolus-2 DWL. A description of how the in-flight performance of ATLID is impacting the Aeolus-2 design and increasing the confidence in the performance at end of life of Aeolus-2 will be provided.

Keywords: EarthCARE, ATLID, performance check, laser pulse energy, laser line of sight LIDAR; UV laser; hot pixels; pressure,

INTRODUCTION

EarthCARE mission and satellite

The EarthCARE mission represents the third Earth Explorer Core Mission of ESA's Living Planet Program and is designed to address key uncertainties in the representation of clouds, aerosols, and their radiative effects in climate and weather prediction models. Its core scientific objective is to provide simultaneous, co-registered observations of the vertical structure and horizontal distribution of cloud and aerosol fields, together with outgoing thermal and solar radiation, across all climate zones. These observations will directly support the improvement of numerical weather prediction and climate modelling by enabling more reliable parameterization of cloud–aerosol–radiation interactions. [Allegato +1]

To achieve this, the EarthCARE spacecraft carries a coordinated payload of four instruments on a common platform: the ATLID (ATmospheric LIDAR, developed by Airbus Toulouse), the CPR (Cloud Profiling Radar, provided by JAXA/NEC), the MSI (Multi-Spectral Imager, from SSTL), and the BBR (Broad-Band Radiometer, from TAS-UK). The shared platform architecture ensures that all instruments observe the same atmospheric column with well-characterised geometric relationships, allowing both individual and synergistic data processing. All fields of view are nominally aligned with the satellite ground track; the MSI field of view covers nadir but is slightly offset to one side of the track, while the BBR additionally incorporates forward- and backward-looking fields of view.

EarthCARE operates in a sun-synchronous orbit at an altitude of approximately 400 km, with a descending node crossing time of 14:00 and a repeat cycle of 25 days. The nominal mission lifetime is three years, with sufficient consumables to support a one-year extension. The mission builds upon the heritage of CloudSat/Calipso, offering enhanced performance and fully collocated radiation measurements.

The mission's data products are intended to deliver vertical profiles of aerosols, liquid water, and ice; observations of cloud distribution and vertical motion within clouds; and retrievals of atmospheric radiative heating and cooling rate profiles. These products will be generated from the combined measurements of the four instruments, exploiting their complementary capabilities to characterise microphysical and radiative properties of clouds and aerosols.

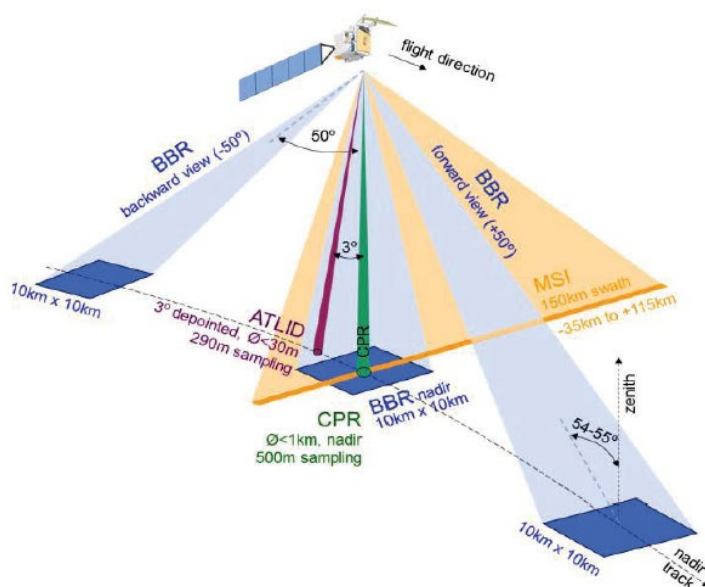


Figure 1. EarthCARE and payload observation geometry.

Verification of instrument performance follows a two-level strategy. First, comprehensive performance verification tests are conducted at instrument level. Second, a series of Instrument Performance Checks (IPCs) is executed periodically at both instrument and satellite levels. IPCs are specifically designed to confirm that the baseline performance established during instrument-level testing is preserved after integration onto the spacecraft platform and throughout the subsequent satellite assembly, integration, and testing (AIT) campaign up to launch.

For ATLID, five IPCs have been defined in close coordination between the Airbus instrument team and the satellite prime contractor. Their definition reflects a compromise between rigorous performance verification and the practical constraints of repeating such checks during satellite AIT. These constraints include laser safety requirements, cleanliness constraints (ISO8 environment), the complexity of optical test configurations, the need to limit individual test durations to less than one day, and reduced accessibility of the instrument once integrated at a height exceeding 3 m on the satellite structure.

The EarthCARE mission is implemented in collaboration with the Japan Aerospace Exploration Agency (JAXA), which is responsible for providing the Cloud Profiling Radar. The European payload comprises the Atmospheric Lidar, the Multi-Spectral Imager, and the Broad-Band Radiometer.

The satellite, with a mass of approximately 2 tonnes, was fully integrated at Airbus Friedrichshafen. The ATLID Proto-Flight Model (PFM) was delivered by Airbus Toulouse in March 2020 and integrated onto the platform in May 2020. The integration operation involved sliding the 550 kg instrument into a platform compartment with less than 2 cm of clearance, as illustrated in Figure 2 (right). This activity was further complicated by restrictions imposed during the first coronavirus-related lockdown.

Following an unexpected failure of the ATLID laser electronics in June 2021, the instrument was removed from the platform to allow repair of the laser electronics module and was subsequently re-integrated in March 2022. After each integration of ATLID onto the platform, a dedicated set of ATLID IPCs was performed to verify that the instrument's health and performance remained within specifications.

As of August 2022, the EarthCARE satellite is complete and has been transferred to the Environmental Test Site (ETS) in Noordwijk. The satellite environmental test campaign is scheduled to begin in October 2022 with vibration and acoustic testing, following the completion of remaining CPR retrofit activities over the summer period.

Figure 1 shows the EarthCARE spacecraft and the observation geometry of its payload, while Figure 2 (left) depicts the fully integrated satellite inside the Airbus Friedrichshafen cleanroom, highlighting the ATLID instrument with its protective covers closed and its limited accessibility within the platform at a height of approximately 3.5 m above the floor

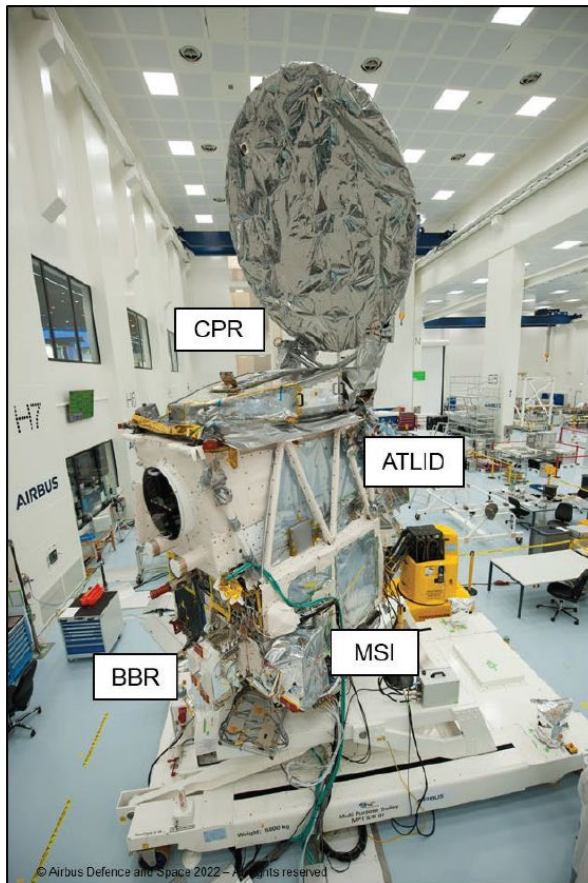


Figure 2. EarthCARE satellite with all instruments integrated, CPR reflector antenna deployed, in Airbus Friedrichshafen cleanroom (left). ATLID integration into the EarthCARE platform (right).

ATLID instrument

ATLID is a spaceborne ultraviolet lidar designed to provide high-spectral-resolution observations of atmospheric aerosols and clouds. Its distinguishing feature is the combination of HSRL (High Spectral Resolution Lidar) capability with polarization-sensitive detection, a configuration not previously implemented in orbit. This dual capability underpins the instrument's capacity to generate novel lidar products for the EarthCARE mission. [Allegato]

The instrument operates at a wavelength of 355 nm in the ultraviolet domain. This spectral band was selected because molecular (Rayleigh) scattering is significantly stronger at shorter wavelengths, thereby enhancing the molecular backscatter signal relative to that from aerosol particles. The resulting spectral contrast enables a clear separation between the monochromatic backscatter from aerosols (Mie scattering) and the spectrally broadened molecular backscatter (Rayleigh scattering), which is widened by a few GHz due to thermal motion. By quantifying this separation, ATLID allows the retrieval of the extinction-to-backscatter ratio, a key parameter in aerosol and cloud optical property characterization.

Spectral discrimination between Mie and Rayleigh components is achieved using a High Spectral Resolution Etalon (HSRE) located in the telescope focal plane. In parallel, a polarizing optic enables measurement of the cross-polarized component of the backscattered signal. This measurement provides sensitivity to non-spherical or oriented aerosol particles, supporting the identification of specific aerosol types based on their shape and orientation characteristics.

ATLID acquires data through three independent detection channels: co-polarized Mie, co-polarized Rayleigh, and cross-polarized. The simultaneous availability of these three channels enables a more comprehensive characterization of atmospheric scattering properties than previously achievable from space. Earlier orbital lidar missions have not

combined HSRL functionality with polarization measurements. For comparison, CALIPSO operated as a dual-wavelength lidar (1064 nm and 532 nm) with polarization sensitivity but without UV wavelength coverage or HSRL capability, while the AEOLUS mission provided indirect backscatter products with Mie–Rayleigh separation but only for a single polarization state. [Allegato]

The vertical sampling strategy of ATLID is adapted to altitude. Backscattered signals are measured with a vertical resolution of 100 m in the lower and middle atmosphere (0 to 20 km) and 500 m in the upper atmosphere (20 to 40 km), as illustrated in Figure 3. The ultraviolet laser emits pulses with an energy of 35 mJ and a duration of 35 ns, at a pulse repetition frequency of 51 Hz. The total emission cone angle is typically 36 μ rad.

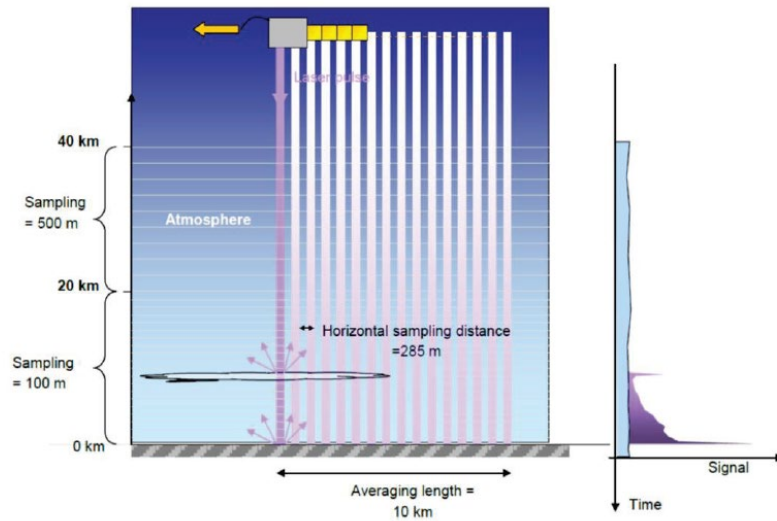


Figure 3. ATLID sampling scheme for vertical range and ground sampling.

In the baseline acquisition mode, backscattered signals are accumulated on the Memory CCD (MCCD) detector after every two laser shots. This accumulation scheme results in a along-track ground sampling distance of 285 m, derived from two laser footprints with a typical diameter of 14 m each. The primary performance metrics for ATLID are evaluated using on-ground averaging over 10 km segments of these accumulated measurements.[Allegato]

Figure 3 depicts the ATLID sampling scheme, showing the vertical range coverage and the along-track ground sampling

ATLID design description

ATLID adopts a bistatic lidar architecture, in which the transmitter and receiver subsystems follow two optically independent paths. The transmitter assembly (TxA) and the receiver assembly (RxA) are mounted on a common stable structure, which provides passive co-alignment of the two optical lines of sight. An active co-alignment control loop compensates for residual thermo-elastic line-of-sight perturbations and maintains co-alignment between the two optical paths.[Allegato]

The transmitter subsystem is centred on a frequency-tripled, diode-pumped Nd:YAG laser configured in a MOPA (Master Oscillator Power Amplifier) arrangement. The laser unit was developed by Leonardo in Pomezia. Beam expansion is provided by an external beam expander (EBEX) supplied by Sodern (Limeil-Brévannes). Laser emission timing is synchronised with the detection chain to ensure consistent temporal alignment between pulse emission and signal acquisition. [Allegato]

The receiver subsystem is based on a silicon carbide (SiC) telescope with an aperture of 620 mm, coupled to a SiC focal plane assembly. To suppress solar background radiation, the incoming atmospheric echo passes through a narrow-band spectral filter and a blocking filter. These elements restrict the instrument field of view to a total cone angle equivalent to 66.5 μ rad. After background suppression, the echo enters the HSRE (High Spectral Resolution Etalon) section,

developed by RUAG, which performs two functions: extraction of the cross-polarized component and spectral separation of the co-polarized signal into two distinct channels.[Allegato]

Within the HSRE section, a Fabry–Pérot etalon splits the co-polarized backscatter into a transmitted component and a reflected component. The transmitted signal, corresponding predominantly to particulate (aerosol and cloud) backscatter, is directed to the so-called “Mie” channel. The reflected signal, dominated by molecular backscatter, is directed to the “Rayleigh” channel. The spectral response of the Fabry–Pérot etalon, combined with the shape of the backscattered spectrum, introduces a degree of spectral cross-talk between the two channels. This effect is accounted for and corrected during ground data processing.

Following spectral and polarization separation, the optical signals are coupled into optical fibres and routed to a Memory CCD (MCCD) detector. This sensor technology provides very low read-out noise while maintaining high quantum efficiency. [Allegato]

Co-alignment between the transmitter and receiver lines of sight is maintained through a closed-loop control system. The loop acts on a beam steering mechanism (BSM) integrated within the laser unit, adjusting the transmitter line of sight to match that of the receiver. Control inputs are derived from centroid measurements of a sampled portion of the laser beam, acquired by a co-alignment sensor (CAS) located in the focal plane. This active correction compensates for thermo-elastic line-of-sight perturbations with a characteristic response time on the order of 10 minutes.[Allegato]

Figure 4 provides an overview of the ATLID design, illustrating the arrangement of the TxA and RxA subsystems, the HSRE section, the detector assembly, and the co-alignment control loop.

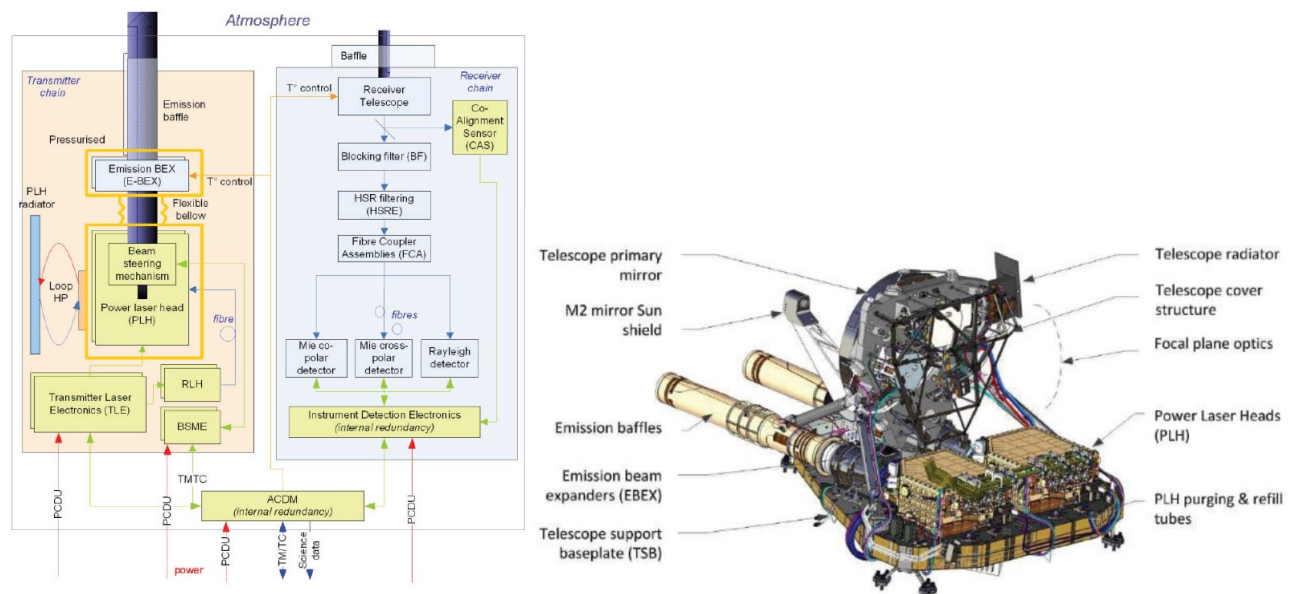


Figure 4. ATLID block diagram description and ATLID Optical Flight Model placed on stable structure assembly.

EARTHCARE – ATLID LASER PERFORMANCES EVOLUTION AFTER 3 BILLION AND HALF SHOTS SUCCESSFULLY IN-FLIGHT OPERATIONS.

ATLID Transmitter description

The ATLID Transmitter is composed of the TxA (Transmitter Assembly), the EBEX and the baffle.

The TxA is composed of the Power Laser Head (PLH, including a Beam Steering Mechanism, BSM), the Reference Laser Head (RLH) and Transmitter Laser Electronics (TLE) as reported in Figure 5.

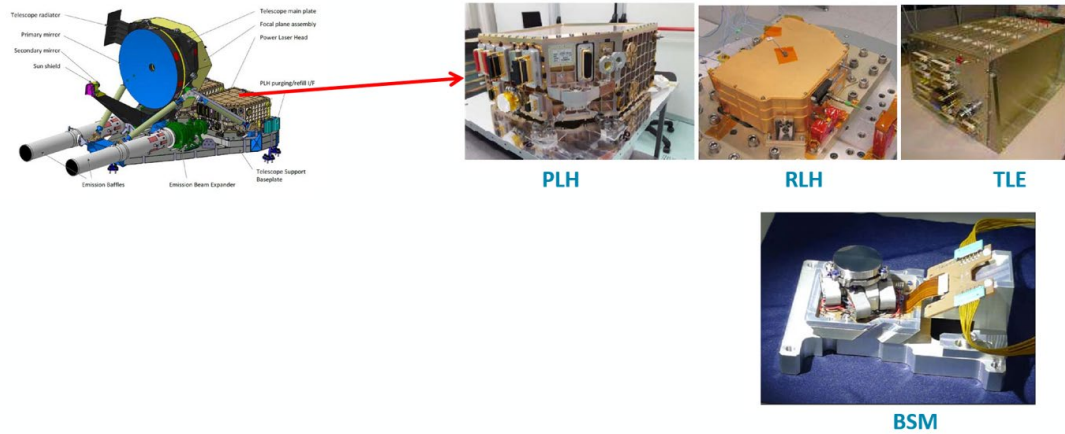


Figure 5. ATLID Transmitter Assembly parts.

The ATLID LASER is a MOPA DPSS Laser: a diode-pumped, Q-switched, Nd:YAG Laser frequency tripled. The TxA Architecture is reported in the Figure 6

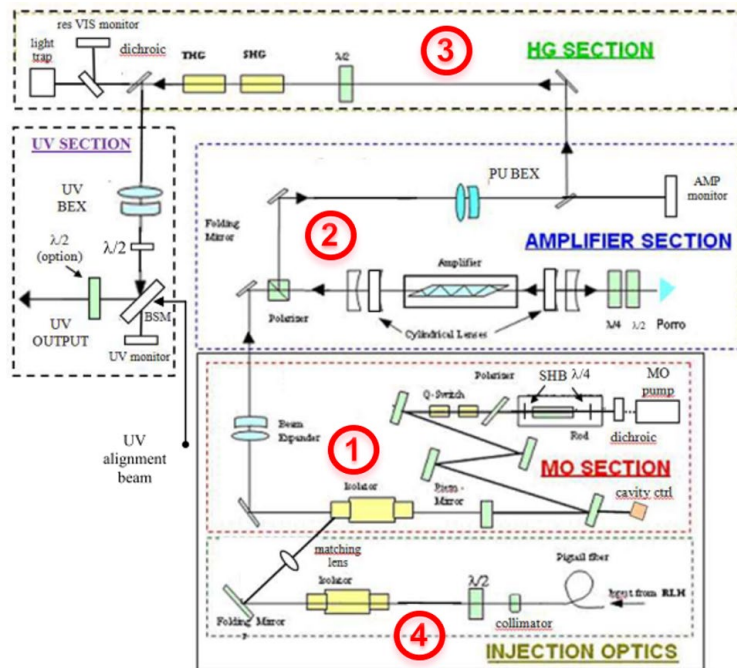


Figure 6. ATLID – TxA architecture with 3 sections: 1) Master Oscillator, 2) Amplification 3) Wavelength Conversion and 2 Features: 4) Seeder injection locking and Oscillator cavity control loop.

ATLID – PLH evolution of AEOLUS Aladin PLH

The ATLID laser presents many improvements with respect to Aeolus mission's ALADIN laser. ATLID transmitter is very similar to Aladin one. It is composed of the same optical sections but with only 1 Amplifier due to lower energy requested by the mission (40mJ by design wrt 80mJ of ALADIN UV emitted energy). Based on Aladin TxA heritage, efforts have been put into ATLID PLH design to improve [13]:

- robustness against Laser Induced Contamination (LIC) and Laser Induced Damages (LID): ATLID TxA design includes dry air pressurization whose reliability has been verified through the execution of leak tests

- improvement of thermo-mechanical stability:
 - The ATLID H model Optical Bench is designed to minimize pressurization impact on the amplifier and optical components stability.
 - ATLID PLH design focuses on thermal and mechanical interface separation to minimize distortions: the ATLID single Pump Unit (PU) is mounted on the Optical Bench wall to guarantee a single thermal interface for the PLH separated from the MO invar plate.
 - The decoupling the MO (Master Oscillator) alignment from thermal perturbations, reducing the dependence on external thermal disturbances

The ATLID PLH optical layout (Figure 7) is characterized by an upper optical bench with the Master Oscillator (and cavity control loop), the seeder injection and the BSM and the lower optical bench with the Amplification Section and the UV Section (protected by a carter). The MO is on a separate plate to increase stiffness and reduce misalignments. The amplifier is mounted on a lateral wall of the enclosure to have direct heat dissipation from outside by the Laser Cooling System.

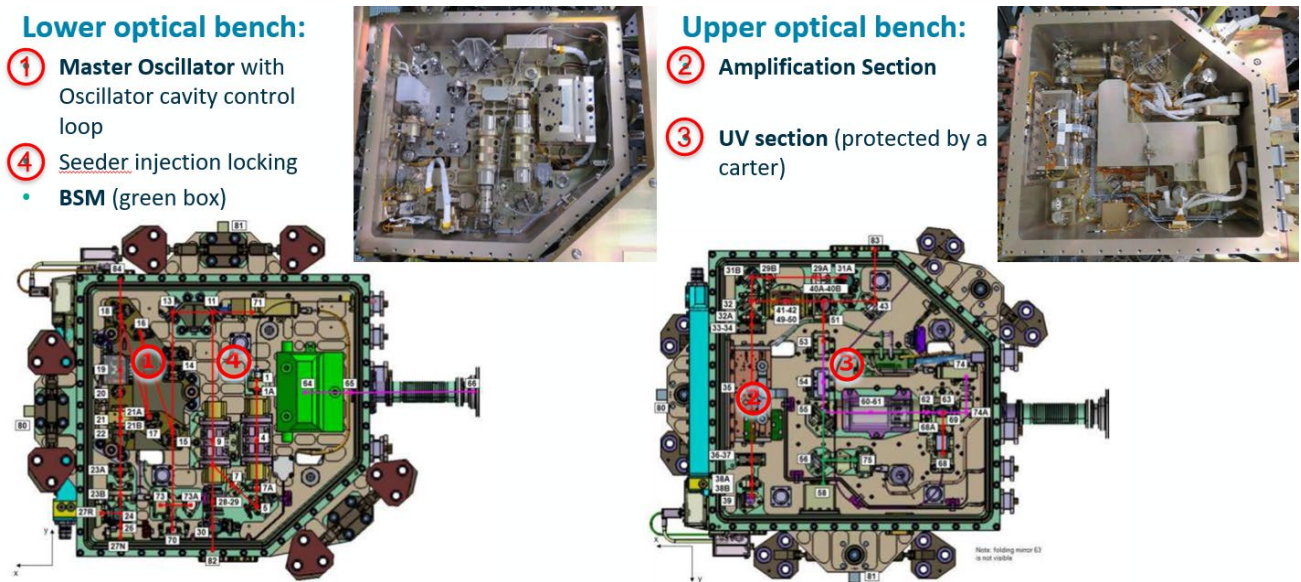


Figure 7. ATLID PLH Optical layout.

ATLID TxA energies evolution after more than 2 years of in-flight operations

The ATLID laser was switched on for the first time in flight on July 25th, 2024, about two months after the launch and, after the necessary time for the decontamination of the UV optics of the E-BEX. After some setting optimizations, like Harmonic Chrystal temperatures, the final UV emitted energy of 37.8mJ was reached, well in line with the requirements for the instrument. A continuous linear decay of 4 μ J/day of the UV energy (loss of almost 4% per year) has remained constant from December 2024 till May 2026. In the last months the decay rate has increased to 5 μ J/day but with a trend that seems to return to the original one. At the end of August 2026, the decreasing trend seems reduced again confirming a probable relation of the energy trend with seasonal effects that have an impact on external temperatures with respect to the PLH; anyway, the new trend reasons are under investigation and are continuously monitored. In any case this change has no impact on the duration of the mission, and it is in the margins that could be managed. There are several TxA parameters that could be used to increase energy again and to extend the lifetime of the instrument well beyond the nominal mission duration. After more than two years of operations the laser confirms the enhanced performance stability proved during on ground tests. Until now no TxA parameter (Diodes currents in terms of amplitude, duration and phases)

has been used to increase the UV energy even: a study of a possible approach to restore the initial UV energy is under investigation, and it will be considered in case of the necessity to increase the data quality.[12][13]

In Figure 8 the evolution of UV energy after more than 2 years is shown

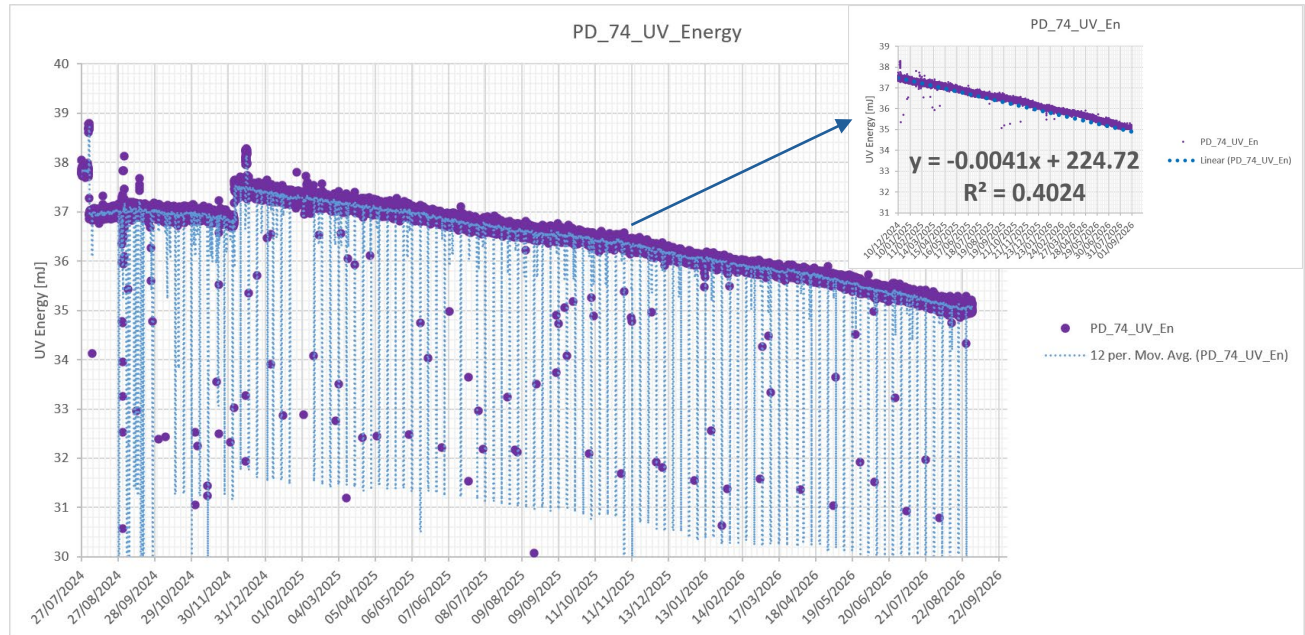


Figure 8. A continuous linear decay of $-4\mu\text{J/day}$ of the UV energy (loss of almost -4% per year) has remained constant since December 2024, in line with best EOL prevision, lower than Aladin one of -7% per year

After 3.5 billion shots ATLID laser confirms the enhanced performance stability proved during on-ground tests. In Figure 9 the evolution of all ATLID Energies is shown. MO energy shows a different evolution compared to UV, like the Aladin MO energy with an exponential trend probably due to an initial thermomechanical assessment and initial misalignment and a secondary stabilization phase. This initial phase was also related to the initial unbalance of the LCS that was fixed with the adjustment of the LCS heat load in October 2024. The Amplifier energy has been always stable that confirms the ATLID Diode ageing is very low with respect to the Aladin Amplifier Diodes. The visible residual energy is flat after the LCS heat load adjustment and after the crystal temperature adjustment. The fact that before the LCS adjustment the residual energy increased confirms that a tilt was present on the horizontal axis of the HS. After the changed of HC temperature, no more tilt has been present, and this was confirmed by an HS sensitivity test in December 2025.

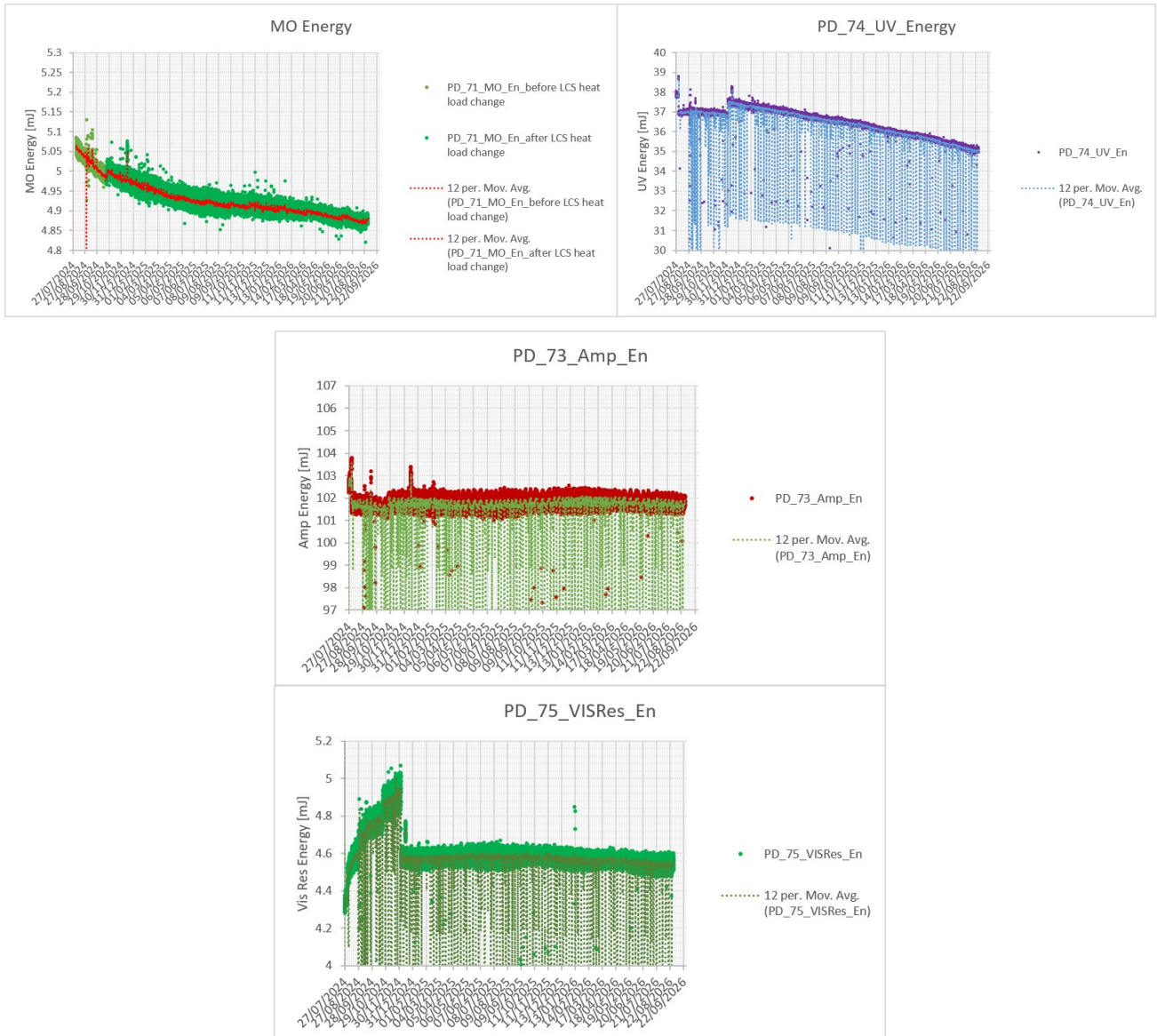


Figure 9. ATLID Energies after 3.5 billion shots successfully in-flight operations

ATLID UV energy trend

As said, a continuous linear decay of - 4μJ/day of the UV energy (loss of almost - 4% per year) has remained constant since December 2024, in line with best EOL prevision, lower than Aladin one of -7% per year.

The energy loss trend is in line with the best expectation based on the laser on-ground test before launch (BIT, LTT and so on) and based on the test on ATLID Laser Diode lifetime performed in ESTEC.

The possible UV energy loss causes could be:

- Diode Ageing (confirmed by LFT on Diodes) but no big evidence on Amp photodiode, MO photodiode,
- NO evidence of LIC at least to HS crystals: HS Driving voltages are very stable and very stable Residual energy signal, no possibility to completely exclude LIC on optics after HS (UV BEX with optics in transmission and periscope)

- very small LIDT or LIC or other phenomena on the UV optics after UV dichroic and before the UV photodiode (from Energy trend) to be analyzed more
- Beam movement or tilt from Coalignment System meas, from the trend of MO energy and from HS sensitivity no evidence of any tilt in any direction
- Before the heat load optimization of the LCS, a tilt in the horizontal direction was present for sure: confirmed by HS temp adjustment, change of CLCL max and Multimode Ratio, MO and energy residual energy and CAS tilt meas

In Figure 10 all energies and CLCL max rolling average over one day are shown to better individuate the correlation.

In Figure 11 the CAS centroid tilt is reported, only an initial tilt is visible that coincide with the period before the heat load of LCS adjustment.

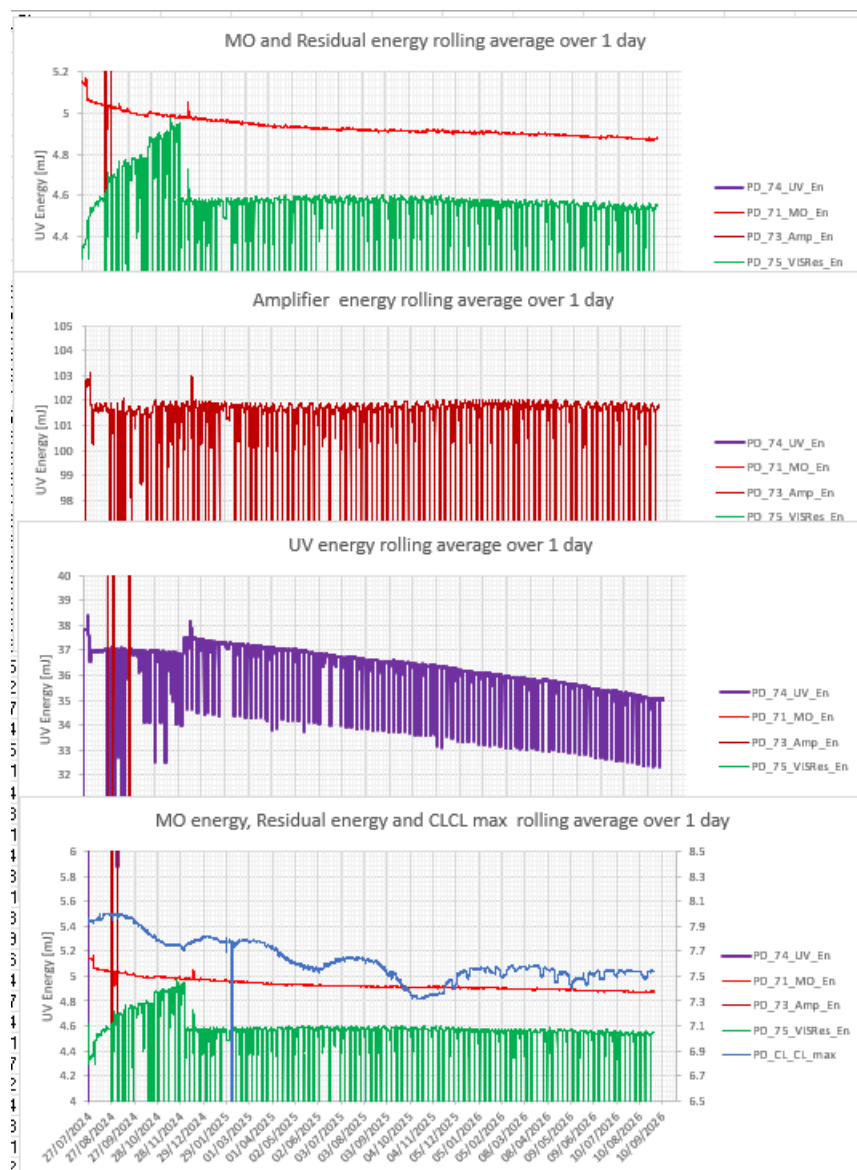


Figure 10. ATLID – TxA energies and CLCL max rolling average over 1 day since the Atlantis switch-on.

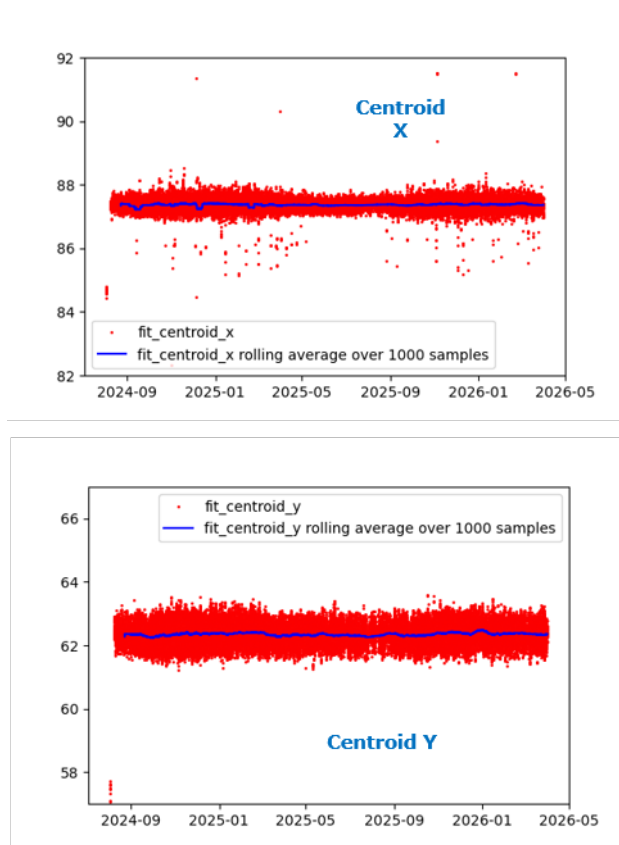


Figure 11.CAS tilt measurement

ATLID UV energy recovery

Nominally the energy recovery should follow the rules of the ATLID TxA Command Flow, rules already studied from the test on-ground: it suggests some steps based on the changes along time visible in the TxA HKs like energies, temperatures etc.

The first step is optimization of the HS conversion efficiency, but a test was already performed in January 2026 without any big sign of need of optimization. An HS sensitivity test could be repeated but for sure a complete Sensitivity Test could give an idea of the status and health of the laser and of the amount of change that is necessary on the parameter selected. The last sensitivity was performed in 2024 during commissioning.

It is worth mentioning that, even if the Command Flow gives the most reasonable indications on how to increase energy, it could be very important to take into account also the possible causes of the loss of UV energy. In fact, it could be very useful to select, despite the command flow indications, the parameters that do not increase the cause of the energy losses like:

- Increase Diode Ageing (confirmed by LFT on Diodes)
- Avoid LIDT or LIC on UV opticts
- Avoid Beam movement or tilt

The AMP phases (delay between MO diode pulse and AMP diodes pulses) is the easier way to increase energy without impact on power balance and diodes ageing and with low increase of fluence for UV optics.

ATLID PLH pressure evolution

Pressure in the PLH is critical for the laser lifetime (due to LIC): now it was demonstrated that the improvement in the mechanical stability of the PLH design has guaranteed the lifetime of ATLID for the mission .Pressure is measured in both PLHs, even in non-used ones. Raw measurements are corrected with the TLE temperature before the analysis of the data by Airbus Toulouse every 6 months. TLE temperature is not controlled so there is an impact on the raw values.

The Pressure decay trend is still in line with the expectation. Currently, PLH Pressure seems not to be a limitation for the extension of the mission. The pressure decrease rate has seasonal dependence for example due to eclipse season: over 2 years similar decay trends have been detected in the same year period. The average pressure decrease rate over last 6 months:

- 0.116 mbar/day for the end of this period vs $\rightarrow$ 0.056 mbar/day over previous period (PLH B, active)
- 0,089 mbar/day for this period vs -0.069 mbar/day over previous period (PLH A, redundant)

The absolute pressure in April 2026 was about 117 mbar (PLH B, active) and about 1060 mbar (PLH A, redundant, important uncertainty).

On 25 May 2026 a change of the Voltage was applied to increase the lifetime of the batteries, this has an impact on TLE temperatures and as already known from on-ground tests on the PLH pressure values reads by the sensors.

On 8/8/2026 a pressure drop of almost 100 mbar in PLH B was reported but after a detailed analysis, it appears not physical and no evidence is present on other TMs. It seems that the change of the external temperature brings the sensor to read the pressure as in the original pattern (lower noise) but at a lower absolute medium value.

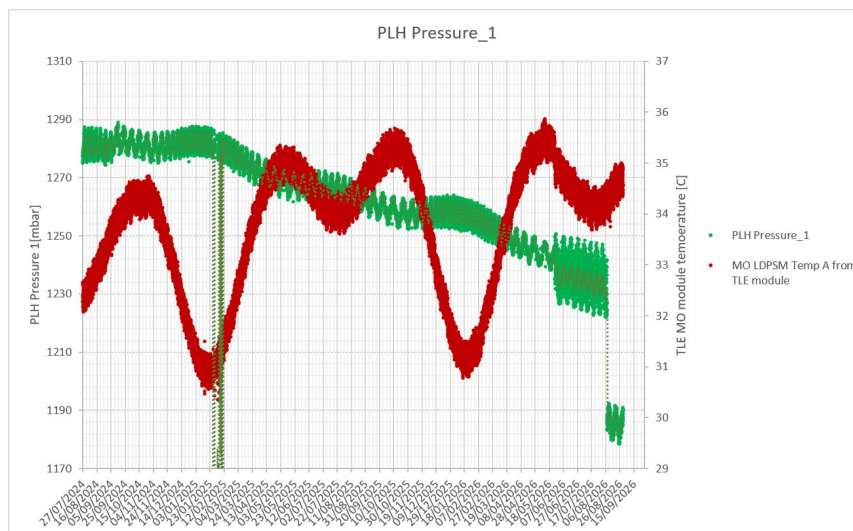


Figure 12. Pressure evolution in PLH B and TLE Module temperature.

ATLID PLH Internal Temperatures

ATLID PLH Internal Temperatures are stabilized by the Laser Cooling System (LCS) of ATLID: an in-flight Cold Plate, based on mini loops heat pipes technique, applied on the lateral wall of the PLH optical bench to control the temperature of the MO Pump Diode and of the Amplifier. After an initial period of thermal assessment with a decay trend, already seen in Aeolus mission and in ATLID laser Lifetime Test on-ground, all internal temperatures (MO Diodes, MO Active Material and MO bench, Cold Plate and Amplifier Diodes and Active Materials) have demonstrated high stability. Situation was improved after the change of the heat load of the LCD in October 2024 to improve the efficiency of the mini loop heat pipes. This is well visible on the MO temperatures. From this optimization the MO temperature has been

better controlled and also the MO energy decrease trend changes asymptotically. Noise on the temperatures changes on seasonal basis and are well correlated with TLE external temp.

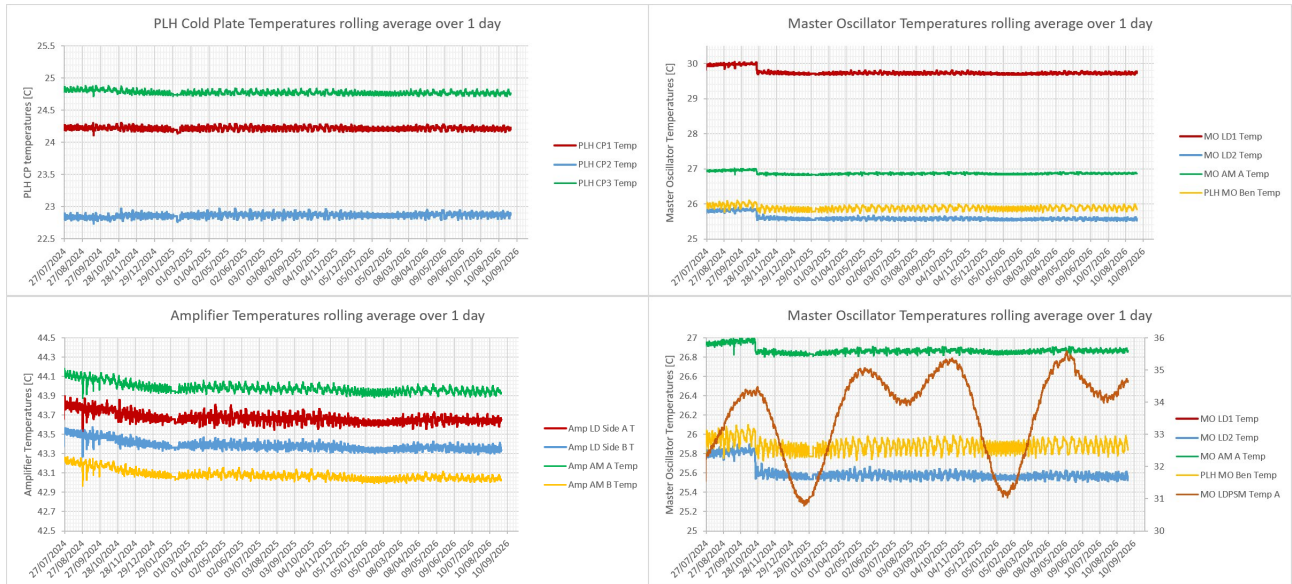


Figure 13.PLH internal temperatures, noise is correlated with external temperature

ATLID Harmonic Section temperature and Driving Voltages

The stability of driving voltages confirms the absence of the LIC at list till the HS. HS temperature is well controlled and stable

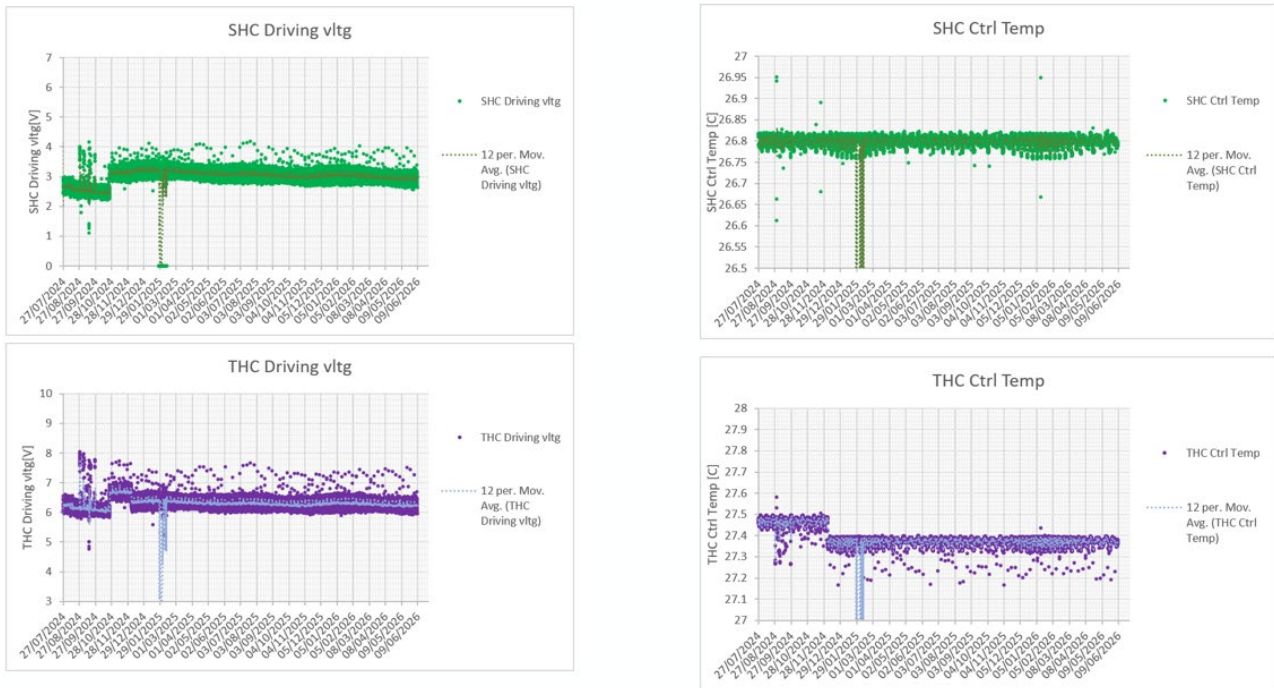
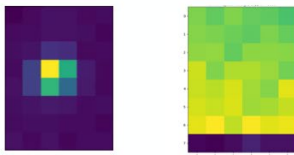


Figure 14. PLH internal temperatures, noise is correlated with external temperature

ATLID INSTRUMENT PARAMETERS

Beam pointing and divergence evolution

- Laser beam properties can be derived from CAS image analysis



- The images are strongly impacted by solar background
- Filtering only images without strong solar background impact, the evolution of beam pointing and divergence can be derived over the whole >17 months period
- No significant variation of the beam centroid is observed
- Slight divergence increase of the horizontal divergence with time and small seasonal (orbital?) oscillation
- A characterization of background in daylight conditions would help, just TUBA in different moment of the day:
 - To investigate the effective Solar Background (SBKG) integration time – overcorrection of SBKG
 - To investigate reduced Charge Storage Ratio (CSR) on Rayleigh cold pixel

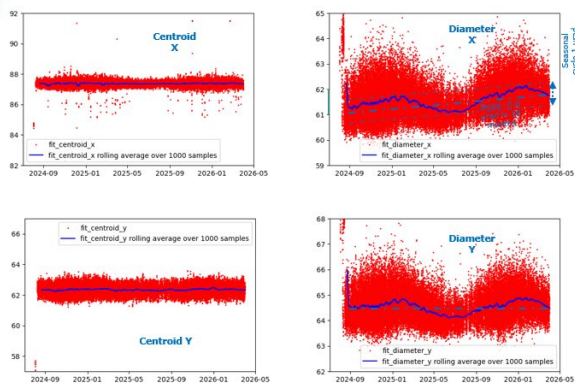


Figure 15. Beam pointing and divergence evolution from CAS[13]

ATLID Hot pixels - Dark Current Calibrations from the beginning of the mission

Every week a Dark Current Calibration (DCC) is executed, as for requirement, and Hot and Cold pixels has been identified since the instrument switch-on on all receiver channels (Rayleigh, Mie and Crosspolar)

- ATLID Rayleigh channel Hot pixels, DCC from the first switch-on to 7/06/2026

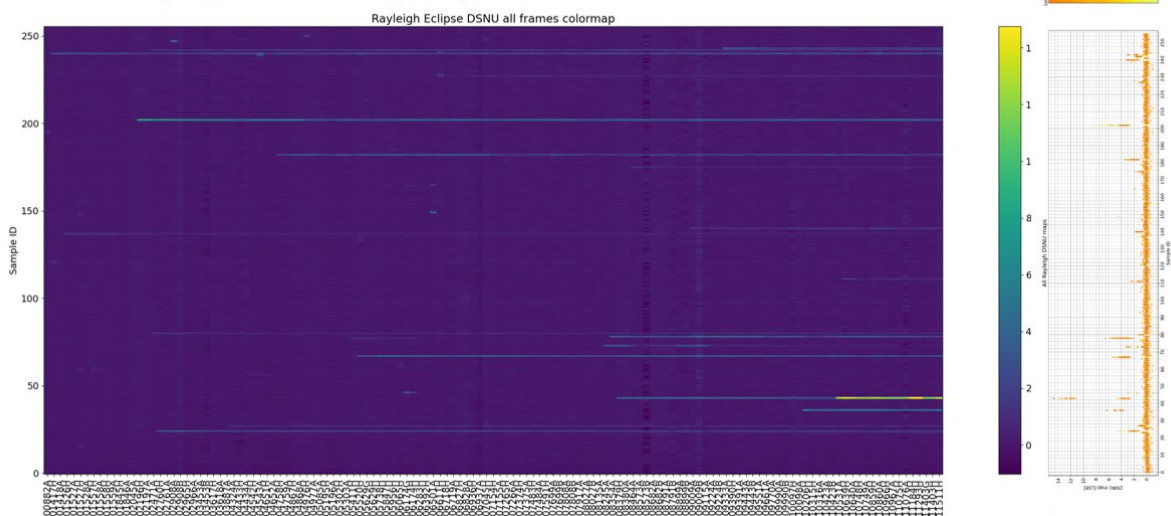


Figure 16 ATLID Hot pixels - Dark Current Calibrations from the beginning of the mission: Rayleigh channel, different types of cold and hot pixels and at different levels.[13]

The table provides the ATLID LIDAR Hot and Cold pixels since the switch-on on all channels to last Sunday, almost 2 years.

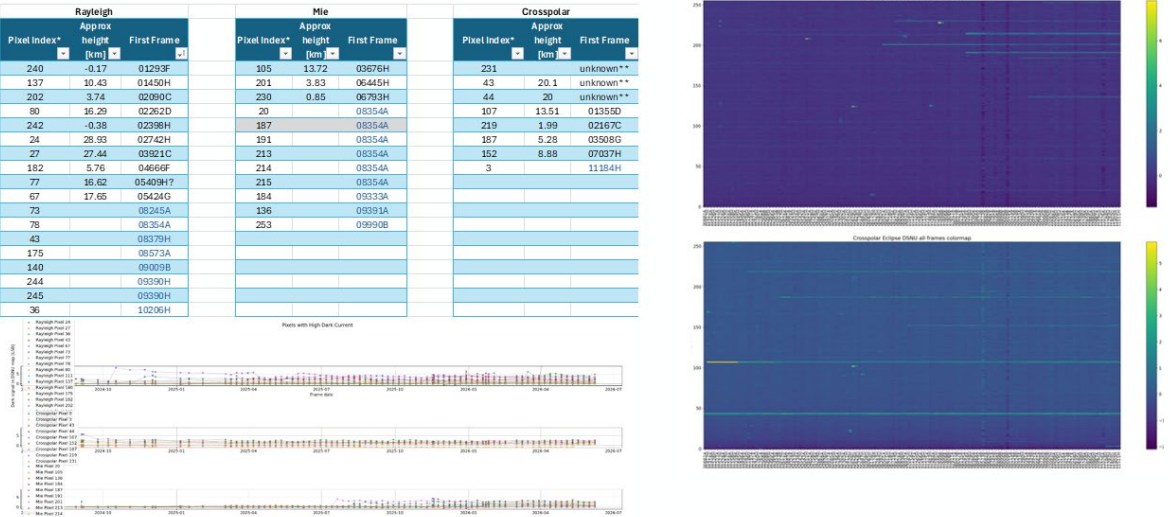


Figure 17 ATLID Hot pixels - Dark Current Calibrations from the beginning of the mission: Mie and cross polar channels, different types of cold and hot pixels and at different levels.[13]

CONCLUSION

After more than 2 years of in-flight operations and 3.5 billion shots ATLID confirms its improvement in thermomechanical design, pressure stability and beam movement and tilt stability and paves the way for the confirmation of the selection of ATLID PLH and instrument design for the AEOLUS 2 mission.

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