

Aeolus: A successful wind profiler and lidar laboratory in space

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ABSTRACT

Aeolus, an ESA Earth Explorer mission launched in 2018, was the first spaceborne Doppler wind lidar. While the mission successfully demonstrated the impact of wind profile data on weather forecasting, the priority on operational availability limited the time available for instrument testing. However, featuring a sophisticated high performance UV laser and receiver optical system, several topics for specific testing accumulated along the mission, despite its convincing performance. To address remaining open questions and support successor missions, such as EarthCARE with its atmospheric lidar ATLID and Aeolus-2, a dedicated End-of-Life Activity (EOLA) program was implemented during the final three months of the almost 5-year mission. The EOLA campaign consisted of 22 prioritized tests focusing on laser frequency stability, signal losses, optical alignment, and detector anomalies. This effort was supported by a flexible collaboration between ESA operations, industry, and the science community, including complementary ground-based reference tests using the ALADIN Airborne Demonstrator (A2D). The EOLA phase served as a crucial in-space laboratory, yielding record-breaking results on laser performance and characterizing detector anomalies essential for the design of future spaceborne lidars. This contribution provides an overview of the EOLA program and showcases key results to motivate similar instrument special operation and test strategies for other missions. Furthermore, it suggests incorporating dedicated test slots immediately following the commissioning phase of future missions to optimize performance throughout the operational lifetime.

Keywords: Aeolus, space-borne wind lidar, ALADIN, ATLID, in-orbit performance test, laser, detector, lidar.

1. INTRODUCTION

The Aeolus mission, an ESA Earth Explorer launched in August 2018, represented a paradigm shift in atmospheric observation as the first spaceborne Doppler wind lidar. Its primary objective was to demonstrate the operational capability of providing timely, global wind profile data to improve the accuracy of numerical weather prediction (NWP) models [1]. Throughout its almost 5-year mission period – significantly exceeding its nominal lifetime of 3.5-years – Aeolus successfully validated the impact of satellite-derived wind profiles on weather forecasting, filling a critical gap in the Global Observing System. Due to the mission's priority on operational availability and the inherent risks associated with non-routine instrument operations, the opportunity for extensive technical characterization was limited during the nominal phase. However, the complexity of the Atmospheric LAsER Doppler INstrument (ALADIN) – featuring a high-performance ultraviolet (UV) laser and a sophisticated receiver optical system – resulted in a growing amount of open technical questions regarding laser frequency stability, signal losses, and detector anomalies. As the mission approached its end-of-life (EOL) due to depleted fuel in combination with increasing solar activity, ESA implemented a dedicated End-of-Life Activity (EOLA) program. This campaign, conducted during the final three months of the mission before the re-entry phase, effectively pivoted the satellite from an operational wind profiler into an "in-space laboratory." The EOLA program aimed to investigate remaining open issues and transfer critical knowledge to successor missions, specifically the ATLID

instrument on EarthCARE, the upcoming operational follow-on wind lidar mission Aeolus-2, and future lidar missions in general. By accepting a higher risk at the end of the mission, the EOLA phase allowed the team to yield record-breaking performance data and fundamental insights into detector degradation that would have been impossible to pursue during the operational phase. Tests were executed around nominal set points and within parameter ranges such that no damage occurred. The platform attitude tests conducted during EOLA contributed to an optimized satellite decay phase which cumulated in the successful first assisted reentry in July 2023 that finally terminated the mission.

2. AEOLUS DESIGN AND ACHIEVEMENTS

The core of the Aeolus mission was the ALADIN instrument, a Doppler wind lidar (DWL) designed in a transceiver optical geometry to measure wind along the line-of-sight (LOS). The optical arrangement is sketched in Figure 1. The transmitter system utilized two redundant flight model lasers (FM-A/B) which both were pulsed, injection-seeded UV lasers (Nd:YAG Master Oscillator Power Amplifier, tripled to 355 nm) operating at 50.5 Hz with a nominal energy range of 40–100 mJ during most of the mission. The lasers were designed to be wavelength-tunable to facilitate precise receiver calibration. The receiver system employed a sequential arrangement of two spectrometers to derive vertical profiles of the Doppler shift and the particle-to-molecular backscatter ratio from the surface up to 30 km. A Fizeau spectrometer was utilized for the Mie channel (sensitive to clouds and aerosols), while a double-edge Fabry-Pérot spectrometer captured the Rayleigh signals (clear-air molecular return). These spectrometers fed two identical Accumulation Charge-Coupled Device (ACCD) detectors, which allowed for the integration of multiple laser-shot returns along-track to increase the signal-to-noise ratio (SNR) in 24 altitude-layers before readout. Thus, exploiting the frequency-dependent signals after the spectrometer, with proper calibration and corrections for known systematic errors, the LOS wind (v_{LOS}) in each layer could be deduced from the measured frequency difference Δf between emitted and Doppler-shifted atmospheric return by applying the relation $\Delta f = f_0 \cdot 2 v_{LOS}/c$, with $f_0 \approx 845$ THz at 355 nm and c the speed of light. A 35° off-nadir angle pointing into the east-west direction perpendicular to the polar dusk-down orbit at 320 km enabled the deduction of horizontal wind speeds in these prevailing wind directions on a global scale.

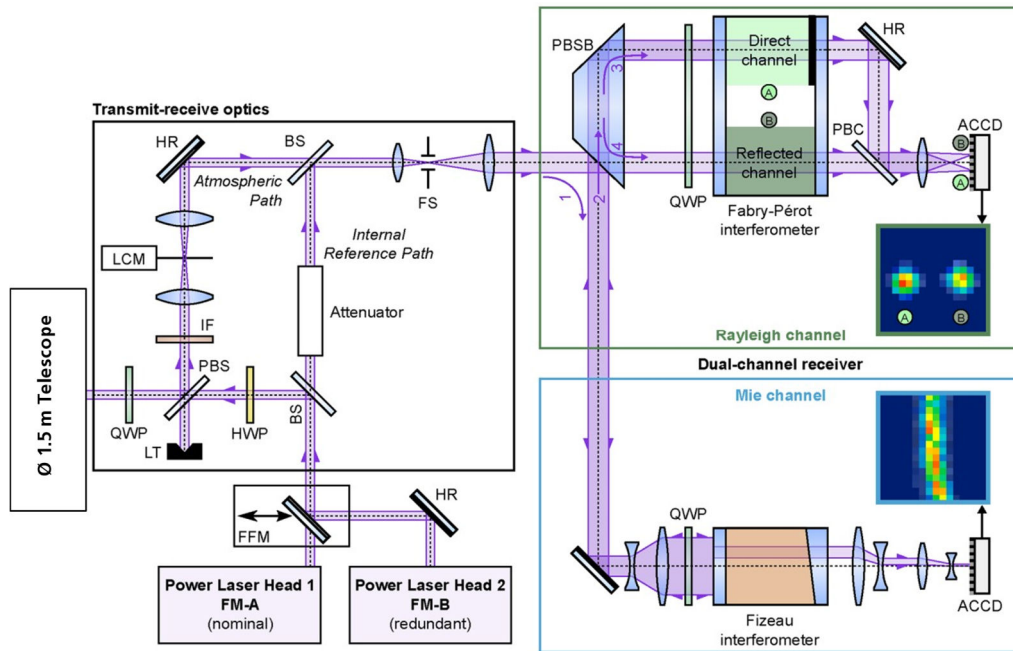


Figure 1. Aeolus optical layout modified from [2]. The inserts show typical transmission signals for the two channels (A and B) of the double-edge Fabry-Pérot (Rayleigh channel) and the Fizeau (Mie channel), imaged to the ACCD. QWP: quarter-wave plate; HWP: half-wave plate; PBSB: polarizing beam splitter block; PBC: polarizing beam combiner; FFM: flip-flop mechanism; BS: beam splitter; HR: high-reflectance mirror; LCM: laser chopper mechanism; FS: field stop; IF: interference filter; LT: light trap.

The mission's primary achievement was the successful operational ingestion of these wind profiles into global NWP systems, proving that spaceborne wind lidar data can significantly reduce forecast errors. The error requirements on the horizontally projected LOS (HLOS) were a random error of $< 2 - 3$ m/s and a systematic error < 0.7 m/s. The systematic error requirement was finally achieved, despite technical challenges associated to the telescope thermal stability and detector issues, thanks to a significant effort of the Aeolus Data Innovation and Science Cluster (DISC [3]) and referencing to the average along-track NWP model winds. However, a lower than expected signal level in space and a signal decay due to optical degradation outside the FM-B laser (probably affecting optics inside or around the flip-flop mechanism, FFM in Figure 1) was observed during the mission [4]. Consequently, the random error requirements could not be fully met and mostly reached $3 - 4$ m/s for Mie winds and $5 - 8$ m/s for Rayleigh, according to the current processing evolution [3]. A significant reduction of the random error and increased detection sensitivity has been realized during and after the mission by combining algorithms evolutions within the DISC and lessons learned from operations and validations with the DLR airborne DWLs including the ALADIN Airborne Demonstrator (A2D) [5]. The latter features a high technological commonality with the satellite instrument, as it was built around the ALADIN pre-development model.

Beyond the successful wind measurements and atmospheric science contributions, Aeolus demonstrated the viability of high-power UV laser operation in a space environment over several years, providing a technological baseline for the next generation of atmospheric lidars.

3. EOLA METHODOLOGY

The EOLA program was designed to maximize technical gain while managing the risks associated with late-mission operations. The primary goals were twofold: the investigation of open operational issues (e.g., laser frequency stability and signal losses along the instrument chain), and the transfer of knowledge to future missions (e.g. Aeolus-2 and EarthCARE/ATLID).

The selection of tests followed a rigorous prioritization process. Proposals were submitted by the DISC, ESA, and industry partners, and filtered through a trade-off matrix ranking risk and severity against priority and complexity. The actual sequence of execution was not determined by priority alone, but was the result of a complex optimization considering priority, available opportunity windows (such as weather forecasts or the replacement of regular calibration slots), and

specific technical requirements (e.g., nominal vs. decaying orbit). This ensured that high-priority tests were prioritized while allowing for the opportunistic execution of lower-priority tests when conditions were ideal.

To execute this intense campaign within a three-month window, a "lean hierarchy" was adopted. Coordination was centralized through ESA/ESTEC, which translated high-level test requirements into executable procedures for the Flight Operations Segment (FOS) at ESOC. This agile framework was supported by an end-to-end (E2E) expert working group from the partners collaborating on the specific test definitions before execution, as sketched in Figure 2. An increased communication cadence, with three S-band passes booked per day, provided the necessary telemetry and command windows. This flexible operational mindset allowed the team to adapt parameters on-the-fly and to introduce new tests – such as EOLA#26 and #27 – on short notice based on preliminary results.

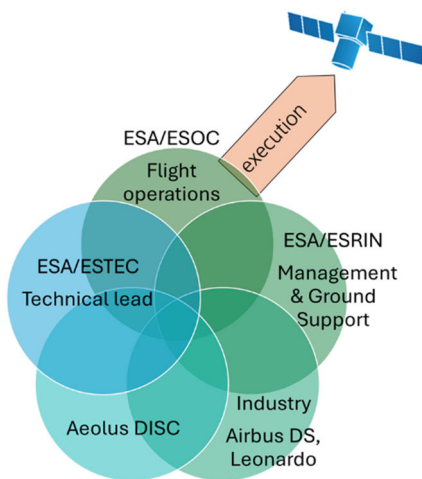


Figure 2: Sketch of interplay between involved parties for test selection and execution.

4. OVERVIEW OF EOLA TESTS

The EOLA campaign spanned from April to July 2023, coinciding with the final phase of the mission and the beginning of the natural orbital decay (re-entry phase) which started in mid-June. A total of 22 prioritized tests were executed out of 26 proposed. The success rate was high, with 17 tests fully successful and 5 partially successful. Only one test dedicated to a platform maneuver had to be cancelled, because of unfavorable solar activity conditions.

The tests were categorized by their topics concerning science, instrument calibration and performance, and mostly had a technical focus:

- **Laser Performance:** Focused on pushing the UV energy to record levels and optimizing the Cavity Length Control Loop (CLCL) to reduce frequency noise.
- **Detector Characterization:** Investigated the temperature sensitivity of "hot pixels" and the ability to perform Dark Current Calibration (DCC) while the laser was active.
- **Optical Alignment & Thermal Stability:** Explored the impact of telescope temperature gradients and alternative pointing configurations (e.g., 42° off-nadir) on signal-to-noise ratios.
- **Platform & Re-entry:** Tested equilibrium attitudes to reduce aerodynamic drag, which proved critical in reducing fuel consumption during the final re-entry phase.

The execution timeline was divided into three distinct periods: the initial phase in April using calibration slots; the nominal EOLA period in May and June; and the final phase in mid-June to early July during the natural decay. Notably, the campaign concluded with a record-breaking achievement: the laser operated at a stable output of 182 mJ for 33.3 hours, surpassing the previous space-borne UV laser record held since 1994.

Table 1: Test overview (non-chronologically) ordered along color-coded topics. The quantity of executions is given in the last column, where N/A is used in case the test was running over a longer duration in parallel to other tests. LWU refers to an execution during laser warm up, without laser emission. PAO: Pierre Auger Observatory (on ground UV detection); WVM: Wind Velocity Mode; OBA: Optical Bench Assembly; IDC: Instrument Defocus Characterization; INT/ATM: Internal/Atmospheric signal; LCM: Laser Chopper Mechanism; SBK: Solar Background; DUDE: Down Under Dark Experiment; PLH: Power Laser Head; MO: Master Oscillator; STRO: Sealed Transmit-Receive Optics.

#	Category	ID	Name	Goal	Priority	Laser	Quantity
1	Detector	EOLA#03	Hot pixel ACCD temperature	Determine temperature dependence of ACCD dark currents	Very High	FM-B	1
2	Performance	EOLA#27	SBK integration time and P/N set.	Investigation of hot pixels & BK correction	High	FM-B (LWU)	N/A
3	Instrument Calibration	EOLA#18	Broad Instrument Response (BIER)	INT/ATM response & ATM path calibration	High	FM-A+B	3
4		EOLA#16	DCC with laser on	Monitoring dark current in imaging zone	High	FM-B	2
5		EOLA#26	Hi-DUDE	Comparison to nominal DUDE (below ground)	High	FM-B	N/A
6	Laser	EOLA#05	Test CLCL ramp set point to 7/8	Improve laser frequency stability and ATM efficiency	Very High	FM-A+B	1
7		EOLA#07	FM-B on-ground energy	Verify Lidar margin & Aeolus-2 closure	Very High	FM-B	2
8		EOLA#08	MO/PLH max energy + STRO pres.	Verify Lidar margin & UV energy record	Very High	FM-B	1
9	Optical Efficiency	EOLA#04	Telescope thermal control	Improve ATM signal and efficiency	Very High	FM-B	1
10		EOLA#13	M1 temperature increase	Improve ATM signal and efficiency	Very High	FM-B	1
11		EOLA#23	ATM-LBM	Monitoring of ATM beam profile	Medium	FM-B	3
12		EOLA#12	LCM phasing	Verification of initial loss & ATM signals	Very High	FM-A+B	1
13		EOLA#10	Extended IDC	Investigation of signal variation/clipping	High	FM-A+B	2
14		EOLA#17	Imaging mode (IDC) in nadir	Observation of focus changes (Rayleigh)	Medium	FM-A	1
15		EOLA#11	ATM divergence test	Increase laser beam and ATM signals	High	FM-B	1
16		EOLA#19	IDC with ATLID config	Monitoring of alignment	Low	FM-B	1
17	Platform	EOLA#14	OBA temperature	Verify instrument alignment & link-budget	Medium	FM-B	1
18		EOLA#15	Platform test	Equilibrium attitude (min drag) for re-entry	Very High	FM-B	1
19		EOLA#20	WVM in 42°	Improve random error via HLOS contribution	Very High	FM-A+B	1
20		EOLA#24	WVM in nadir	Measurements of vertical air motions	Medium	FM-A+B	3
21		EOLA#02	WVM with ATLID config	Return signal measurements (ref. ATLID)	High	FM-B	2
22	Science	EOLA#22	PAO measurements	Verification of emit energy	N/A	FM-A+B	N/A

5. SELECTED TEST RESULTS & ANALYSIS

Discussing all the tests and results is out of scope for this contribution. In the following a few examples are introduced in more detail to illustrate the value of the EOLA program, showcasing the focus on detector performance (EOLA#03), laser performance (EOLA#05 and #07), and instrument calibration (EOLA#16). Other tests addressed the temperature tuning of the telescope (EOLA#04 and #13) or the receiver optical bench (EOLA#14), the increased off-nadir angle of 42° (EOLA#20) as well as the nadir-pointing for vertical wind measurements (EOLA#24) or in ATLID-representative spectral setting (EOLA#02). All test descriptions and analyses were convoluted in a ESA-Report, summarizing the results from all contributing partners (ESA, DISC, industry) [6].

5.1 Detector Tests: Anomalies and Calibration

A primary objective of the EOLA phase was to more deeply characterize the detectors in both their imaging and lidar operation modes [7, 8]. The imaging zone samples the signal levels for one laser return over a commanded altitude range, whereas in lidar mode, accumulated signals are stored in a memory zone comprising 25 lines of 16 pixels each, with each line corresponding to one of the 25 atmospheric layers. A growing number of so called "hot pixels" appeared in the ACCD memory zones over the course of the mission in both Mie and Rayleigh channel ACCDs, causing detrimental signal and wind biases which needed a regular calibration and correction of the dark current of each pixel (up to 8 times per day). The ACCDs that have been operated non-continuously in the A2D during ground and airborne campaigns distributed over the years from 2004-2026 did show only very few pixels with slightly enhanced dark currents (see Figure 3). To identify the root cause and evaluate potential mitigation strategies for these hot pixels, dedicated tests focusing on the imaging and accumulation zones were executed as part of the EOLA.

EOLA#03: Temperature Sensitivity of Hot Pixels This test investigated the dark current behavior of the ACCD memory zone by increasing the temperature from the nominal -30°C to -15°C in 5 K increments (see Figure 4). By fitting the temperature sensitivity of the dark current levels according to the Arrhenius law, the activation energy (E_a) for individual pixels was derived. The results revealed a clear distinction between "normal" and "hot" pixels.

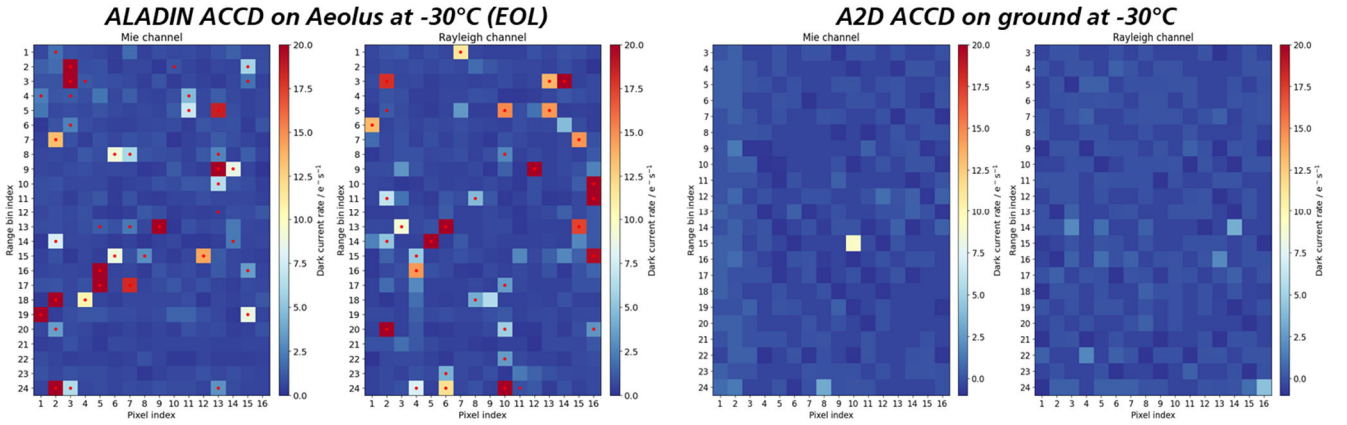


Figure 3: Dark current rates (color coded) of the Mie and Rayleigh channels ACCD memory zones at nominal operation temperatures for the case of ALADIN at EOL (left) and the A2D tested on ground (right).

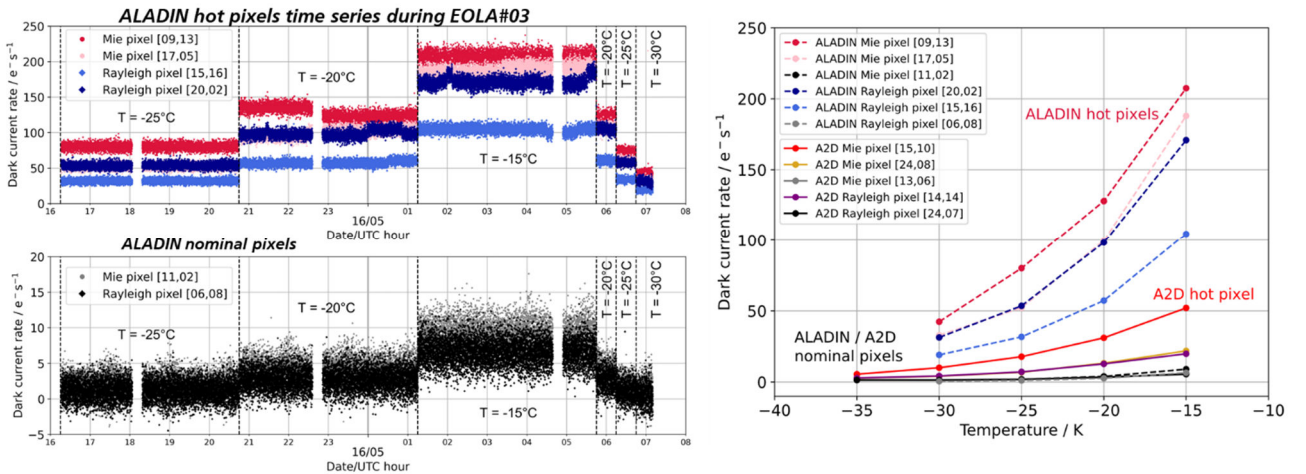


Figure 4: Left: Evolution of the dark current rates (in electrons per second) of hot pixels (upper panel) and nominal pixels of the ALADIN ACCDs during EOLA#03. Right: Temperature sensitivity of the dark current rates deduced from the time series and a similar test performed with the A2D ACCDs on ground.

Normal pixels exhibited an E_a slightly below the silicon bandgap (mean $\approx$ 0.87–0.89 eV). In contrast, hot pixels showed a significantly reduced and broader distribution of activation energies (mean $\approx$ 0.65–0.73 eV). This temperature dependency and the reduction in E_a strongly suggests that these anomalies were caused by radiation-induced displacement damage in the silicon lattice rather than clock-induced charges.

Crucially, these results were compared with data from the A2D. While the A2D ACCDs (tested on ground) confirmed the expected temperature dependence of the dark current rates, they did not exhibit the same population of hot pixels and showed a lower temperature sensitivity for the most activated A2D pixel [15,10] on the Mie ACCD (see Figure 3 and Figure 4 right). This comparison confirmed that the anomalies were a direct result of the long-term space radiation environment, providing strong evidence for the design of the Aeolus-2 detectors, which are specified for operation at -50°C to mitigate these effects. Further information is provided in [8] and [9].

EOLA#16: High Dark Current Calibration (Hi-DCC) Traditionally, Dark Current Calibration (DCC) of the ACCD imaging zone required the laser to be switched off (LWU mode). This is a substantial operational effort and would significantly limit the wind data availability, thus a regular DCC-monitoring was discarded. EOLA#16 demonstrated that by adjusting the trigger timing between laser emission and image recording, a "Hi-DCC" could be performed while the laser was active. By acquiring signals from a high-altitude range (above the atmosphere, hence no backscattered signal), the team was able to monitor the dark current in real-time. This mode revealed that the intensity of certain “suspicious” pixels (e.g., the high-signal Rayleigh pixel [16,14]) scaled with the intensity of the laser spot and solar background, suggesting a non-perfect flushing process in the ACCD readout. A similar effect is not observed for the A2D ACCDs. The Hi-DCC mode required minimal changes to the on-board commanding and bared minimal risk. It is an example of a test, which the mission could have benefited from by an execution earlier than during EOLA, i.e. for being implemented as a nominal calibration and correction procedure. It is a new operational mode suggested for continuous detector performance monitoring over the lifetime of future missions with similar technology.

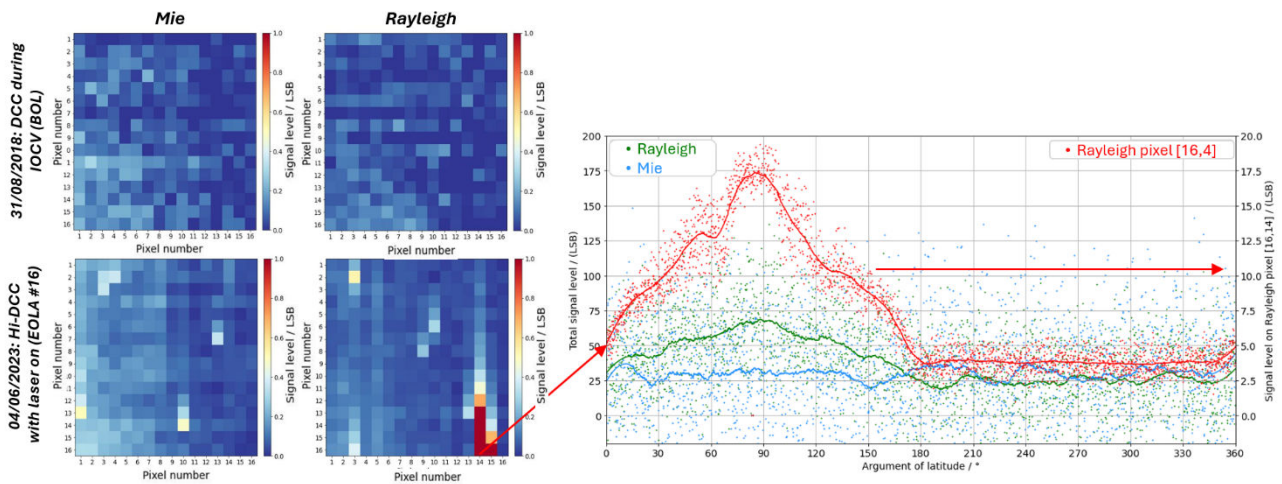


Figure 5: Aeolus ACCDs dark signal levels (in least significant bits, LSB) of the imaging zone at beginning of life (BOL) and EOL (left). The orbital variation of the total signal compared to “suspicious pixel” indicated on the lowest line 16 in column 14 of the Rayleigh ACCD is shown in the right panel.

5.2 Laser Performance: Stability and Power

The EOLA phase allowed the team to push the UV laser beyond its operational levels and towards its ultimate technical limits. Two tests were remarkable by resulting in records with regards to the laser frequency stability and the UV energy output.

Frequency Stability - EOLA#05: Laser frequency noise is a critical driver of wind measurement error. EOLA#05 focused on reducing the time between peak detection and the laser pulse emission by modifying the locking parameter of the Cavity Length Control Loop (CLCL) ramp set point from 5/8 to 7/8, where the values denote the timing of pulse emission relative

to the cavity-length ramp duration. The efficacy of the 7/8 set point to reduce the positioning noise was already observed during ground tests performed on the laser, but not initially applied in orbit, as the lasers were qualified with the 5/8 setting. Enhanced frequency noise was observed in flight for short periods caused by mechanical disturbance in resonance with certain reaction wheel speeds [2]. The new setting was functionally tested with the spare laser (FM-C) on ground at ESA-ESTEC prior to the execution in space. Applied during EOLA#05, it mitigated the impact of mechanical micro-vibrations on the master oscillator cavity length, resulting in an improvement in frequency stability by approximately a factor of two for both laser transmitters, as shown in Figure 6. First tested in space with FM-A, the optimized set point was maintained until final laser switch-off, as well as for FM-B

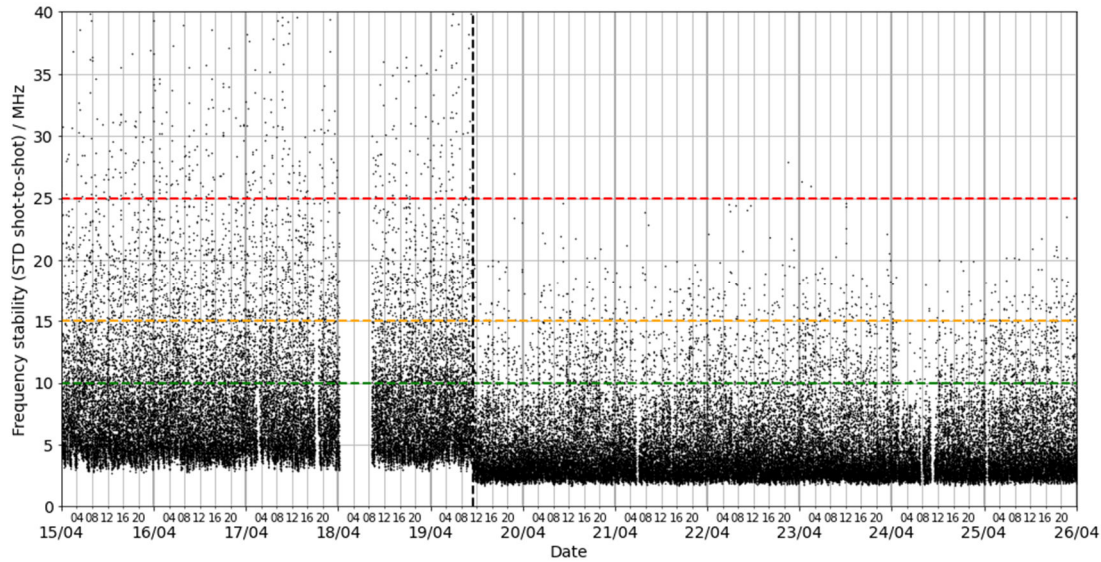


Figure 6: Laser frequency stability (rms on shot-to-shot level for each observation) of the FM-A before and after the CLCL ramp set point change on 19/04/2023. The horizontal lines mark the levels where the frequency fluctuations exceeded 10 MHz (green), 15 MHz (yellow) and 25 MHz (red). The respective percentages of wind observations above these levels were reduced from 25% to 6%, 9% to 1% and 1% to 0.01%.

Maximum Energy Output - EOLA#07: In the final weeks before the laser switch-off, the team explored the maximum UV energy output by adjusting pump currents, Q-switch duration, and amplifier phasings of the then active FM-B laser. This culminated in a record-breaking stable output of 182 mJ over 33 hours, surpassing the previous spaceborne record (169 mJ for less than 21 hours set by NASA's LITE in 1994 [10]). While this energy boost led to a ~17% decrease in transmit-path efficiency (likely due to increased clipping at the field stop and decreased transmission through the contaminated parts of the optics on the FM-B path outside the laser), it provided an unprecedented characterization of the laser's ultimate potential and the robustness of the optical chain. This result was especially relevant for the Aeolus-2 mission, where a nominal UV energy of 150 mJ is foreseen that may evolve over a lifetime of 5.5 years to ~142 mJ EOL.

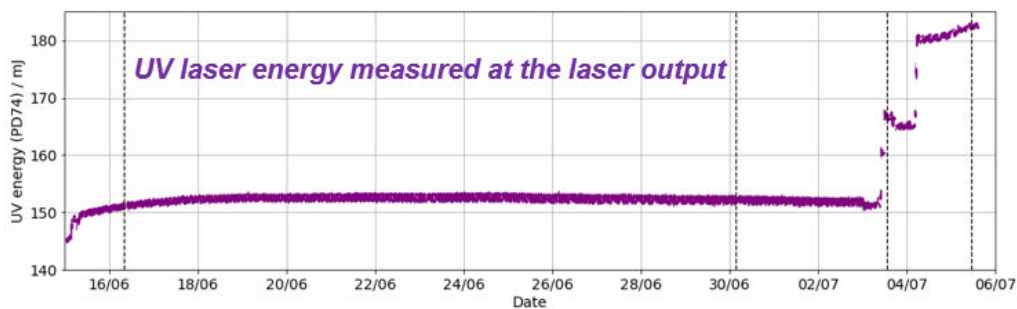


Figure 7: Timelines of the UV energy according to the laser-internal photodiode energy monitor (PD74) during EOLA#07 in June-July 2023. The dashed vertical lines indicate internal monitoring measurements of the near-field laser beam profile, utilizing the Mie ACCD.

6. LESSONS LEARNED AND FUTURE STRATEGIES

The EOLA program built upon the operational success of Aeolus by providing a deeper technical understanding of its instrument limitations and potential capabilities. By demonstrating a willingness to accept higher risks than during nominal operation at the end of the mission, the campaign maximized the scientific and technological return of the platform, transforming Aeolus into a pioneering in-space laboratory. The findings provide a substantial contribution to the roadmap for the development of Aeolus-2 and the operation of ATLID on EarthCARE.

6.1 Technical and Operational Achievements

The EOLA phase yielded several high-impact results that directly influence the design of successor missions. The characterization of ACCD hot pixels confirmed that these anomalies are radiation-induced defects with a strong temperature sensitivity unlike clock-induced charges, providing a clear justification for the lower operational temperatures planned for Aeolus-2. Similarly, the optimization of the laser cavity control ramp and the achievement of a record-breaking 182 mJ UV output energy provided a benchmark for the ultimate potential of single-frequency, spaceborne UV lasers.

Operationally, the EOLA campaign demonstrated that an agile mindset – characterized by trustful collaboration and a higher risk tolerance – significantly increases invaluable science and technology return at the end of a mission. The ability to introduce extended calibration routines, such as the Hi-DCC (EOLA#16), proves that instrument operational flexibility is a primary asset when tackling unforeseen in-orbit anomalies.

6.2 Future Strategies for Space Lidar Missions

To build upon the Aeolus legacy, the following strategies are proposed for future missions such as EarthCARE/ATLID and Aeolus-2 or future lidar missions in general:

- **Integrated Test Baselines:** An EOLA-like campaign should become a baseline for current and projected missions. This ensures a systematic approach to improving performance, validating design assumptions, and maximizing knowledge return for the mission science and future technologies.
- **Proactive Characterization:** To avoid the tension between operational availability and technical testing, future missions should incorporate dedicated "opportunistic" test slots immediately following the commissioning phase. This allows for the early execution of low-risk tests and the refinement of procedures before the end-of-life phase.
- **End-to-End Expert Synergy:** The success of EOLA was rooted in an efficient E2E expert working group with minimal approval layers. Establishing this lean hierarchy early in the mission is essential for rapid response to in-flight anomalies.
- **The Role of Airborne Demonstrators:** The ALADIN Airborne Demonstrator proved to be a cost-effective booster for mission success. Maintaining a technologically representative airborne lidar is highly recommended to support the development, validation, and in-orbit tuning of future space instruments. It fosters the collaboration between technology, operational and processor developments, and thus acts as a condensation nucleus for the interdisciplinary spirit and trust required for a successful mission.

7. CONCLUSION

Aeolus has established Europe as a leader in space lidar technology, achieving several "firsts": the first operational Doppler wind lidar, the first laser power validation with ground measurements (at the Pierre Auger Observatory [4]), the first extensive EOLA campaign, and the first-of-its-kind assisted re-entry. The Aeolus mission not only proved the operational value of spaceborne Doppler wind lidars for weather forecasting and atmospheric science, but also culminated in a pioneering EOLA program that transformed the satellite into a sophisticated in-space laboratory. By pushing the ALADIN instrument closer to its technical limits, the EOLA campaign yielded fundamental insights into detector degradation as well as record-breaking laser performance in the UV and frequency stability. All EOLA tests were non-destructive and provided valuable measurements until the required switch-off during the orbit decay phase. The satellite was finally deorbited due to reaching its fuel limit. The EOLA program demonstrated that the end of a mission's life can be its most productive period for technical innovation, ensuring that the legacy of Aeolus continues to shape the future of lidar in earth observation and beyond. The transition from a rigid operational schedule to a flexible, expert-driven test campaign allowed

for the resolution of long-standing technical questions and the generation of a rich dataset for Aeolus, Aeolus-2 and EarthCARE/ATLID as well as for other missions inside and beyond the lidar horizon.

By building on the lessons learned from the EOLA phase – ranging from detector and laser stability to the efficient test methodology– the next generation of missions will benefit from a more robust design and a more flexible operational philosophy. A key element for such an activity is the cooperation build around ESA, integrating the expertise from industry, the Aeolus DISC and the airborne demonstrator program.

The legacy of the Aeolus mission is thus manifold: It achieved the first global operational wind profiles, provides a role model for profiting from an airborne representative lidar, and established a gold standard for how the end-of-life phase of a complex space instrument can be leveraged to support the success of the next generation of spaceborne lidars.

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