International Conference on Space Optics—ICSO 2018

Chania, Greece

9–12 October 2018

Edited by Zoran Sodnik, Nikos Karafolas, and Bruno Cugny

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International Conference on Space Optics — ICSO 2018, edited by Zoran Sodnik,
Nikos Karafolas, Bruno Cugny, Proc. of SPIE Vol. 11180, 1118028 · © 2018 ESA
and CNES · CCC code: 0277-786X/18/$18 · doi: 10.1117/12.2535999

MERLIN: Overview of the design status of the Lidar Instrument

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ABSTRACT

The Methane Remote Sensing LIDAR Mission (MERLIN) is a joint French-German cooperation on the development, launch and operation of a climate monitoring satellite, executed by the French Space Agency CNES and the German DLR Space Administration. It is focused on global measurements of the spatial and temporal gradients of atmospheric Methane (CH4) with a precision and accuracy sufficient to constrain Methane fluxes significantly better than with the current observation network.

Merlin is a LIDAR Instrument using the IPDA principle. This instrument principle relies on the different absorption of the laser signal by atmospheric Methane at two laser wavelengths – on-line and off-line – both around 1.645 μm, reflected by the Earth surface or by cloud tops. The attenuation is strong at the on-line wavelength; the off-line "reference" wavelength is selected to be only marginally affected by Methane absorption. Being an active instrument with its own light source, the MERLIN LIDAR Instrument does not have to rely on sun illumination of the observed areas and can therefore continuously operate over the orbit.

Airbus DS GmbH was selected by the German DLR Space Administration as the industrial Prime Contractor for the Mission Phase C/D, to build the MERLIN Payload, which is the first realization of such an instrument for space in Europe.

This presentation will concentrate on the Architecture and the Design of the MERLIN Payload developed during the ongoing Mission Phase C. Further details of the instrument development status will be shown by an overview of the current hardware and design status of the major subsystems.

Keywords: MERLIN instrument, LIDAR, DIAL, IPDA

1. INTRODUCTION

The joint French-German cooperation Methane Remote Sensing LIDAR Mission (MERLIN) employs an Integrated Path Differential Absorption LIDAR (IPDA) to measure the spatial and temporal gradients of atmospheric CH_4 columns [1], [2]. on a global scale The satellite is being developed and operated by both countries in a joint partnership between the French Space Agency CNES and the German Space Administration DLR. A general overview on the MERLIN mission and a detailed description of the overall instrument architecture is given in [3] and [4] respectively.

The MERLIN LIDAR operates at nadir with a wavelength of approximately 1645nm, where methane has a line sextet offering suitable absorption cross sections and lineshape for implementation of a differential absorption scheme (DIAL). This is implemented by repetitive emission of dual laser pulses at slightly offset laser wavelengths, such that the on-line pulse experiences absorption from the methane feature (referred as λ_{on} at 1645.552 nm) and the other pulse provides a reference for the absorption of the atmospheric column outside the absorption feature (referred as λ_{off} at 1645.846 nm). The absolute methane content can then be inferred from the difference between the "on-line" and "off-line" back scatter signals between instrument and scattering surface. Being an active instrument with its own light source onboard, the MERLIN Lidar instrument does not have to rely on sun illumination and can therefore continuously operate over the orbit at day and night and even through thin cirrus cloud layers [3].

The paper presented here concentrates on the architecture and the design status of the MERLIN Payload.

2. PAYLOAD DESIGN OVERVIEW

The MERLIN payload is a LIDAR instrument using the Integrated Path Differential Absorption (IPDA) principle. It relies on the different absorption at two laser wavelengths – on-line and off-line – both around 1.645 µm, reflected by the Earth's surface or by cloud tops. The attenuation due to atmospheric Methane absorption is strong at the on-line wavelength; the off-line "reference" wavelength is selected to be only marginally affected by Methane absorption. The main instrument parameters are summarized in the followingTable 1.

Parameter	Unit	Value
Online Wavelength	nm	1645.552
Offline Wavelength	nm	1645.846
Pulse Energy	mJ	9
Pulse Length	ns	20 - 30
Repetition Rate	Hz	20 (for double pulses)

Table 1: Main characteristics of the MERLIN IPDA LIDAR instrument

The accommodation of the preliminary design of the MERLIN payload on the MYRIADE Evolutions platform is illustrated in the following Figure 2-1. Similar to other LIDAR instruments under development (e.g. for EarthCARE), the MERLIN instrument uses two separate telescopes for the transmission (Tx) and reception (Rx) of the laser pulses. Both telescopes are mounted on the same optical bench, which accommodates also the laser transmitter, the detection unit as well as two star trackers for verification and control of the pointing. The main structural element of the payload is the optical bench, made of CFRP and designed for maximum stiffness and lowest CTE. Primary and secondary mirrors of both Tx and Rx telescopes are made of Zerodur. The aim of the optical bench is to ensure a proper operational alignment of the two telescopes with the start tracker, and to decouple thermally and thermo-elastically the payload from platform for greater stability.

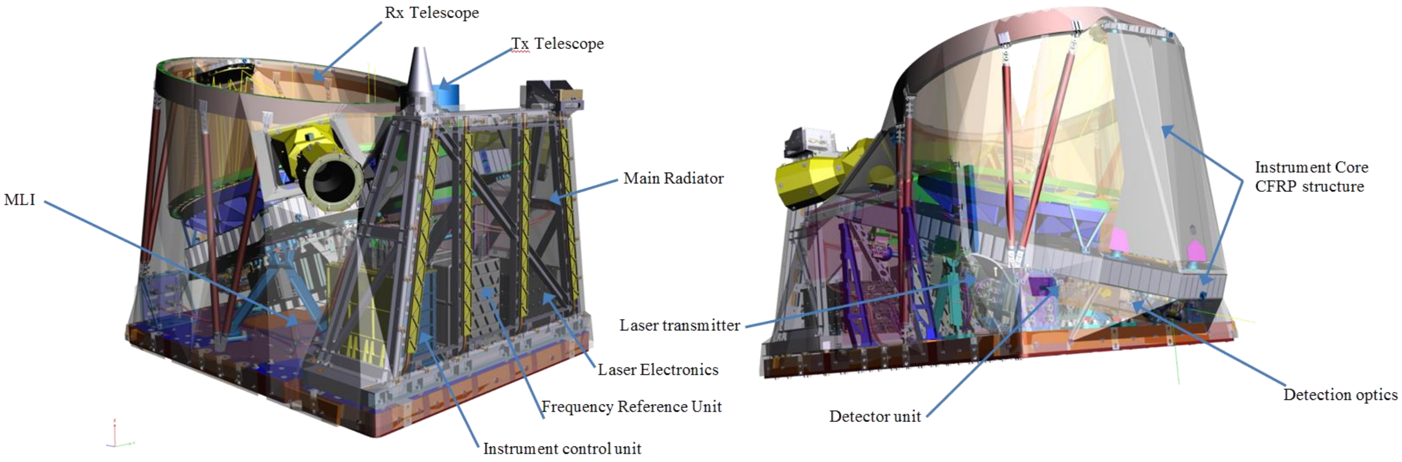


Figure 2-1: Merlin Payload accomodation

3. PRESENTATION OF THE INSTRUMENT SUBSYSTEM DESIGN STATUS

3.1 Laser

Laser optical bench – subcontracted to Fraunhofer Institut for Laser Technology (ILT)

On the top and bottom of the laser optical bench (LASO) are the optical components that form the Nd:YAG master oscillator power amplifier (MOPA) and the subsequent optical parametric oscillator (OPO).The design makes use of specially developed key optical components for spaceborne lasers [4]. All mirrors, lenses and crystals – especially for the demanding components like Faraday isolator, Pockels cell, piezo actor and OPO crystal control heater – are soldered to their mounts avoiding any adhesives. Different soldering methods are used, some of which allow an active alignment of the optics in the µrad regime. Also the electrical harness is built of soldered and screwed metal and ceramic parts without any plastics. These designs and more – like fiber coupled diode modules for oscillator crystal pumping and diode pumped InnoSlab amplifier - are inherited from the technology demonstrator FULAS [5] and are currently qualified for use in the LASO FM.

Phase C/D of the LASO started in 2017, the EQM/FM baseline design status is almost achieved and CDR is planned for March to May 2019. LASO EQM and FM long-term parts procurement is underway and both models will be assembled from parts procured together.

A LASO breadboard with complete end-to-end functions was built, tested and used for several development tests: Seeding and frequency control with FRU (frequency reference unit) breadboard was verified. Demanding output beam performance requirements such as pointing between λ_{on} and λ_{off} pulse were successfully demonstrated with an optimized OPO design. The LASO breadboard is currently being upgraded to be ready for representative interface testing with FRU EM and LAE (laser electronics) EM.

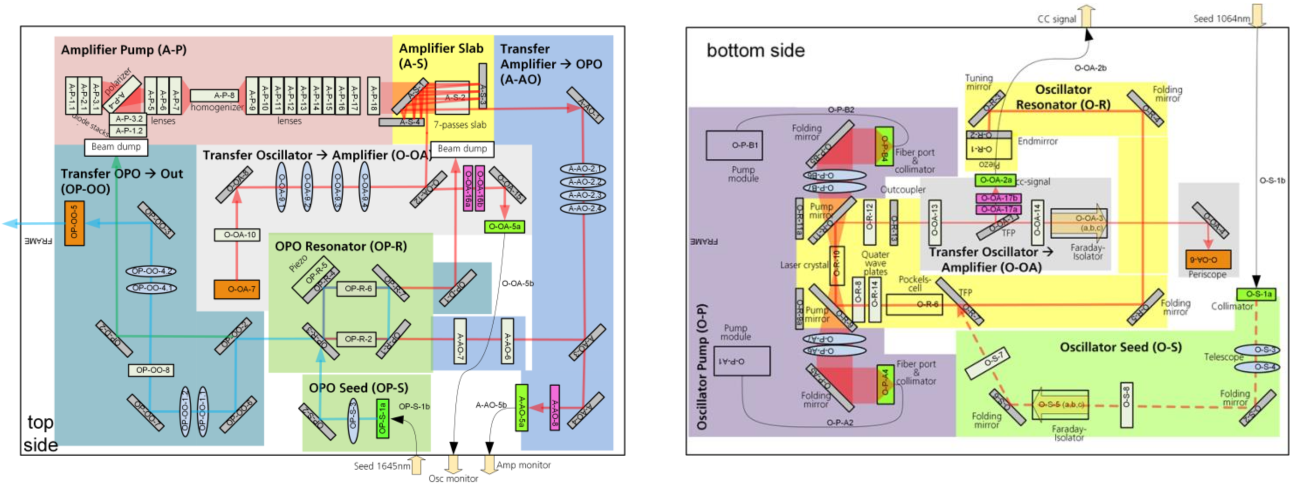


**Figure 3-1: Left: Optical design of the top side of LASO with the Nd:YAG amplifier and the subsequent optical parametric oscillator (OPO)
Right: Optical design of the bottom side of LASO with the Nd:YAG oscillator**

Laser Housing – Airbus internal build item

The laser housing is built as a pressurized and hermetically sealed housing with an isostatic mounting I/F for accommodation e.g. into an LIDAR instrument structure. As shown in Figure 3-2 , the central frame of the housing provides several hermetical feedthroughs for electrical and optical connectors, thermal-hydraulic feedthroughs for the miniature loop heat pipes (LHP) and a beam exit window. Furthermore two connectors for purging and pressurizing the housing before final sealing are implemented.

The mounting of the laser optical bench is optimized for mechanical decoupling from the surrounding structure. By isostatic mounting inside the housing central frame, the optical bench is insulated from stress induced by the instrument environment. Particularly, the design features a maximum tolerance with respect to mechanical deformation due to environmental pressure changes.

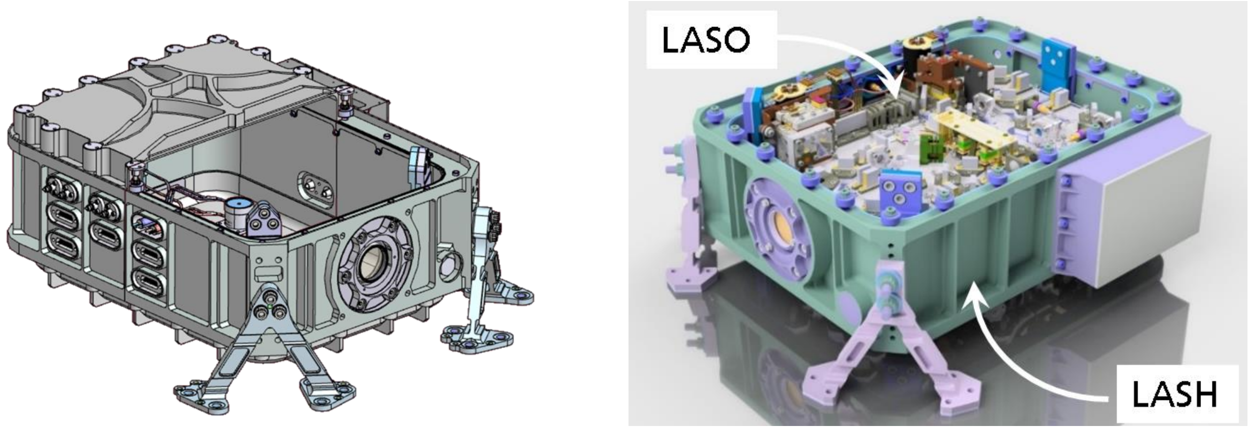


Figure 3-2: Merlin Laser Housing **Housing with integrated optical bench**

To achieve space compatibility, the design is optimized with special attention on LIC issues introducing several new technologies. To reduce LIC effects, the hermetically sealed housing provides lifetime atmospheric pressure conditions for the laser optical system. Use of innovative soldering techniques for optics alignment and glue free mounting, concepts for the electrical harness avoiding plastic insulation, a newly developed friction stir welding (FSW) process for the pressurized housing and other details enable the realization of the design goal of an "all metallic, ceramic or glass design" by very few exceptions only.

The compliance of the concept has been validated before in air-borne LIDAR applications and the ESA/DLR cooperation FULAS.

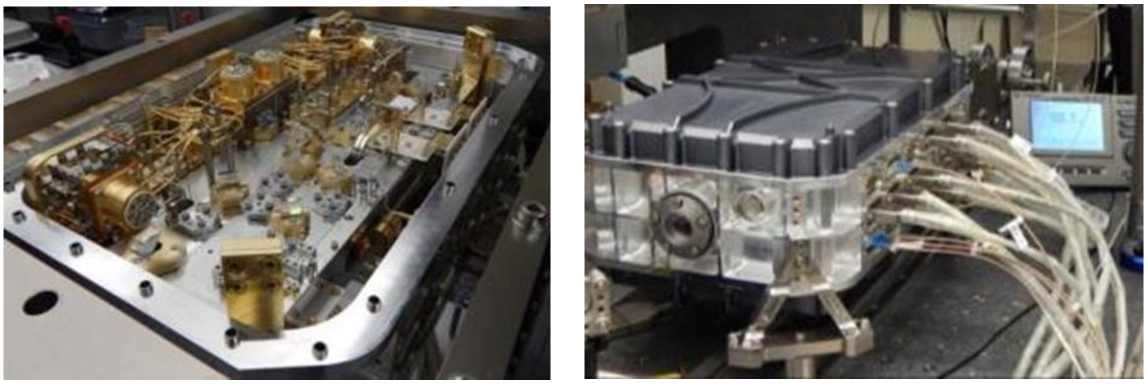


Figure 3-3: FULAS
Left: LASO in LASH frame **Right: First operation at full performance**

3.2 Frequency reference unit – Subcontracted to SpaceTec Immenstaad (STI)

One part of the MERLIN laser system is the Frequency Reference Unit (FRU), which stabilizes the frequency of the pulsed laser relative to the absorption lines of methane at around 1645.55 nm with MHz accuracy. For the absolute reference, a methane gas cell is flown within the unit. For relative frequency measurements, a Fizeau wedge with about 4.28 GHz FSR is used, being part of a wavemeter. Low noise laser diode drivers have been developed and implemented in order to keep the laser frequency within the desired accuracy range. Also, the MERLIN master oscillator is seeded by the FRU with narrowband 1064 nm laser light.

The major functional and performance requirements of the FRU are:

- Seeding of the 1064 nm master oscillator with an optical power of 10 mW and a linewidth smaller than 1 MHz.
- Absolute frequency referencing to the 1645.55 nm (6077 cm-1) methane line.
- Seeding of the OPO at the two wavelengths, λon and λoff, with each > 5 mW and the linewidth < 2 MHz. The frequency stability and accuracy of λon needs to be better than 10 MHz. λoff is determined by the OPO.
- Spectroscopic measurement of every individual OPO laser pulse λon and λoff, providing a frequency knowledge better than 8 MHz for the online and 50 MHz for the offline frequency.
- Control and stabilization of the instrument’s OPO cavity length according to the performed measurements.

In summary, the FRU consists of fiber-coupled laser diodes (both at 1064 and 1645 nm), optical fibers, optical switches, a methane gas cell, a wavemeter and the associated electronics to operate all components. Refer to the figures below, showing the FRU configuration. It is mounted to a thermal and mechanical interface plate, which itself is mounted to the satellite x-panel. The FRU has an envelope of 237 x 190 x 232 mm, a mass of <6.2 kg and an operational power dissipation of <23 W. The command and control interface to the spacecraft ICU is via a SpaceWire interface. A reprogrammable FPGA is used in order to control and operate the unit after the ICU has initialized and commanded it. Different implemented modes serve for operation, calibration and diagnostics. For more details, please refer to the article in the same issue of these proceedings.

The FRU completed its Critical Design Review (CDR) in July 2018 and is ready now to begin manufacturing of the Protoflight Model (PFM). The Engineering Model (EM) FRU is flight-design representative and is currently completing its test and evaluation program prior to delivery to the spacecraft integrator in Q4 2018. The PFM FRU is planned for delivery in Q3 2019.

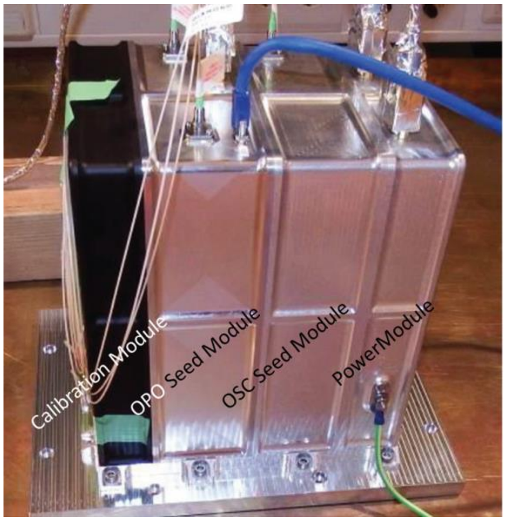
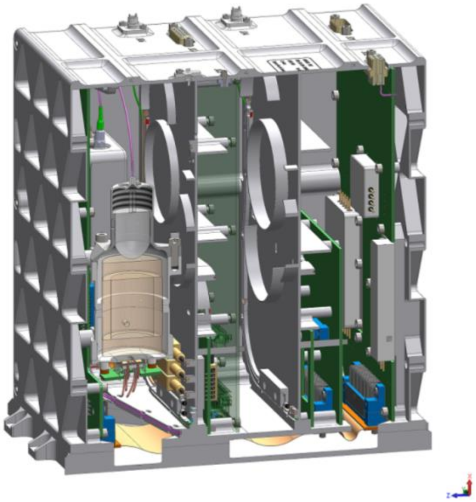


Figure 3-4: Mechanical Design of the FRU – Overall System (EM @ EMC Test)



Cut-Away View of the FRU Assembly

3.3 Internal calibration chain - Subcontracted to SpaceTec Immenstaad (STI)

The Internal Calibration Chain (ICC) is one subsystem within the MERLIN instrument. It is intended to provide respectively enable to determine the following informations:

(1) Radiometric calibration signal

(2) TX Laser pulse time stamp

(3) TX Laser pulse frequency

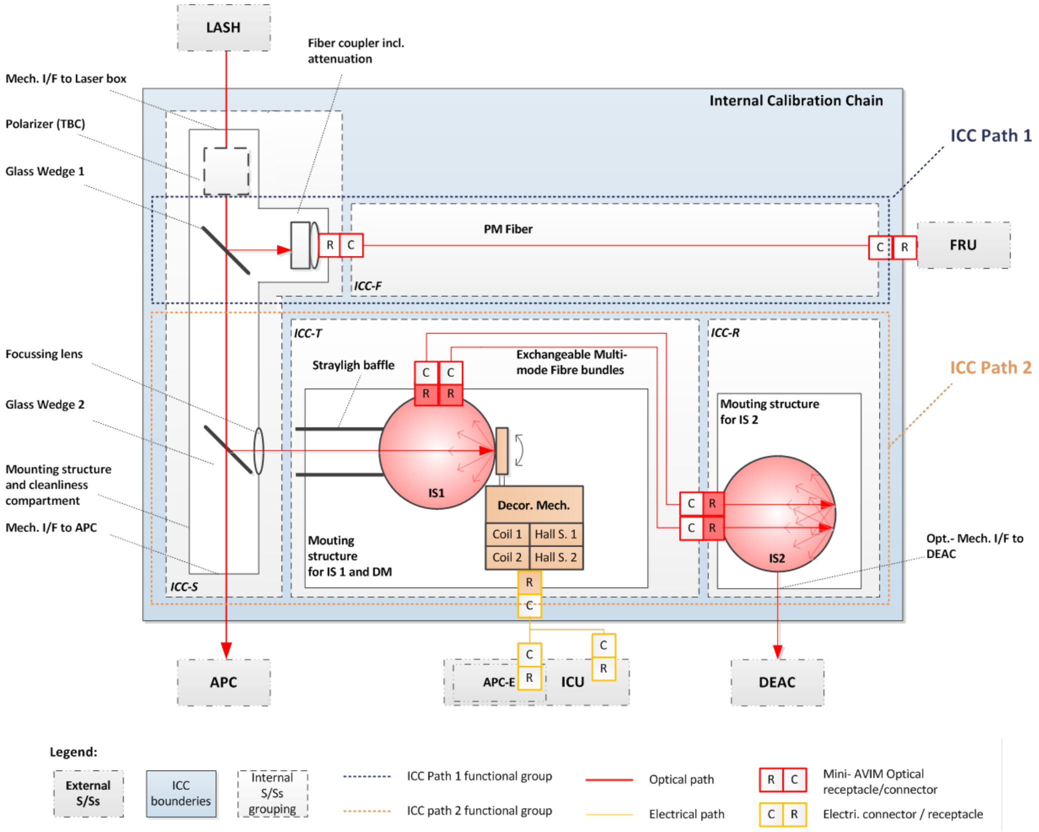


Figure 3-5: ICC schematic setup

Tasks (1) and (2) is assigned to the ICC path 2. Task (3) is assigned to the ICC path 1.

The dominating performance aspect of the ICC is the radiometric energy references for the IPDA zero layer. Here a huge effort was spend to meet the dynamic range of the signal chain and to minimize the systematic errors in this subsystem. One of the important elements for this systematic free concept is the pure white noise behavior of the two wavelengths for error sources like coating variations, etalon effects and speckle statistics.

For the speckle topic a dedicated decorrelation mechanism will be used to generate for any shot pair an independent start conditions for the phase correlation of the two pulses. This mechanism is realized by a moving diffusor at the first scattering surface of the reference path.

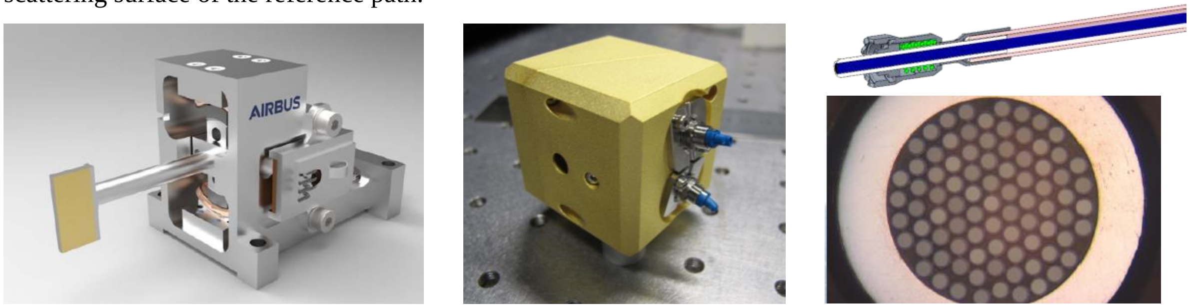


Figure 3-6: ICC HW status

Decorrelation mechanism **Integrating sphere** **Transfer Fiber Bundle**

These functions are supported by the Merlin Signal Chain S/S for the detection of the radiometric calibration signal as well as the TX Laser pulse time stamp, and the Frequency Reference Unit (FRU) for the detection of the Laser pulse frequency.

3.4 Laser electronics Subcontracted to von Hoerner&Sulger (vH&S)

The Laser Electronics (LAE) is the only electrical Interface (I/F) towards the Solid State Laser (LAS). It provides:

- quasi-continuous closed loop control for oscillator cavity length matching to the FRU generated seed light by sine wave excitation of a piezo following a cavity dither approach,
- high power current pulses towards both: oscillator and amplifier pumping laser diodes,
- fast rising, high voltage pulses to the Pockels cell for active q-switching of the oscillator,
- FRU input based control of the OPO cavity length by active drive of a further piezo,
- overall closed loop thermal control of the optical bench employing two loop heat pipes, and
- high accuracy thermal control of the two OPO crystals via resistive heaters.

All tasks are fulfilled by dedicated hardware driver modules whose analogue parameters and required timing are controlled by a complex FPGA, making the LAE an almost self-standing unit that can be parameterized, monitored and triggered by the ICU via a Space Wire I/F.

Following a breadboarding phase for all hardware drivers, the present work concentrates on the manufacture and verification of a Mechanical-Thermal-Dummy (MTD) as well as an elegant Engineering Model (EM), the latter providing as far as possible representativeness to the planned Proto-Flight-Model (PFM). Apart from stand-alone functional verification using electrical dummy loads, the EM will be used for qualifying ESD- and shock-tests while all other qualification aspects will be performed using the upcoming PFM. In addition, the LAE EM will be used for concept-verification of LAS and LAE interaction employing a representative laser breadboard prior to PFM manufacture. The LAE consists of two boxes: one box is mounted directly at the laser housing and accomodates the Pockels cell driver (see **Figure 3-7** left side) , the other one is mounted onto the common panel and provides all other functionalities (see **Figure 3-7** reight side).

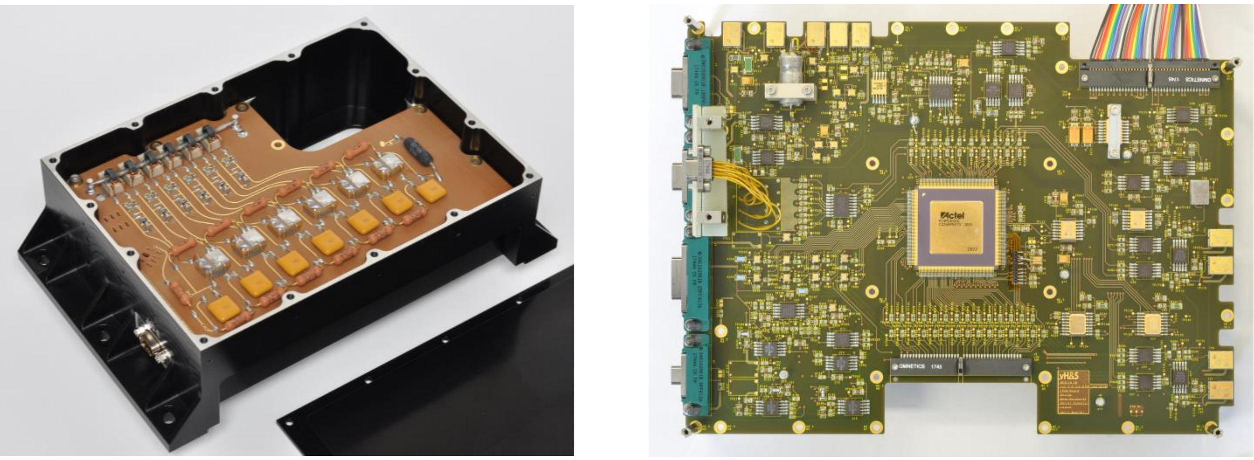


Figure 3-7: Merlin laser electronics unit
Pockles Cell driver **Control electronics main board –**

3.1 Instrument control unit – Airbus internal build item

The Instrument Control Unit (ICU) with the included DCM module of the SIgnal Chain (SIC), is the sole command interface between the platform and the instrument. It provides the command interface and the science data interface. The command interface will be used to receive commands and to send telemetry. The science data interface will be used to provide the measurement data and all ancillary data, which is required for the on-ground processing of the measurement data (e.g. timestamps, signal energy data, detector temperature, etc.).

The ICU makes use of recurring modules, with the exception of the SIC, which is instrument specific.

To date, the interface tests with the platform have successfully been performed in cooperation with CNES and Airbus Defence and Space SAS.

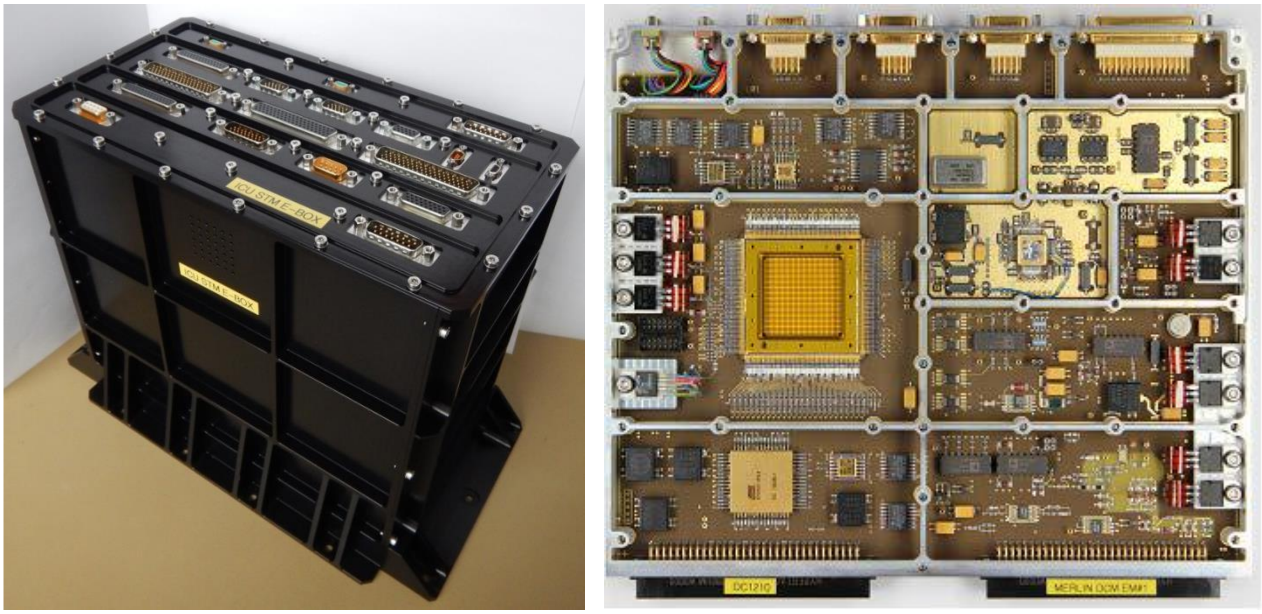


Figure 3-8: Merlin instrument control unit – STM and DCM EM

3.2 Signal chain – Airbus internal build item

The main processing steps of the Signal Chain after are:

- Co-addition of the individual pixel values (within each sampling period [“vertical”]),

- Data width reduction of the co-added values (e.g. 16 bit, 20 bit or 24 bit),
- Measurement-source oriented PUS and CCSDS SpW formatting and time stamping of measurement data,
- Acquisition, PUS and CCSDS SpW formatting and time stamping of the Configuration data package / settings for each measurement,
- Acquisition, PUS and CCSDS SpW formatting and time stamping of specific and standard ancillary data packages,
- Sorting of the data, coming from the different data sources, into the mission data stream and output of the data to the P/F Mass Memory.

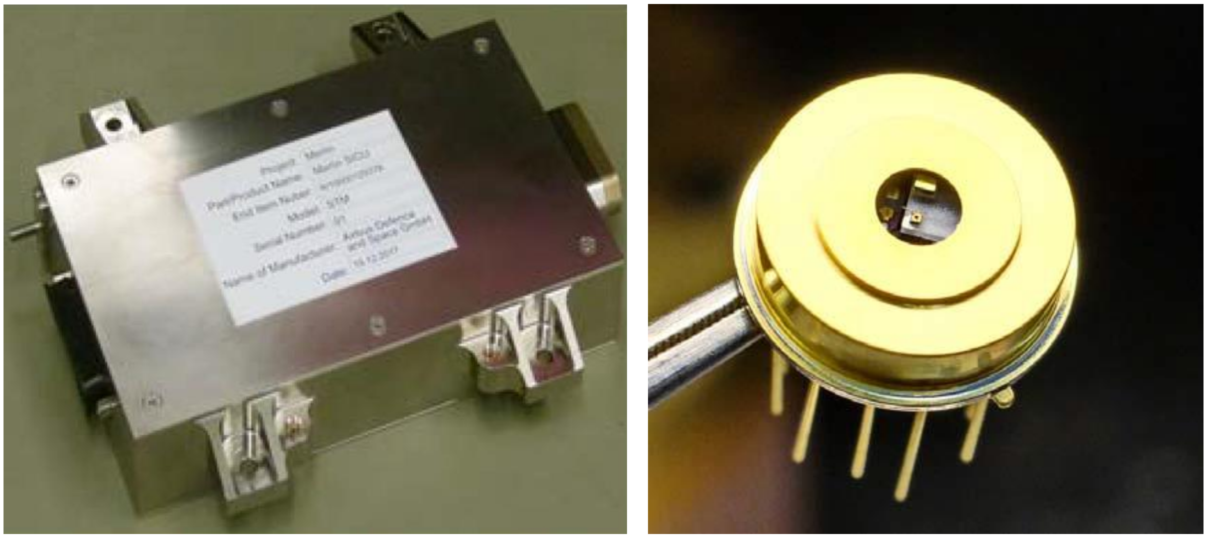


Figure 3-9: Merlin instrument control unit – STM and Detector EM

To date the radiometric resolution performance has been confirmed with the selected combination of detector, front-end electronics and A/D converter. The confirmation of the system's linearity is currently on-going. The main challenge is the long measurement time due to the stringent requirement (10e-4 residual non-linearity over the full dynamic range) in combination with the low number of photons (approx. 1500) at 13% radiometric resolution.

3.3 Instrument Core – Airbus internal build item

The entire instrument is accommodated on the top panel of the platform, and consists of two main subassemblies: an aluminum sandwich accommodating three electronic units and the main instrument radiator – presented in more detail in the chapter on thermal hardware – and a CFRP structure, named "instrument core". Such structure represents the backbone of the optomechanical part of the instrument, since it ensures the necessary strength, stiffness and stability to let the optical elements both survive the launch environment and operate in orbit preserving the relative alignment under a range of thermal loads.

The optical bench is connected to the platform via three titanium isostatic mounts: two longer mounts on the side towards the main radiator, and a shorter one on the opposite direction. This leads to a slanted orientation of the optical bench, as a consequence of the severe constraints imposed by the reduced envelope in launch direction (820mm).

The structure is based on a proprietary sandwich design with both face skins and honeycomb made of ultra high modulus CFRP optimized for low hygro-thermal deformations.

In order to achieve an early structural and thermal verification of the instrument, an STM-PFM approach is followed. In particular, the STM is presently being manufactured: the Figure 3-10 show recently completed CFRP items of the receiver telescope, fully representative of the flight design, and which are presently being integrated in view of the test campaign in the first half of 2019.

The test campaign will include both thermal cycling and balance phases, with continuous monitoring of the deformation through a dedicated OGSE, and mechanical verification against sine, acoustic and shock environments. On the other hand, microvibration transmissibility is end-to-end tested in a later phase with a flight representative model of the Laser, being this the subsystem most sensitive to microvibrations.

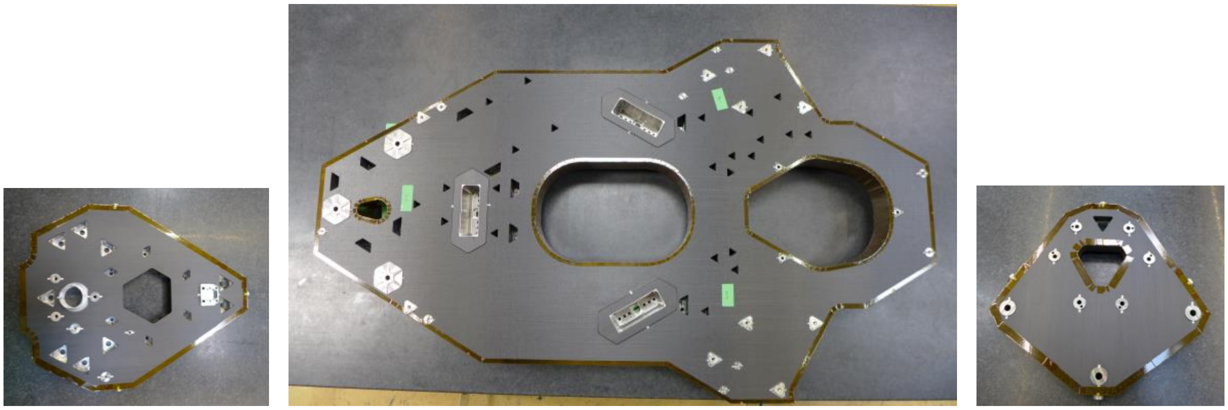


Figure 3-10: Examples of CFRP elements of the Merlin STM, fully representative of the flight design; the largest item is represented by the optical bench, with a length of approximately 1.3m.

3.4 Optical Subsystem - Subcontracted to Safran Reosc

The Merlin optical concept is based on a bistatic concept for Tx and Rx path
The receiver telescope RX is an afocal design with a magnification of 50x. It consists of two conical mirrors and an achromatized ocular lens (OCL).A design driver has been the need for a compact envelope allowing a maximal M1-M2 mirror distance 470mm. The DFL focuses the collimated light from the exit pupil onto the detector. Due to the scientific specifications of low detection noise (small detector) and large ground spot a very high f# of <0,65 for the DFL was required, which was one driving factor for the Rx design.

The transmitter telescope consists of the primary TXOTP (M1) and secondary TXOTS (M2) transmitter mirrors, an optical cover window (TXOW), and an active pointing control mirror (APC). The TXOW is required for contamination protection and the APC is necessary for active in orbit co-alignment between the RX and TX beams.

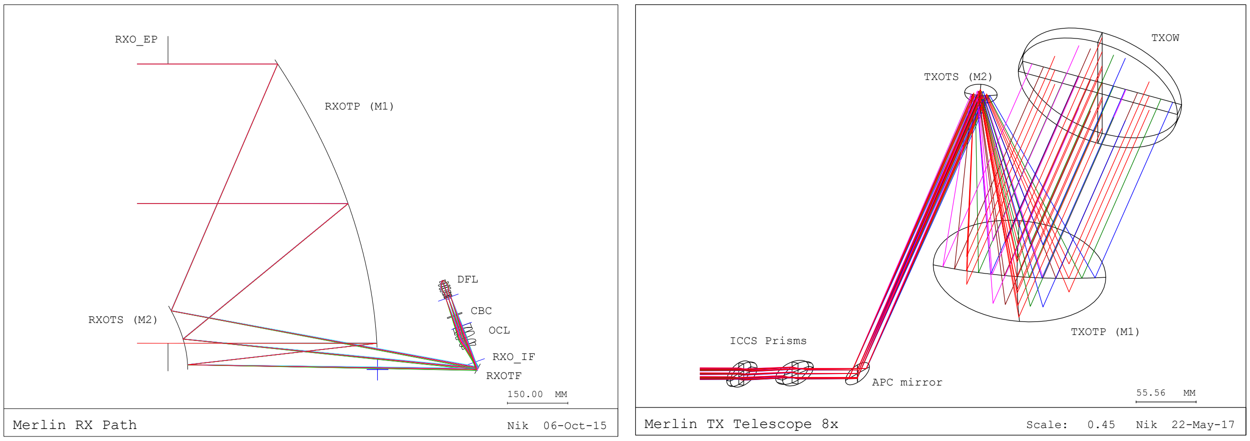


Figure 3-11: Overview of the Rx path **Overview of the Tx path**

Safran Reosc has been selected as our subcontractor for all of the RX and TX telescope optics, including the lens packages OCL, DFL and DEAC. One supplier for all main components allowed us to find the best balanced solution for the RX and TX optics that ensures a good feasibility and an efficient manufacturing for all design aspects.

Figure 3-12: M1RX QM mirror after acid etching, courtesy of Safran Reosc

DFL body

DEAC body

Safran Reosc's critical design review (CDR) has been successfully passed and hardware manufacturing is in progress at the date of this publication. Figure 3-12 shows the photo of the M1 RX after acid etching. The mirror has been light weighted by approximately 90%. Load cases, which are presented in the next chapter for mirror deformations resulting from opto-mechanical analyses, have been performed by the Safran Reosc engineers.

3.5 Active pointing control (focus on optomechanical unit) – Airbus internal build item

The active pointing control mechanism (APC-M) is an electro-mechanical tip/tilt mirror system developed and manufactured by Airbus DS GmbH, Friedrichshafen, Germany. Its gimballed mirror can be tilted about two Cartesian axes by driving the two-channel spherical motor. Position feedback is obtained by an inductive Position Sensor System (PSS). This mechanism was implemented to adjust the critical Rx/Tx co-alignment in the case of drifts or changes due to operational conditions or setting effects.

The APC can be used to perform this calibration on a short-term period (day) and long-term period. In the first case this can be used for daily monitoring and in the second for re-calibration for example on a monthly basis.

The calibration method lets the APC mechanism perform a symmetric scan with even steps along-track and across-track, starting from the position the mechanism currently is placed. The centroid of the scan grid using a common centre of mass method and a 2D curve fit is then calculated in order to give the correction values for the APC mechanism for the Rx/Tx re-centring. Based on the current simulations and BB results the residual pointing error can be reduced to < 5µrad.

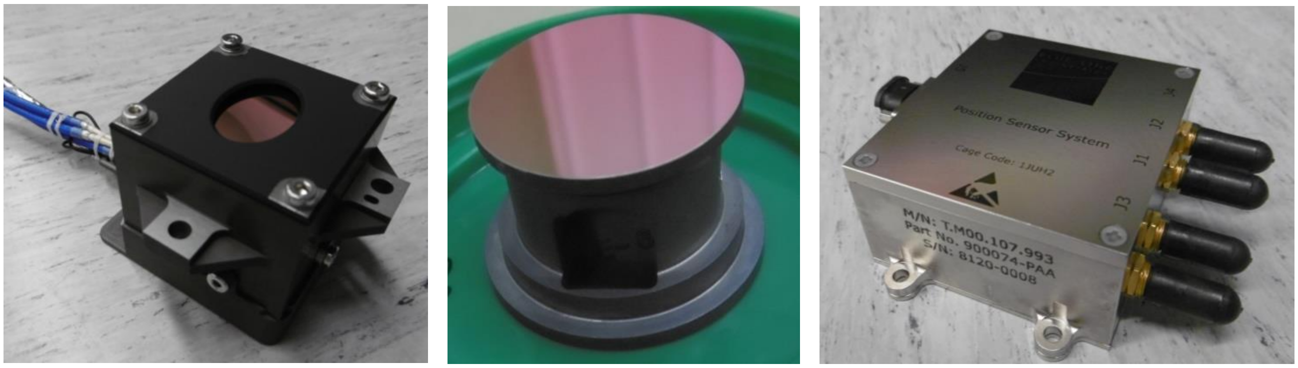


Figure 3-13: APC Elements
Complete Fine Steering unit **Scan Mirror** **Sensor electronics**

All mechanical parts are available and on stock. Only two subcomponents needs to be procured, but those are the key driver for a successful in-time delivery: The Positioning Sensor System PSS) and the optical mirror. Since the first part is almost an of the shelf item and shall be available in assessable time, the second part needs a specific and additional delta mirror (coating) qualification. This is driven by the project needs which showed that the existing mirror (coating) cannot be used and a specific coating needs to be developed for the project. This qualification is already in progress and shall be completed end of this year. Based on this assumption a delivery of the FM mirror is planned optimistic mid of 2019, with following mechanism AIV phase.

3.6 Thermal control hardware – Airbus internal build item

The MERLIN instrument Thermal Control Subsystem (TCS) relies on passive thermal control elements like Multi Layer Insulation (MLI), Radiators (RAD), Thermal Straps (TS), Heat Pipes (HP) and Loop Heat Pipes (LHP) assisted by an actively controlled heater system, single layer Kapton heater mats, provided by the platform, in non-operational cases. The Payload TCS is a single failure tolerant design to keep all electrical unit temperatures and optical assembly temperatures, especially the laser and the detector assembly, within their applicable limits during satellite launch, early orbit phase, nominal operation and when in survival mode.

The main challenge of the Merlin TCS is to guaranty stable I/F temperatures inside the laser or on the detector, in a range of ±1K, without active thermal control and without applying the normal uncertainty/margin approach based on the given working point by laser physics.

Most of the instrument outer surfaces are covered by MLI with Beta cloth outer layer. Beta cloth has been used for decades for outer layers because it is resistant against atomic oxygen (ATOX) erosion in low earth orbit. At an Merlin orbit altitude of almost 506 km ATOX can’t be neglected. The fabric Beta cloth has some throwbacks in kind of mass and stiffness to the mechanical design in comparison to a standard Kapton outer layer. For internal MLI blankets, inside the instrument and also inside the RX telescope baffle, standard Kapton outer layers are used. The complete MLI design, manufacturing and implementation on the STM is performed by NEXEYA.

Airbus Defence & Space have a long lasting and wide heritage and experience in the development, manufacturing and testing of space qualified heat pipes with extensive flight heritage since 1981. A large amount of heat pipe profiles have been designed and manufactured for different space applications, most of them for Aluminium/Ammonia applications. For this, the heat pipe profiles have been optimized with respect to thermal performance by targeting a low profile mass, while still being able to fulfil the safety requirements for proof load and burst. The Merlin L-shaped heat pipes collecting the heat dissipations of the three electrical units (ICU, LAU and FRU) which are mounted via the support structure to the intermediate baseplate and the HiPeR radiator. The condensor of the heat pipes is connected to the HiPeR radiator via a clamp plate to guaranty the optimum heat flow. At the current project status the HPs are machined, bended and filled. In the next months all HPs have to fulfill a number of mechanical and thermal tests, for example proof pressure and leakage tests or thermal performance tests.

Figure 3-14: Main HeatPipe

The HiPeR radiator, is provided by Airbus Defence and Space Netherlands, uses pyrolytic graphite to efficiently spread the heat from the HP I/Fs over a large radiative area. This solution offer more flexibility in terms of design and Assembly Integration and Test (AIT) while offering a lower mass than conventional aluminum radiators. The HiPeR laminate provide up to 10 times higher thermal conductivity than aluminum, while having almost half of its density (1600 kg/m3). Additionally, it allows last minute access to the units while keeping the heat pipe interface fixed, as the radiator can be folded similarly to what could be done with Kapton MLI. To provide a high epsilon and a low alpha outer surface white paint is applied on the Kapton layer. During the Merlin STM Test in Q2 2019 the concept will qualified and the trade between HiPeR and Aluminum radiator will be finished.

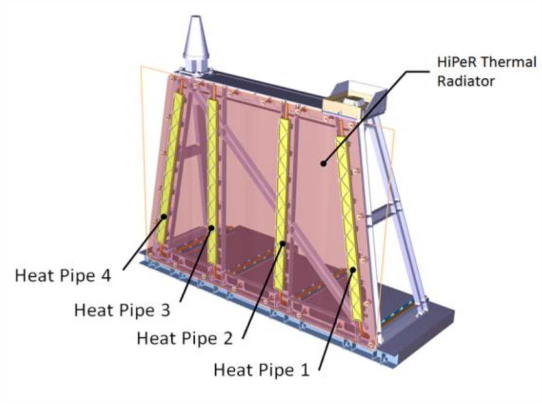


Figure 3-15: -Z Radiator

As mentioned before the absolute temperature and temperature stability requirements on the optical bench inside the laser are very tough. To maintain the equipment on the optical bench in a stable operating range and to ensure an efficient heat transfer to the remote radiator without disturbing the mechanical stability the Merlin project make use of the Mini-LHP

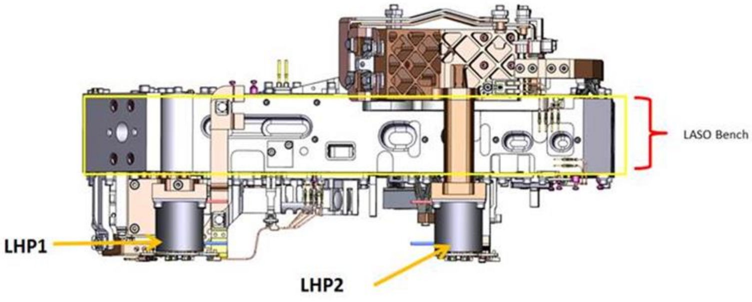


Figure 3-16: LASO internal Loop Heat Pipe Configuration

technology. These two-phase passive technology, provided by Airbus Defence & Space Toulouse in cooperation with Euro Heat Pipes (EHP), uses heater controlled evaporators with PTFE wick inside to collect the thermal power via ammonia vaporization, transfer the vapor to the condenser mounted on a radiator and transfers the liquid back to the evaporator in a closed loop. The final design of the evaporator height, the tubule routing through the instrument and also condenser routing on the radiator is started.

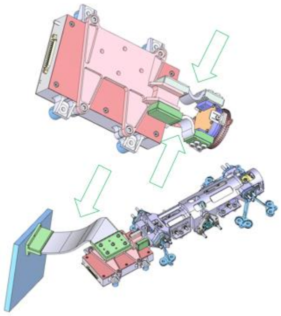


Figure 3-17: HiPer Straps

To guaranty the required temperature levels and stabilities for the detector assembly and the SICU HiPeR thermal straps are used. HiPeR straps employ a stack of pyrolytic graphite foils to maximize thermal conduction between components while minimizing mechanical coupling. In comparison with aluminum/copper competitors, these thermal straps allow a significantly higher heat flow over larger distances with a more flexible strap. In the Merlin application this technology is also challenged in size of the I/Fs and the distance between source/sink. The two straps between SICA and SICU are very small in all dimensions and the single strap between SICU and RAD is very long. During a co-engineering phase all critical design parameters are proofed and the manufacturing can be started ASAP.

4. CONCLUSION

The joint (satellite and payload) MERLIN project performed in cooperation by CNES and DLR is currently in the middle of phase C/D. First Subsystem CDRs has been performed and all other will be realized in the next 12 month.
The PF has successful finalized the first AIT activities of the flight model and has now transferred in a hibernation phase until the PL has reached to final tasks in the preparation of the CDR in Sumer 2019 leading to a PL CDR end of 2019.

5. ACKNOWLEDEMENT

The authors would like to thank the whole MERLIN project team at DLR, CNES, Airbus DS, SpaceTech, Fraunhofer ILT, von Hoerner & Sulger, Safran Reosc, for their continuous support and their fruitful cooperation in this challenging project. The German part of the MERLIN project is funded by the German Federal Ministry for Economic Affairs and Energy under DLR contract 50 EP 1601.

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