1 Instrument description and architecture

The instrument assembly consists of an electronic box (DPU) and a separately installed sensor connected to the electronic box by a bundle of optical fibers and electrical cables (harness). A specific sensor bracket is designed to mechanically interface 2 identical sensors with the satellite boom (a cold redundancy has been chosen for Swarm, each sensor being connected to a dedicated DPU located within the satellite main body).

1.1 Data Processing Unit

The DPU functional architecture is depicted on Figure 1.

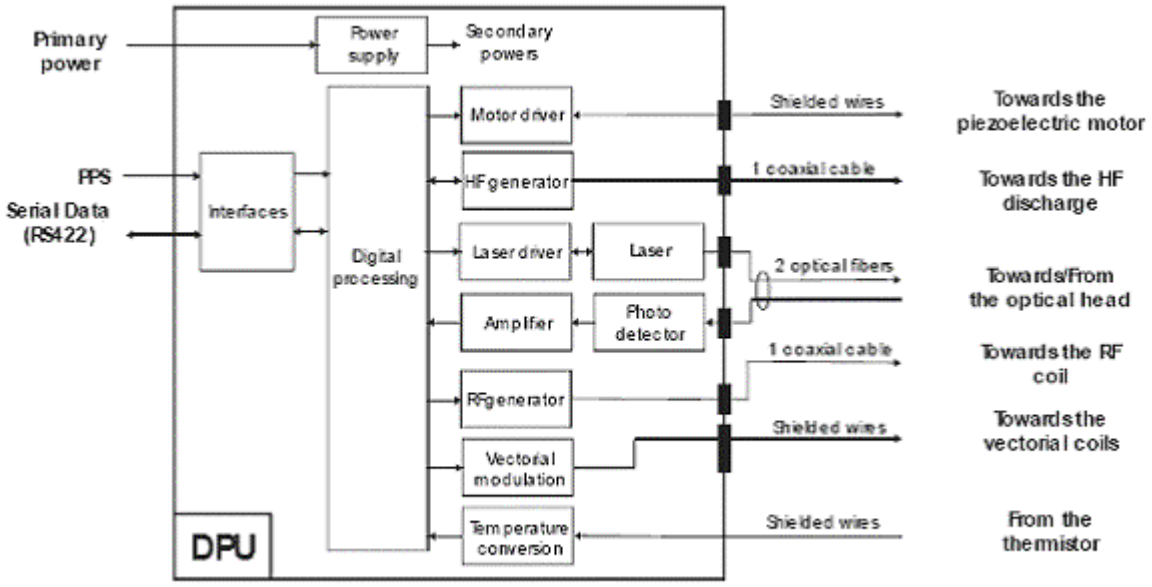

Figure 1: DPU functional architecture

The DPU unit consists of 2 stacked modules whose component architecture is presented on the Figure 2 below.

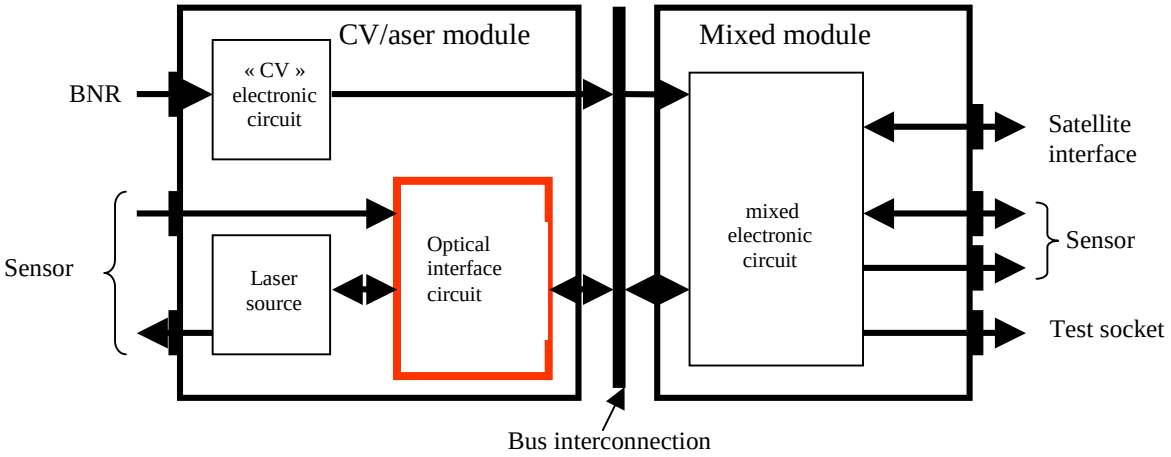

Figure 2 : DPU component architecture

This architecture can be divided in:

A first module called "CV-Laser" consisting in the optical part of the DPU (1083 nm laser synthesis and the optical interface with the sensor) and the primary and secondary power DC-DC converters. This module can be divided in 3 sub-systems:

- The CV card which delivers the secondary voltages (±5V, +3,3V) to all the electronic circuits of the DPU.
- The laser source which delivers optical power to the sensor, including the LFA, WDM, EOM and the electro-optical isolator sub-blocks.
- The optical interface circuit including the pump laser diode, two photodiodes and their dedicated low noise amplifiers, the EOM interface circuit and electrical bonding for the piezoelectric actuator.

A second module called "Mixed card" containing the main digital and analog circuits, and regrouping most of the electrical interfaces with the sensor and the satellite. This module regroups:

- The main digital core
- Electrical interfaces and a test socket
- The different data acquisition and signal processing modules
- The RF,HF, laser, piezoelectric motor and vector mode drivers

An artist view of the 2 stacked modules of the DPU is presented on Figure 3.

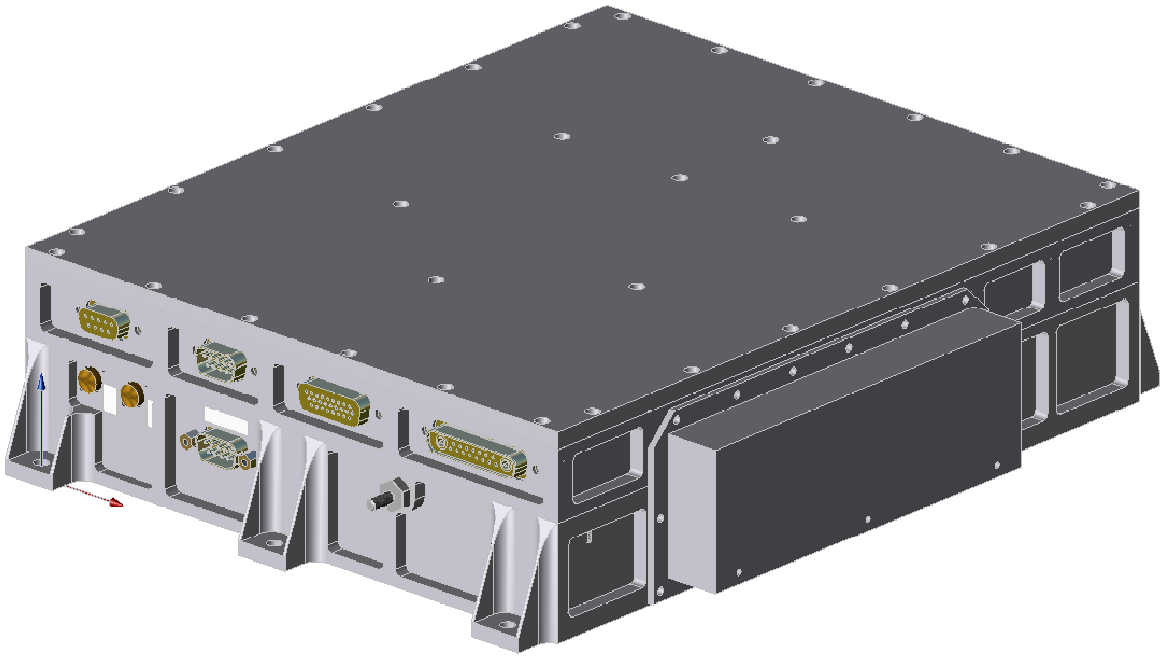

Figure 3: DPU artist view

1.2 Sensor and bracket

The sensor can be divided in different sub-systems depicted on Figure 4.

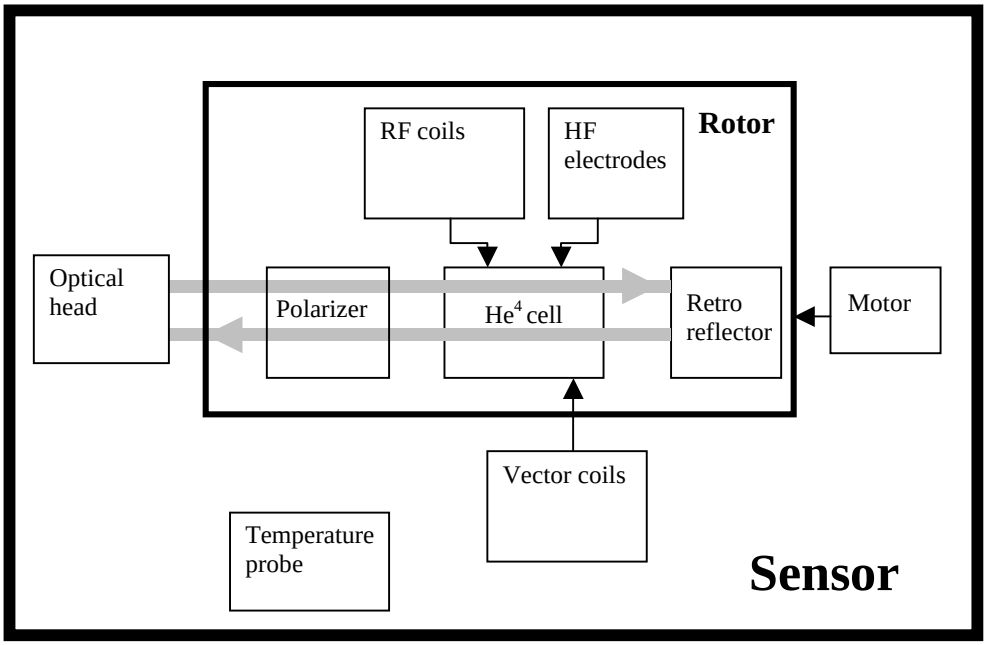

Figure 4. Sensor architecture

The sensor sub-parts are:

A rotor comprising:

- the He^4 cell containing a low pressure helium gas which is the sensible part of the sensor
- HF electrodes used to apply an electric discharge to the He^4 gas thus transferring some of the atoms from the 1^1S_0 ground state to the 2^3S_1 metastable level
- RF coils used to apply a RF field to the excited helium atoms to induce the magnetic resonance between the Zeeman sublevels of the 2^3S_1 metastable level
- A linear polarizer whose rotation ensures optimal pumping conditions of the He^4 gas
- A retro reflector used to reflect the laser light back through the cell to the optical head

Keeping a constant 90° angle between both polarizat ion and RF field directions and the ambient magnetic field ensures the complete isotropy of the sensor.

- A stator comprising :
- The totally amagnetic piezoelectric motor used to drive the rotor
- Rotating transformers to ensure contactless electrical connections to the HF electrodes and RF coils integrated on the rotor
- A temperature sensor probe
- Three orthogonal vector coils for the vector mode. These coils are used to create vector modulations that are superimposed on the static field.

An artist view of the sensor is given on Figure 5

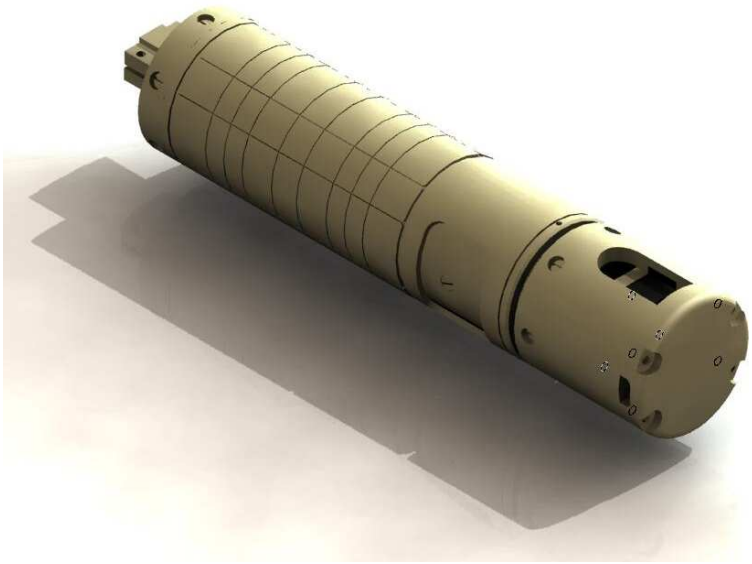

Figure 5

The ASM sensor will be mechanically interfaced at the extremity of the SWARM satellite boom thanks to a sensor mount. Due to the cold redundancy configuration chosen for Swarm, two sensorsare in fact accommodated in this sensor mount. An artist view of these two sensors assembled in the sensor mount is shown on Figure 6.

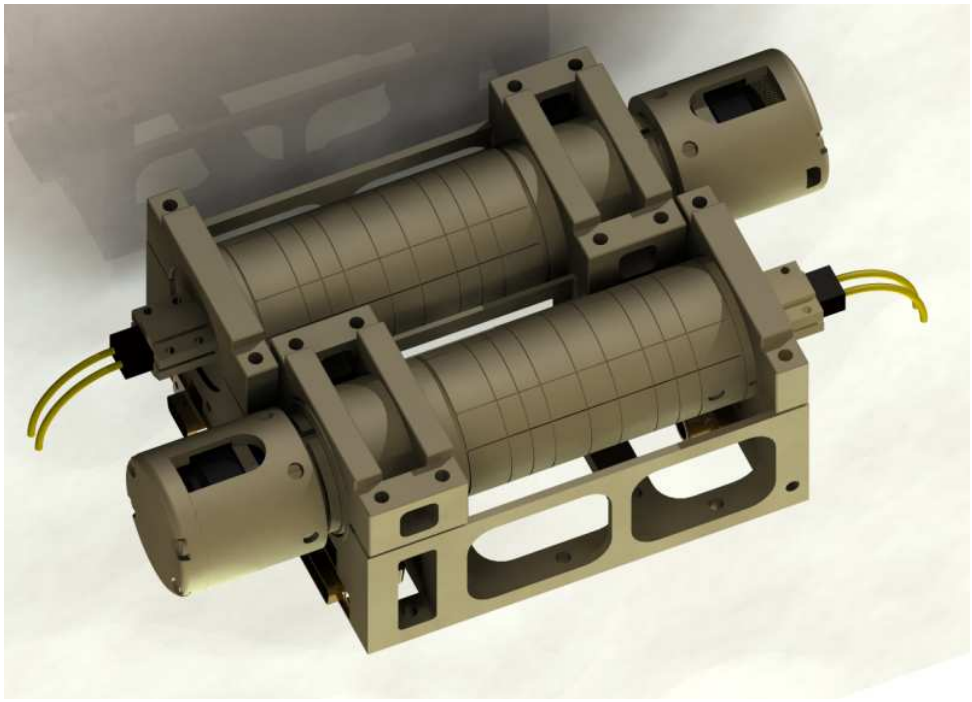

Figure 6.Two ASM sensors and their sensor mount

1.3 Harness

- The sensor is connected to the electronics box by two optical fibres, two coaxial cables, and a set of electrical wires (6 twisted pairs).
- The electrical cables are used to supply the piezoelectric motor (low current at 50-55 kHz), the HF discharge (f ~11 MHz) and the RF-coils of the Helium cell while the fibre cables guide the laser light back and forth.
- A cable links each electronic box to the satellite via connectors for the power supply, the data and command control bus and the GPS clock.