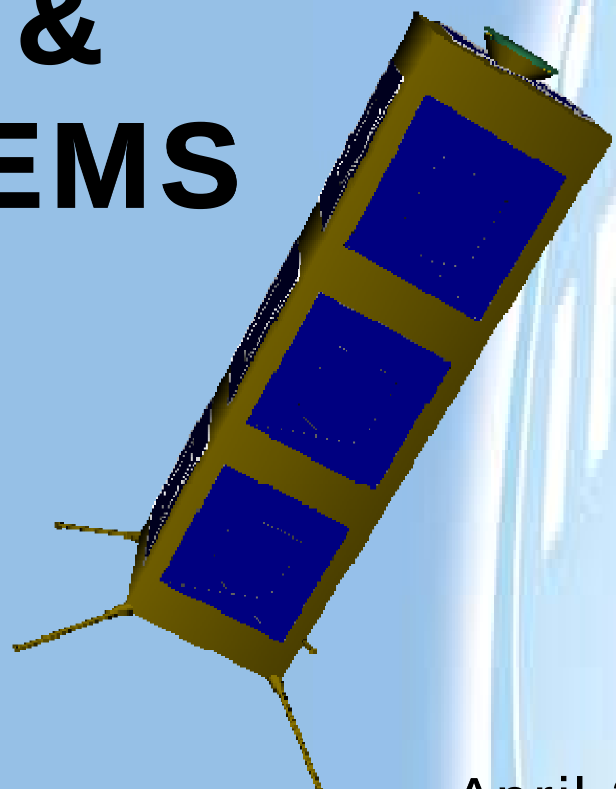
INTA PICOSATELLITE OPTOS

MISSION & SUBSYSTEMS



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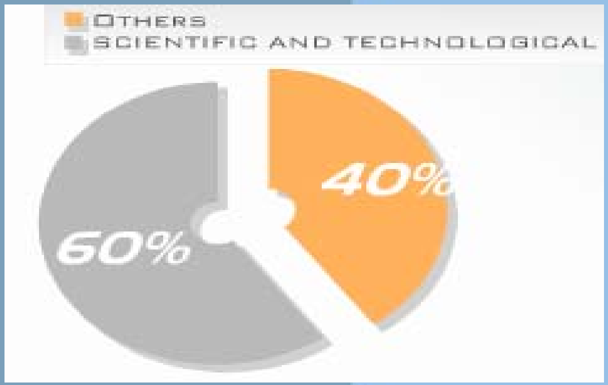
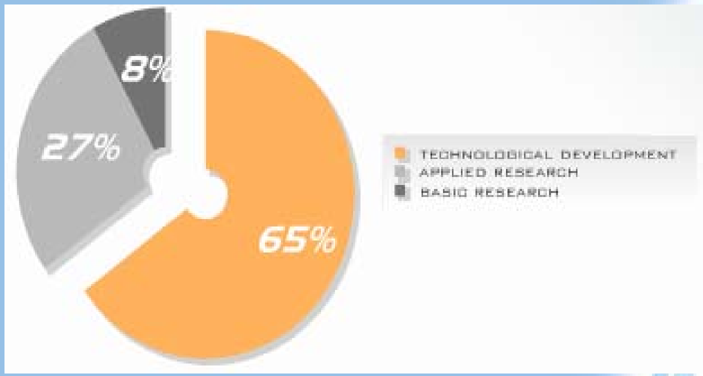
INTA www.inta.es

- National Institute for Aerospace Technology (INTA), an Organism under the supervision of Spanish Ministry of Defence.
- INTA's staff is comprised of over 1400 individuals, of whom approximately a thousand are dedicated to R+D activities. More than 40% of the Institute's personnel has a university degree.
- The INTA budget is more than one hundred million euros.
- Income comes from the State Budget and from Its commercial operations



Budged Distribution



Activities

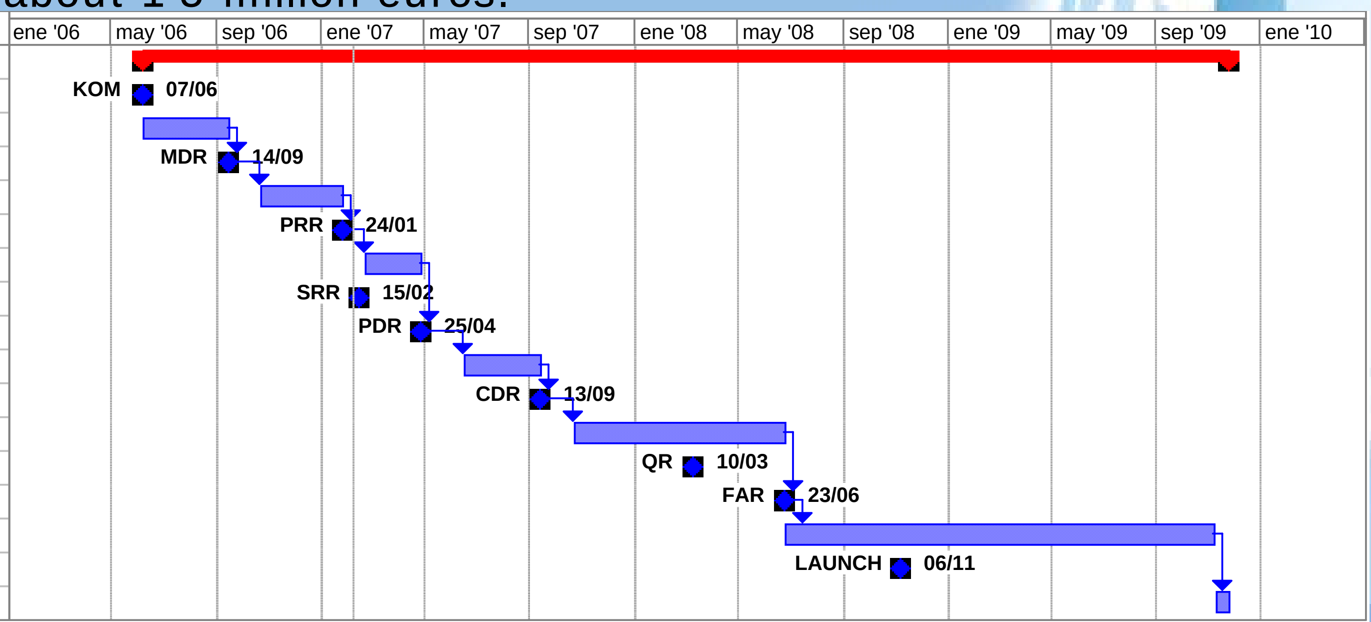
- INTA has some lines open in the field of small satellites (MINISAT-01, NANOSAT-01). One of the last initiatives is OPTOS Project.

MISSION

- **OPTOS:** Picosatellite system used as a technological platform to demonstrate the capacity to develop low cost and short timeline projects. The main goal is to develop a platform to provide an "easy" access to the Space for Spanish scientific and business community. Ambicious mission with 5 payloads from different scientific fields:
  - <u>Magnetism:</u>
    - GMR-S (Giant MagnetoResistive sensors for magnetic field measurement)
  - <u>Radiation:</u>
    - ODM (Evaluation of total radiation dose using commercial RadFET)
    - OPTORAD (Optoelectronic radiometer for protons)
  - <u>Optics:</u>
    - SOI (Microphotonic devices for temperature measurement)
    - CAMERA (Low resolution camera (≈200 m) using CMOS technology)

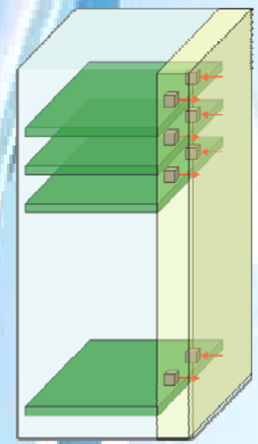
- In addition, some new solutions and technologies will be included in the platform.
- The project budget is about 1'5 million euros.

Id	Nombre de tarea
0	**OPTOS**
1	KOM
2	PHASE 0: MISSION ANALYSIS
3	MDR
4	PHASE A: FEASIBILITY
5	PRR
6	PHASE B: PRELIMINARY DEFINITION
7	SRR
8	PDR
9	PHASE C: DETAILED DEFINITION
10	CDR
11	PHASE D: PRODUCTION/GROUND QUALIFIC.
12	QR
13	FAR
14	PHASE E: UTILIZATION
15	LAUNCH
16	PHASE F: DISPOSAL



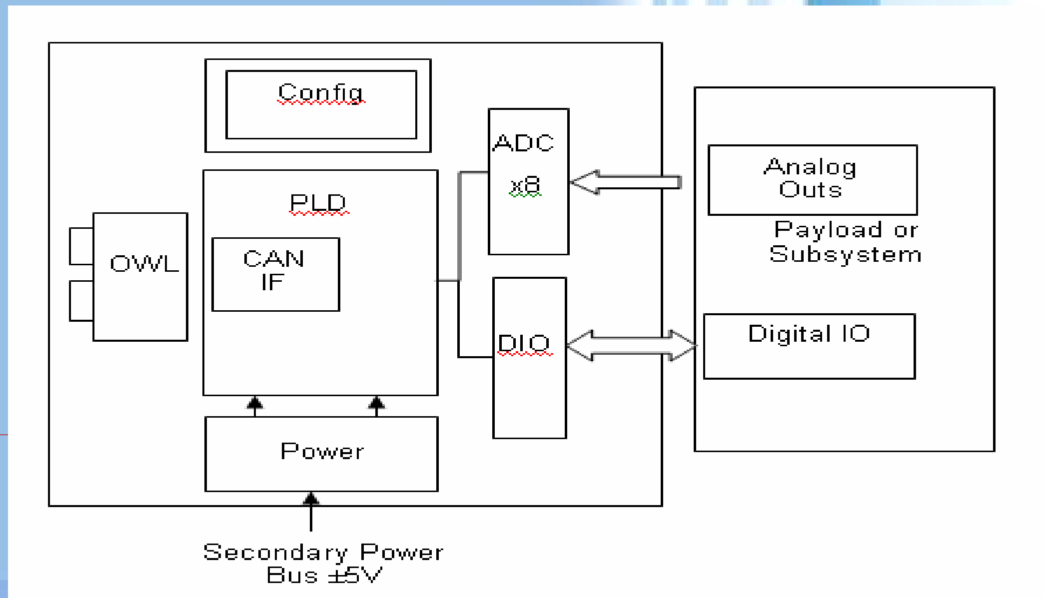
SUBSYSTEMS

- **OBDH**
  - Distributed OBDH architecture based in CAN protocol using CPLD/FPGA with a LEON2 processor to run the high level software. Subsystems and payloads have their own specific and miniaturized computer → DCUs (Distributed Control Units).



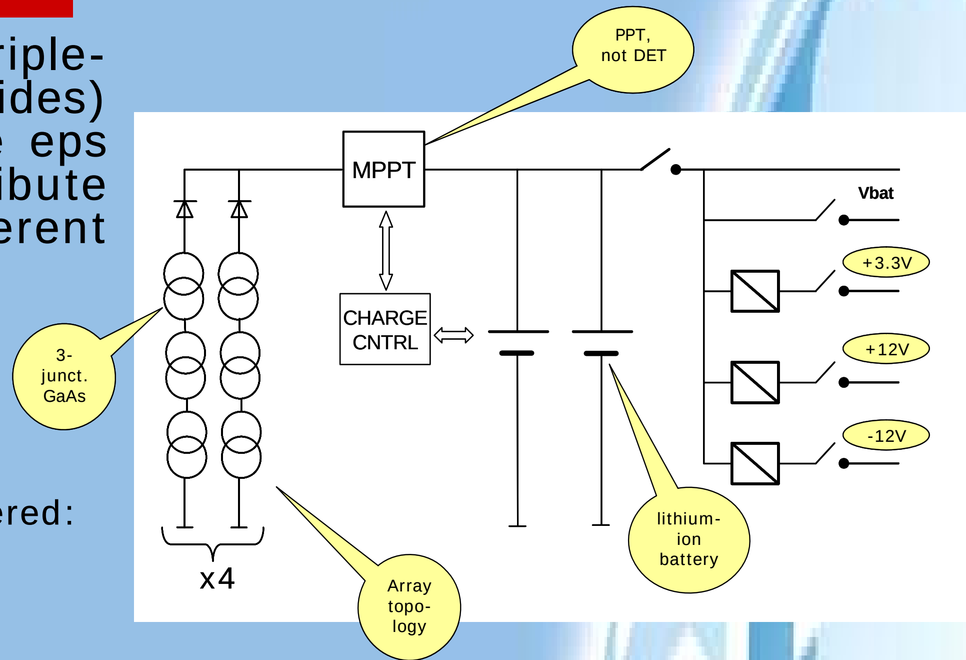
- **OBCOM**
  - Internal wireless optical communications subsystem using OWLs (Optical Wireless Links) and wireless CAN is considered as the main TM/TC bus for the satellite, so it is mandatory for all this units.

- The unit joined to the ground communications subsystem (TTC) will avail oneself a LEON2 embedded processor, supplying extra software capabilities; and the elements of the rest of **DCUs** will be the next:
  - **Power IF:** The satellite power system should supply ±5V (500mA)
  - **ADC:** Each Processing Unit includes an Octal Analog to Digital Converter (12 bits TBC) available for its payload or subsystem
  - **DIO:** Supply discrete digital input-output (clocks, actuators, etc.)
  - **OWL:** Optical wireless link
  - **PLD:** FPGA with VHDL core
  - **Config:** Configuration memory for the PLD

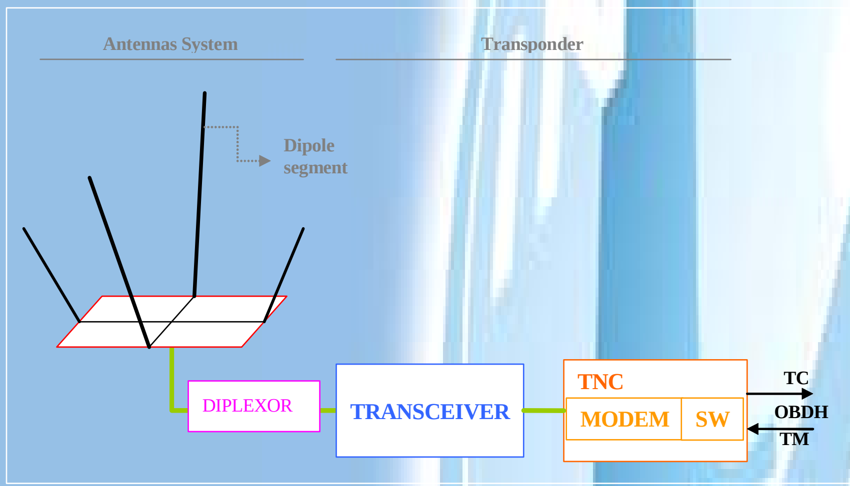


SUBSYSTEMS

- **EPS:** Power subsystem with external Triple-Junction GaAs (1 string with 6 cells x 4 sides) as primary source and Li-ion battery. The eps will use DC/DC converters to distribute regulated +5V, +/-12V supply to the different subsystems and payloads.



- **TTC**
  - Antennas system:
    - OPTOS could work in a frequency band in both directions. The possible bands considered:
      - VHF(145MHz)
      - UHF(435MHz)
    - Or in dual band:
      - VHF(Tx) / UHF(Rx)
  - Transceiver:
    - Separated RX chain (receive TC) and TX chain (send TM)
  - Terminal Node Controller (TNC):
    - Modem:
      - Modulate the TM to be sent to ground station and acquired from the OBDH
      - Demodulate the received TC to be sent to OBDH to process them
    - Process capacity – SW
      - Translate into the established protocol the data flux in both directions

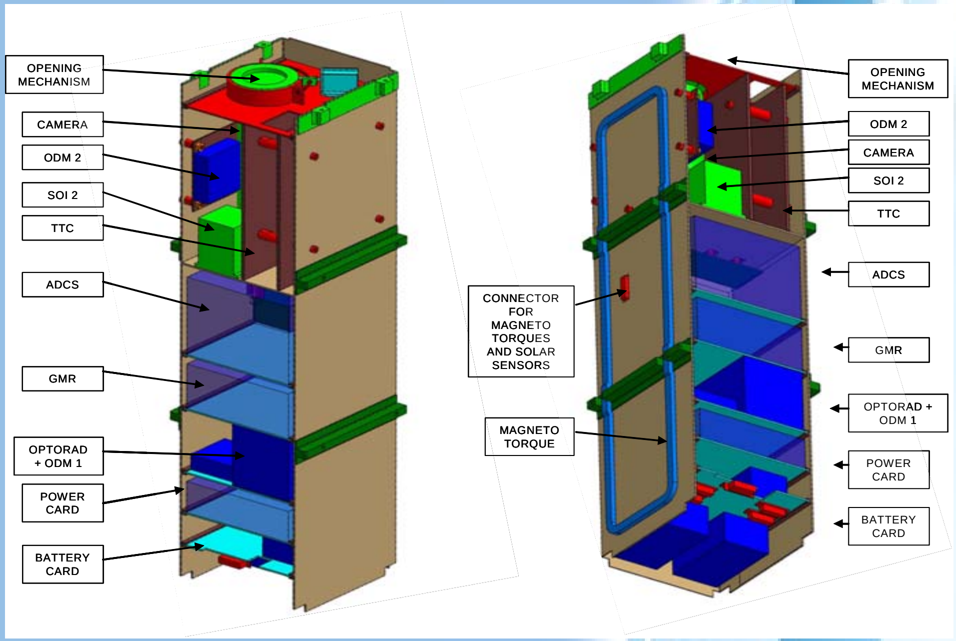


- **ADCS** with a momentum wheel to stabilize in one axis, 3 magnetometers, 3 magnetotorques and a solar sensor

SUBSYSTEMS

- **STRUCTURE**
  - EXTERNAL STRUCTURE: Cubesatkit standard structure (solid walls 3-U)
  - INTERNAL STRUCTURE: Internal composite structure to support all the elements and to allow easy integration and test

OPTOS SYSTEM - CONFIGURATION



- **TCS** (Thermal Control Subsystem)
  - Passive thermal control based in the selection of materials, internal arrangement and paints or MLIs

INTA PICOSATELLITE

OPTOS PROJECT

PAYLOADS

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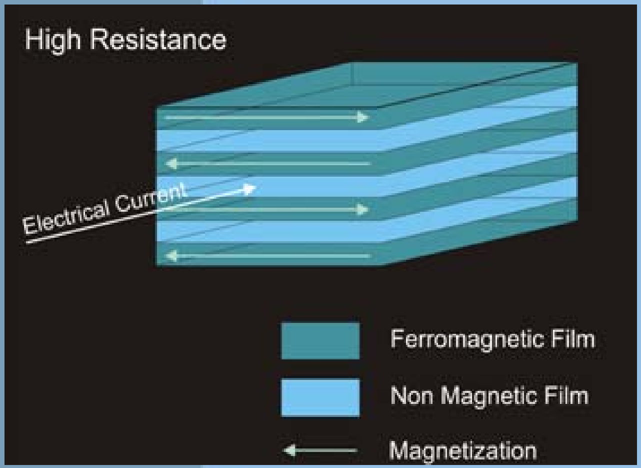
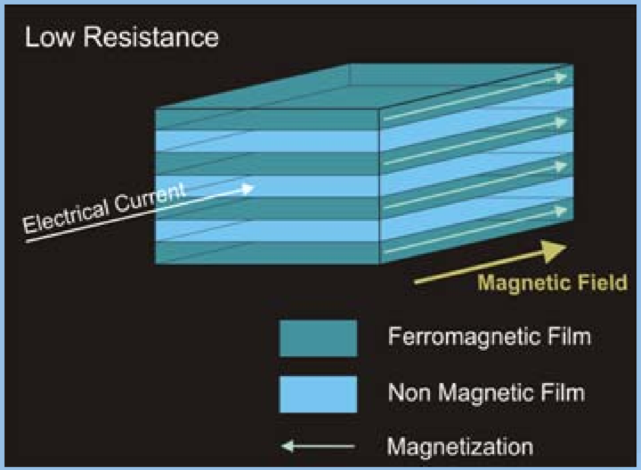
MAGNETIC PAYLOAD

GMR-S: Giant Magneto Resistance Sensor



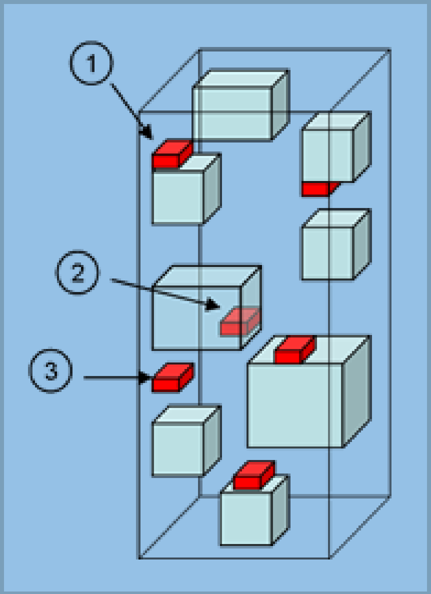


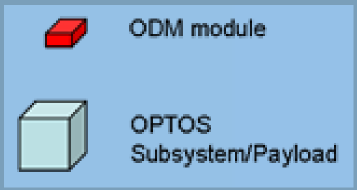
In presence of a magnetic field the GMR-S electrical resistance increase considerably

- Low cost technology
- High sensitivity
- Low consumption
- Non space tested

RADIATION PAYLOAD

ODM – Optos Dose Mapping System

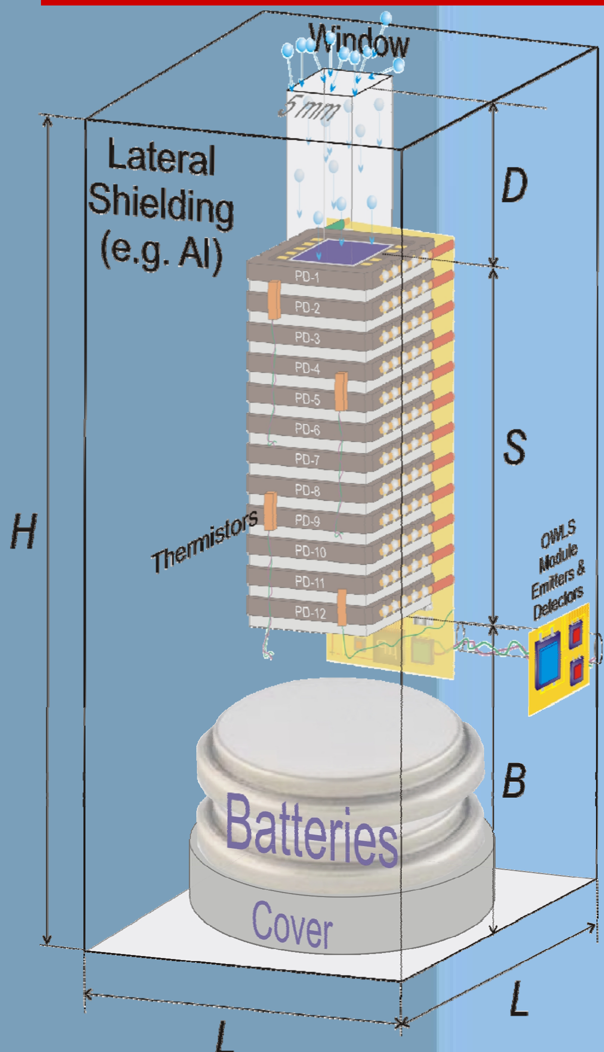




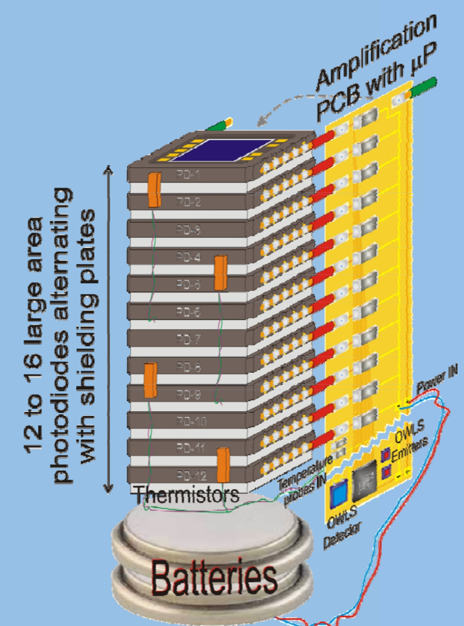
- Dose mapping during the mission in several satellite interest points considering mass distribution (shielding).
- Validation and correlation of different models (AP8, AE8, …) and tools (SHIELDOSE, GEANT4) used to calculate missions dose mapping.
- Design dosimeters based in RadFET technology for spatial use.

RADIATION PAYLOAD

OPTORAD-Optoelectronic Radiometer



- Measures platform deposited protons and their energy.
- It is an auto supplied payload.

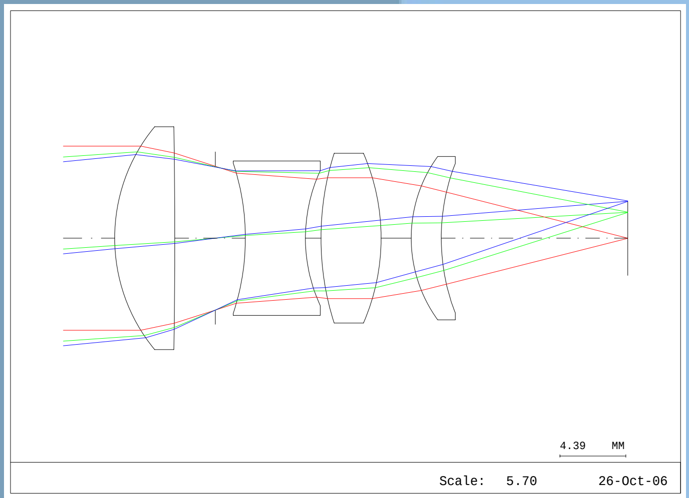


OPTICAL PAYLOAD

OPTOS CAMERA

- **DESCRIPTION**
  - Panchromatic-low resolution electro-optical system for Earth observation in a LEO orbit.
  - Working wavelength band of 0.45 μm a 0.7 μm (visible spectrum).

- **SCIENTIFIC GOALS**
  - Verify theoretical model of radiation-induced defects in optical glasses.
  - Maintain the focus and image quality within a temperature range of ± 20ºC by using a passive athermalization mechanical system.



Refractive objective based in a modified Cooke Triplet

1 / 3" CMOS SENSOR
Power consumption: < 320 mW
Dimensions:28.8x28.8x5.6mm

1 / 3" CCD SENSOR
Power consumption: < 0.8 W
Dimensions:17.16x19.25x14.29mm

OPTICAL PAYLOAD

OTHER OPTICAL SENSORS

- **SCIENTIFIC GOALS DURING MISSION LIFETIME**

  Evaluate the viability and feasibility of the optical sensors proposed to measure TEMPERATURE during aerospace missions

- **DESCRIPTION**
  - **SOI- Silicon on Insulator:** Two types of optical sensors will be used to measure the temperature of the OPTOS camera and satellite structure.
    - **Mach Zehnder based Microphotonic device**
    - **Fiber Bragg Grating (FBG)**
  - **Classical thermocouples** will be installed close to the optical sensors to assure their correct behaviour

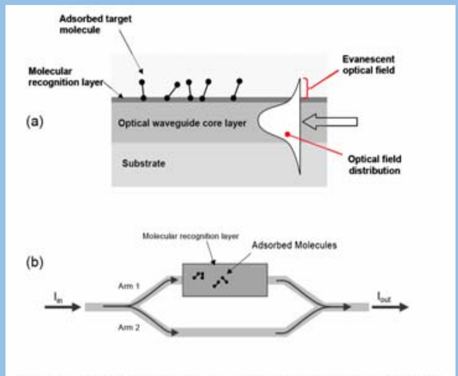


Figure 21. Schematic diagram of (a) an evanescent field sensor, and (b) a simple waveguide circuit where the sensor is incorporated into a Mach-Zehnder interferometer.