
CNES: Laser and fibre components qualification results

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Pharao

(Projet d'Horloge Atomique par Refroidissement d'Atomes en Orbite)

Fibre optical components

- Polarisation maintaining fibre (PM fibre 850 Bow-Tie) tested :
 - Traction PASS
 - Thermal vacuum PASS
 - Humidity PASS
- Connections:
 - NASA FC/PC (PM fibre 850 Bow-Tie) 4 tested
 - Vibration (losses < 3dB) PASS
 - Geltec Aspheric lens 7 tested
 - Coupling (<70%) FAIL
 - Selfocs Index gradient lens 7 tested
 - Radiation (1.6krad) PASS
 - Coupling (70%) PASS

Pharao

Non fibre optical components of interest

- Laser diodes not pigtailed (JDSU 5420) 18 tested:

– Lifetime (accelerated under vacuum)	FAIL
– Thermal vacuum	FAIL
– Thermal cycling/Storage (hot)	PASS
– Chip connection pull	PASS
– Mechanical vibration and choc	PASS

Note Beryllium present in the laser chip, not JDSU packaging

- AOM (A&A ST-88/75/90/163) 8 tested:

– Storage	FAIL 1 transducer size
– Thermal vacuum	FAIL (T>40-70°C)
– Mechanical vibration and choc	PASS

IASI

(Infrared Atmospheric Sounding Interferometer)

Fibre optical components 1

- Laser diodes pigtailed (Alcatel ILM 246) 9 tested:
 - Fibre pull PASS
 - Mechanical vibration and shocks PASS
 - Thermal vacuum/Storage/Life Test PASS
 - Radiation PASS
- Coupler 2x1 monomode (Gould WFC 80/20 1x2 S) 5 tested:
 - Mechanical vibration and shocks PASS
 - Thermal vacuum PASS
- Faraday isolator (ISOWAVE 1-15-PIPT-X-A) 6 tested:
 - Mechanical vibration and shocks PASS
 - Thermal vacuum PASS

IASI Fibre optical components 2

- Fibre welding (CSO fibres 8.5/125) 31 tested:
 - Pull/Shear/Mechanical PASS
 - Thermal/Storage (cold and hot) PASS
- Detection module (Thales FMR-21000) 10 tested:
 - Thermal vacuum/Thermal/Storage PASS
 - Mechanical vibration and shocks PASS
 - Fibre pull PASS
 - Life test PASS
 - Radiation PASS
- Monomode fibre (Corning SMF28) 1 tested (system test):
 - Mechanical vibration and shocks PASS
 - Thermal vacuum/Storage PASS

SWARM

ESA Earth Observation mission

CNES is responsible for Absolute Scalar Magnetometer

Fibre optical components to be tested

- Fibre Laser Assembly (Koheras/LETI custom made) PQ
- Laser diodes pigtailed (JDSU 2700 or LUMICS LU0980S450)
- WDM (980-1083nm) (OZ Optics custom made)
- Electro-Optic Modulator (Photline custom made)
- Multimode fibre (@1064nm currently used)
- Photodiodes pigtailed (@1064nm currently used)
- Coupler 2x1 (@1064nm currently used)
- Faraday isolator (@1064nm currently used)

T2L2 / Optical Interconnections

Laser Time Transfer and R&T CNES-Alcatel Alenia Space

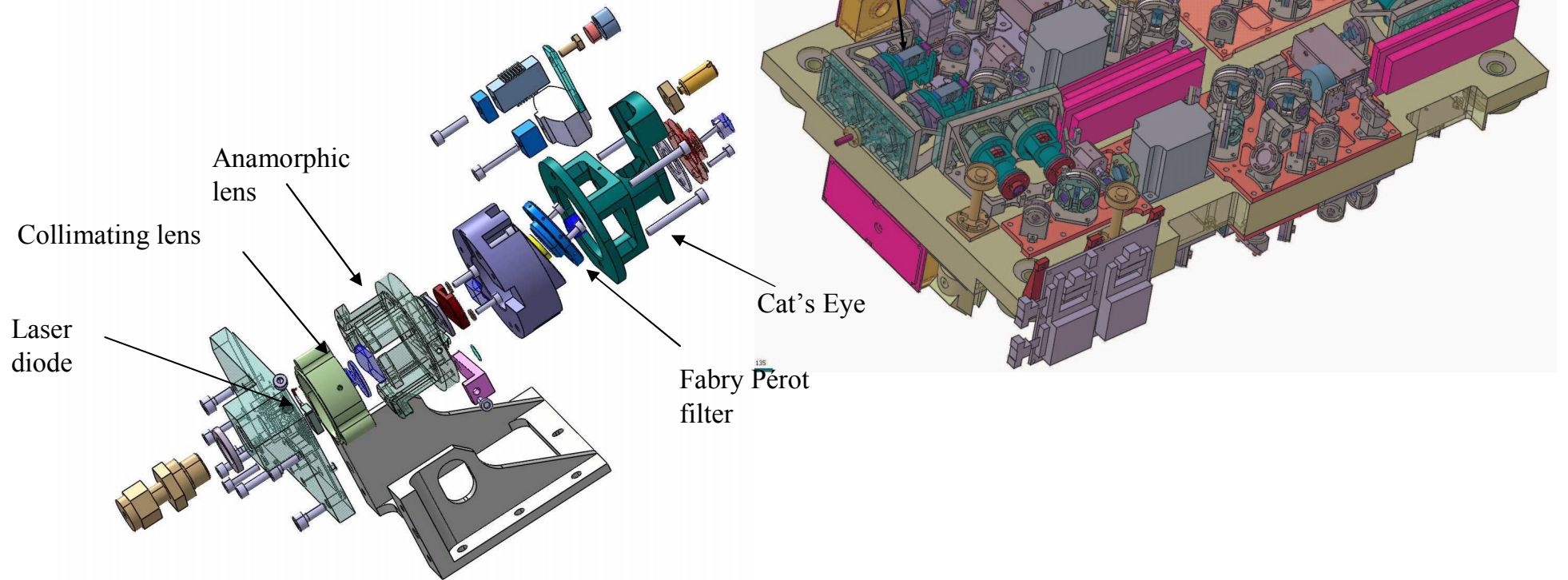
Fibre optical components to be tested

- Polarisation maintaining Fibre @ 532nm, radiation resistant:
 - Thermal cycling
 - Radiation
- Multi channel transmitter and receiver optoelectronic modules:
 - Loss below 0.25dB (already tested)
 - Thermal -40/80°C (already tested)

Conclusions

- ❑ **CNES has several upcoming / on going fibre qualifications :**
 - ❑ **SWARM**
 - ❑ **FOG Pleiades**
 - ❑ **Interconnections (Alcatel Alenia Space)**
 - ❑ **T2L2**
- ❑ **Also R&T environmental studies on**
 - ❑ **Erbium doped fibre amplifier (Alcatel Alenia Space and Montpellier University)**
 - ❑ **Photonic crystal fibres**

PHARAO Space Atomic Clock



Exploded view of an extended cavity laser and view of the PHARAO Laser Source developed under funding CNES by EADS-SODERN (France)