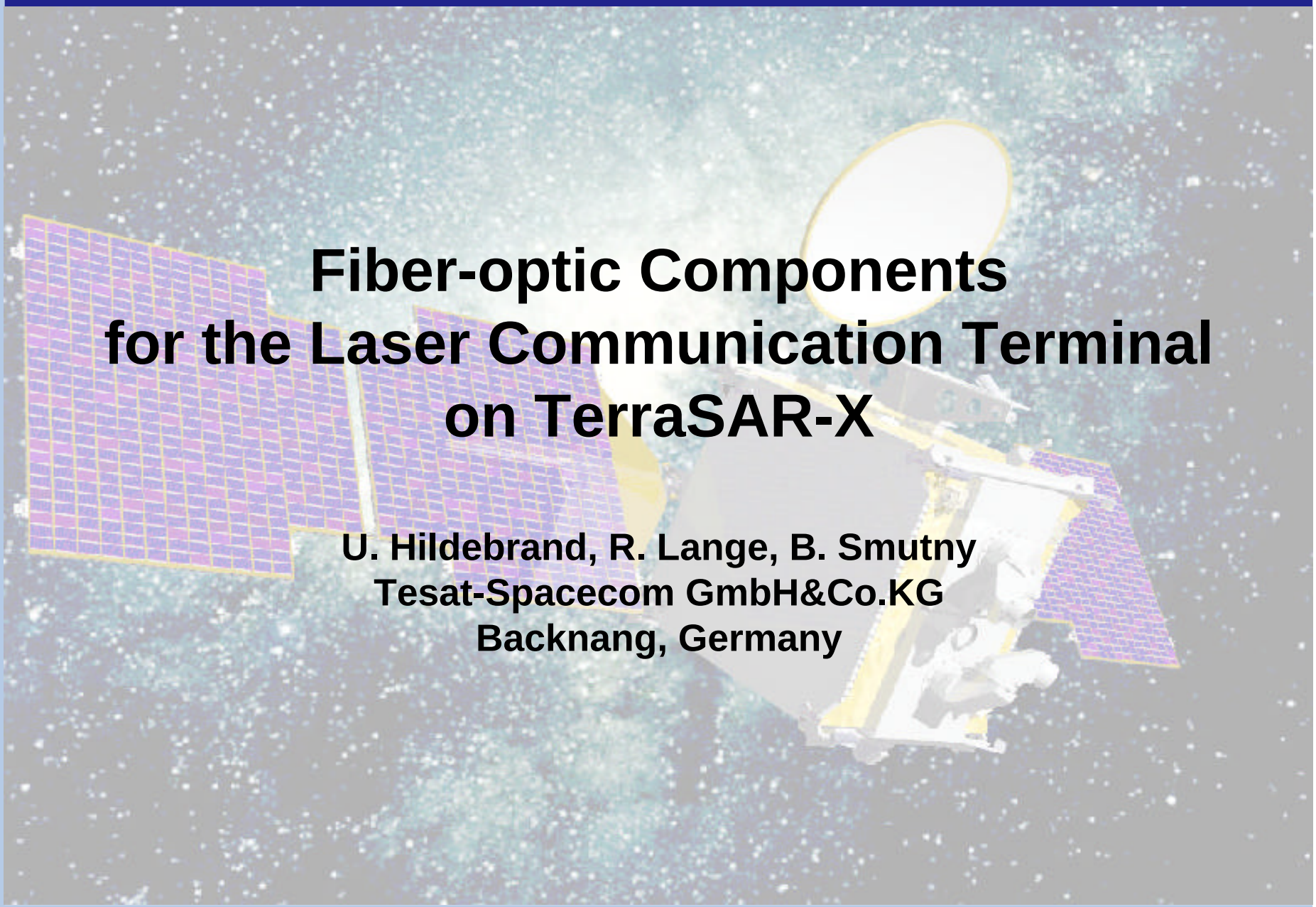
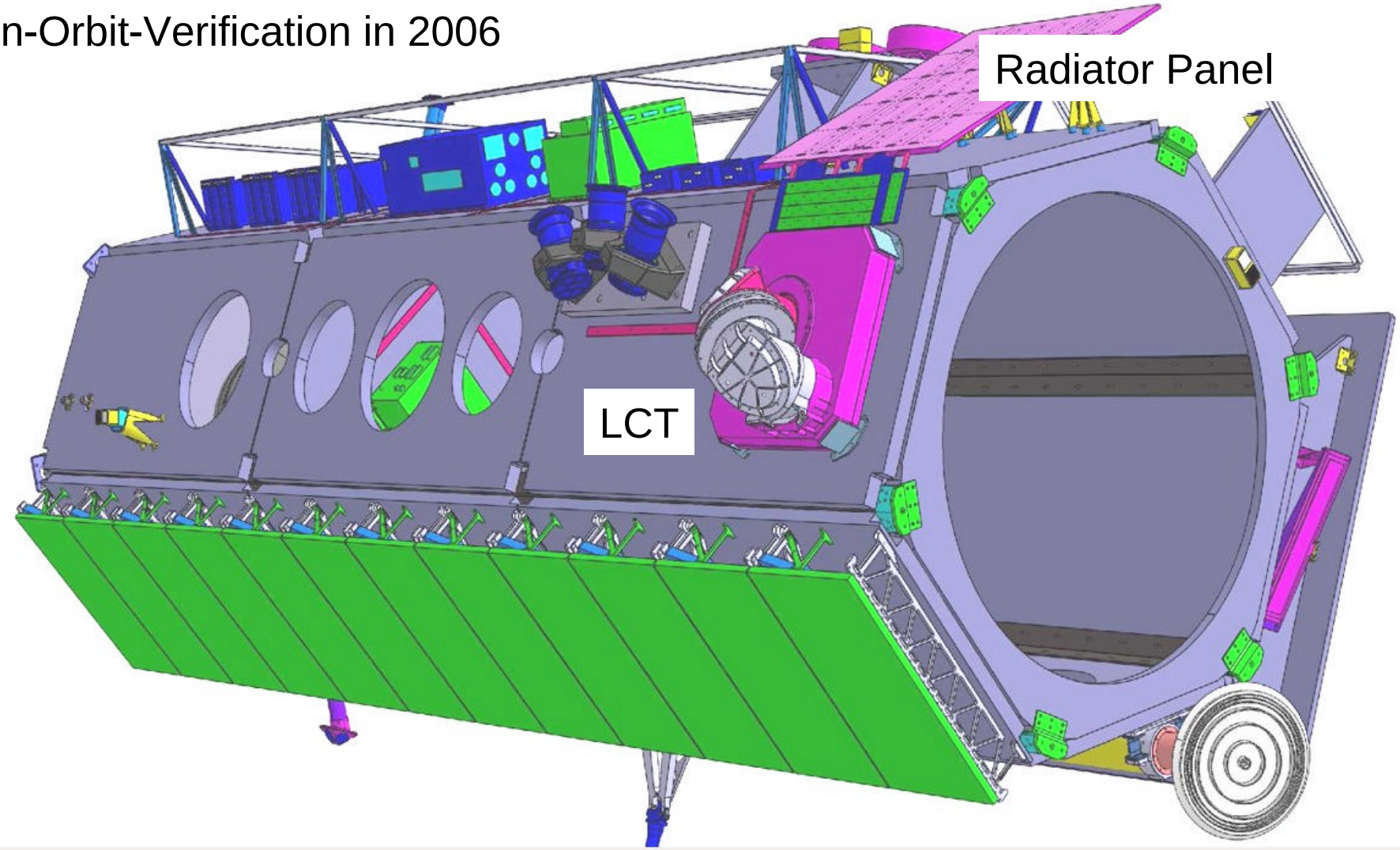


# Fiber-optic Components for the Laser Communication Terminal on TerraSAR-X

**U. Hildebrand, R. Lange, B. Smutny**
**Tesat-Spacecom GmbH&Co.KG**
**Backnang, Germany**

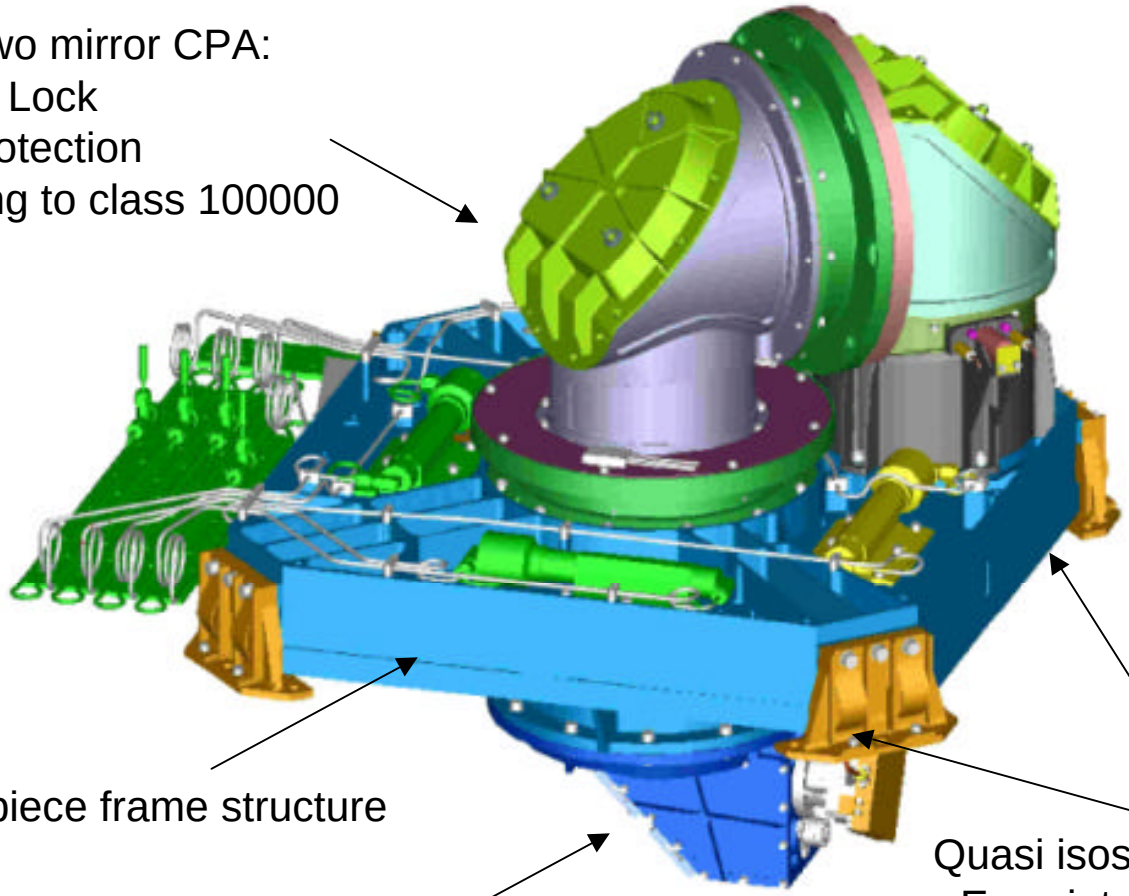
# LEO-Terminal on TerraSAR Satellite

Prime TESAT
In-Orbit-Verification in 2006



# Laser Communication Terminal Design

Folded two mirror CPA:
- Launch Lock
- Dust protection
- Matching to class 100000

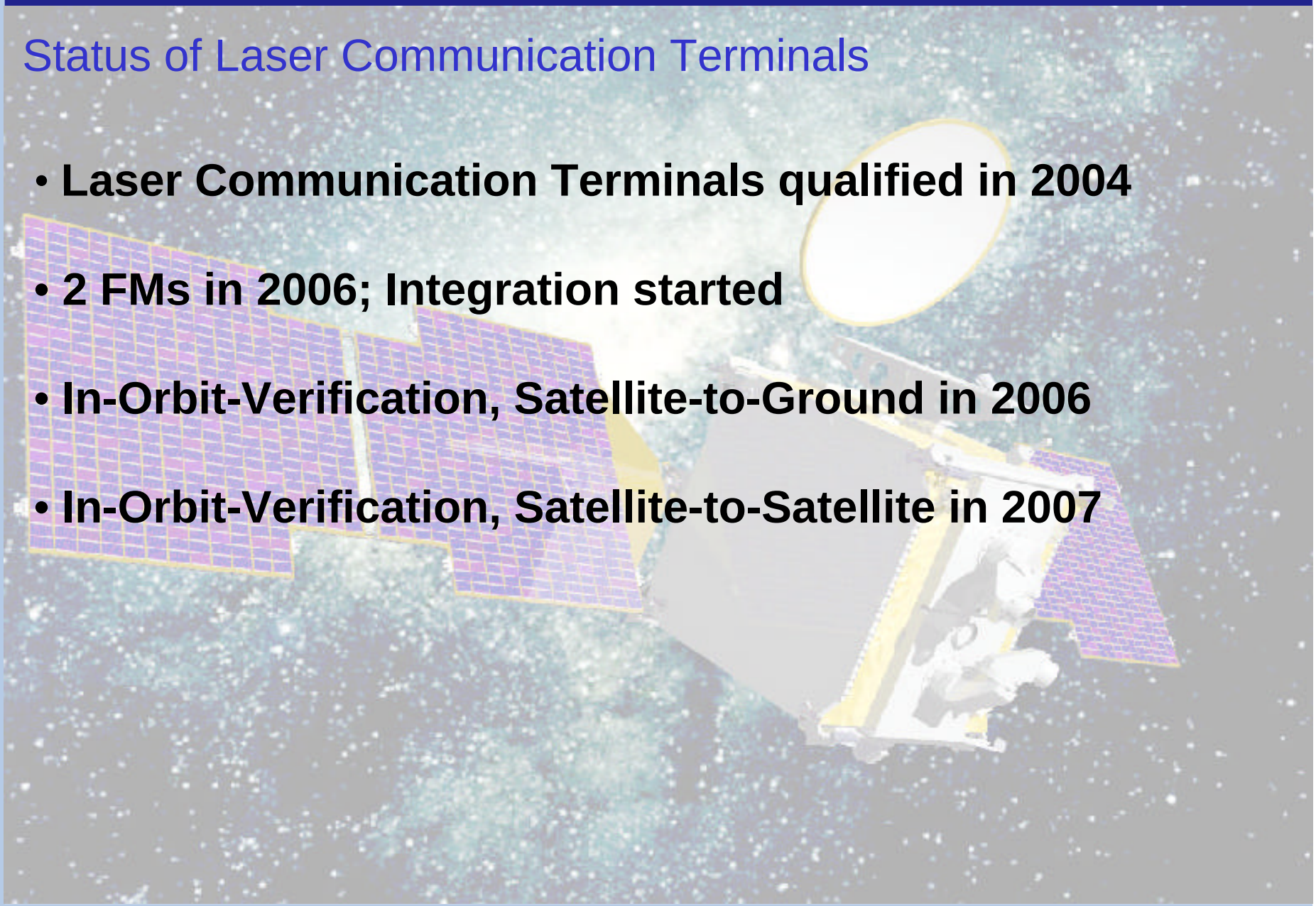


One piece frame structure

Optical bench

Quasi isostatic feet:
- Easy integration of LCT to S/C
- Compensate for induced stress

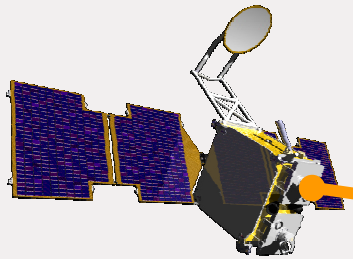
## Status of Laser Communication Terminals



- **Laser Communication Terminals qualified in 2004**
- **2 FMs in 2006; Integration started**
- **In-Orbit-Verification, Satellite-to-Ground in 2006**
- **In-Orbit-Verification, Satellite-to-Satellite in 2007**

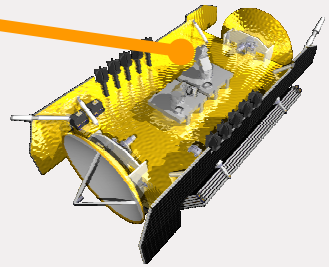
# Inter - Satellite - Link

Laserlink between German TerraSAR-Satellite and US-Satellite



Satellite
USA

High-speed optical data link 5.5 Gbps

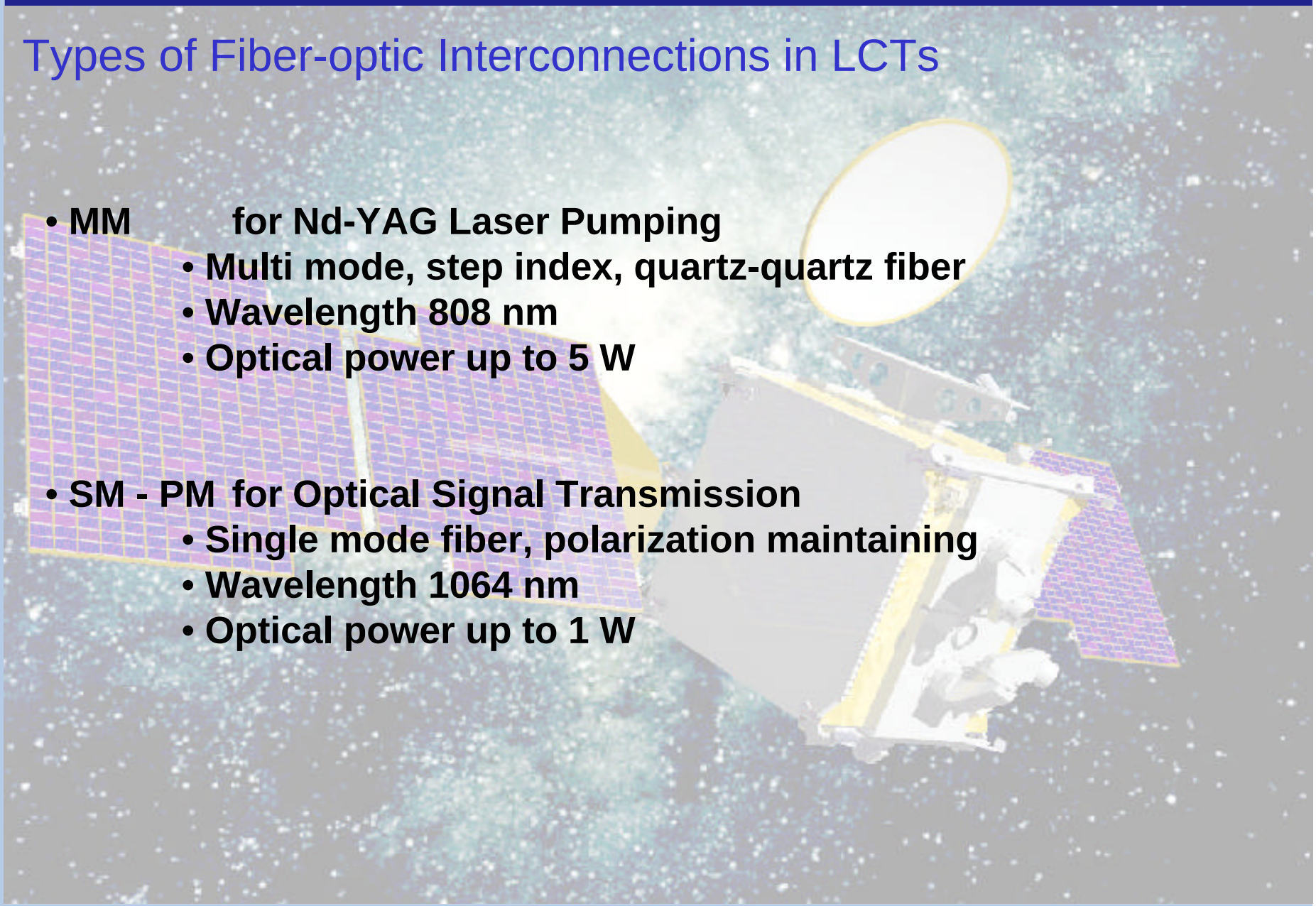


TerraSAR-X
Germany

Objective

- LCT performance verification

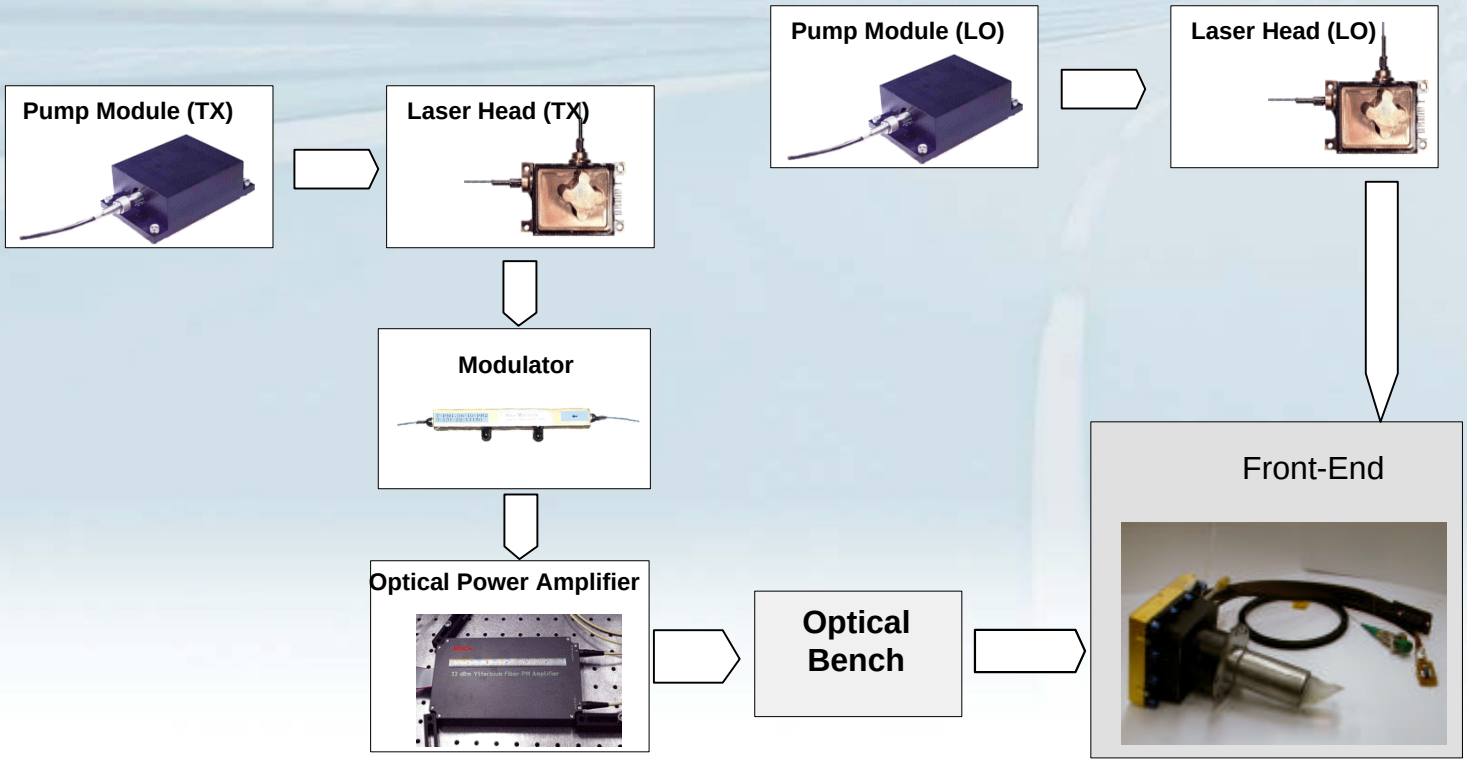
# Types of Fiber-optic Interconnections in LCTs



- **MM for Nd-YAG Laser Pumping**
  - **Multi mode, step index, quartz-quartz fiber**
  - **Wavelength 808 nm**
  - **Optical power up to 5 W**

- **SM - PM for Optical Signal Transmission**
  - **Single mode fiber, polarization maintaining**
  - **Wavelength 1064 nm**
  - **Optical power up to 1 W**

# Block Diagram of Fiber-optic Components



# High-Reliable Pump Modules for Nd:YAG Lasers

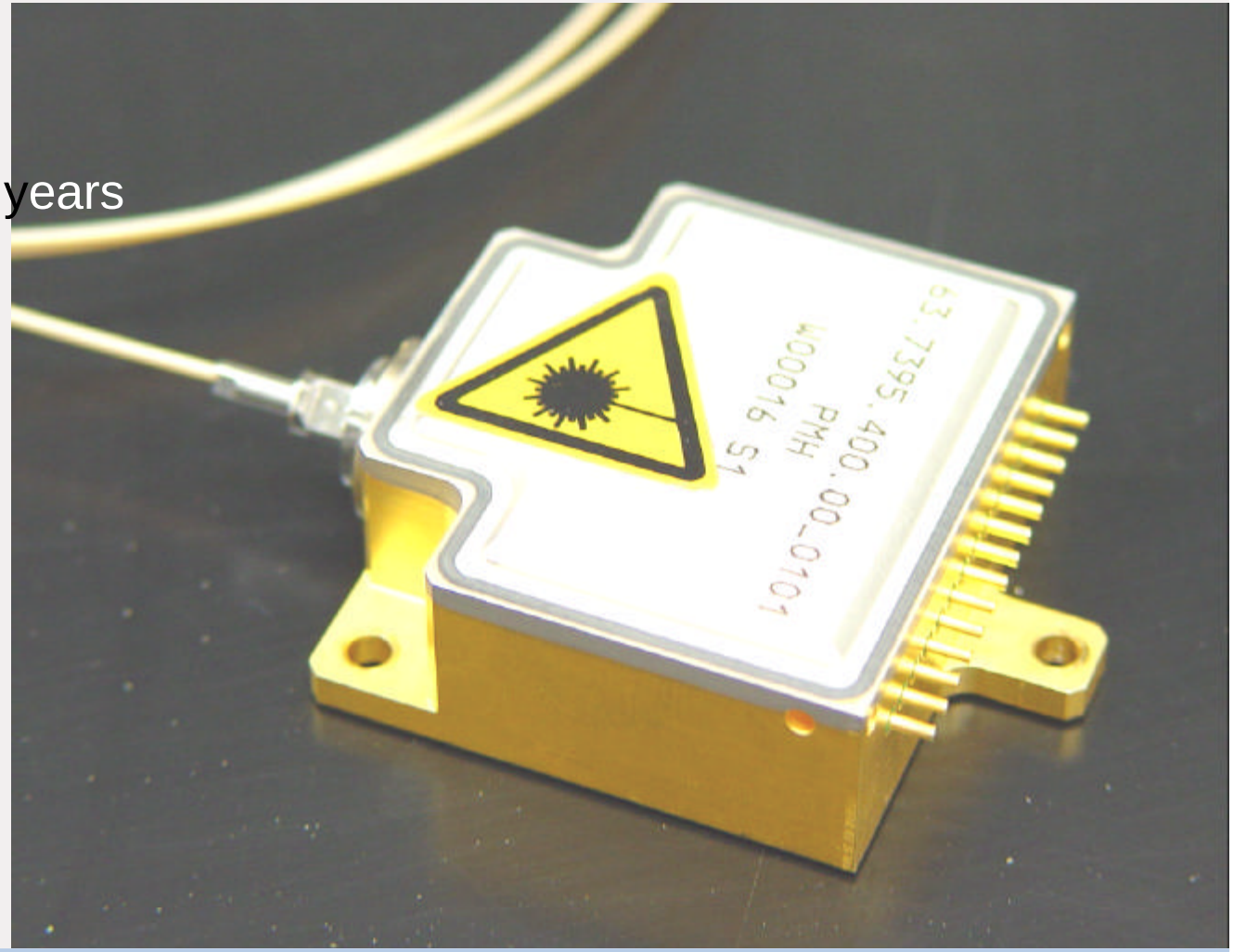
Hermetically sealed

Reliability

0.9999 in 10 years

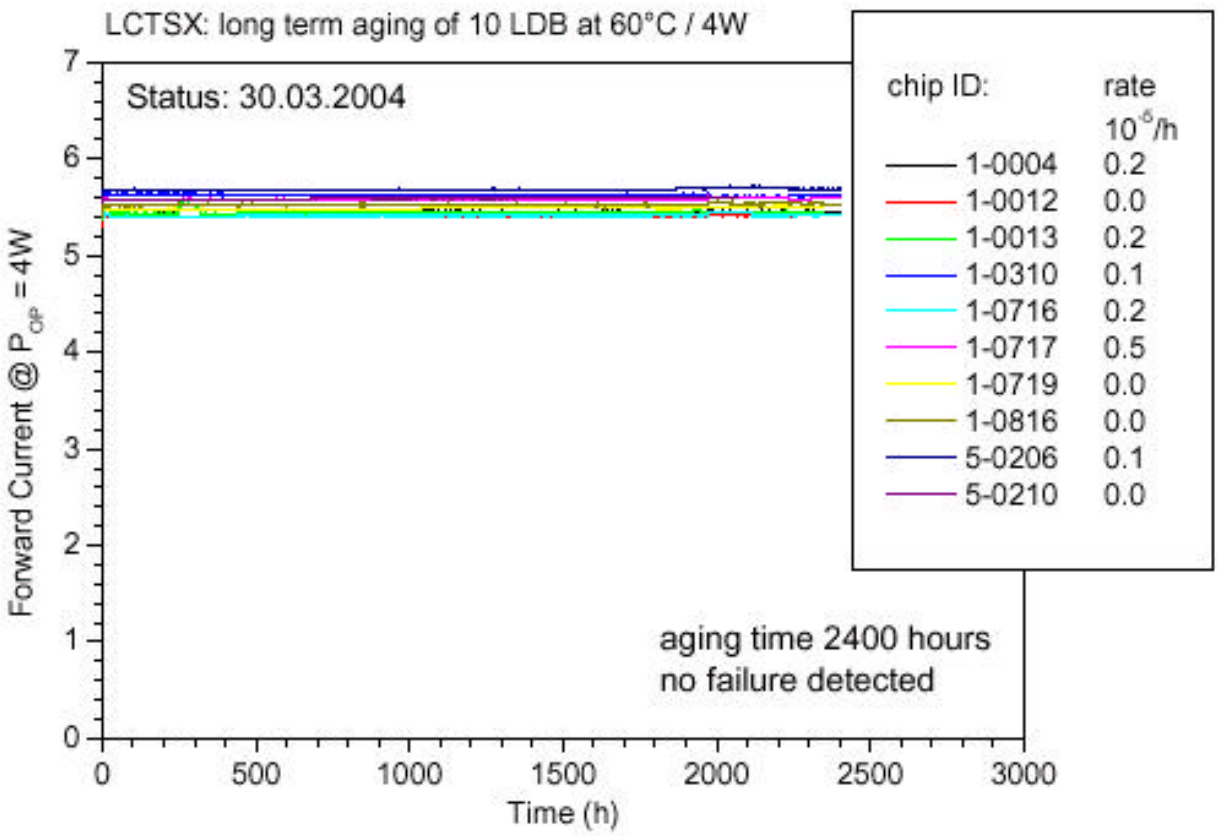
MTTF of laser diode

1.35 Mh



# Laser Diode Bench Life Tests

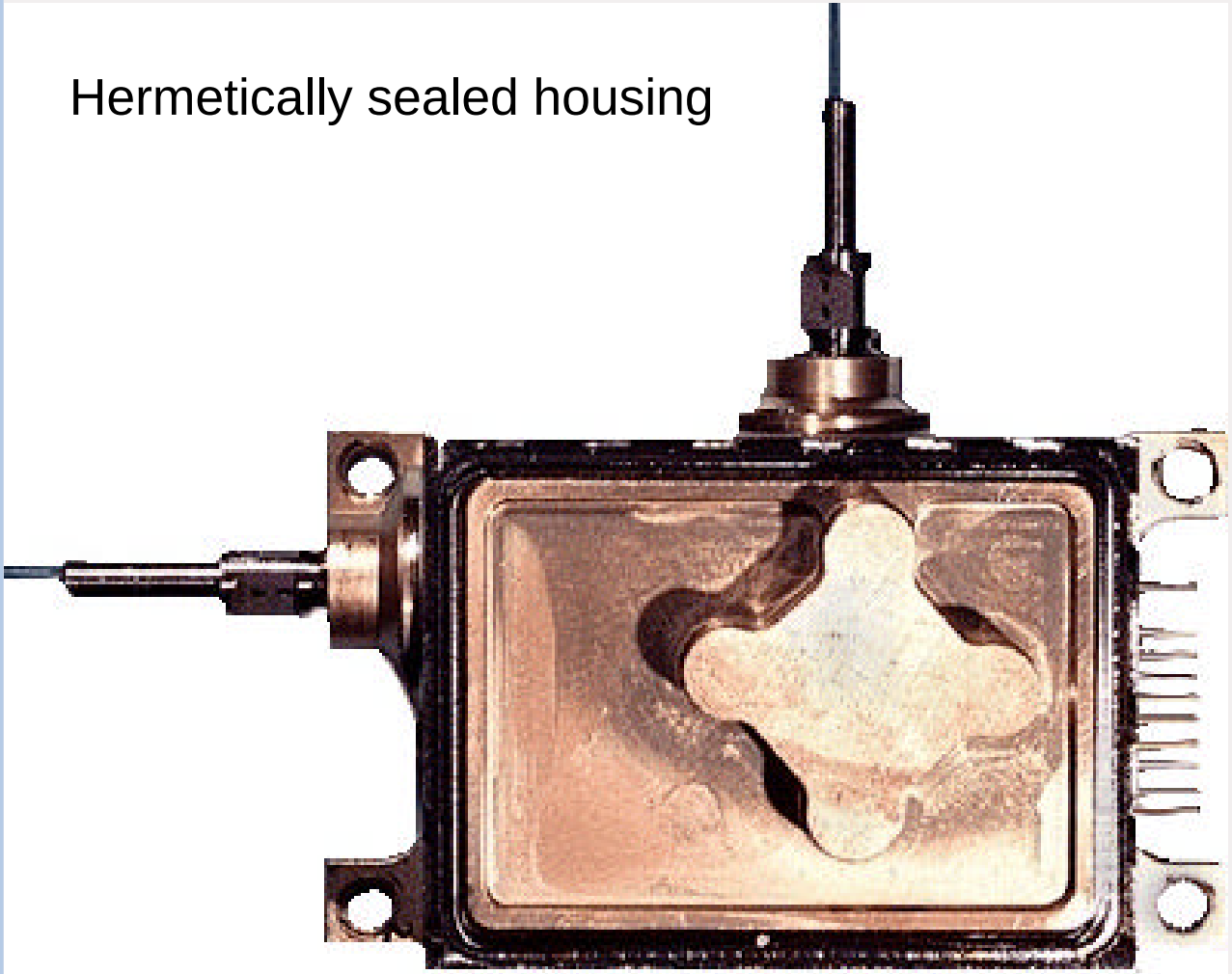
- Various life tests based on the same laser technology performed since 1998
- 12 different test groups investigated
- Strongly accelerated test conditions

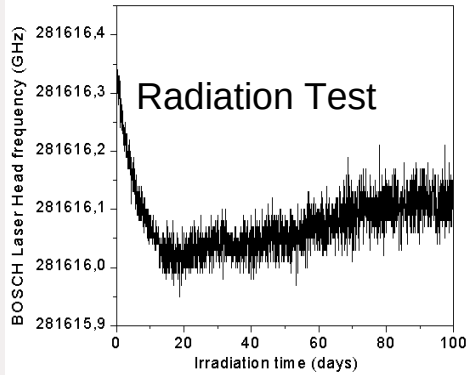


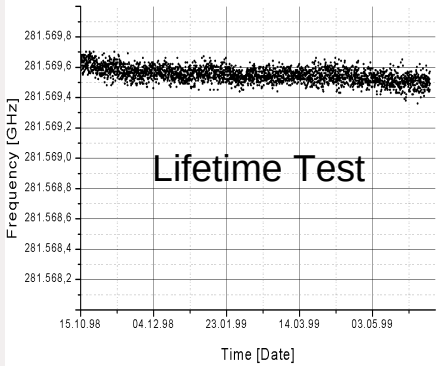

Example from currently running "LCTSX" program

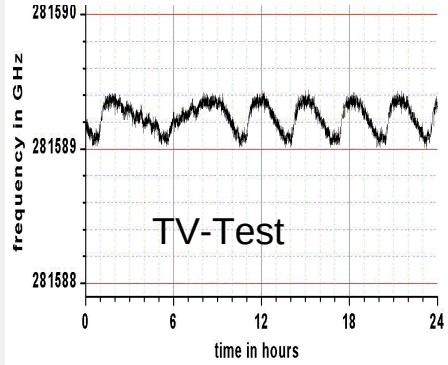
# Qualified Nd-YAG Ring-Laser (NPRO)

Hermetically sealed housing





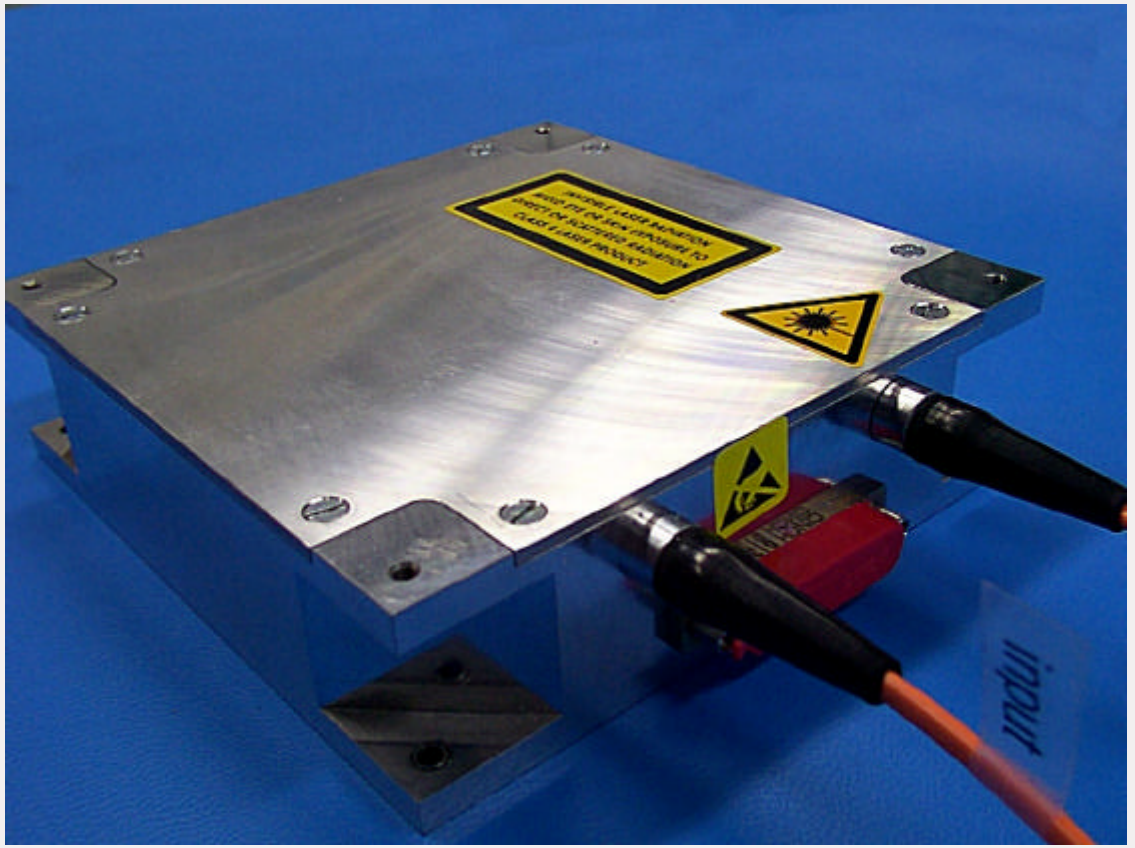

Vibration Tests

# Electro-optical Modulator

- Sealed housing
- Orientated fiber to chip coupling
- Shock resistant

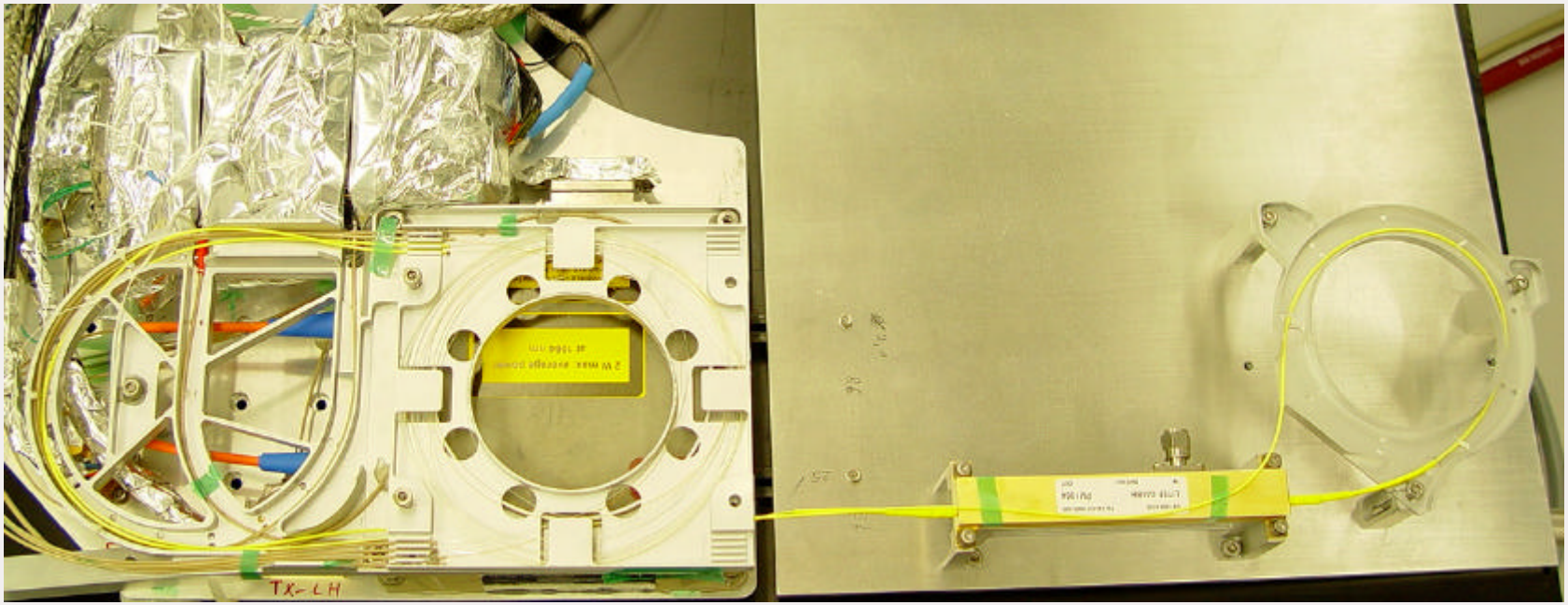
# Optical Power Amplifier

- Polarization maintaining
- Radiation tolerant
- Optimized for single frequency input

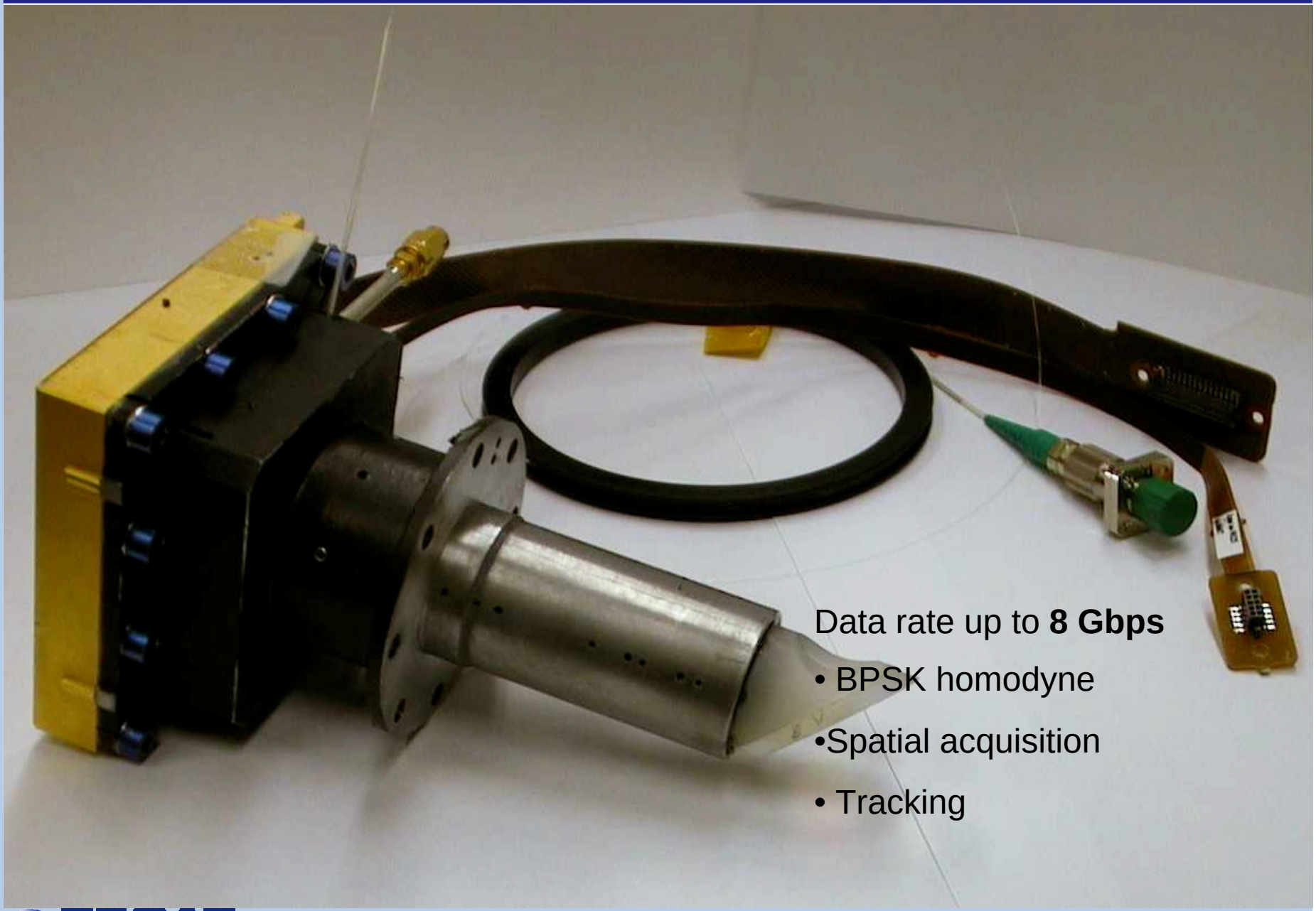


# Fiber Layout Verification in System Test Bed (STB)

- Fibers routed in dedicated fiber support
- Bare fiber protected by tubing
- Fibers connected by fusion splice
- Spare fiber stored in fiber boxes



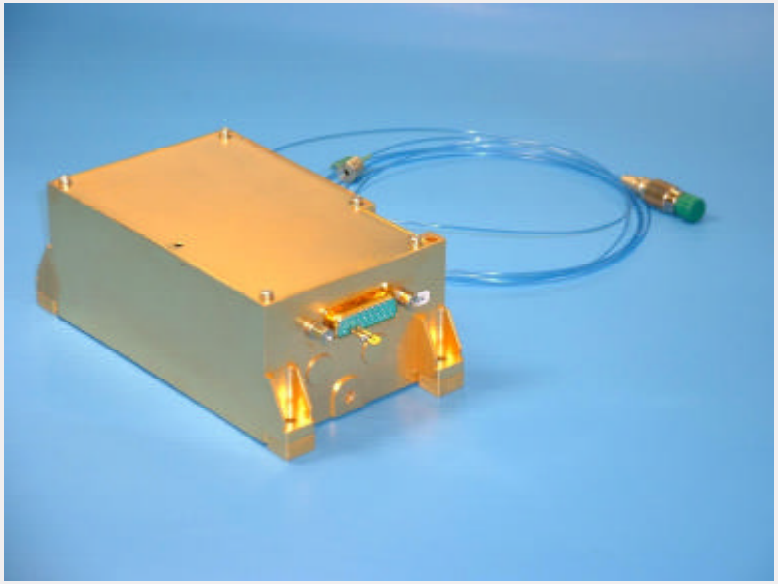
# Laser Communications Terminals



# Laser sources for science and earth observation

## Background

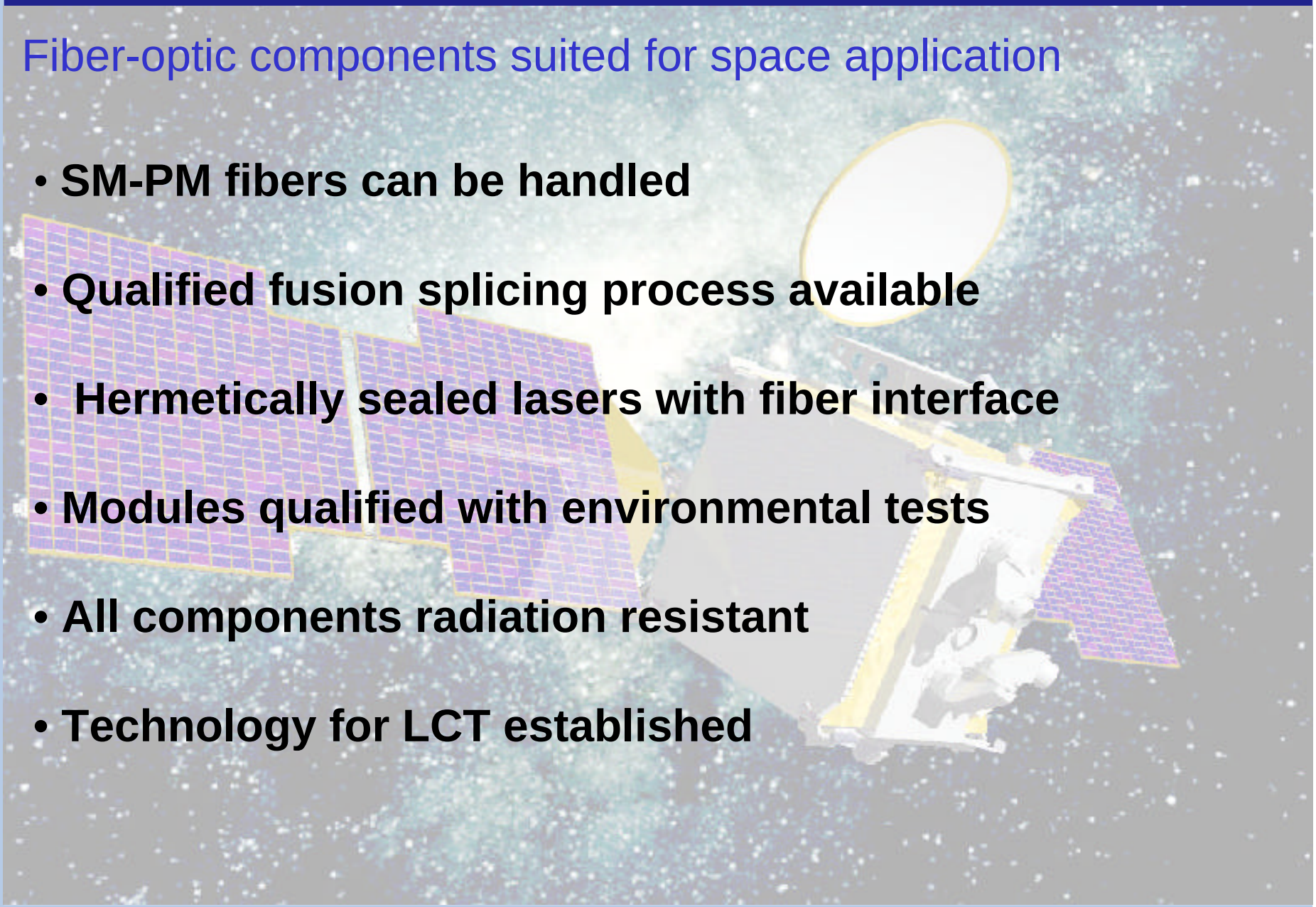
- Single frequency laser developed for coherent LCT
- Spin-off: Use of lasers in scientific / EO programmes
- Adaptation of electronics



## Programs

- DWL BB shipped in September 2001
- GIFTS BB for NASA
  shipped in May 2002
- SMART-2 BB
  shipped in November 2002
- GIFTS FM qualification running, shipped in November 2004
- ALADIN FM going to be qualified
- SMART 2 kicked off

## Fiber-optic components suited for space application



- **SM-PM fibers can be handled**
- **Qualified fusion splicing process available**
- **Hermetically sealed lasers with fiber interface**
- **Modules qualified with environmental tests**
- **All components radiation resistant**
- **Technology for LCT established**