

Light-weight, fiber-coupled qcw diode laser pump module for the BepiColombo laser altimeter

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Research and Development / DL-Systems and Modules

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DILAS Diodenlaser GmbH

DILAS GmbH

founded 1994

**located in Mainz
Germany**



DILAS Inc.

founded 2005

**located in Tucson
Arizona**



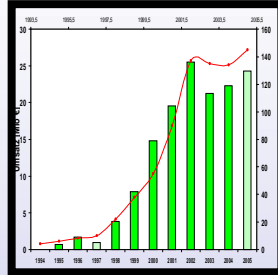


Founded: 1994

Employees: 153

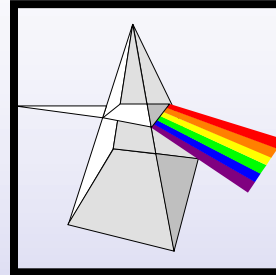
Majority Shareholder:
Rofin Sinar
Technologies Inc.
since 1997
(Nasdaq RSTI)

ISO 9001-2000
certified Quality
System



Markets:

- DPSSL pumping
- Material processing
- Graphic Arts
- Medical
- Defence
- Instrumentation



Research:

35 academics
& engineers


R&D Budget:

~11% of revenue



Facilities:

- §  Mainz / Germany
- § 2 buildings
~3300m² total
- § 500m² clean room
with class 100
workbenches
- § other production
area of ~700m²

- §  Tucson / Arizona
- § 300m² facility

Sales offices:

representatives
in all major market
areas or direct sales
from headquarter



Products:

- § Laser diode bars
- § Laser diode stacks
- vertical / horizontal
- § Fibre coupled LD
- § Laser Diode Systems
- § custom solutions
- § available wavelength
 - 650...690nm
 - 785nm, 792...797nm
 - 808nm
 - 830nm
 - 880nm
 - 915nm
 - 940nm
 - 980nm
 - 1064nm
 - 1470nm



Quasi-cw Products

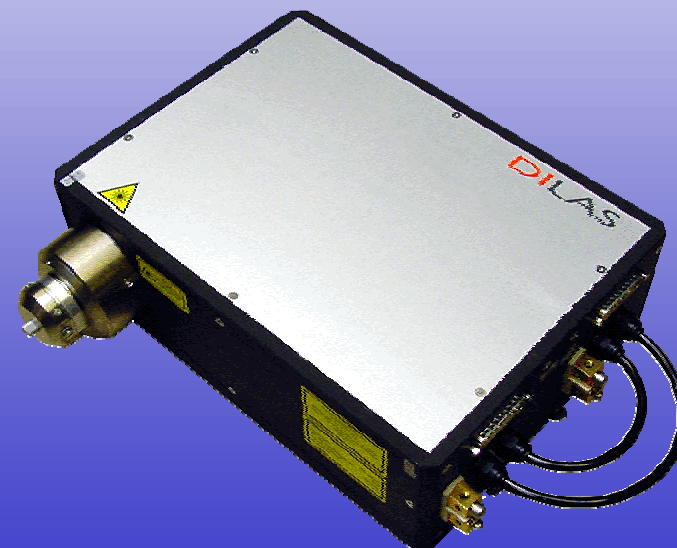
Stack



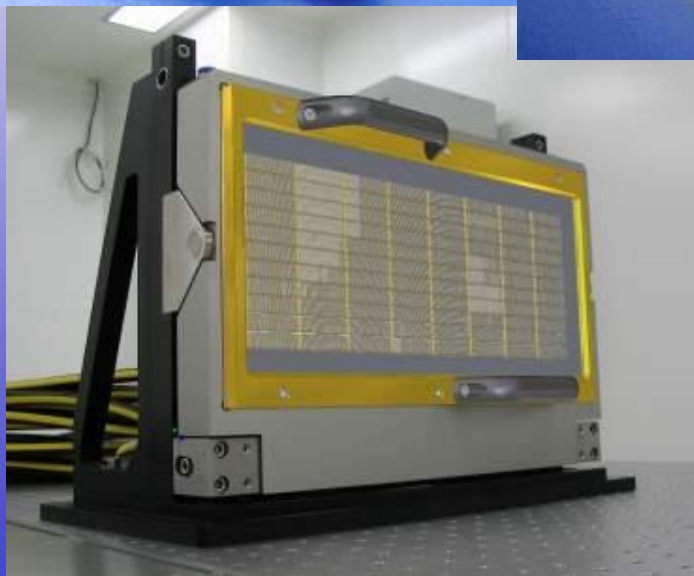
Collimated stack



Fibre coupled module

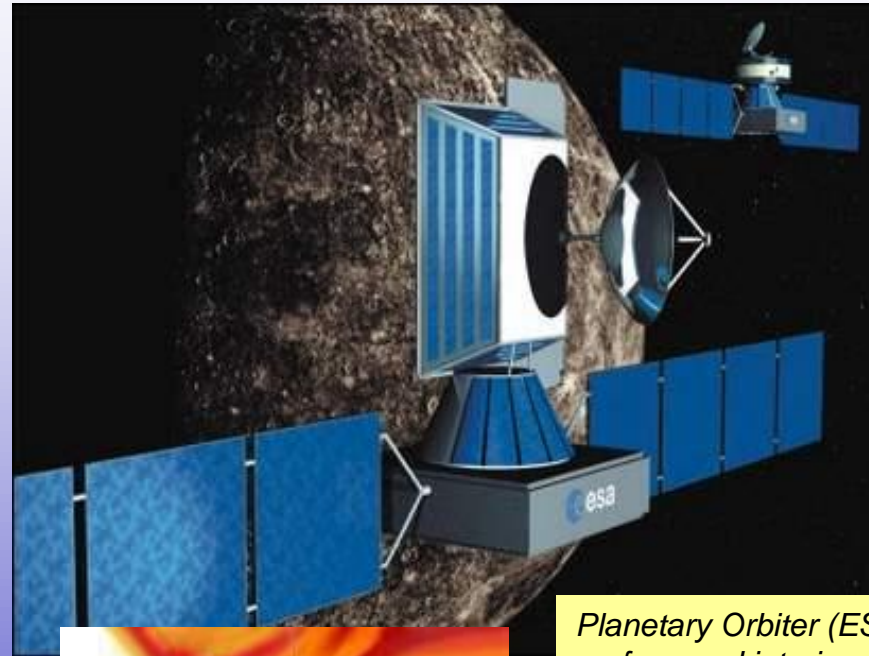


**Large
2D-
Array**

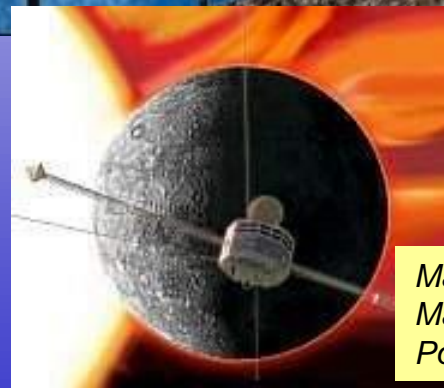


BepiColombo Mission

- ESA & JAXA Joint Mission
- Launch in 08/2013
- 8.45 years travel time
- >1 year scientific operation



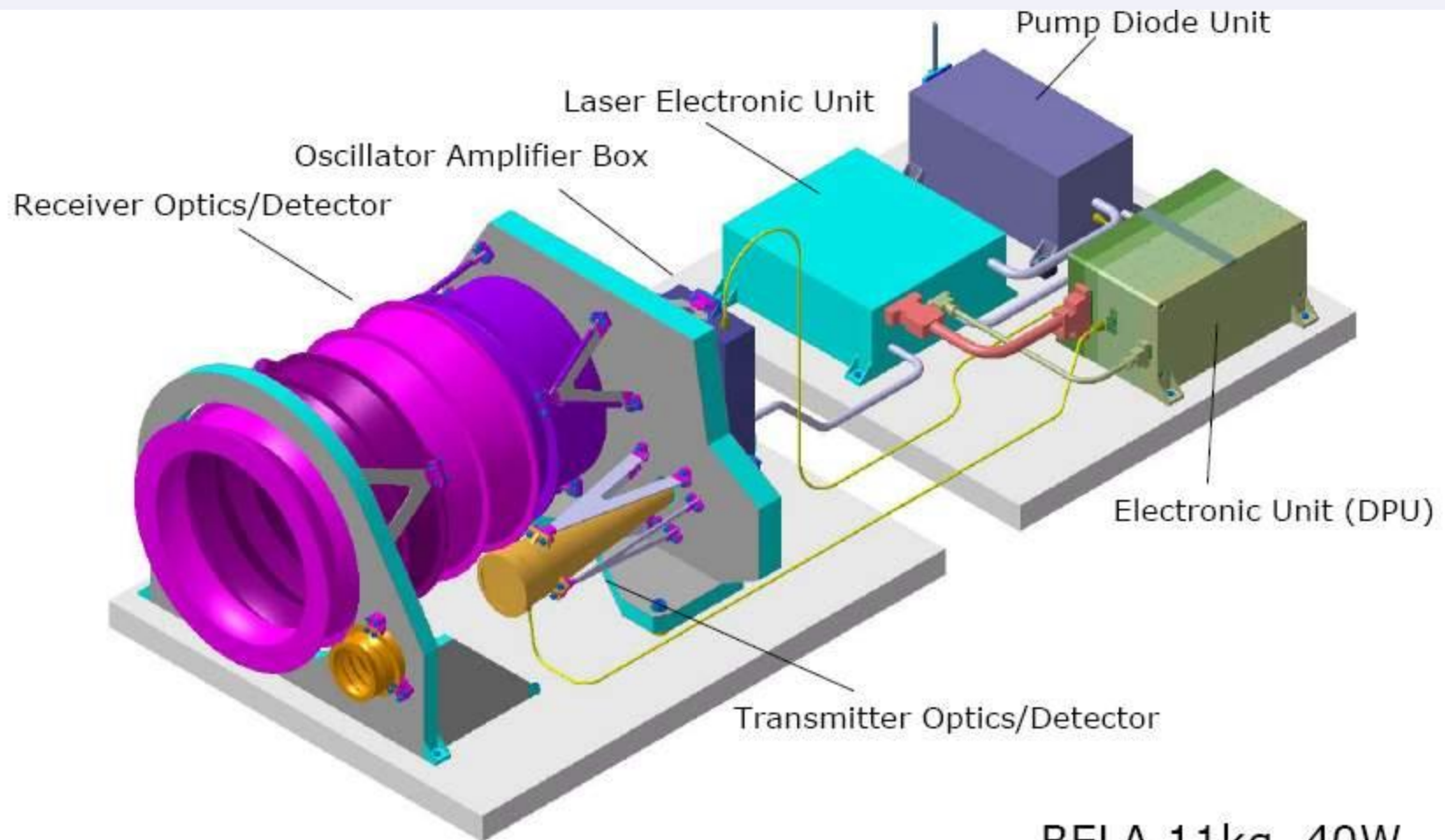
*Planetary Orbiter (ESA)
surface and interior
Polar Orbit: 400-1500km*



*Magnetospheric Orbiter (JAXA)
Magnetic field and magnetosphere
Polar Orbit: 400-12000km*



BELA - BepiColombo Laser Altimeter



BELA 11kg, 40W



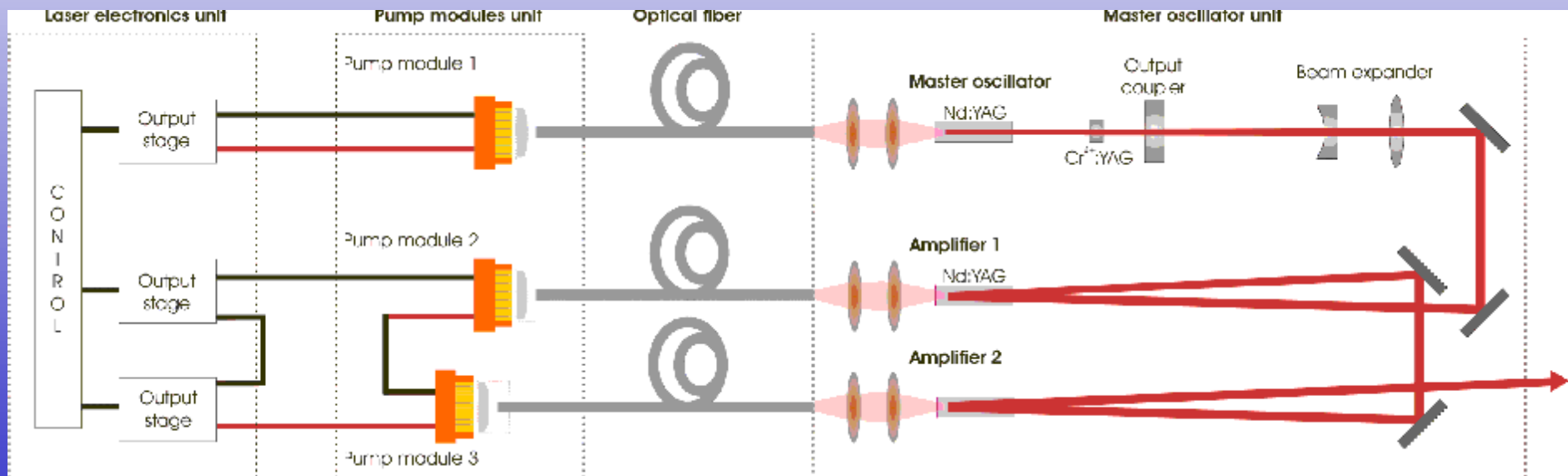
BELA Laser Design Concept

- Fiber coupled pump diodes
 - ▶ thermal and mechanical separation of pump source and laser head
- Longitudinal pumping scheme
 - ▶ long absorption path
 - ▶ optimized overlap pump beam / laser mode
 - ▶ higher efficiency
- qcw pumping
 - ▶ 200ms pump pulse duration as compromise between efficiency and output energy
- Passive Q-switching with Cr⁴⁺:YAG
 - ▶ simple design
 - ▶ low mass
 - ▶ low power consumption
- MOPA with 2-stage amplifier
 - ▶ avoid self-lasing
 - ▶ redundancy



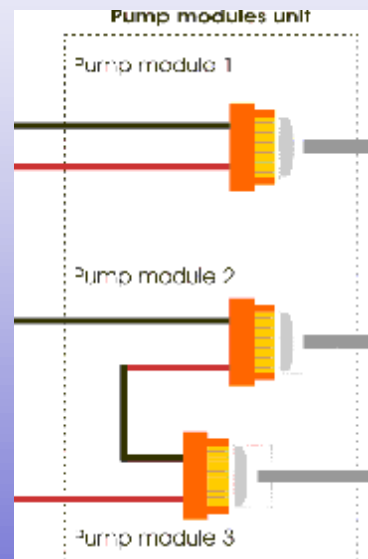
BELA Laser Design Concept

- Wavelength: 1064 nm
- Puls Energy: 50 mJ
- Puls duration: <10 ns
- Beam quality: $M^2 < 1.6$
- Rep. rate: 10 Hz (20 Hz)



Specifications for BELA Pump Diode Unit

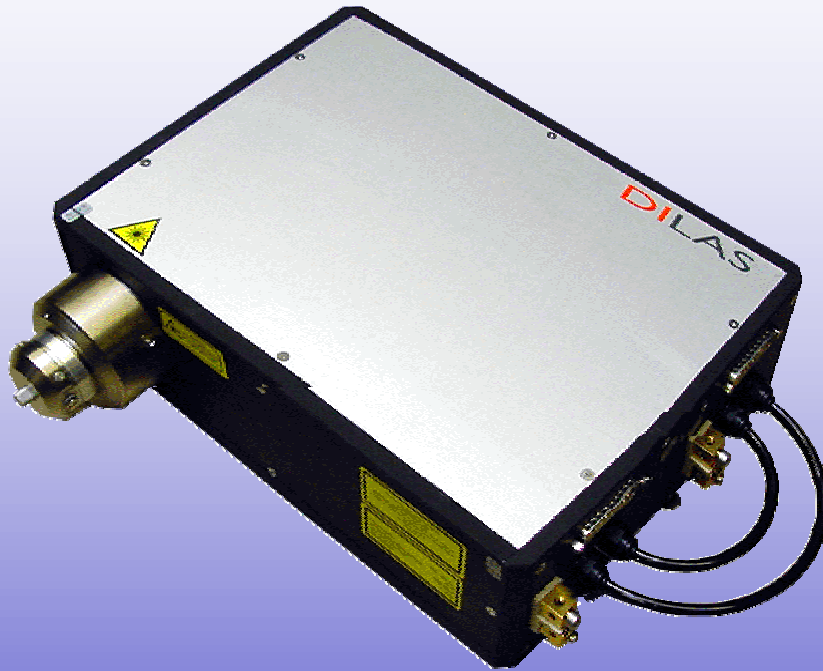
- 3 sub-units:
 - 2 x 500 W (660 W)
 - 1 x 100 W (165 W)
- 800 μ m fibre coupling
- No liquid cooling
- Wavelength: 806 +/- 3 nm
- Puls duration: 250 μ s
- Duty Cycle: 0.25-0.5 %
- Rep. rate: 10 Hz (20 Hz)



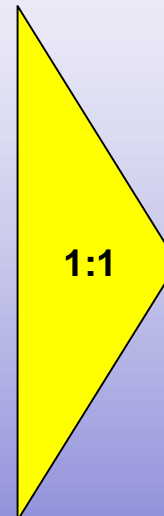
- Electrical power: < 13,5 W
- Diode Current: < 110 A
- Voltage: < 32 V
- Efficiency: > 70 %
- Total mass: < 1,4 kg
- Vibration: 26 g_{rms}
- Radiation: 100 krad
- Temperature:
 - Non-op.: -40 to +60°C
 - Operational: +18 to +33°C



Industrial Module to Space Module



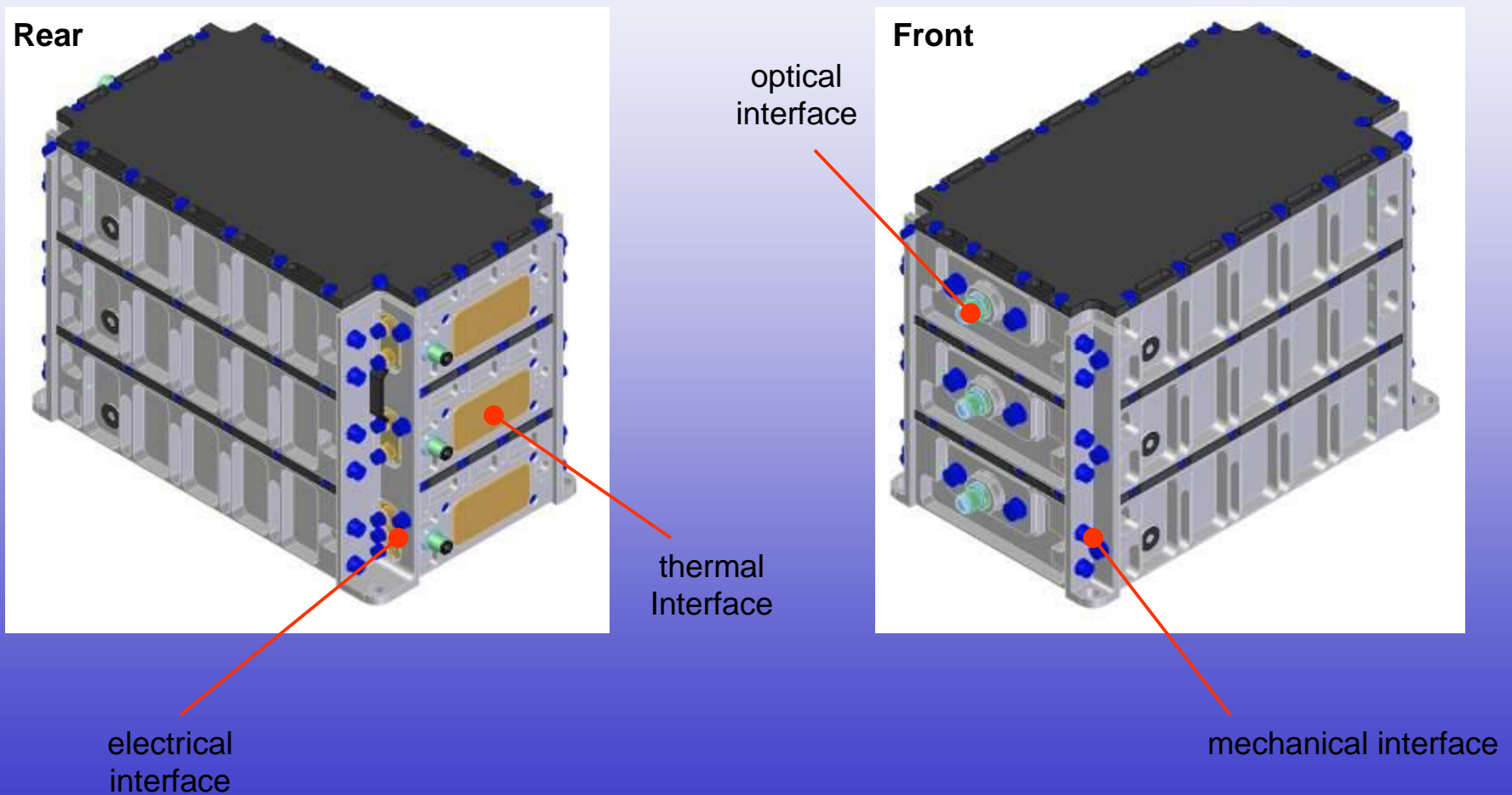
1000 W rated power
16 diodes
Mass: 9.5 kg
Size (l x w x h) : 30 x 23 x 11 cm³
Volume: 7590 cm³



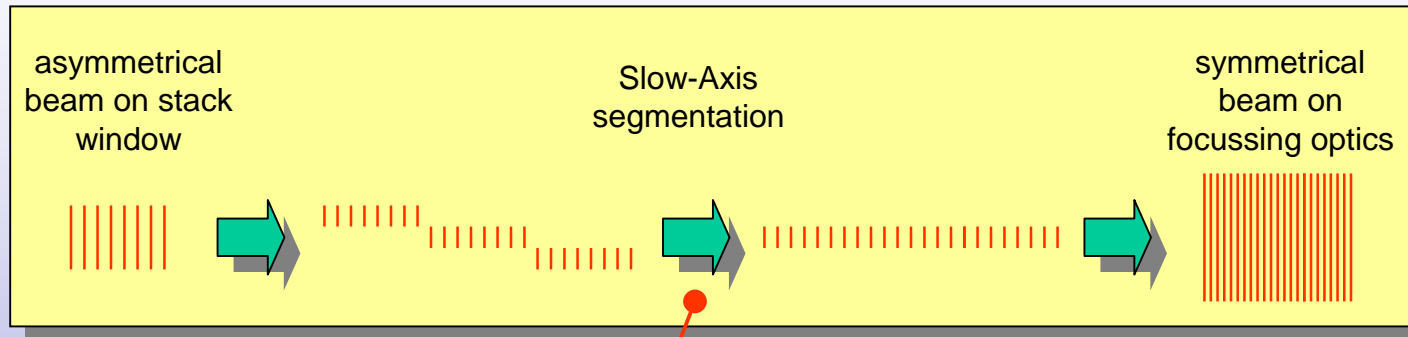
1100 W rated power
22 diodes
Mass: 1.3 kg
Size (l x w x h): 17 x 8 x 10 cm³
Volume: 1360 cm³



BELA Pump Diode Unit

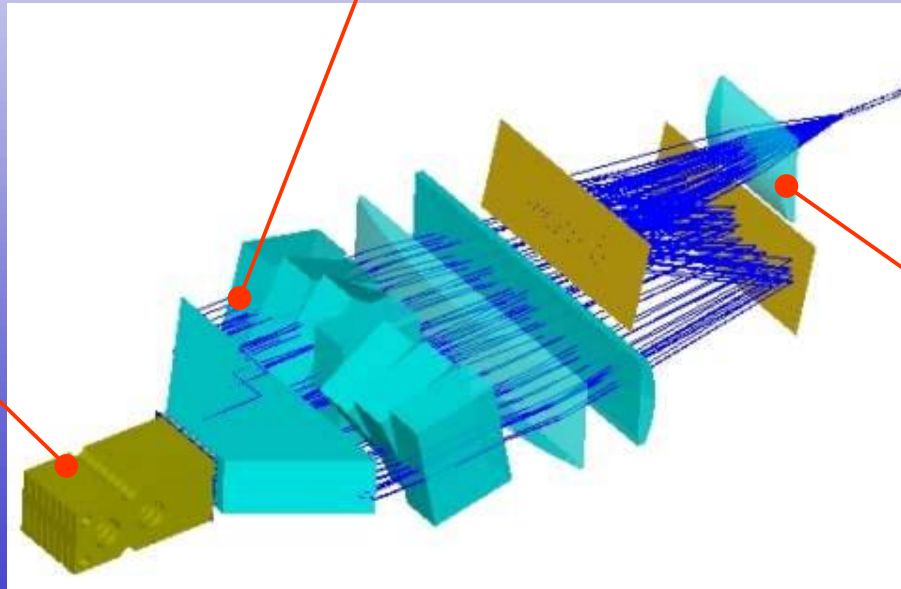


BELA PDU Sub-Module



beam transformation

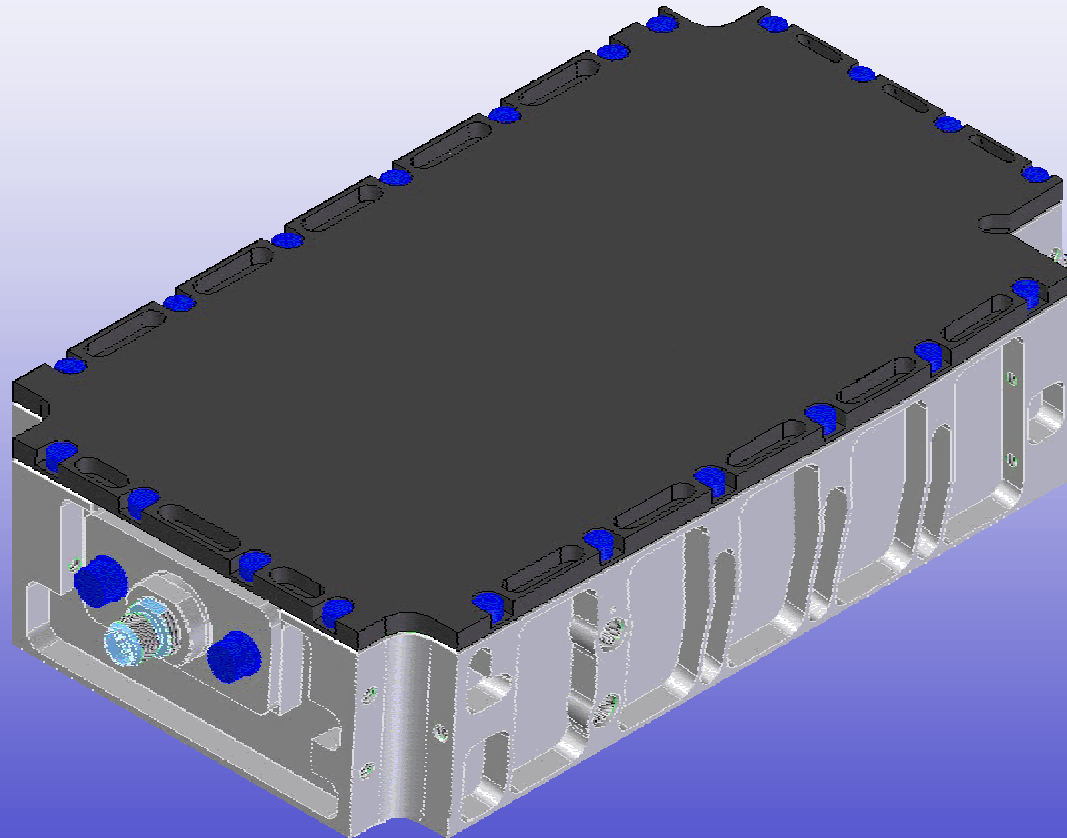
diode stack



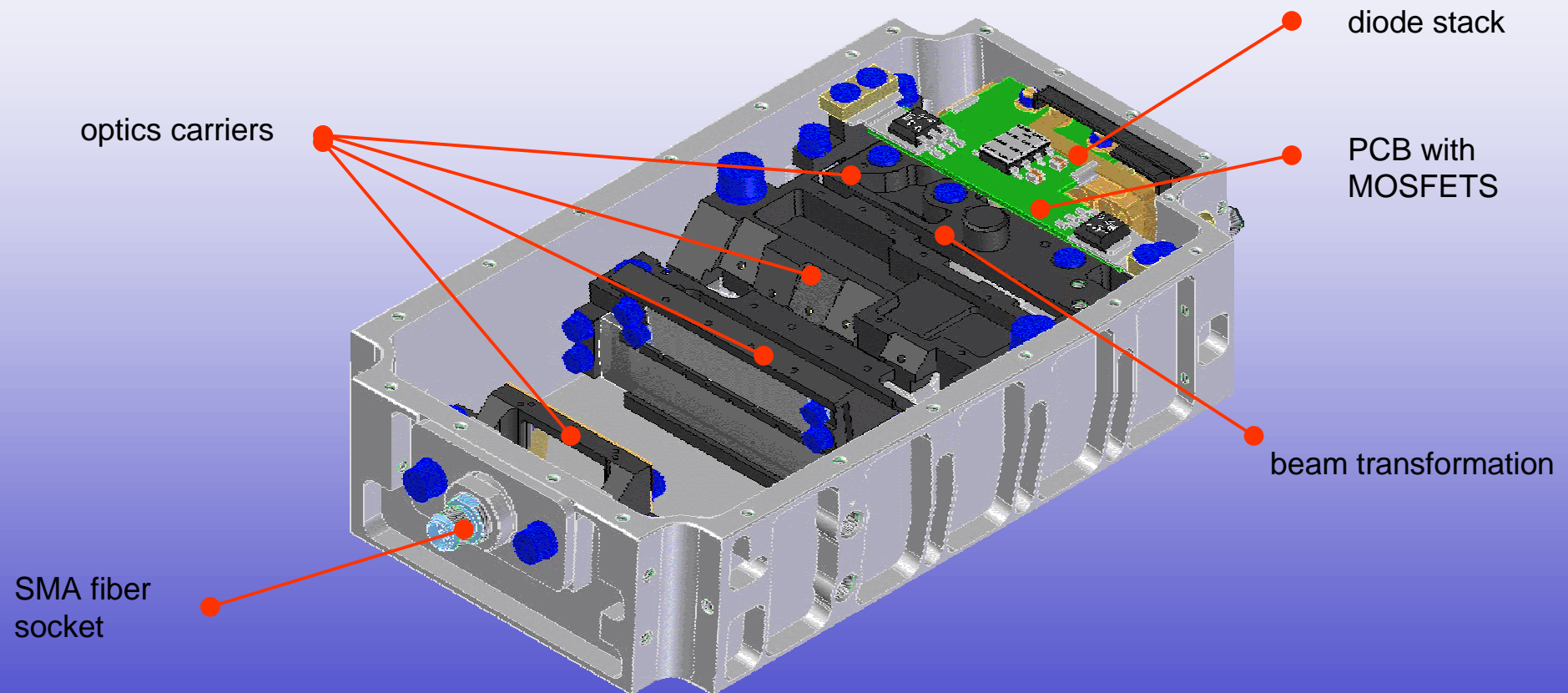
fiber coupling optics



BELA PDU Sub-Module



BELA PDU Sub-Module

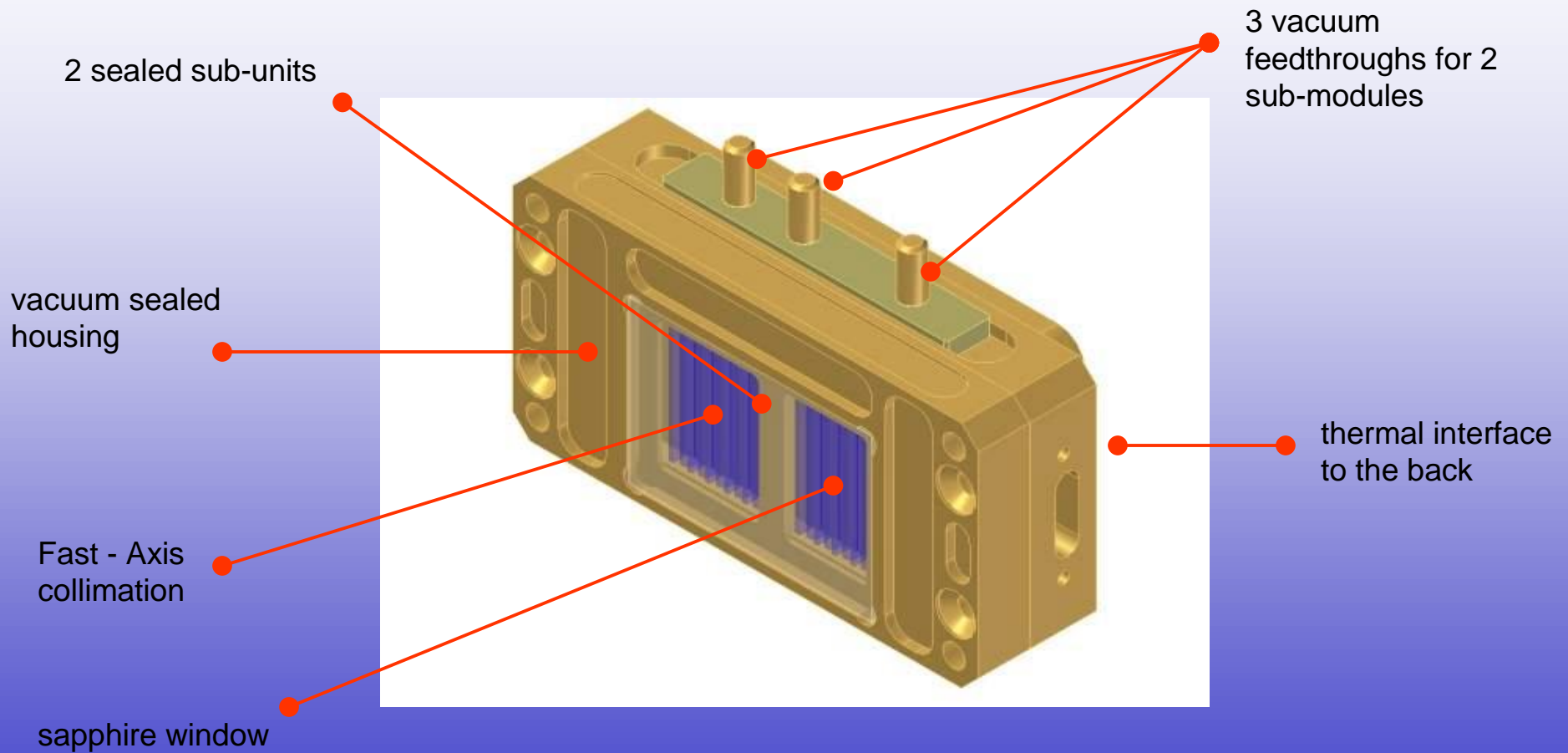


Space Aspects

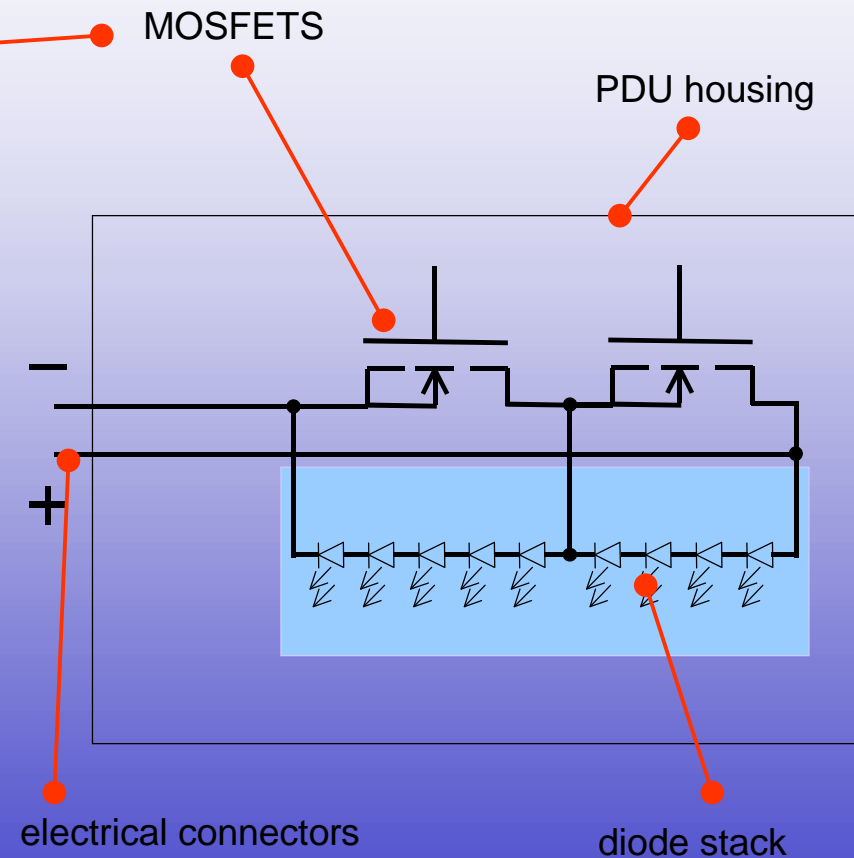
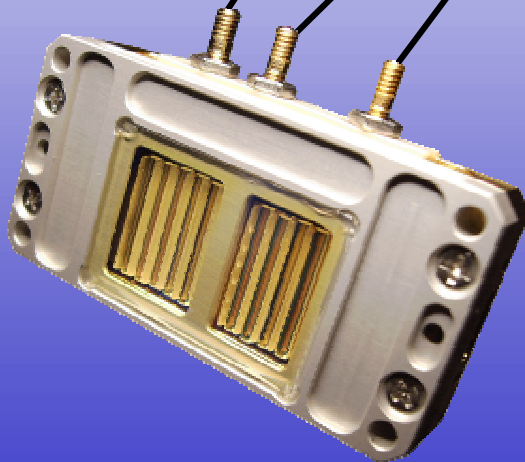
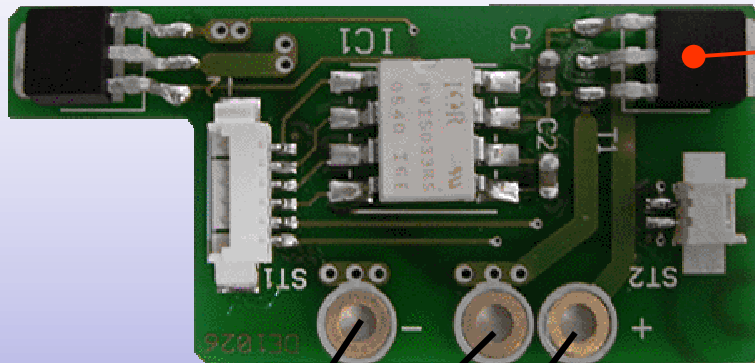
- light weight design / materials
- radiation hard optics, metal coated fiber
- shock / vibration proof according to space specifications
- no / low-rate outgassing materials / adhesives
- space approved diode mounting technology (tbd)
- liquid free cooling system
- multiple redundancy concept for diode failure
- vacuum sealed diode stack



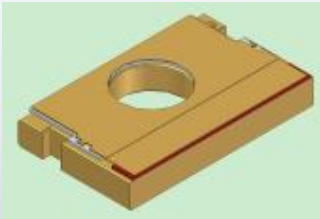
BELA diode stack



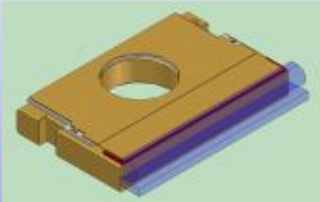
BELA diode stack - redundancy concept



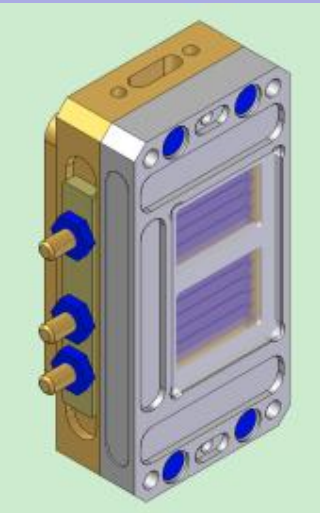
BELA diode stack - qualification



Diode



**Diode
+ FAC**



Stack

- 3 integration stages: diode, diode+FAC, stack
- diodes: 50 % fill-factor
- mounting technology: In-free (AuSn) with submount
- FAC mounting: UV adhesive / solder
- FAC: 600 μm
- pitch: 1.6 mm + x
- connectors: 3
- dimensions: see drawing
- vacuum sealed



Thank you for your attention

Dr. Matthias Haag DL-Systems

Dr. Thomas Brand Optics

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