DILAS Diodenlaser GmbH

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

Dr. Matthias Haag*
Research and Development / DL-Systems and Modules
DILAS Diodenlaser GmbH, Galileo-Galilei-Str. 10, 55129 Mainz-Hechtsheim, Germany

* m.haag@dilas.de, tel. +49 (0)6131 9226 163; fax +49 (0)6131 9226 255

DILAS Diodenlaser GmbH

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DILAS GmbH

founded 1994

located in Mainz Germany

DILAS Inc.

founded 2005

located in Tucson Arizona

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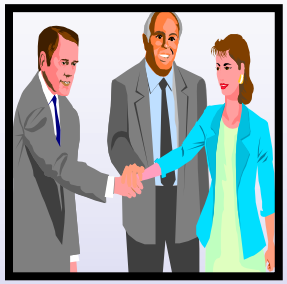
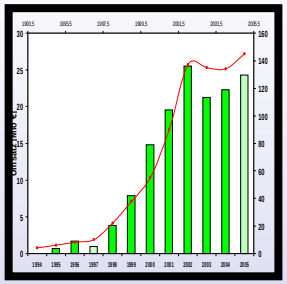


Founded: 1994

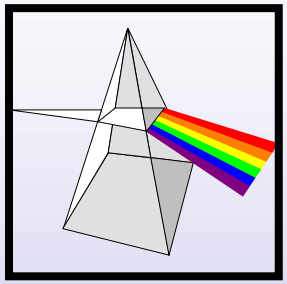
Employees: 153

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



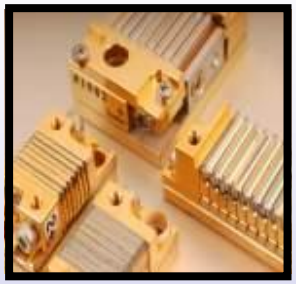
Research:
35 academics & engineers

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

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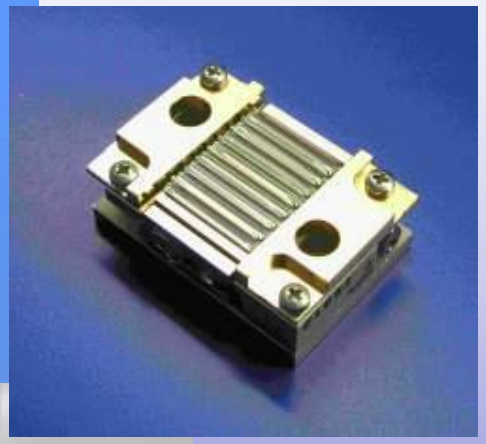
Quasi-cw Products

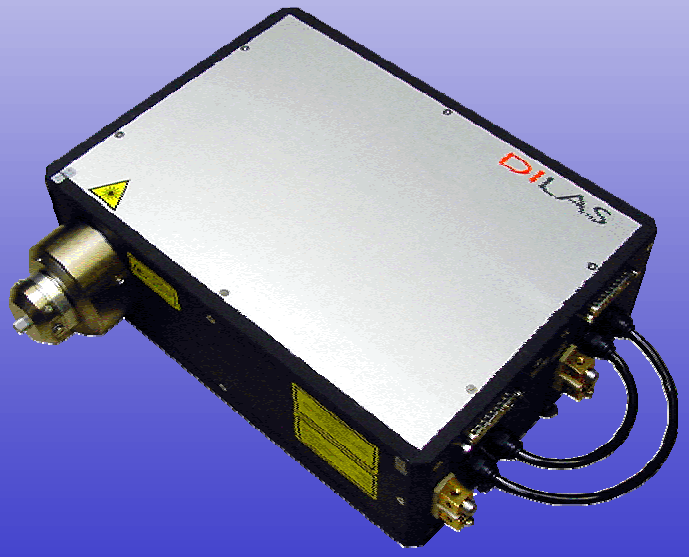
Stack

Collimated stack



Large 2D-Array

Fibre coupled module



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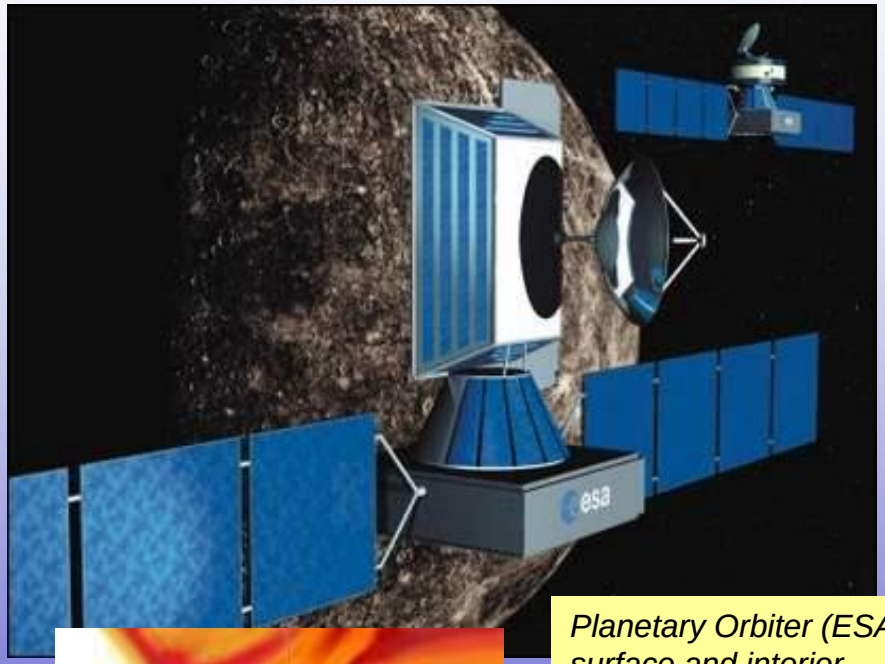
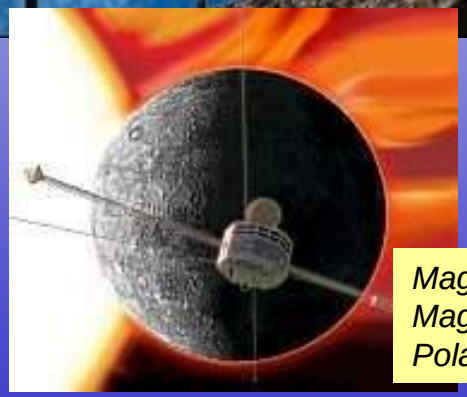
BepiColombo Mission

- 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

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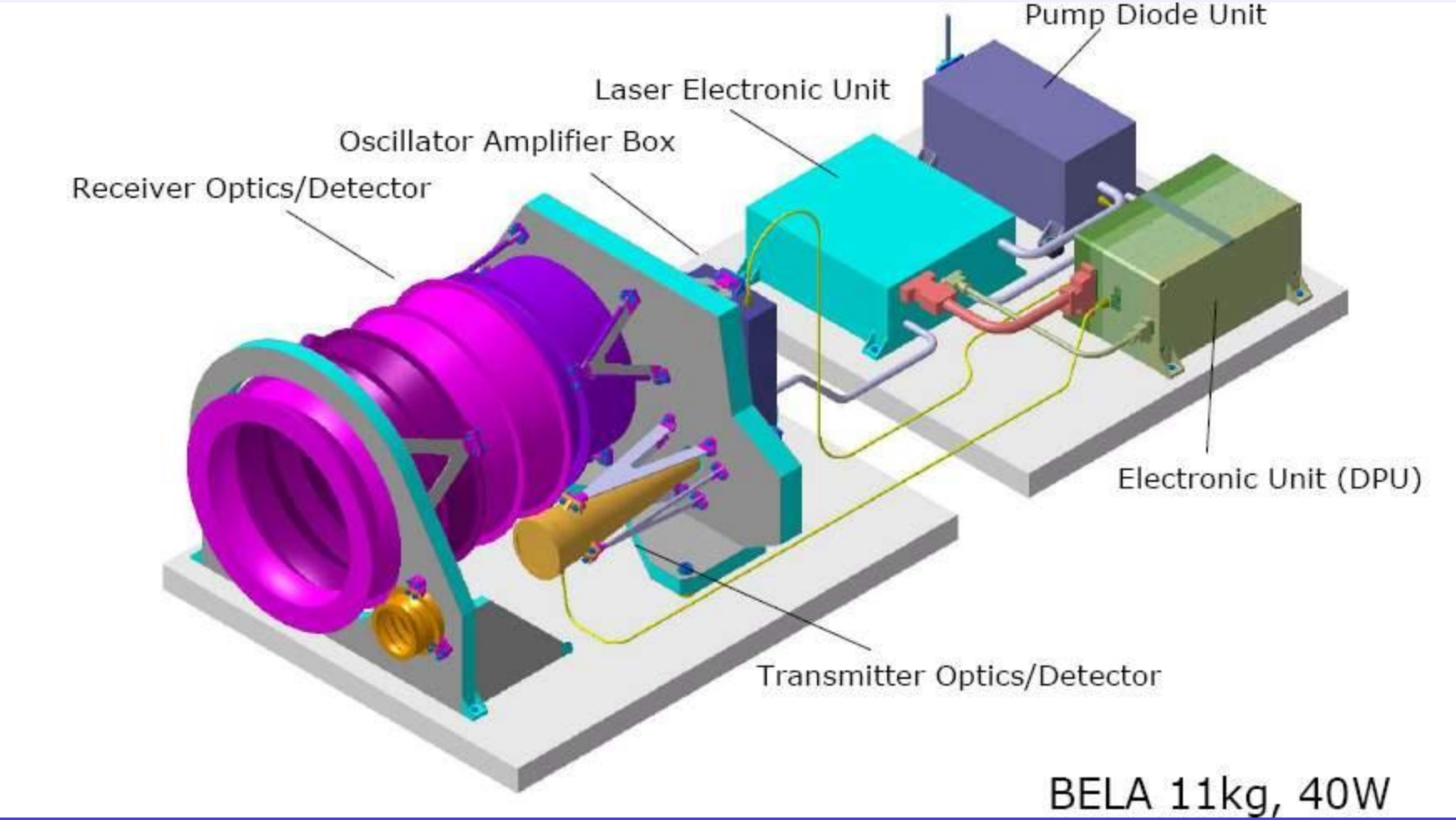
BELA - BepiColombo Laser Altimeter



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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 Cr^{4+}:YAG
  - simple design
  - low mass
  - low power consumption
- MOPA with 2-stage amplifier
  - avoid self-lasing
  - redundancy

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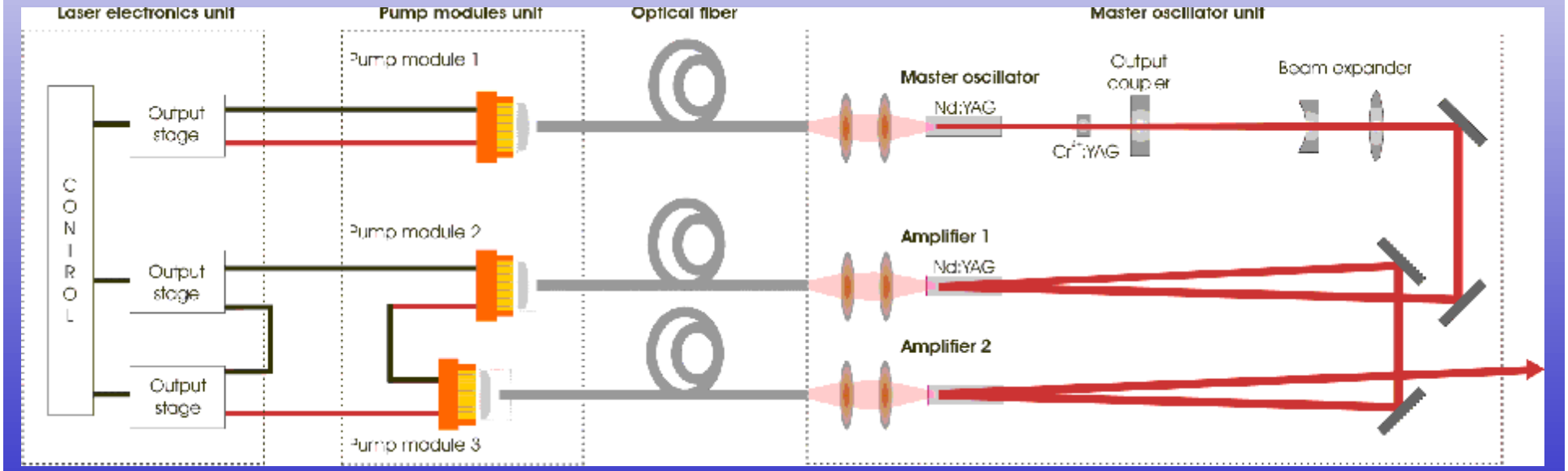
BELA Laser Design Concept

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



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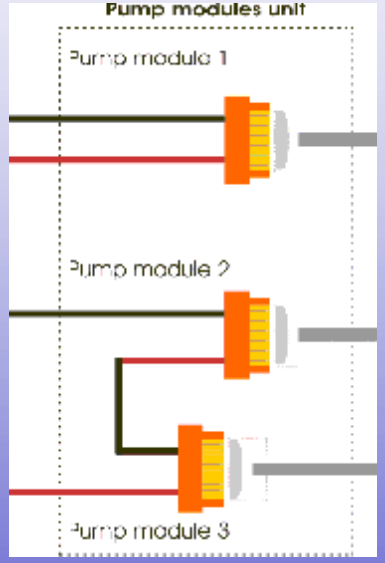
Specifications for BELA Pump Diode Unit

- 3 sub-units:
  - 2 x 500 W (660 W)
  - 1 x 100 W (165 W)
- 800 µm fibre coupling
- No liquid cooling

- Wavelength: 806 +/- 3 nm
- Puls duration: 250 µs
- 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

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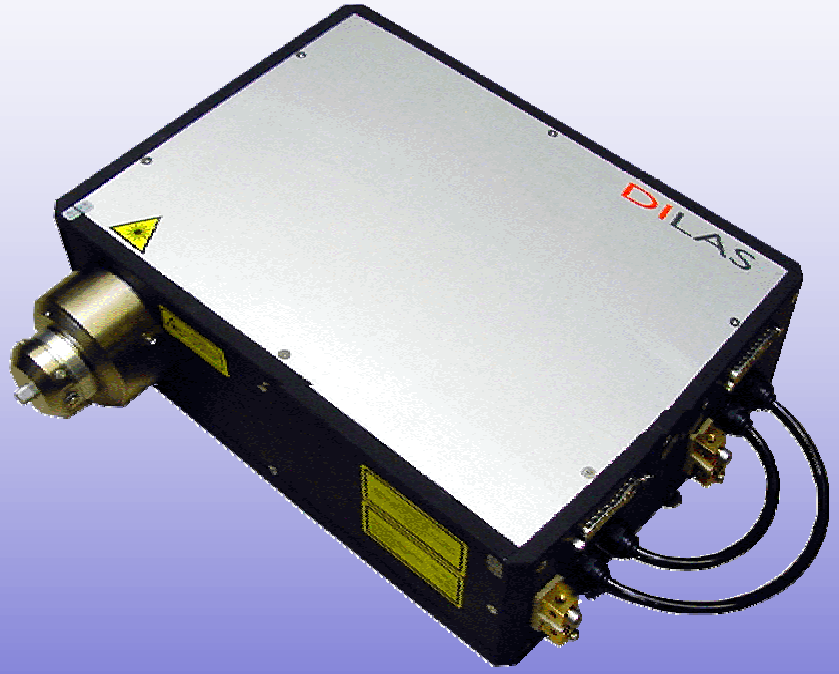
Industrial Module to Space Module



1:1

1000 W rated power
16 diodes
Mass: 9.5 kg
Size (l x w x h) : 30 x 23 x 11 cm^3
Volume: 7590 cm^3

1100 W rated power
22 diodes
Mass: 1.3 kg
Size (l x w x h): 17 x 8 x 10 cm^3
Volume: 1360 cm^3

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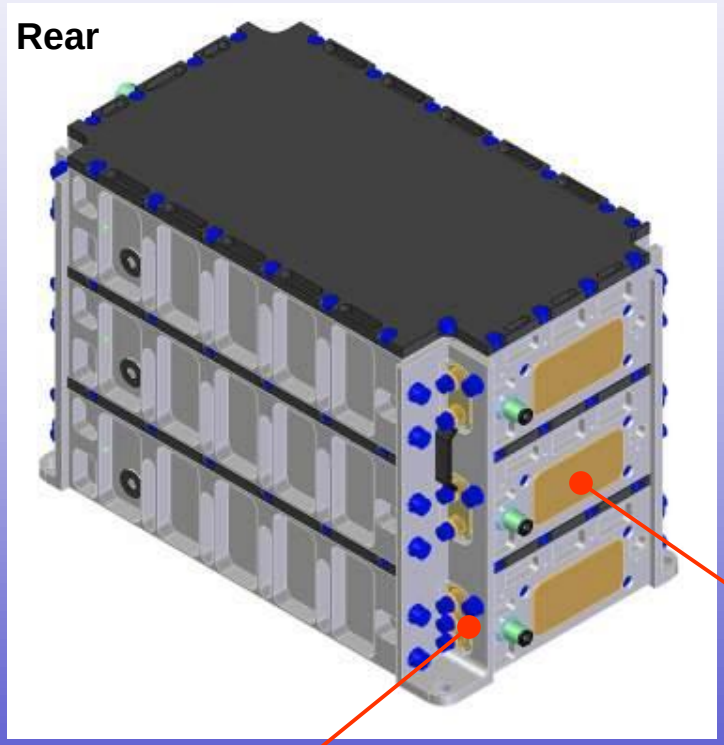
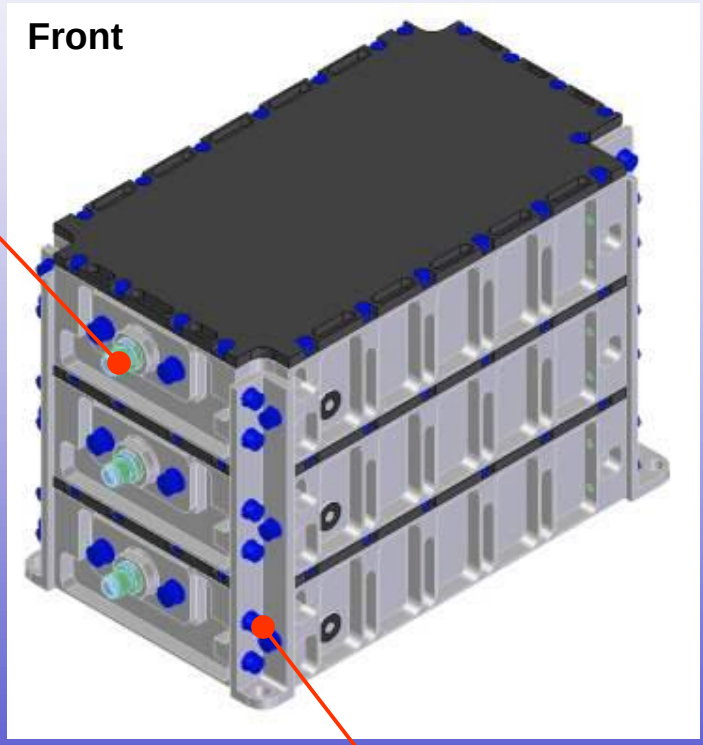
BELA Pump Diode Unit





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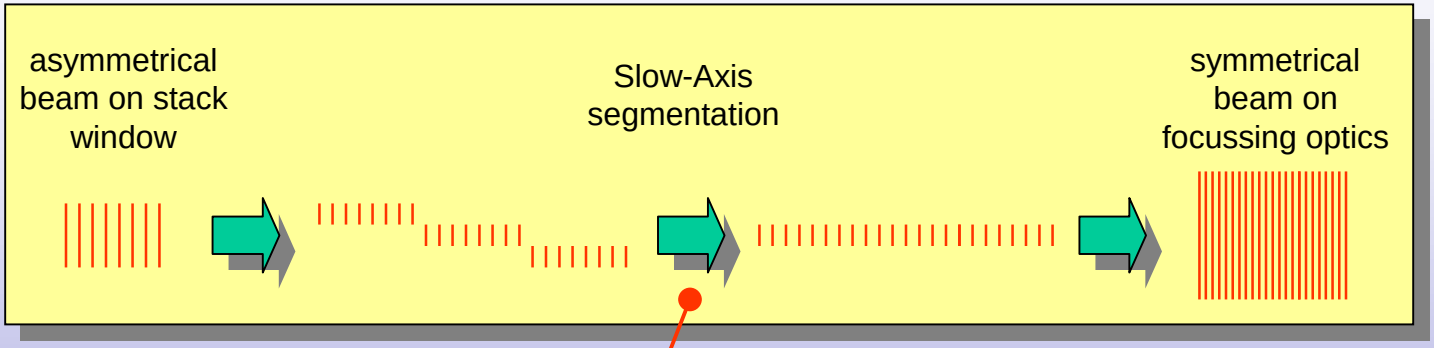
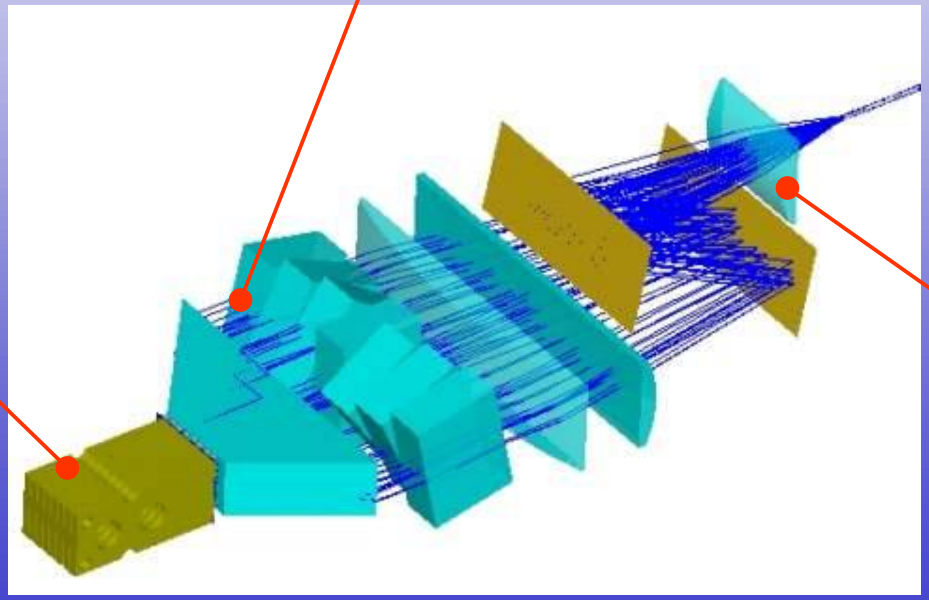
BELA PDU Sub-Module



beam transformation



diode stack

fiber coupling optics

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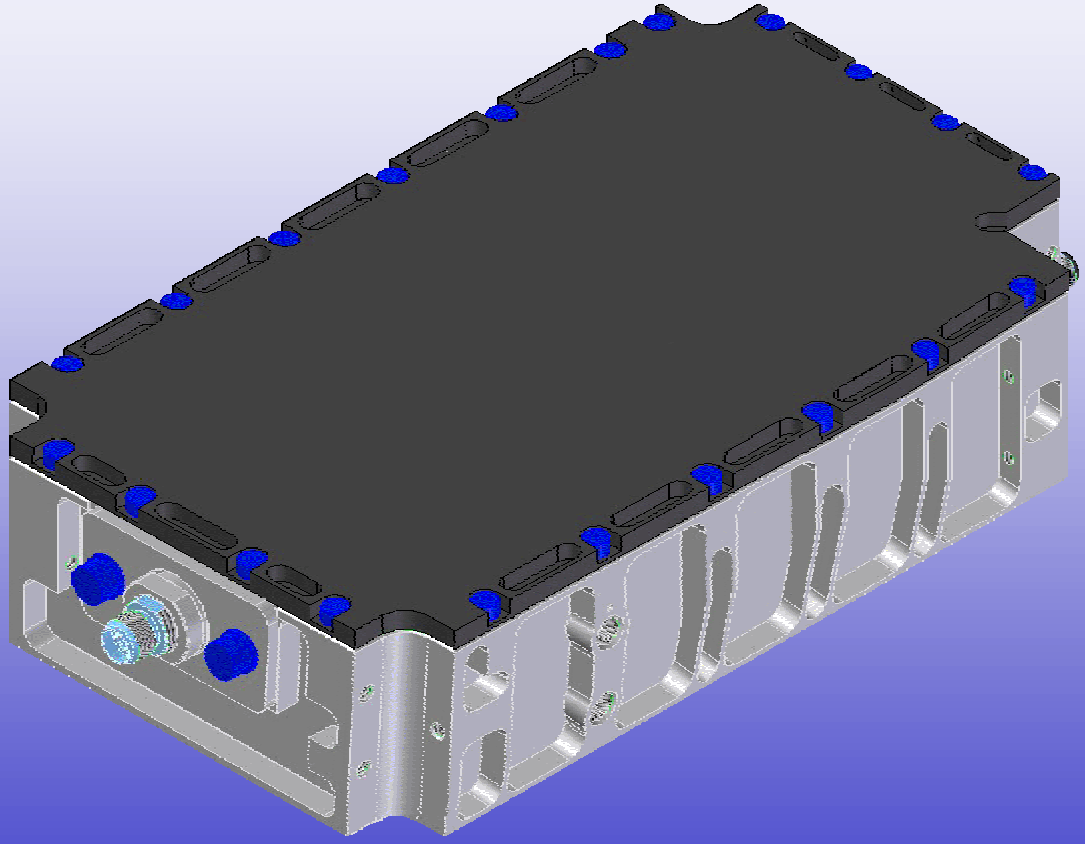
BELA PDU Sub-Module



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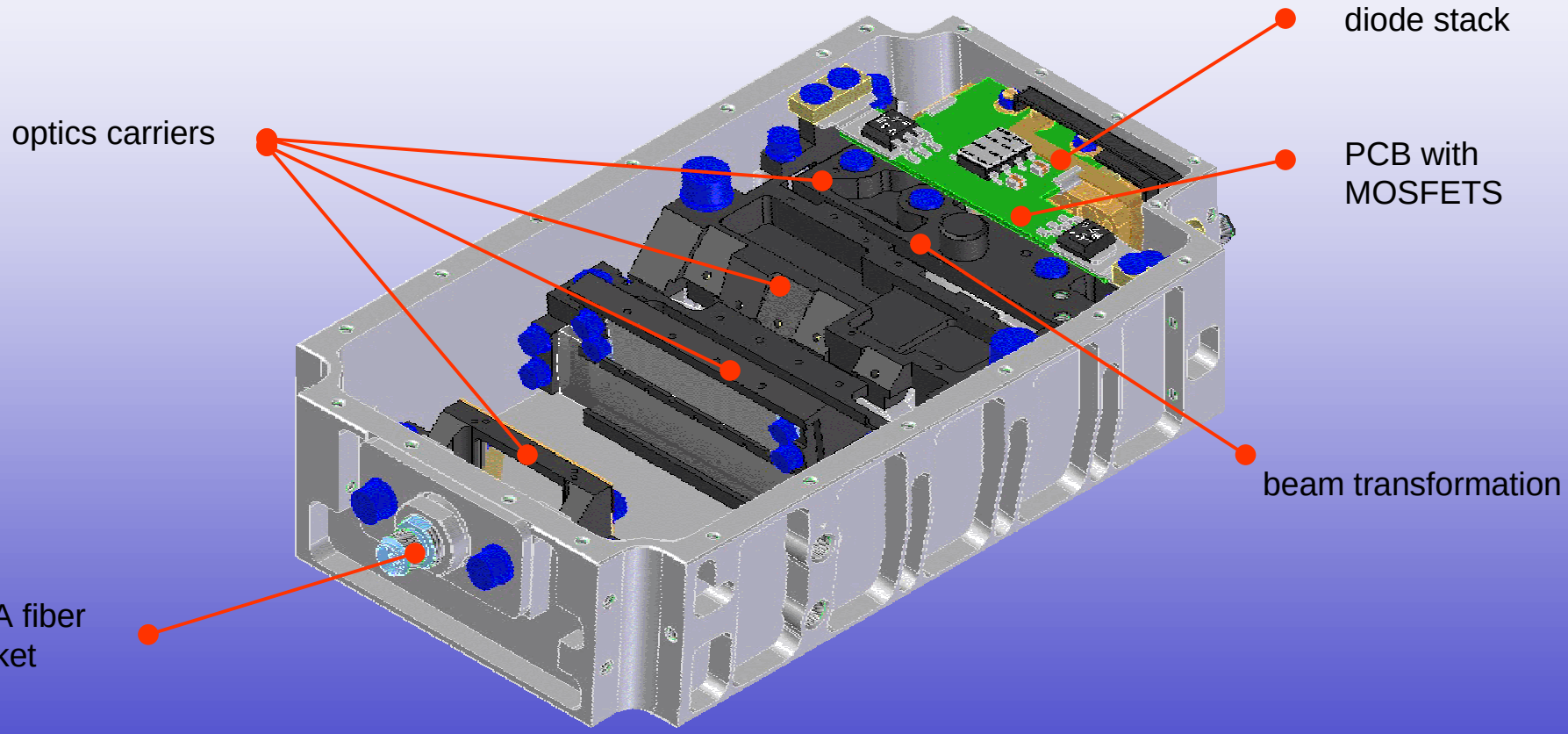
BELA PDU Sub-Module



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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

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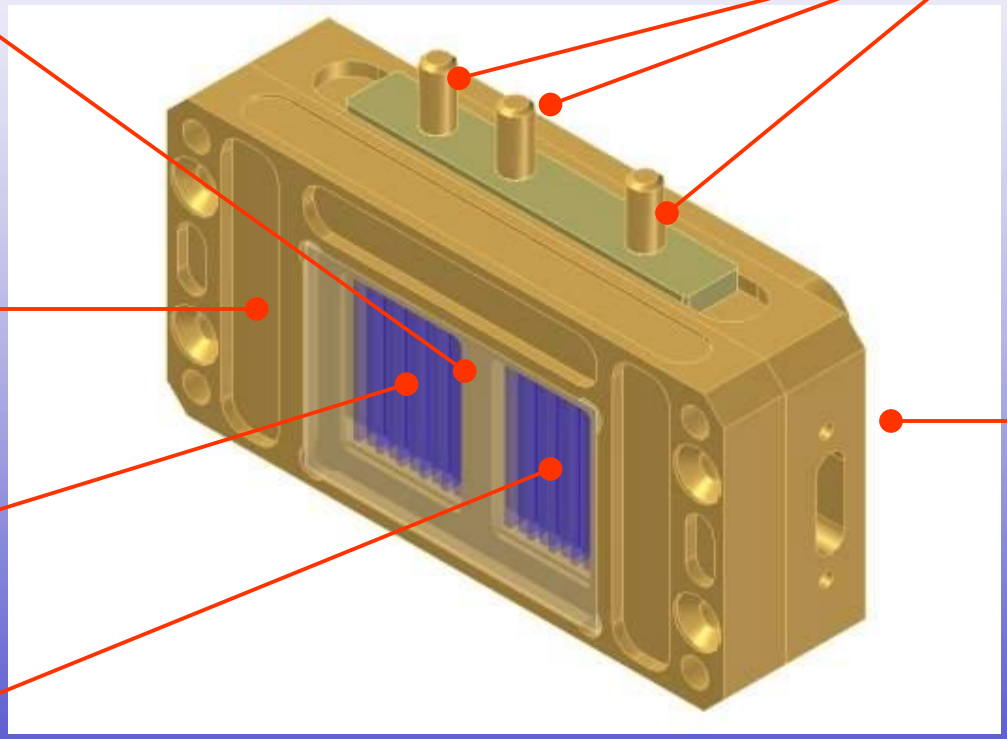
BELA diode stack



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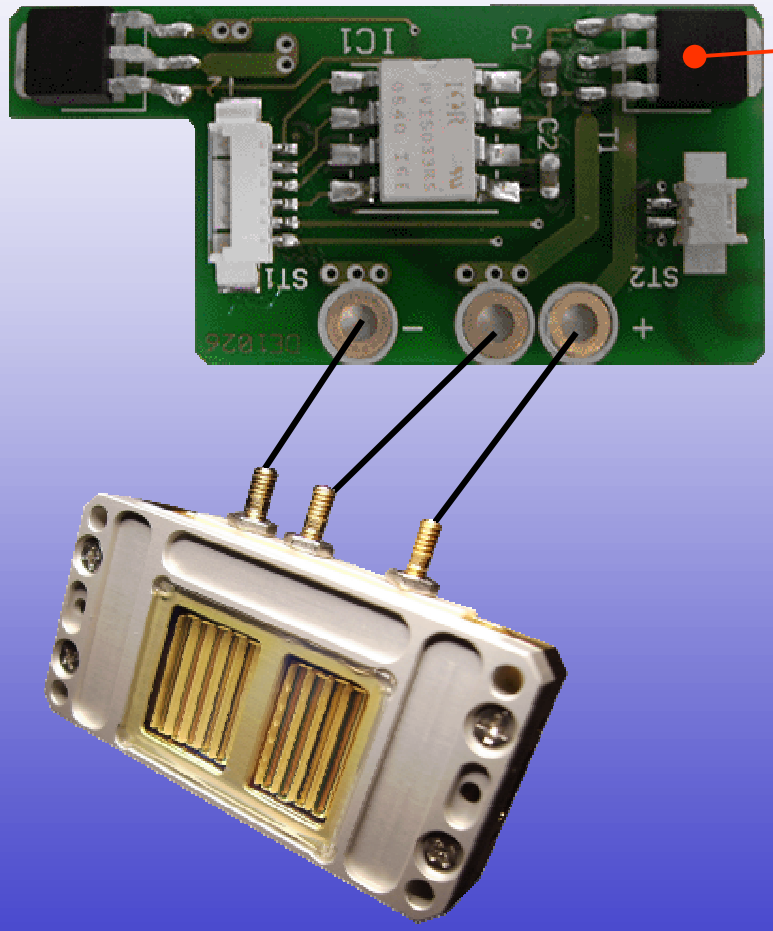
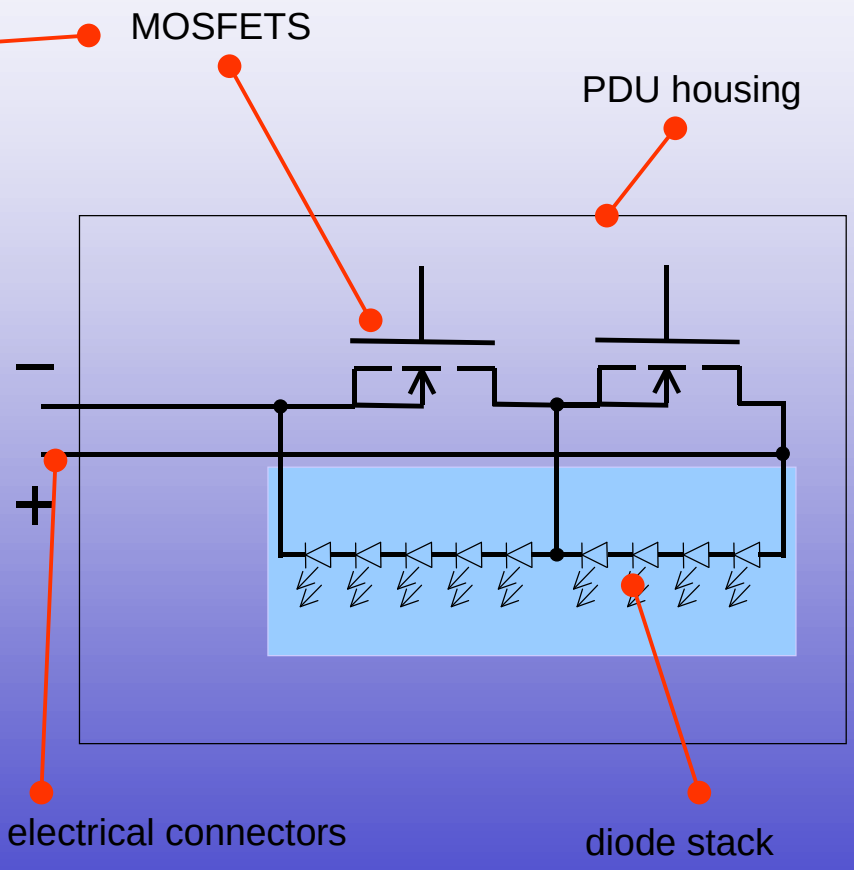
BELA diode stack - redundancy concept





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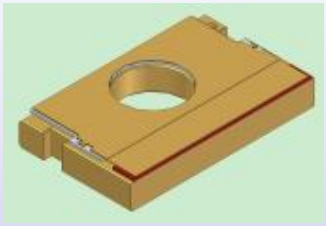
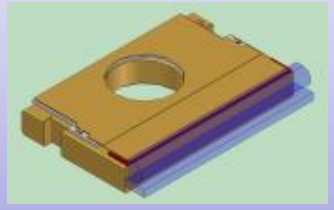
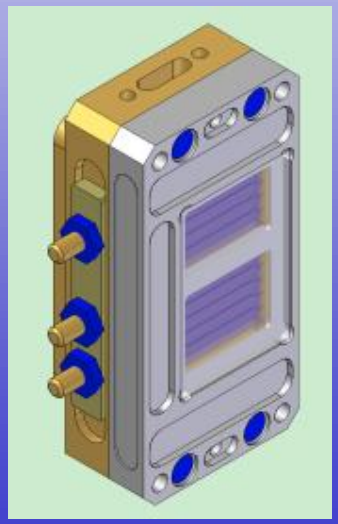
BELA diode stack - qualification



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

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Thank you for your attention

Dr. Matthias Haag **DL-Systems**

Dr. Thomas Brand **Optics**

DILAS Diodenlaser GmbH, Galileo-Galilei-Str. 10, 55129 Mainz-Hechtsheim, Germany