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WWW.BRIGHTER.EU WORKSHOP
CLEO Europe 18th June 2007

High brightness laser diode sources

General Introduction
by

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Introduction

CHALLENGE:

- Strengthen the position of Europe in High Brightness Laser Diode technology and take a large share of the fast growing € 1 billion market foreseen by the end of the decade.

OBJECTIVE:

- Push the limits of current technology (brightness, power and efficiency) - *medium term*
- Develop advanced technologies (high beam coherence, even higher brightness) - *long term*
- Demonstrate applications in the fields of health-care, telecom, display, security and environment.

APPROACH:

- Streamline the technical developments through a coherent exploitation of synergies, leading to pre-industrial demonstrators.
- Accelerate the development and uptake of advanced technologies through partnership between leading Industries, Research Centres and Universities.
- Establish an expert workforce and stimulate new markets by engaging future engineers, industrial players and end-users through training, dissemination and popularisation activities.

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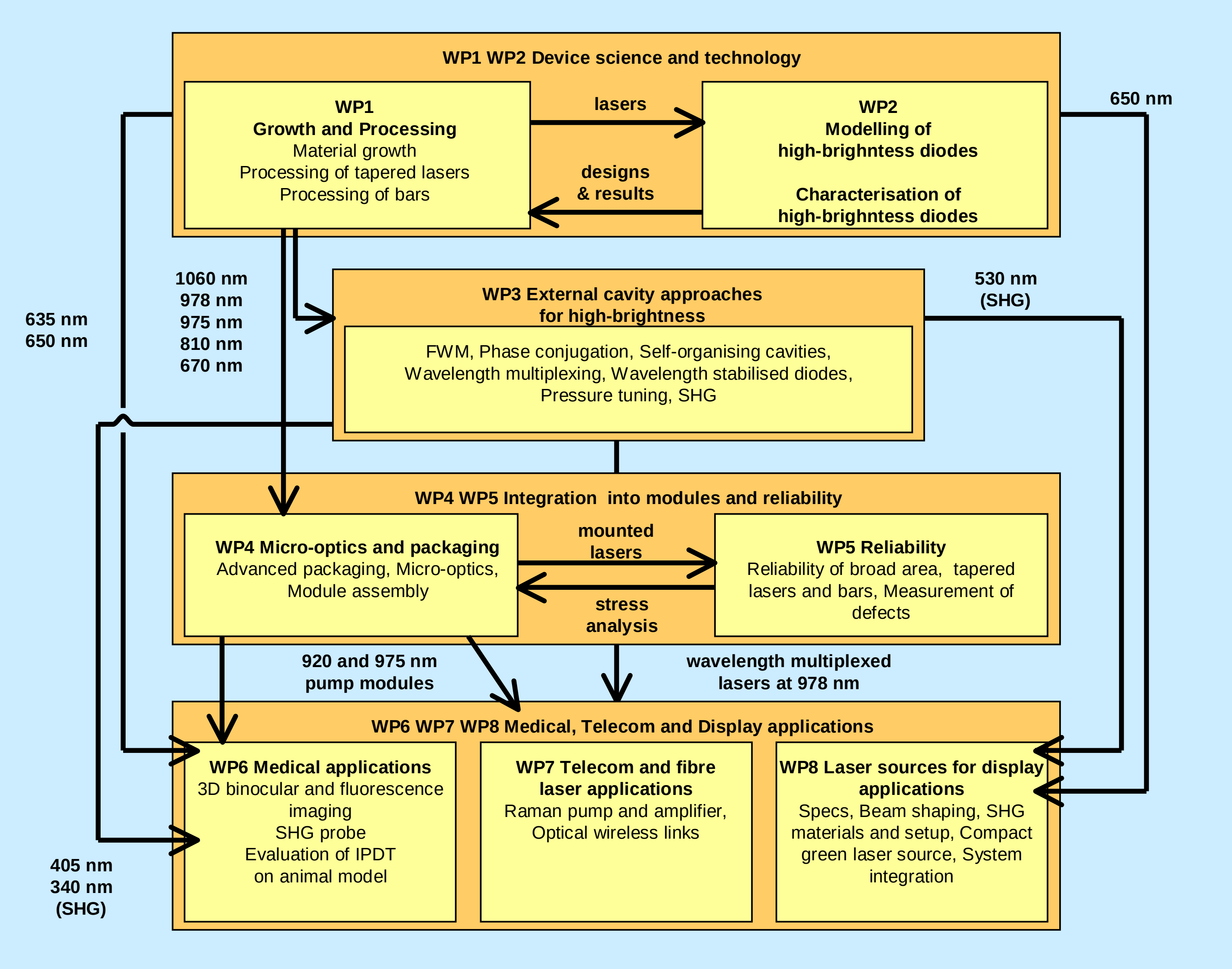
3 years		11 countries involved
8 industrial partners	7 Universities	8 Research centres
24 pre-industrial application demonstrators		

WP DIAGRAMM


WP1 WP2 Device science and technology
WP1
Growth and Processing
Material growth
Processing of tapered lasers
Processing of bars
lasers
designs
& results
WP2
Modelling of
high-brightness diodes
Characterisation of
high-brightness diodes
650 nm
1060 nm
978 nm
975 nm
810 nm
670 nm
635 nm
650 nm
530 nm
(SHG)
WP3 External cavity approaches
for high-brightness
FWM, Phase conjugation, Self-organising cavities,
Wavelength multiplexing, Wavelength stabilised diodes,
Pressure tuning, SHG
WP4 WP5 Integration into modules and reliability
WP4 Micro-optics and packaging
Advanced packaging, Micro-optics,
Module assembly
mounted
lasers
stress
analysis
WP5 Reliability
Reliability of broad area, tapered
lasers and bars, Measurement of
defects
920 and 975 nm
pump modules
wavelength multiplexed
lasers at 978 nm
WP6 WP7 WP8 Medical, Telecom and Display applications
WP6 Medical applications
3D binocular and fluorescence
imaging
SHG probe
Evaluation of IPDT
on animal model
WP7 Telecom and fibre
laser applications
Raman pump and amplifier,
Optical wireless links
WP8 Laser sources for display
applications
Specs, Beam shaping, SHG
materials and setup, Compact
green laser source, System
integration
405 nm
340 nm
(SHG)

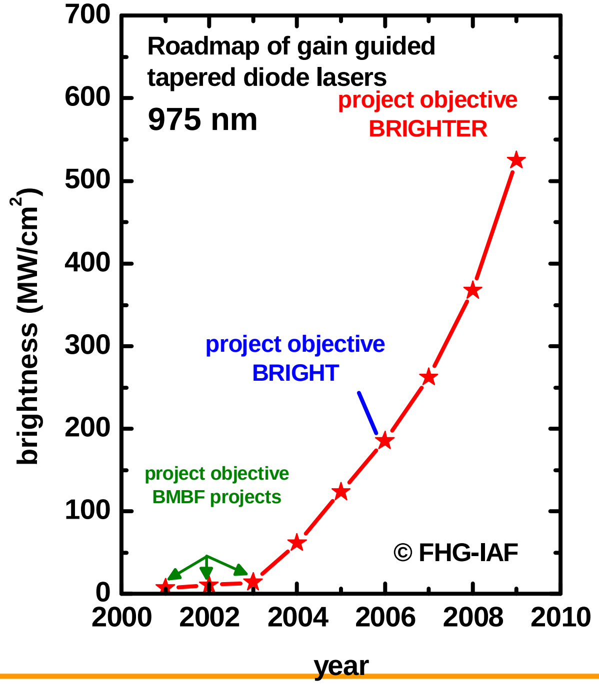
BRIGHTER PARTICIPANTS

No	Country	WWW.BRIGHTER.EU Participant
1	France	Alcatel Thales III-V Lab
2	Germany	Biolitec
3	Sweden	Lund University
4	Greece	Institute of communication and computer Systems
5	Denmark	RISOE National Laboratory
6	Germany	OSRAM Opto Semiconductors
7	United Kingdom	University of Cambridge
8	France	Keopsys
9	France	Alcatel CIT
10	Canada	Institut National d'Optique
11	Germany	University of Würzbug
12	Switzerland	Fisba Optik AG
13	Switzerland	Rainbow Photonics AG
14	France	THALES
15	Spain	Universidad Politecnica de Madrid
16	Germany	Forschungsverbund Berlin e.V. - FBH
17	Germany	Fraunhofer-Gellschaft
18	Poland	Instytut Wysokich Cisnien PAN (UNIPRESS)
19	Germany	Universitat Kassel
20	France	Centre National de la Recherche Scientifique
21	Germany	Forschungsverbund Berlin e.V. - MBI
22	Ireland	Tyndall National Institute
23	United Kingdom	University of Nottingham

Laser fabrication & Modelling

Progress beyond BRIGHT.EU

- QD laser material for 920 nm uncooled pump modules ($d\lambda/dT < 0.1$ nm/K, P: 2 W → 4 W, η_P: 50% → 60%)
- 635 nm red laser (P: 3 W → 5 W, reliability: 1000 h → 2000 h)
- 650 nm red laser (P: 4 W → 7 W, reliability: 1000 h → 2000 h, VFF: 40° → 32°)
- Al-free 975 nm Esaki-junction laser (P: 20 W → 80 W)
- gain-guided tapered lasers ($M^2 < 2$, P: 5 W → 10 W, VFF: 70° → 40°)



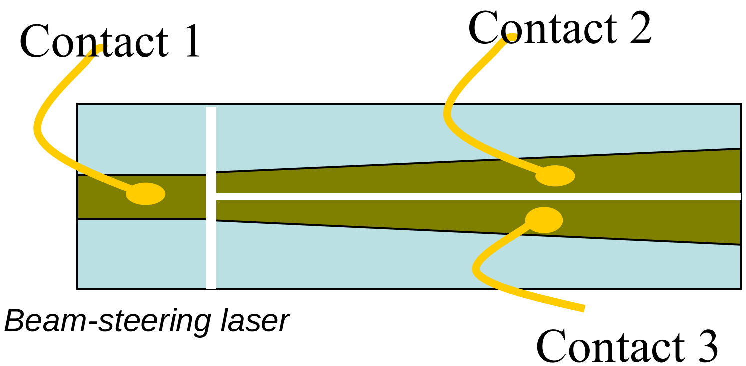
New BRIGHTER activities

- Zero-α QD laser material with tunnel injection design (920/1060 nm) for reduced filamentation (P > 4 W, T_0 > 300 K)
- 1060 nm MOPA laser with integrated overgrown DFB/DBR grating (P > 5 W (single chip), VFF < 22°, $\Delta\lambda$ < 0.1 nm)
- High wall-plug efficiency laser structures (η_P = 70%)
- 670 nm tapered laser (P > 1 W, $M^2 < 2$)
- Large spot size QD/QW SCOWL (1060 nm, P > 3 W (single chip))
- 975/1060 nm beam steering lasers
- Phase coupled tapered laser mini-arrays
- Injection modulated (> 100 MHz) multi-section lasers (650 nm, 1060 nm)
- Simulation and design of QD lasers
- Simulation/design of external cavity lasers (FWM, self-organizing, Talbot effect cavities)
- Simulation of modulation behavior and modal discrimination in astable cavity lasers

Telecom & General applications

Progress beyond BRIGHT.EU

- 975 nm pump sources for EDFA: Increase of power from 5 W → 12 W (50 µm fibre)
- EDFA for WDM and CATV: Increase of Psat from +27 dBm → +33 dBm
- 915 nm pump source for Yb-Laser: Pump power increased from 10 W → 30 W (200 µm fibre)
- From laboratory breadboards in BRIGHT.EU → modules in BRIGHTER



Beam-steering laser

New BRIGHTER activities

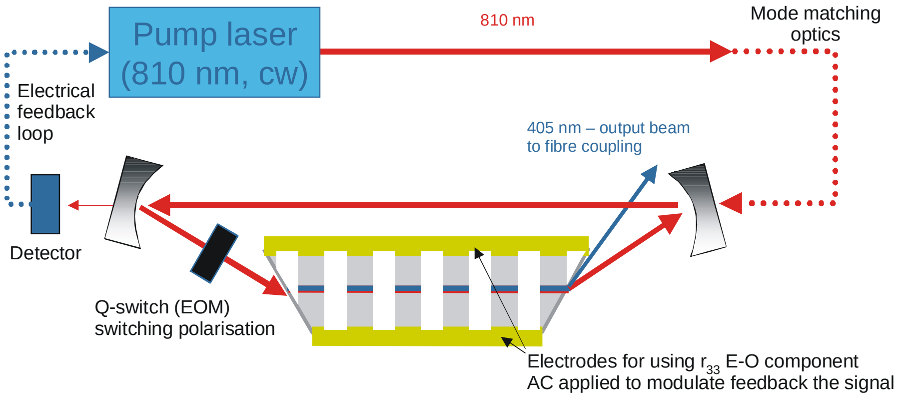
- Raman laser, output power >3 W (using Yb source)
- Raman amplifier, 18 dB gain, P_{sat} >1 W
- System validation of EDFA and Raman amplifiers
- Diffuse source optical wireless: High-speed modulation (max. 1 Gbit/s) of high-brightness laser at 1060 nm
- Directed line of sight optical wireless: Beam steerable, high-speed laser at 5 W, M^2<2, 1060 nm
- Pollutant detection: pulsed Yb fibre laser at 1070 nm, ns-pulses at 100 kHz
- Laser illuminator for security imaging, based on Esaki junction lasers, 80 W peak power from single emitter

External cavities & Medical applications

Progress beyond BRIGHT.EU

- fluorescence diagnostics imaging for use with photosensitisers
  - increased SNR, resolution, and image size
  - SHG into 405 nm from **pulsed**, tapered 810 nm diodes (M^2<1.2, 5 kHz, **P>1W**)
- double brightness of multi-port, red lasers for I-PDT
  - thinner fibres (200-300 microns), higher power **P>7 W**

External cavity for SHG



New BRIGHTER activities

- **auto**fluorescence diagnostics imaging of endogenous chromophores, e.g. cancerous lesions
  - SHG into 340 nm (M^2<1.2, pulsed - 5 kHz, **P>0.2W**)
- extend red PDT laser systems with detection units measuring back-scattered red light during treatment
  - implementation of on-line monitoring of parameters relevant for therapy progress
- application of multi-variate image analysis methods on multi-spectral fluorescence images
  - enables/improves diagnostics

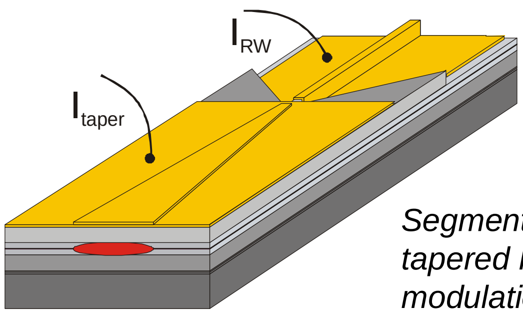
External cavities & Laser displays

EXTERNAL CAVITIES

- **Progress beyond BRIGHT.EU**
  - wavelength multiplexing of stacks of tapered mini-bars
    - >30W in 50 micron fibre
- **New BRIGHTER activities**
  - external diode setup for investigating FWM-induced carrier density gratings with electroluminescence microscopy
    - essential for modelling and fabrication
  - improved brightness of bars by coherent combining of beams in external Talbot cavities

LASER DISPLAYS

- **NEW ACTIVITY**
- **Know-How from BRIGHT.EU**
  - IR and red tapered laser (WP 1)
  - Frequency doubling (WP 3)
  - Optical beam shaping and low-stress mounting (WP 4)
  - Reliability (WP 5)
- **BRIGHTER activities**
  - Direct MHz modulation of IR and red tapered lasers
  - Integrated wavelength stabilization of tapered lasers
  - Segmented contacts for injection and taper regions and structured submounts
  - Frequency doubling with MHz modulation



Segmented contact tapered laser for direct modulation

Workshop purposes

- Publicise the activities, technologies, expertyise and capacity of both the project and the individual partners.
- Learn about the laser needs of different external application fields and organisations active in them.
- Establish links and interaction with these fields and external players.

Workshop at the World of Photonics Congress and Laser2007 fair 18th June 2007 – Munich Program

High Brightness Diode Laser Sources

Workshop Introduction and Welcome (10:30 – 10:35)

10:30 Introduction to WWW.BRIGHTER.EU
Michel Krakowski - *Alcatel-Thales III-V Lab*

High-Brightness Laser Technology (10:35 – 11:45)

10:35 External cavities for controlling spatial & spectral properties of SC lasers
Jean-Pierre Huignard - *Thales Research and Technology*

10:45 Reliable high-power red-emitting laser diodes
Bernd Sumpf - *Ferdinand Braun Institute*

10:55 Wavelength stabilised high-power quantum dot lasers
Hans Peter Reithmaier - *University of Kassel*

11:05 Quantum dot lasers & new device concepts for high-brightness applications
Dieter Bimberg / Nikolai Ledentsov - *Technical University of Berlin*

11:25 High-power laser for surgical applications (cutting and ablation)
Ronald Sroka - *LFL Munich*

Break

Packaging, Micro-Optics and Reliability (12:05 – 12:45)

12:05 Micro-optics and fibre coupling of high-brightness laser bars
Martin Forrer - *FISBA Optik*

12:15 How to measure packaging-induced strain in high-brightness diode lasers?
Jens Tomm - *Max Born Institute*

12:25 High-power laser modules and their applications
Jörg Neukum – *DILAS*

Break

Frequency-Doubled Lasers (14:00 – 14:50)

14:00 Second harmonic generation of external cavity tapered diode lasers
Ole Bjarlin Jensen - *Risoe National Laboratory*

14:10 High-power Semiconductor VECSELs
Anne Tropper - *University of Southampton*

14:30 ps applications of diode lasers
Ranier Erdmann – *Picoquant*

Break

Medical, Telecom and Display Applications (15:10 – 17:00)

15:10 Fluorescence diagnostics in medicine - there is a need for improved light sources
Stefan Andersson-Engels - *Lund University*

15:20 Diode lasers for photodynamic therapy
Tilmann Trebst - *Biolitec*

15:30 Laser-induced fluorescence spectroscopy and molecular imaging as tools for tumour detection in vivo
Bernd Ebert - *Physikalisch-Technische Bundesanstalt*

15:50 Shrinking optically-pumped frequency-doubled green semiconductor lasers to fit into tiny laser projectors
Michael Kühnelt - *OSRAM Opto Semiconductors*

16:10 Laser display markets, technologies and requirements
Holger Mönch - *Philips Research Laboratories*

16:30 Fibre amplifiers and pumping technologies
Mark Le Flohic - *Keopsys*

16:40 Making use of brighter lasers - Optical amplifiers in current and future WDM systems
Jörg Peter Ebers - *Ericsson*

Note: The above program is subject to change at the discretion of the workshop organisers.

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