# Laser Technology at

**DESY TEST BEAMS** 

NAC II

Enabl

DESY.

TIER-2- GRID COMPUTING CENTRE

**FLASH** 2020+

Making FLASH brighter, faster and more flexible **Conceptual Design Report** 

> Upgrade of PETRA III to the Ultimate 3D X-ray Microscope **Conceptual Design Report**

PETRA IV.

Deutsches Elektronen-Synchrotron DESY A Research Centre of the Helmholtz Association

HELMHOLTZ RESEARCH GRAND CHALLENGES

Deutsches Elektronen-Synchrotron DESY A Research Centre of the Heimhoitz Association

17 % **Key Technologies** 

22 %



### **Ultrafast Lasers are Essential for X-ray Free Electron Lasers**



## **Ultrafast Optics at DESY**

#### What we need

- Low timing jitter oscillators, fiber amplifiers
- mJ / MHz power amps (ps, Yb:YAG)
  kW average power kHz green pump lasers
- Wavelength conversion/ tuning techniques (VUV to THz). Power scaling of those techniques (OPCPA)
- Speciality PM-fibers and fiber components
- Spatial and temporal pulse shaping technology
- Active drift stabilization (energy, pointing, timing)
- High damage threshold, dispersion engineered coatings and optics (NIR + UV to MIR)
- High damage threshold, high power components (optics, isolators, shutters, ....)
- Control interface compatible with industry standards.
- Service by in-house staff as much as possible

#### What we have / can provide

- Feedback on long-term performance
- Joint developments with industry
- Technology transfer to industry
- Excellently educated students which are looking for a job in industry

Postcompres	arXiv.org > physics >	arXiv:2101.02920	Search Help   Advance
tew-cycle reg	Physics > Optics		
PRANNAY BALLA, <sup>1,2,1,*</sup> ANNE-LISE VIOTTI, <sup>3</sup> ANNE-LISE VIOTTI, <sup>3</sup> ALA HAMED TAVAKOL, <sup>1</sup> UWE 4 ANDREA TRABATTONI, <sup>1,4</sup> ANNAUC COUAIRON, <sup>7</sup> AN CHRISTOPH M. HEYL, <sup>1,2,8</sup> <sup>1</sup> Deutsches Elektronen-Synchrotron G. <sup>1</sup> Heimholtz-Instillete Jana, Fröbelstig <sup>1</sup> Department of Physics, Lund Univers <sup>1</sup> Center for Free-Electron Laser Science <sup>1</sup> The Hamburg Centre for Ultrafast Ima <sup>1</sup> Instillut für Experimentalphysik, Unive <sup>1</sup> Centre de Physique Théodique, CMR <sup>1</sup> -comail: christoph. heylédesyde <sup>1</sup> Corresponding author: prannay.ballar Beceived 22 January 2020; revised 1 published 24 April 2020	[Submitted on 8 Jan 2021]		
	Compact, a EPJ Yb:fiber NA	Web of Conferences <b>243</b> , 21001 (2020) ROPHOTON 2020	https://doi.org/10.1051/epjconf/202024321
	Yuxuan Ma, Sarpe	Hybridizing Multi-pass and Multi-plate Bulk Compression	
	Aline S. Mayer, O We report a simp on a nonlinear an features a chirper non-reciprocal pl numerically simu performance. Exp 54 MHz repetition intensity noise (R frequency (fceo) 1 optical reference	M. Seidel, <sup>1</sup> P. Balla, <sup>1</sup> T. Binhammer, <sup>2</sup> M. Frede; 1. Deutsche Elektroner, Synchromo 2. neoLASE, Hollerith 3. FFI (Norwegian Defence Research En 4. HelmhörtInstitute Jem With the advent of ultrafast Yb-ion based disk became indispensable for the generation of high broadening in Herriott-type multi-pass cells (M compression in the 5 – 100 MW peak power ran work efficiently. The operation in the critical refocusing of the cell mirrors. Analogously, the broadband continuum generation, relies on the no hybridization of both methods, we demonstrate con exceeds all single-stage compression factors achiev In our experiments, we used a home-built fibre source delivered 10 Hz bursts of up to 800 pulses v Our MPC consisted of dielectric focusing mirrors	<sup>2</sup> G. Arisholm, <sup>3</sup> L. Winkelmann, <sup>1</sup> I. Hartl, <sup>1</sup> and C.M. Heyl <sup>1,4</sup> DESY, Nokestraße 83, 22607 Hamburg, Germany allee 17, 36419 Hamover, Germany tablishment), P. O. Box 25, NO-2027 Kjeller, Norway ta, Fröbelstig 3, 07743 Jena, Germany (s, slab and fibre lasers, nonlinear pulse compression methods h average power sub-100 fs pulses. In particular, spectral IPC) [1] has been established as a novel tool for pulse ge where neither solid-core fibre nor hollow-core capillaries self-focusing regime becomes feasible through repetitive <i>multi-plate</i> approach [2], which has mainly been used for nlinear refocusing of the Kerr media [3]. By introducing the mpression factors up to 14. To the best of our knowledge this red with bulk-based spectral broadening to date (Fig. 1e). e-laser front-end and a neoLASE Yb:YAG amplifier [4]. The with 100 µJ energy, 880 fs duration and 1 MHz repetition rate. s with 200 mm radius of curvature. Inserting a single 6 mm

### **DESY Ultrafast Laser Spin-Offs**

Extreme Power at Extreme Wavelengths

#### → High-Power OPCPAs

- < 10 fs ... 100 fs
- 200 nm 16  $\mu m$
- 100 W

→ Bright EUV/Soft X-Ray sources



www.class5photonics.com Forschungscampus Bahrenfeld Notkestr. 85, Bldg 200 22607 Hamburg, Germany





#### www.cyclelasers.com

- DESY spinoff for ultrashort pulse laser products
- Founded in 2015 by Prof. Kaertner, 15 employees
- Develops femtosecond lasers and laser-RFsynchronization systems
- Worldwide installations at FEL facilities/synchrotrons (SLAC, FERMI, SACLA, SINAP, DICP)
- Supplier to ESA for ground station timing







### **Science City Bahrenfeld**

### Interdisciplinary hub of excellent science, business and education



- > Industry Beamlines
- > Innovation Centres
- > Space for Entrepreneurs
- > Interdisciplinary Research
- > Bridging Science and Industry
- > Mordern workplace & Urban Setting