Precise Optical Synchronization for FELs, Electron Diffraction, and LWA/LPA Facilities

Enabling for femtosecond precision (user) experiments!

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for the LbSync Team
DESY, MSK

5th ARD ST3 Workshop: ps-fs Electron and Photon Beams

DESY-Zeuthen,
July 19-21, 2017

HELMHOLTZ ASSOCIATION

DESY

Applications and Schemes

> Applications of synchronized laser pulses to the accelerator

- **FEL Pump-Probe experiments:** optical laser ↔ free-electron laser
- **FEL Seeding setups:** optical laser ↔ electron bunch
- **UED Pump-Probe experiments :** optical laser ↔ accelerating RF
- **LWFA with External e- Injection:** optical laser ↔ electron bunch
- **PWFA with External Laser Injection:** optical laser ↔ electron bunch

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> Principle: Laser synchronization to machine reference

- Basic RF lock: Direct conversion based phase locked loop
- Precise RF lock: "Mach-Zehnder Modulator (MZM) Setup"
- Precise optical lock: "Balanced Optical Cross-Correlator (OXC) Setup"

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- Principle: Laser synchronization to machine reference
  - To RF reference: "Mach-Zehnder Modulator (MZM) Setup"
  - To optical reference: "Balanced Optical Cross-Correlator (OXC) Setup"

- Femtosecond-stable reference distribution for E-XFEL and FLASH – "Laser-based synchronization system"
  - Master laser oscillators
  - Optical fiber link stabilization units
  - Laser-to-Laser syncs
  - Optical reference for RF stabilization (for LLRF)
  - Bunch arrival time measurement (for LLRF beam-based feedback)

Optical Synchronization Systems at DESY (selection)

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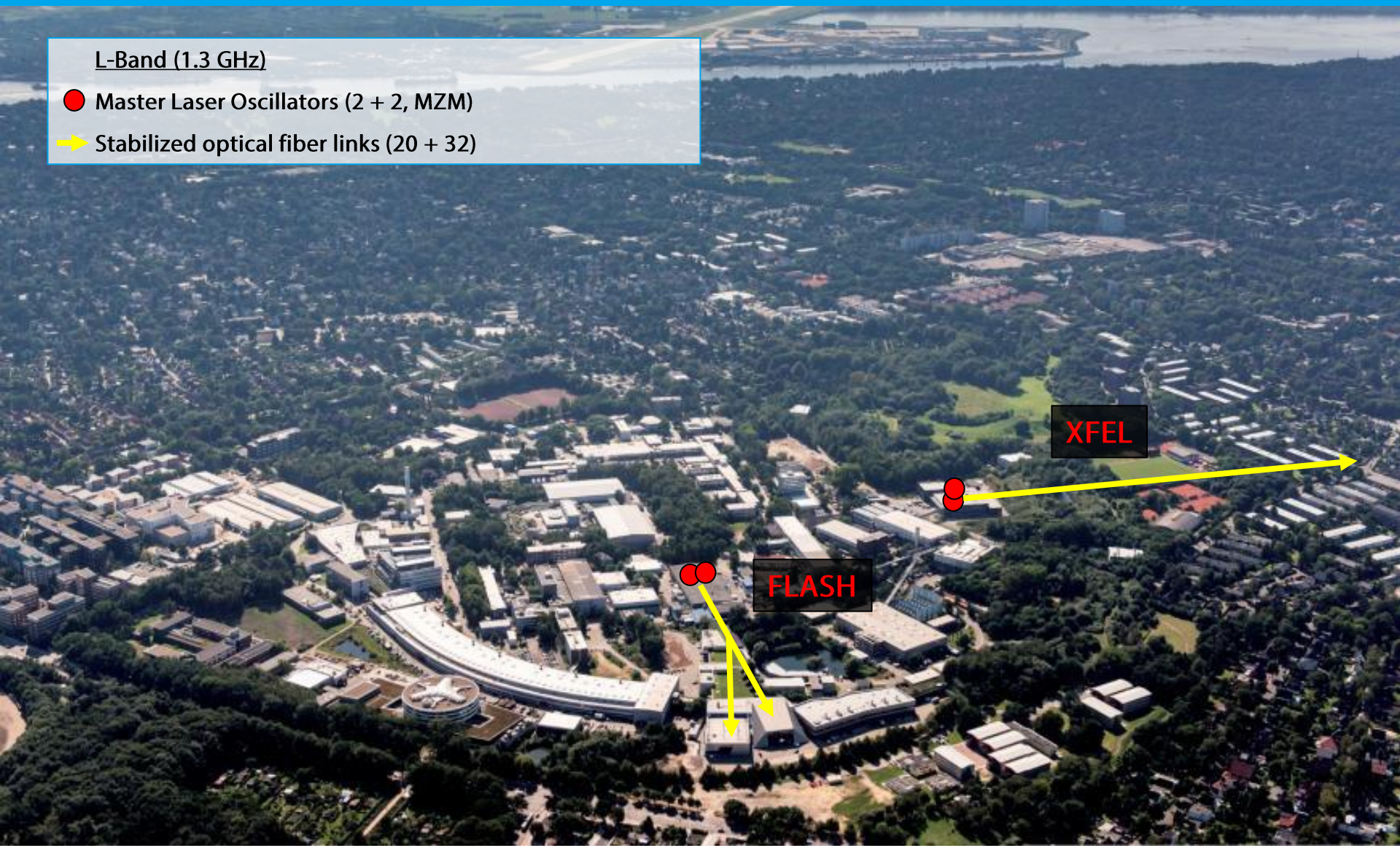
Optical Synchronization Systems at DESY (selection)



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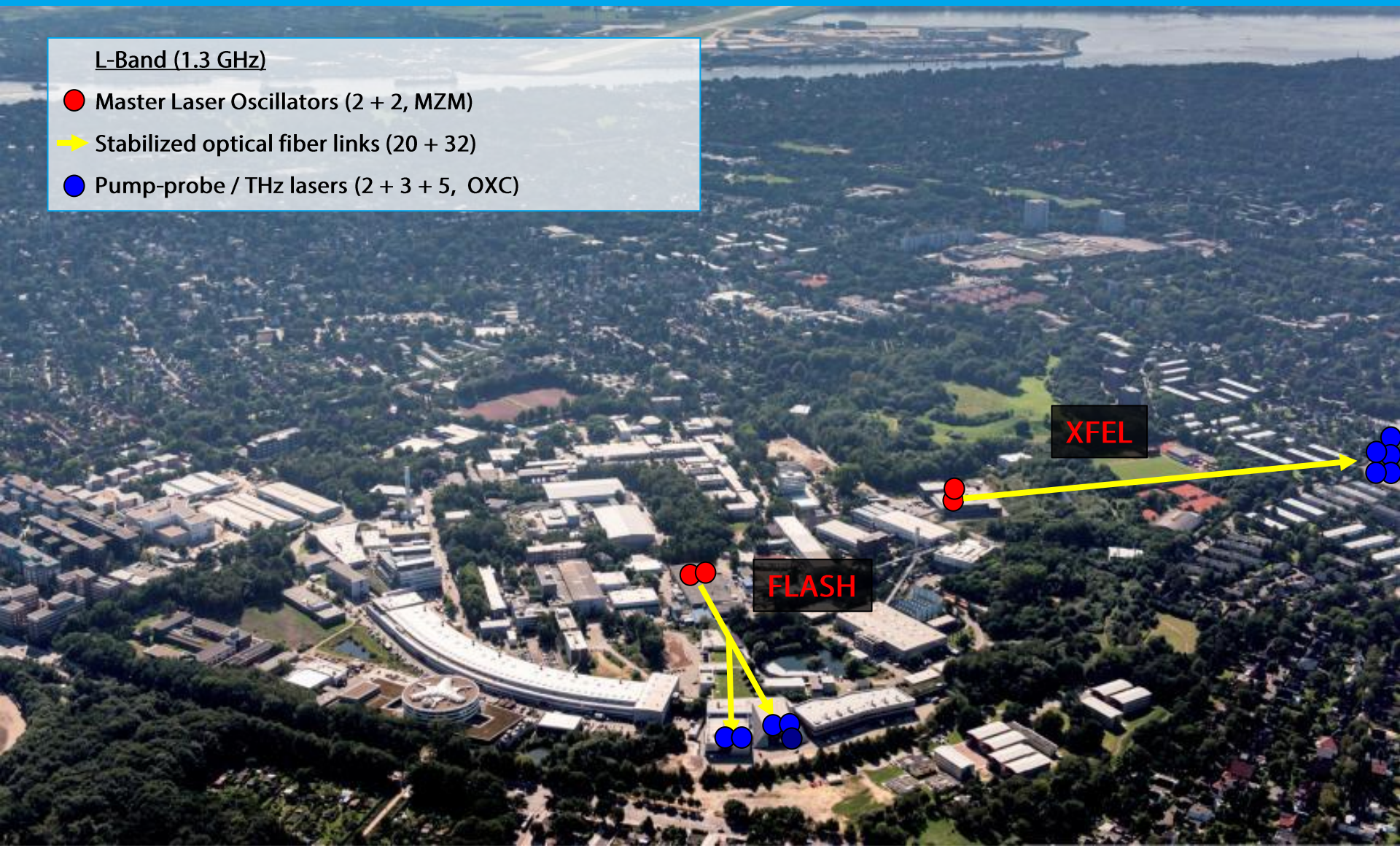

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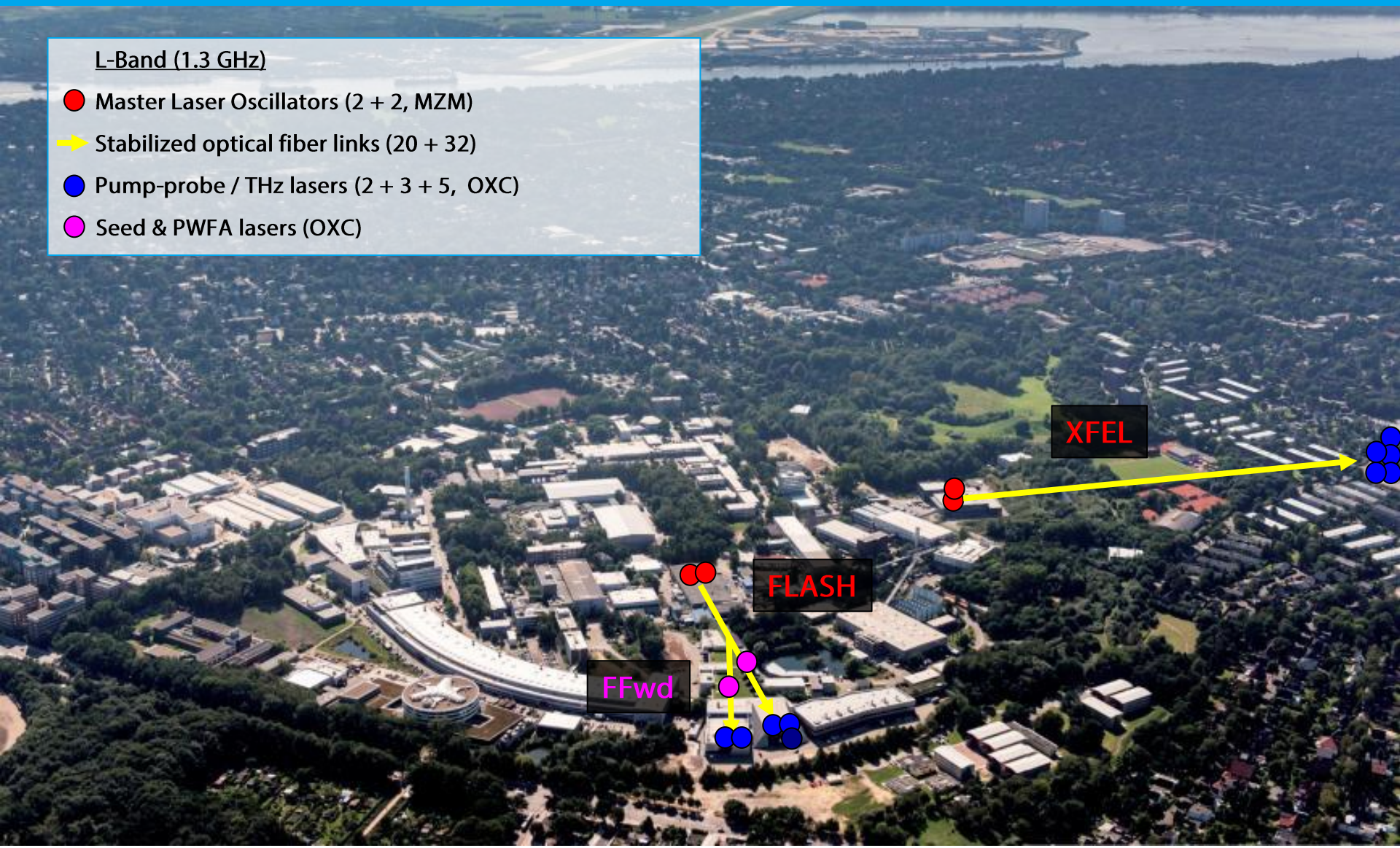

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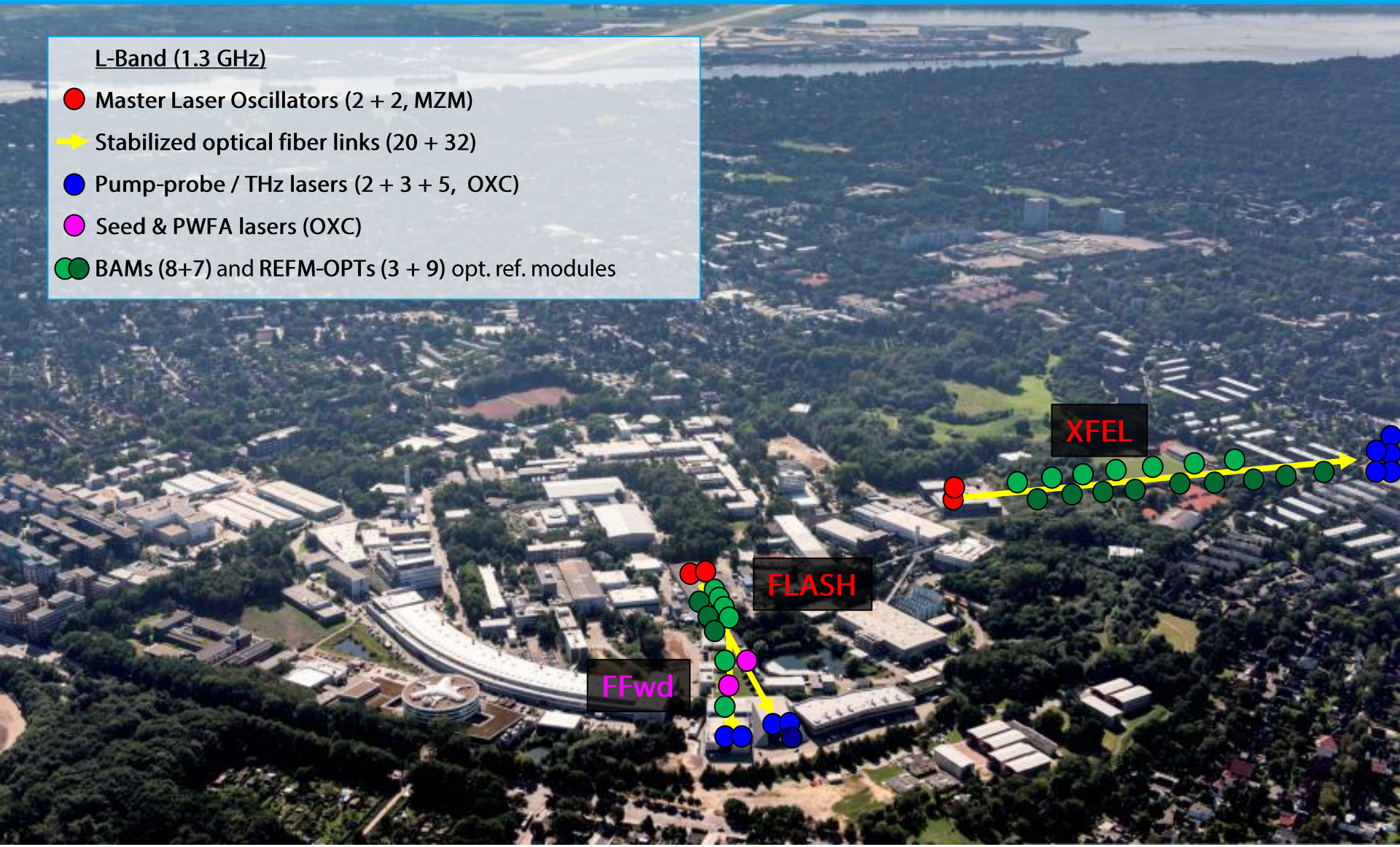

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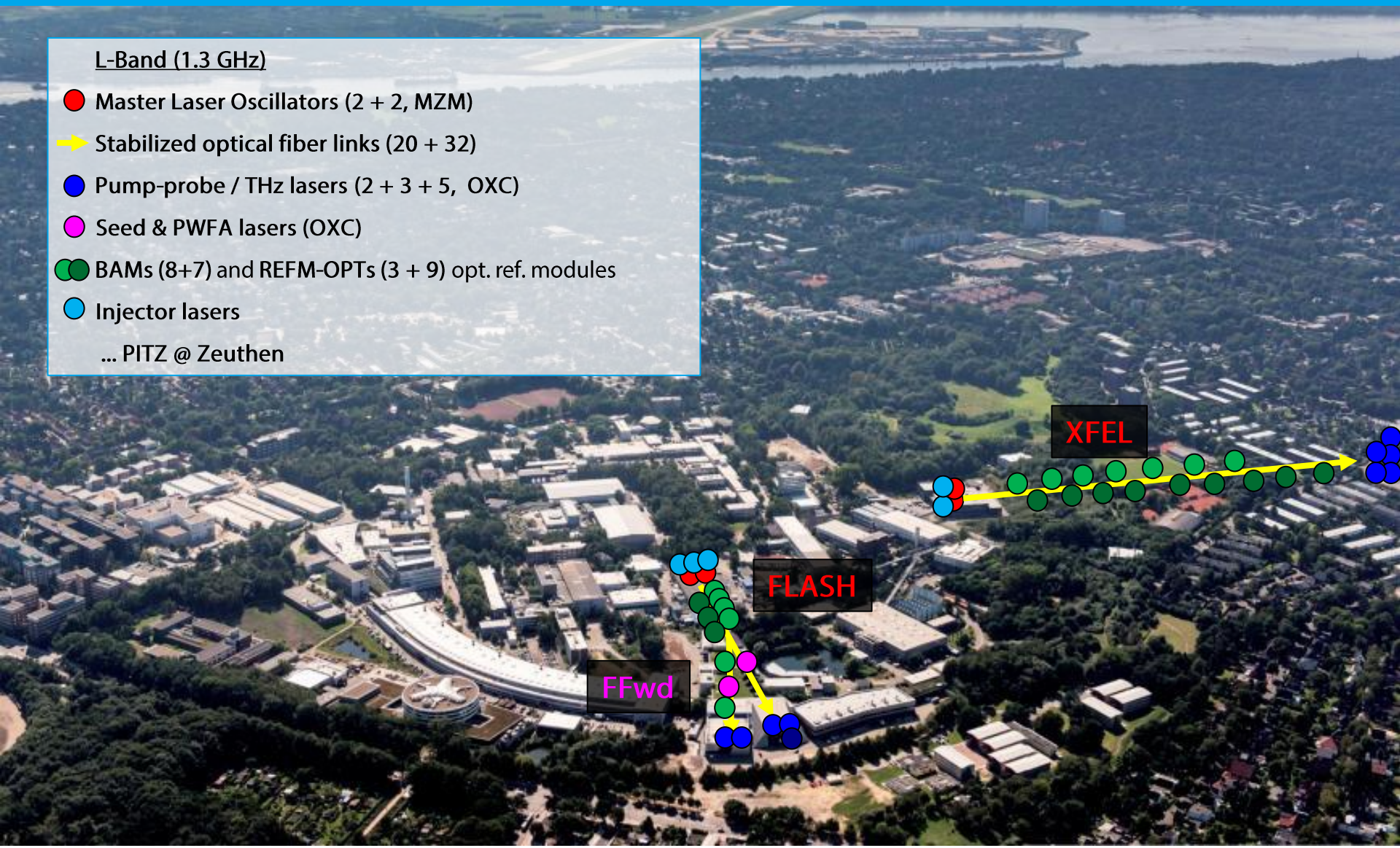

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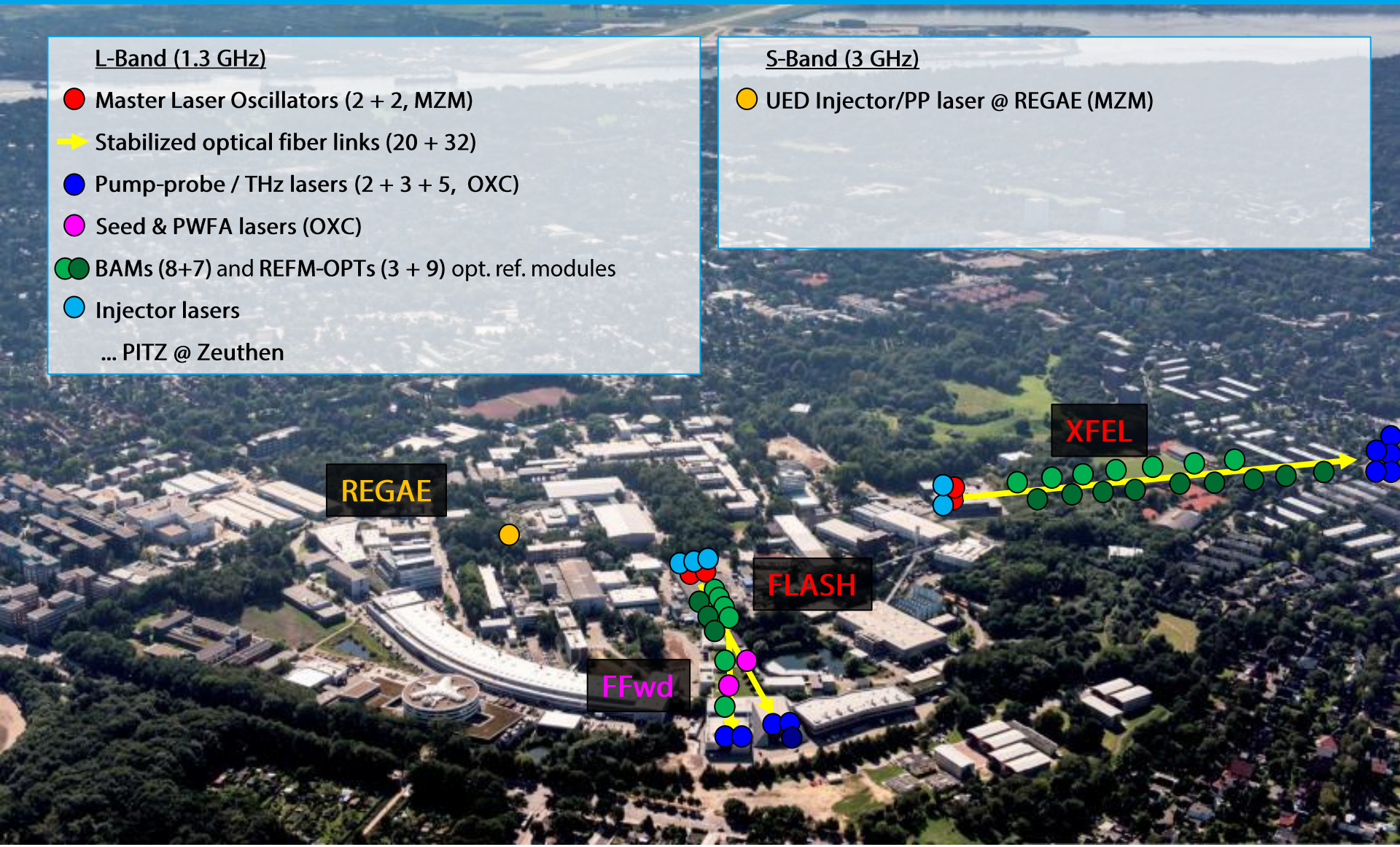

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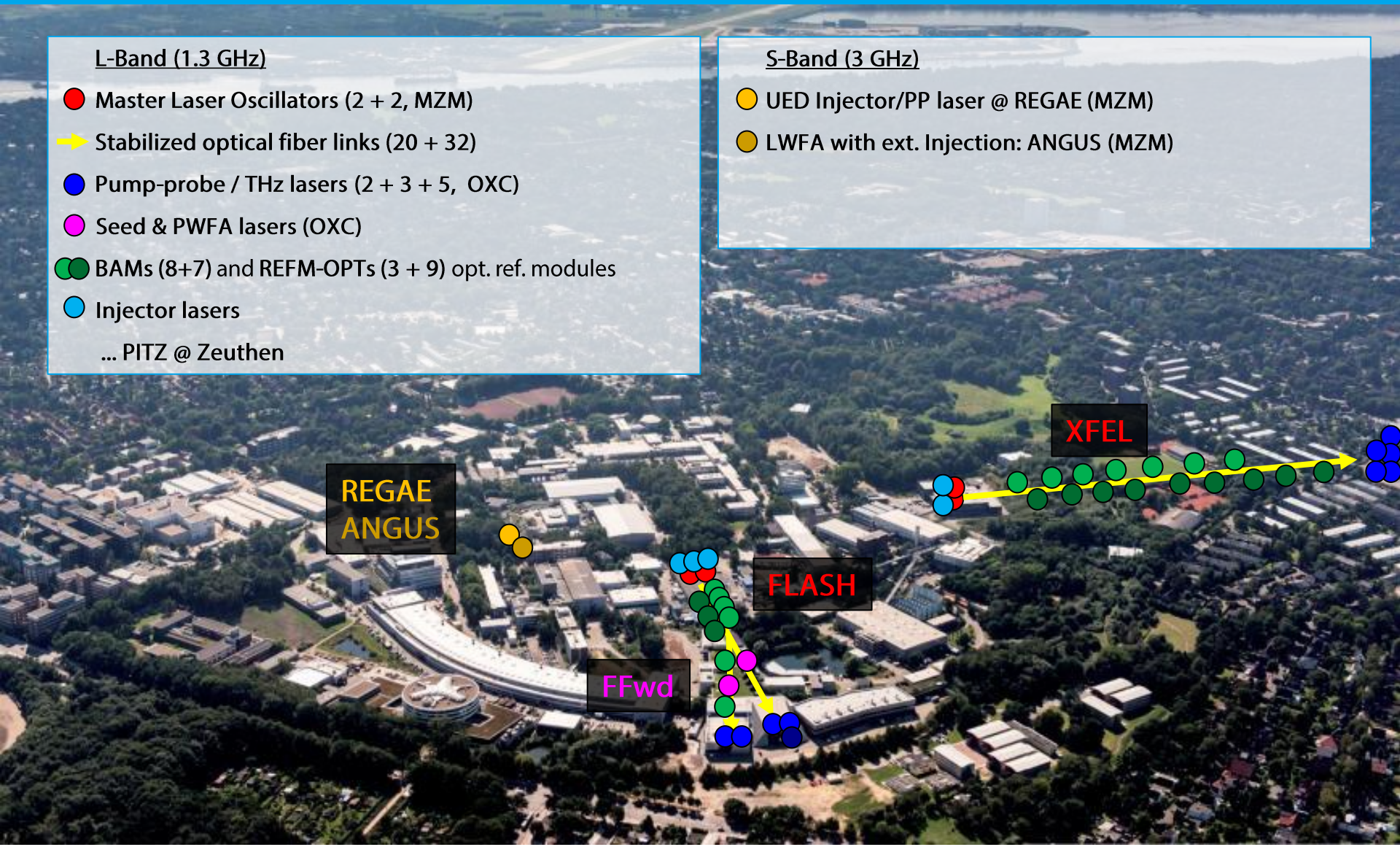

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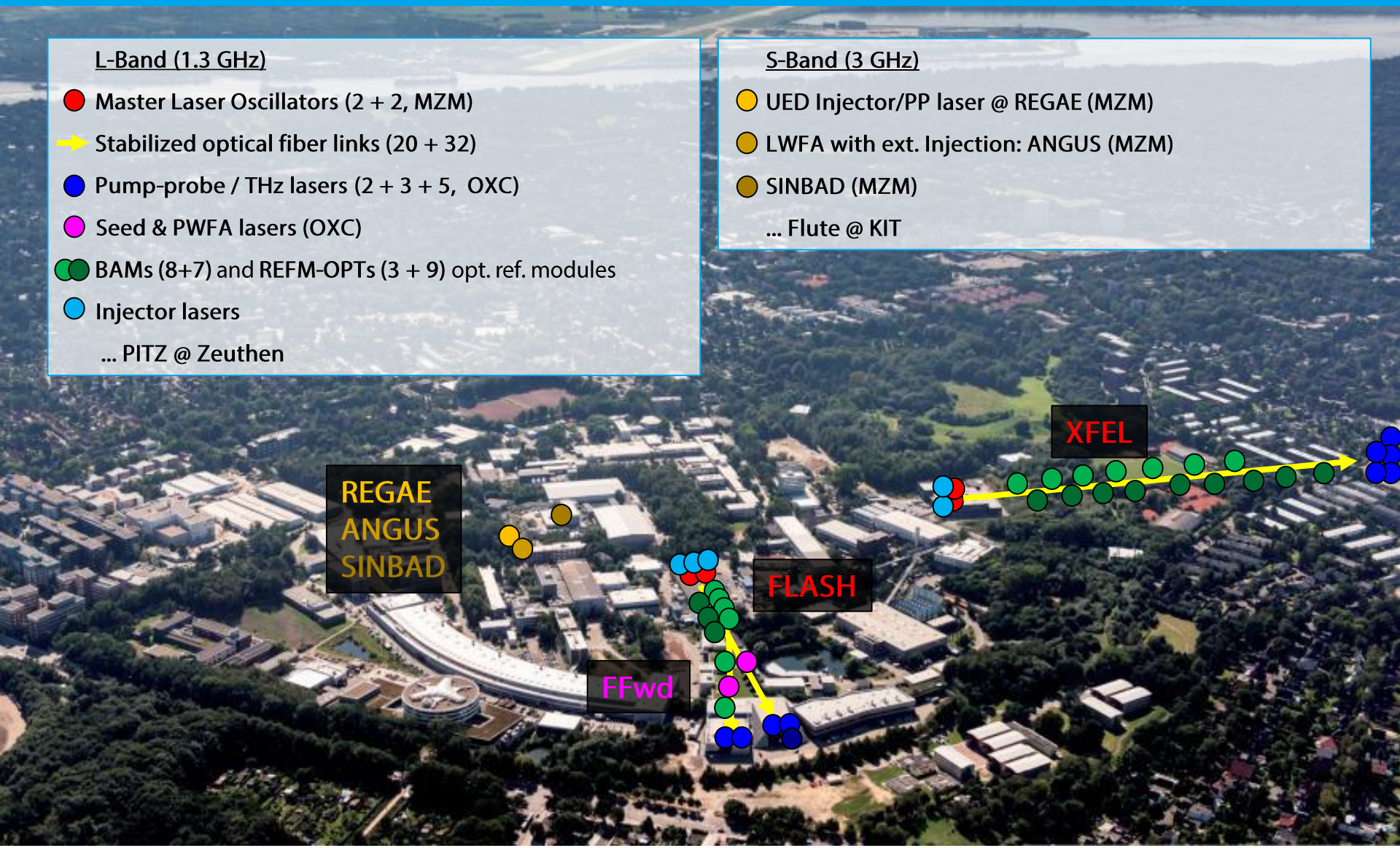

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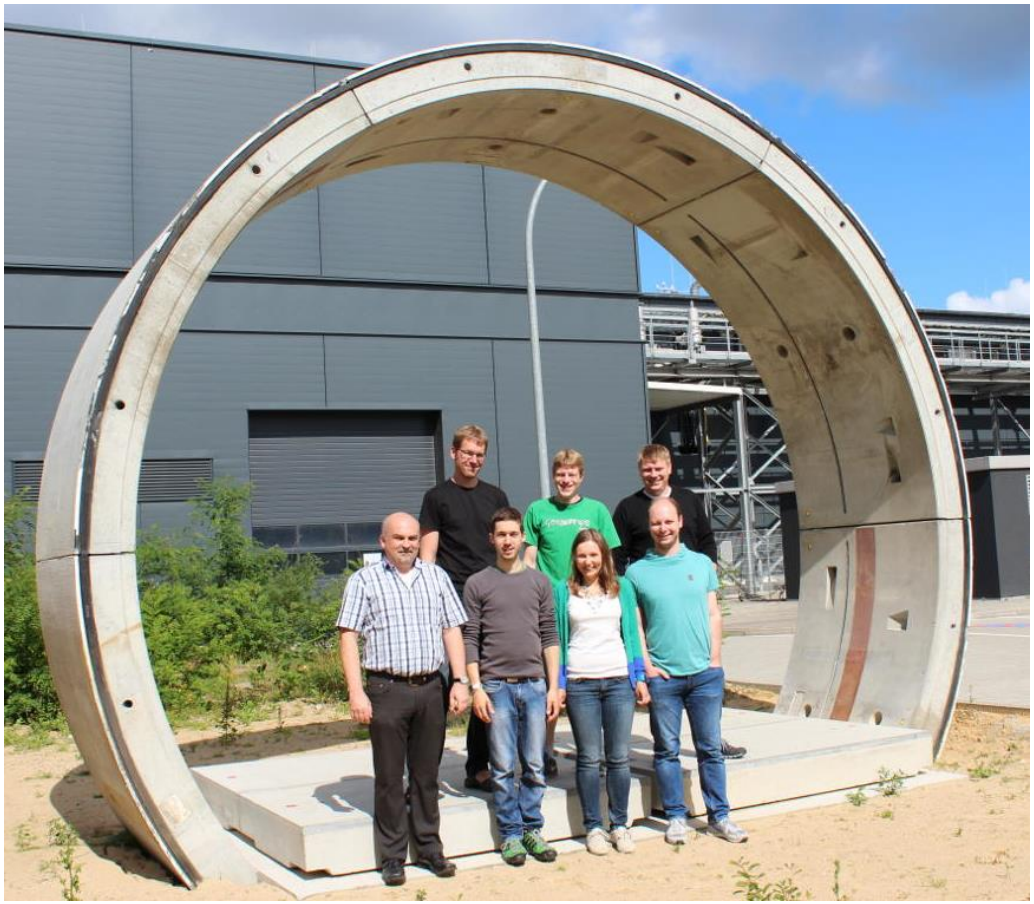
LbSync Team



Group Leader
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Sync Team

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