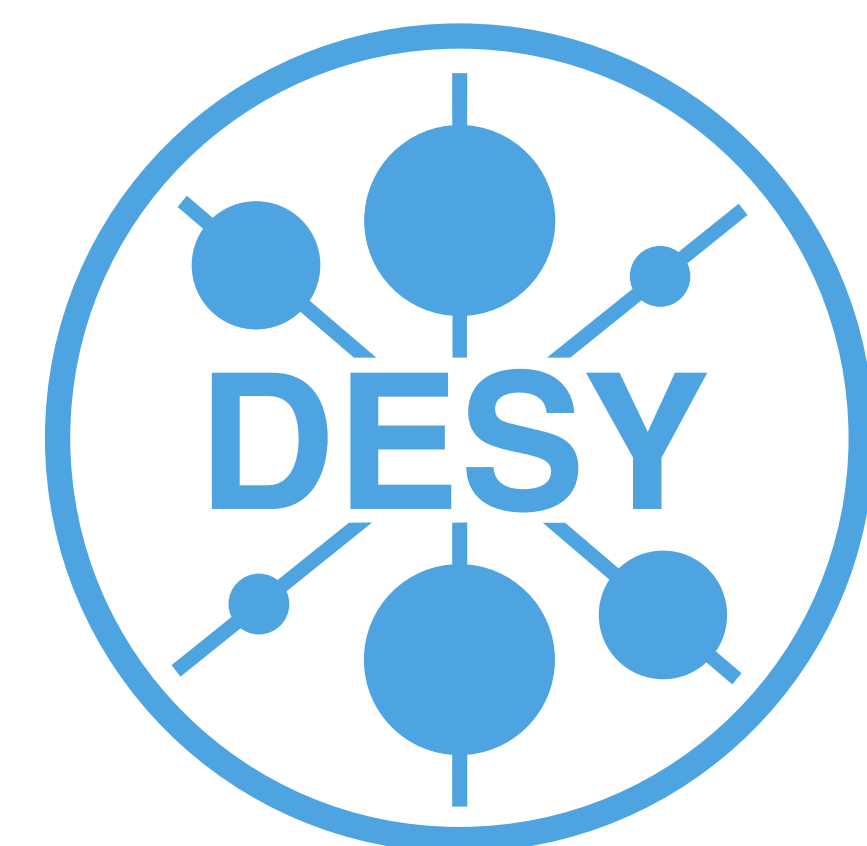


MTCA.4 PHASE DETECTOR FOR FEMTOSECOND PRECISION LASER SYNCHRONIZATION.



E. Janas, M. Felber, M. Heuer, U. Mavric, H. Schlarb, DESY, Hamburg, Germany
K. Czuba, ISE, Warsaw University of Technology, Warsaw, Poland

Introduction

For time-resolved experiments at FELs such as the European XFEL an accurate synchronization of the machine is essential. The required femtosecond-level synchronization we plan to achieve with an optical synchronization system, in which an inherent part is the master laser oscillator (MLO) locked to the electrical reference. At DESY we develop a custom rear transition module in MTCA.4 standard, which will allow for different techniques of phase detection between the optical and the electrical signal, as well as locking to an optical reference using a cross-correlator.

In this paper we present the current status of the development, including two basic solutions for the detection to an RF. One of the methods incorporates an external drift free detector based on the so-called MZI setup. The other one employs the currently used down-converter scheme with subsequent improvements. The module can serve for locking a variety of lasers with different repetition rates.

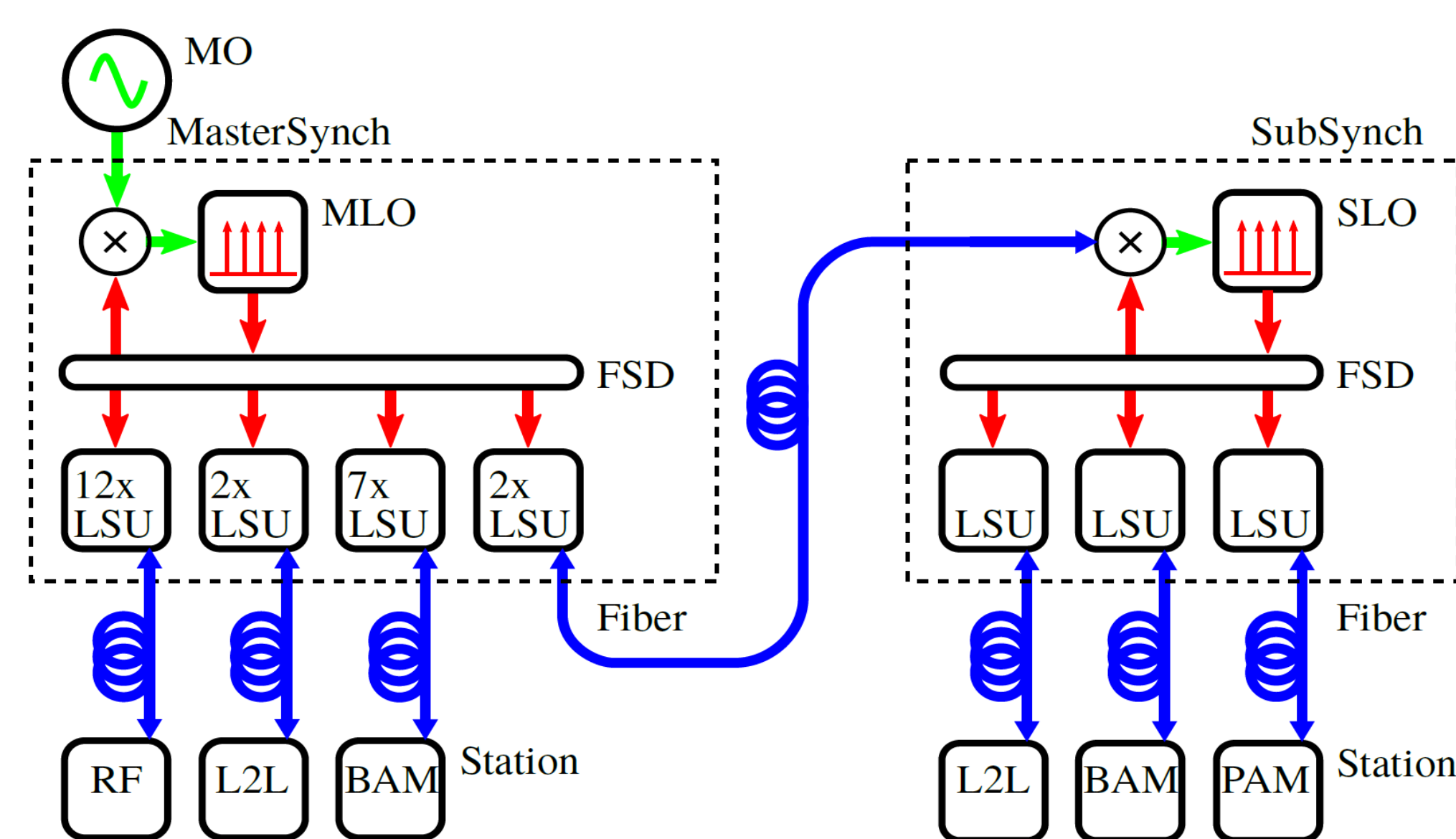


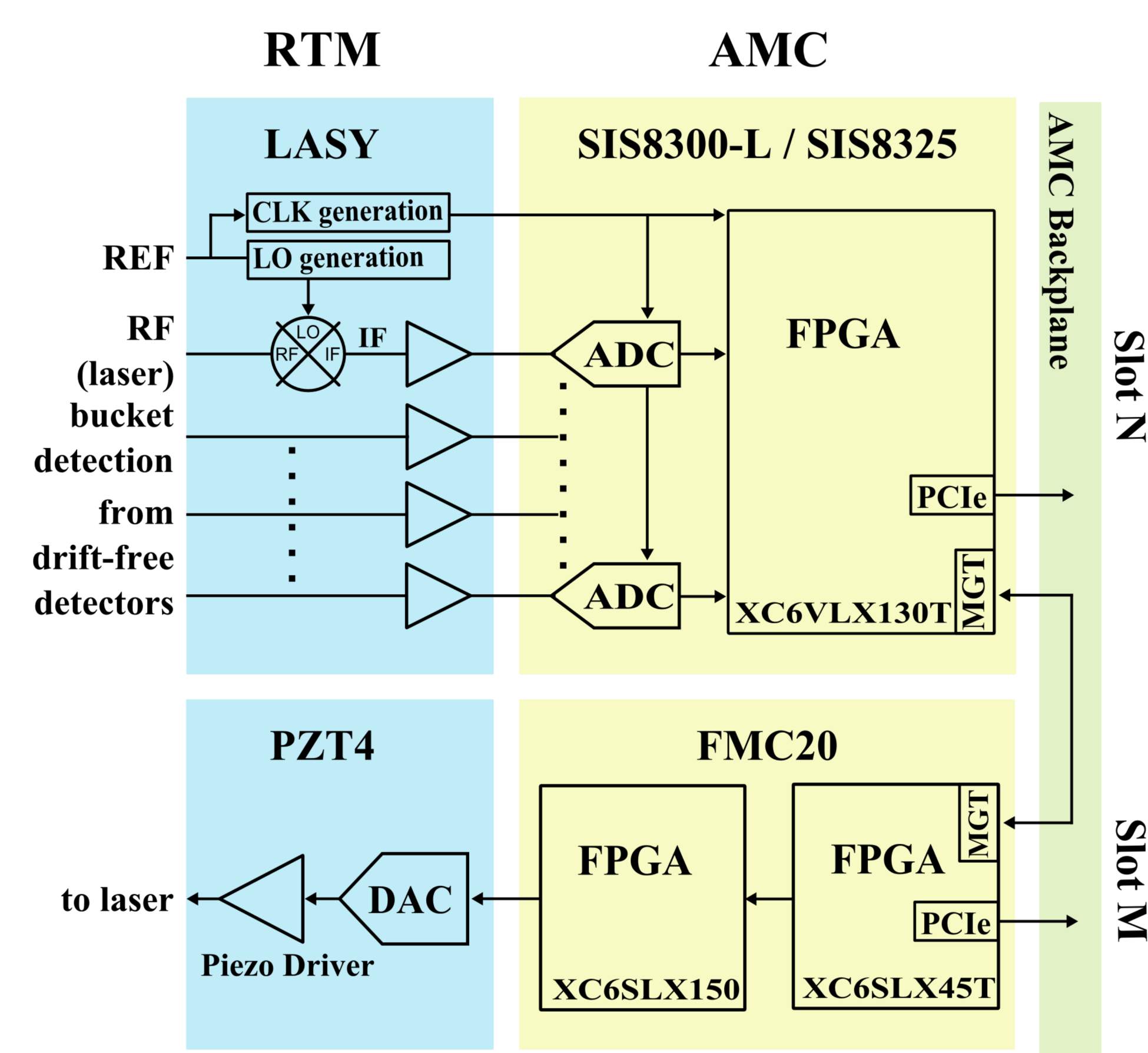
Figure source: courtesy of C. Sydlo

Laser locking scheme based on MTCA.4 standard

Laser synchronization in the European XFEL will utilize the MTCA.4 standard (<http://mtca.desy.de/>). In the current development state, the system is built out of MTCA.4 cards, from which the phase detector item DRTM-DWC10 was designed to fulfill LLRF system needs and adapted for laser locking purpose with external RF components.

current laser synchronization setup

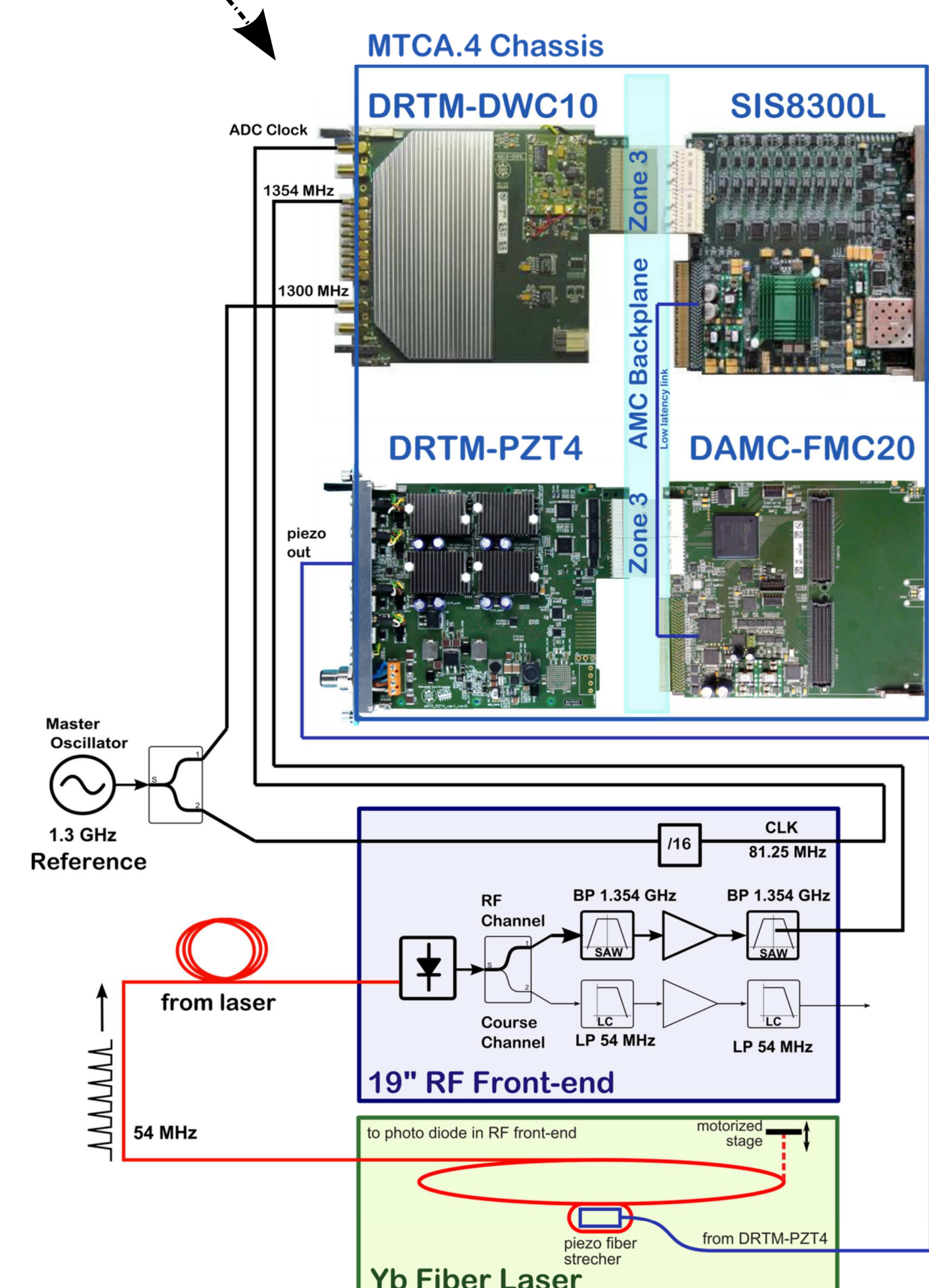
Example for a 54.2 MHz Yb-fiber laser which will be used for electro-optical diagnostics in the European XFEL.
Figure source: courtesy of M. Felber



DRTM-LASY

In the near future, the setup will be enriched by the dedicated rear transition module DRTM-LASY. It will exchange the currently used external RF components and DRTM-DWC10 board, and provide a set of new functions:

- > phase detection based on a down-converter scheme enriched with noise/drift calibration methods
- > support for lock using different available drift-free detectors
- > LO/CLK generation
- > inputs for external LO/CLK
- > RF backplane support
- > DAC outputs
- > photo diode regulated power supply
- > laser power monitor



Phase detection schemes

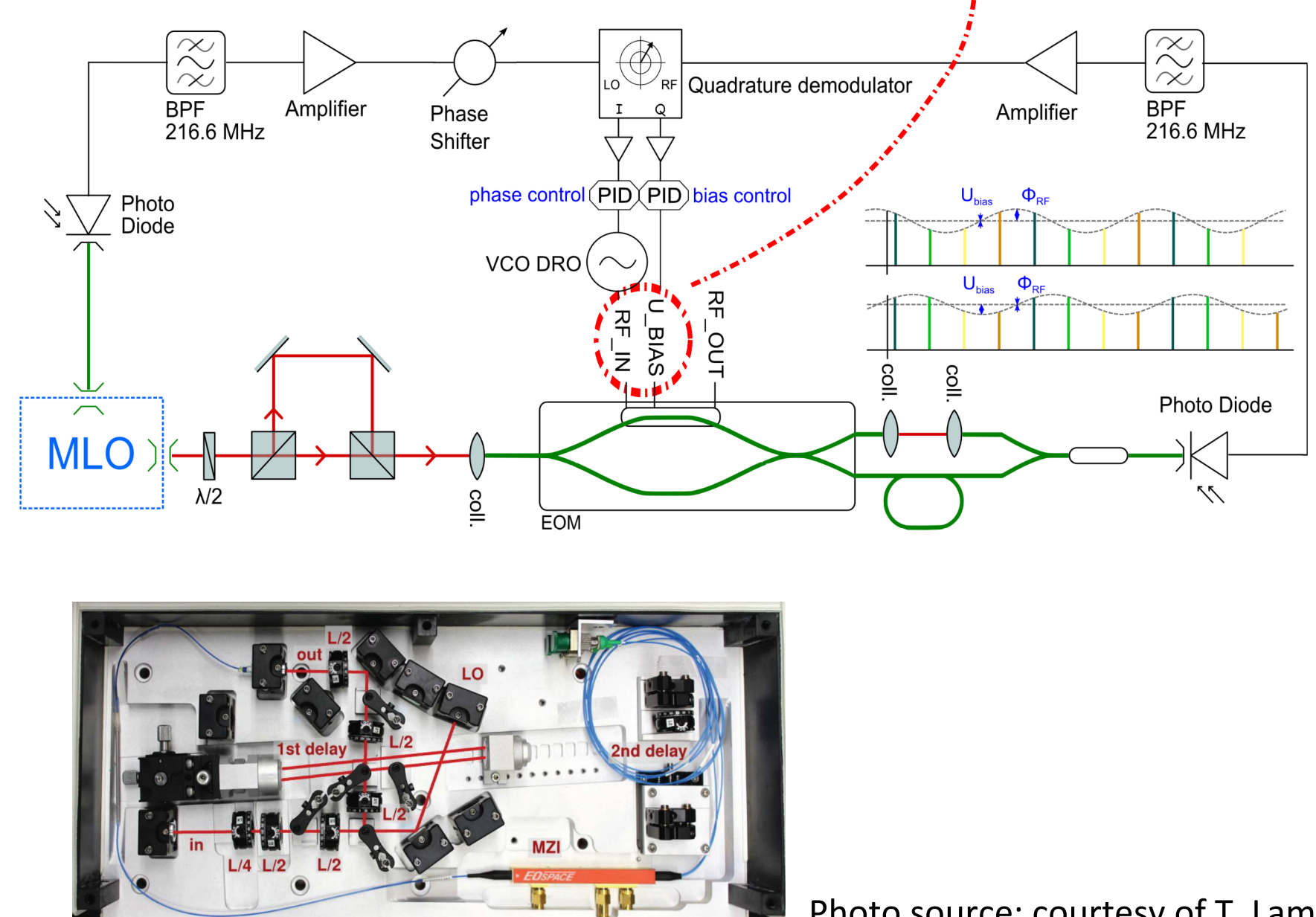
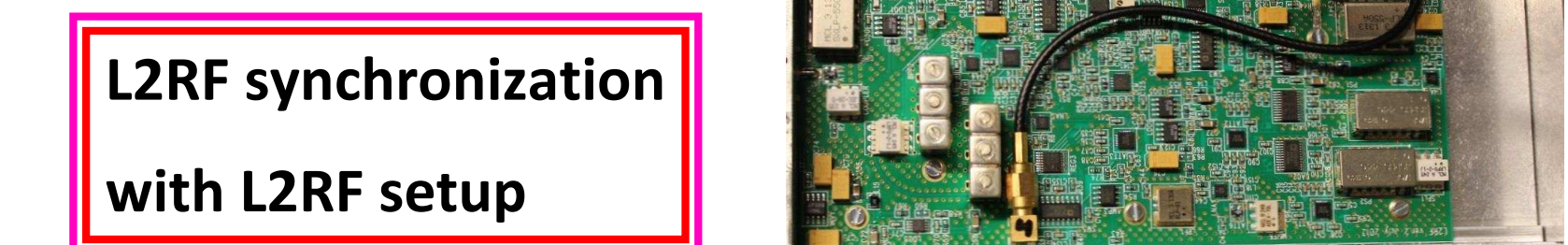
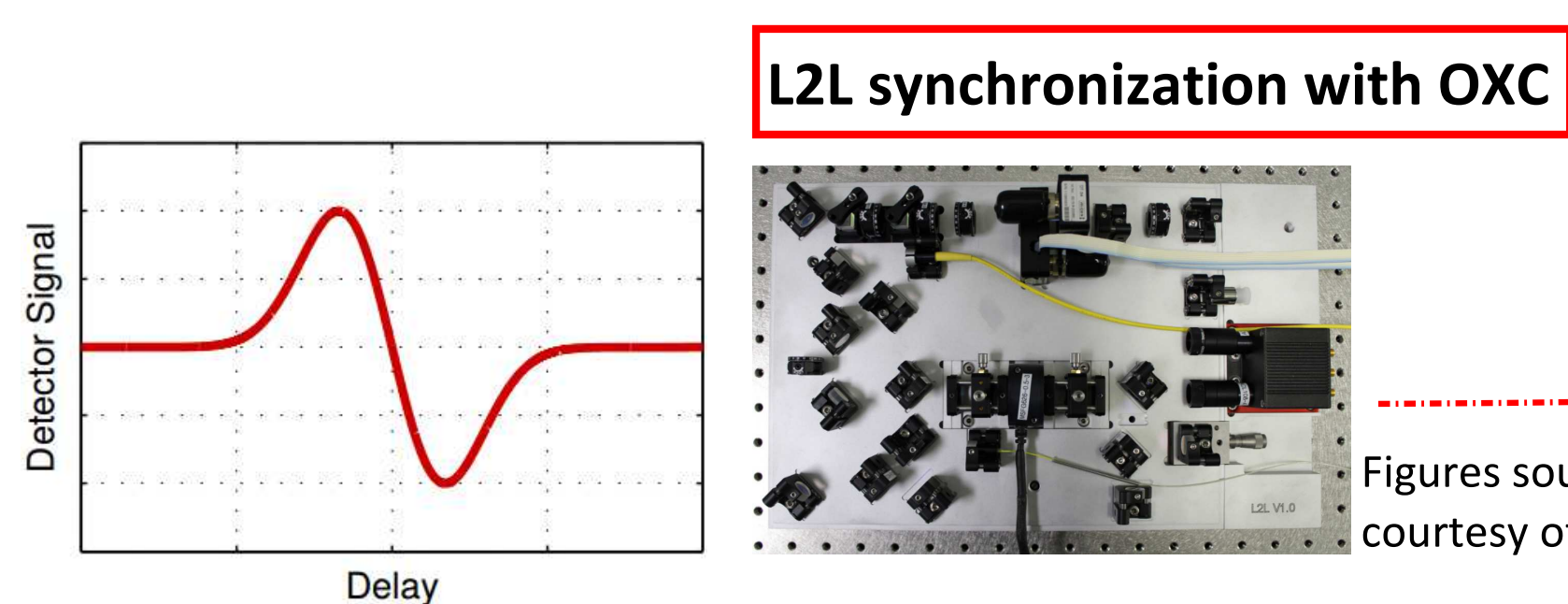


Photo source: courtesy of T. Lamb

