Installation of optical components for the Optical Replica Synthesizer at FLASH

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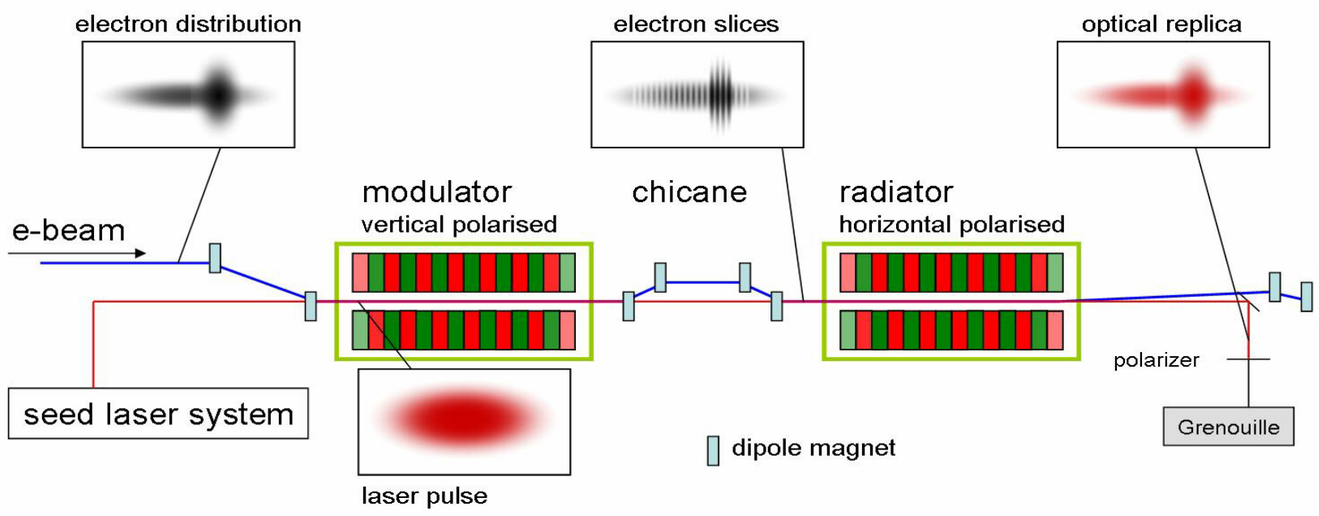
Abstract:

For a new device to measure ultra-short electron bunches at the FLASH accelerator, called Optical Replica Synthesizer (ORS), a laser system is provided to produce an energy modulation of the electron bunch. Furthermore, there are several optical components to analyse short laser pulses. A 25 meter long beam line for guiding the ORS seed laser from a nearby laser hutch to the FLASH tunnel has been installed during a shutdown in spring 2007. All components have to be remotely controlled. This poster presents the idea of the experiment and the design of the laser beam line. (For the whole experimental setup see [4], [5])

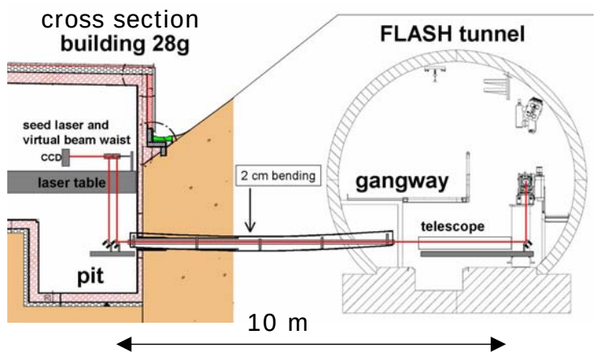
Principle of ORS [1]



- **light electron interaction in an Undulator causes a periodic energy modulation of the e-beam**
- **the e-beam passes a chicane; the energy modulation converts to a density modulation (micro bunching)**
- **e-beam coherently emits radiation**
- **short laser pulse (optical replica) is analysed using standard laser methods**

Laser transfer line

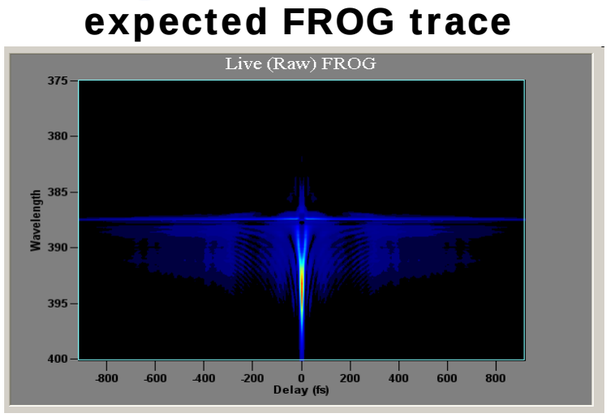
- **~25 m beam line transport**
- **using thin 2'' fused silica optics to minimise B-Integral**
- **backreflecting beam after the telescope for virtual beam waist**



Camera system and diagnostics

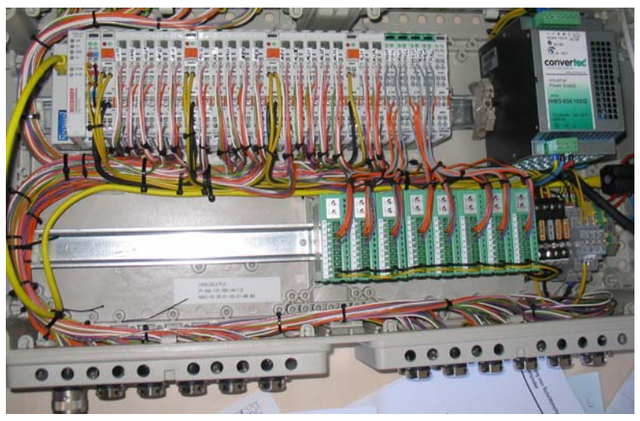
- **installation of 8 USB webcams and 4 trigger able FW cams to supervise optical components**
- **3 Fast Photodiodes to analyse seed laser**
- **using Grenouille (FROG device [2]) to analyse the radiator output**

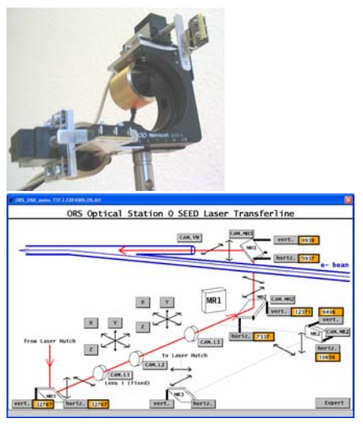
expected FROG trace



Motorised components

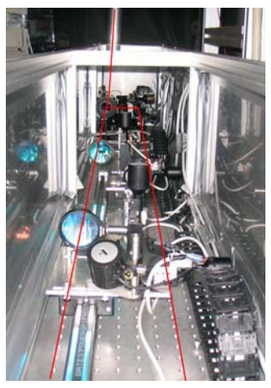
- **horiz. and vert. position of 11 mirrors**
- **X,Y,Z axes of two telescope lenses**
- **virtual beam waist camera (M^2-measurement)**
- **using controller and motor driver from *Beckhoff Automation GmbH* (standardised at DESY)**
- **integrated into DOOCS (FLASH control system)**

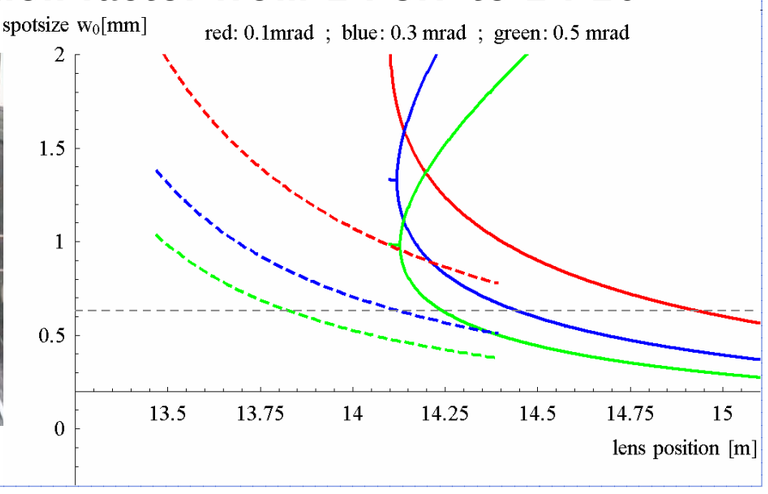




Telescope

- **designed for optimal conditions in the modulator Undulator**
- **used GENESIS1.3 FEL simulation tool [3] for energy modulation studies**
- **three lens solution**
- **two lenses movable for high flexibility**
- **focussing over a length of 12 m**
- **magnification factor from 1 : 3.7 to 1 : 10**





References

[1] E. Saldin, E. Schneidmiller, M. Yurkov, NIM A 539 (2005), 499.
[2] R. Trebino, Frequeny-Res. Opt. Gating (Kluwer, Boston 2002).
[3] S. Reiche, NIM A 429 (1999), 243.
[4] S. Khan et al., Proceedings of PAC07, 965.
[5] G. Angelova et al., Proceedings of FEL07.

Acknowledgements

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