Research Activities at HFT

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THz Generation by Optical Rectification

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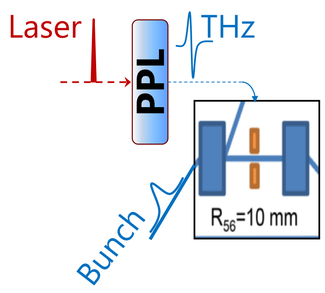
- Synchronization of electron bunches to the master- laser oscillator in the range of **few** femtoseconds for plasma-wakefield accelerators
- Development of a new shot to shot feedback system with a time resolution ≤ 1 fs

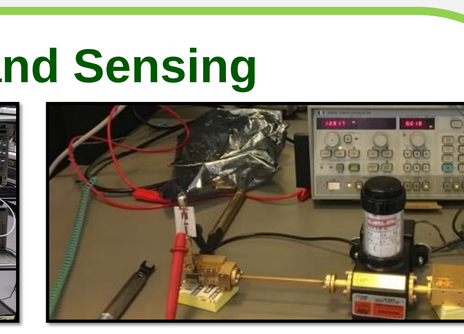


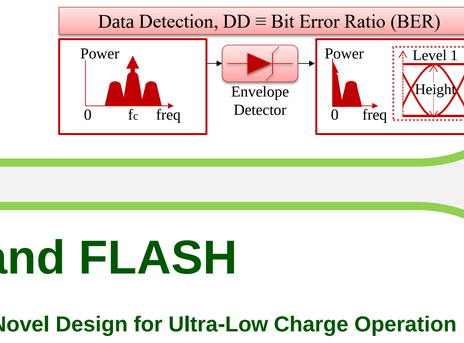
Understanding of the influence of the optical properties on the THz generation using a periodically poled lithium niobate (PPL)

$$\left(\frac{\partial^2}{\partial z^2} + \frac{\omega_m^2}{c^2}\varepsilon(\omega_m)\right) E_m(\omega_m, z) = G_m(\omega_T, \omega_L, z)$$

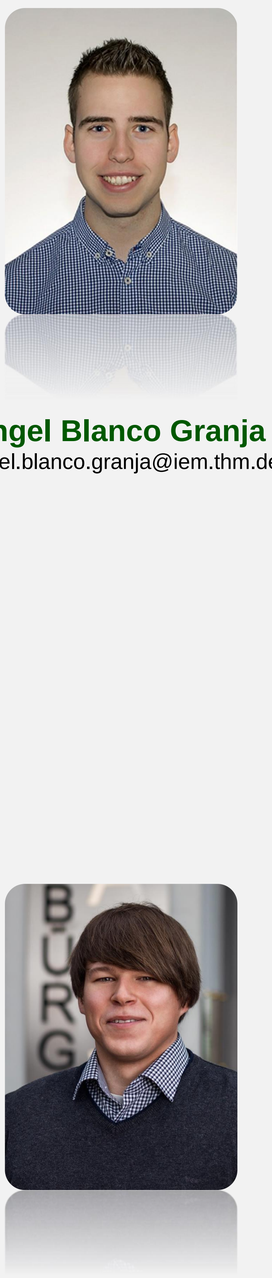
Calculation for different models and approximations

Efficiency & Optimum Length





mmW-Schottky Envelope Detector for Communication and Sensing



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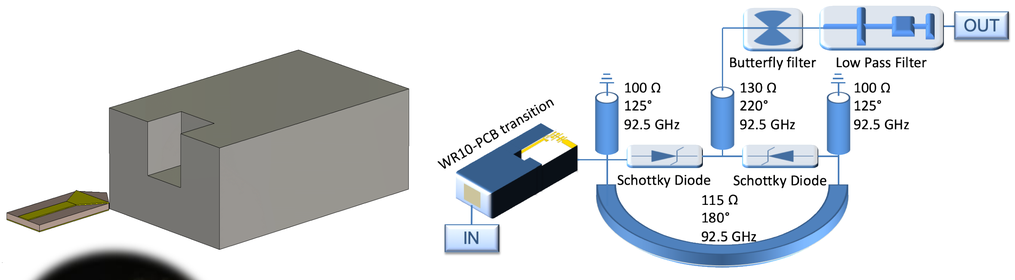
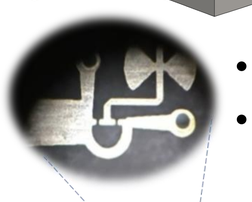
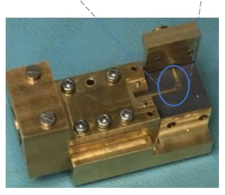


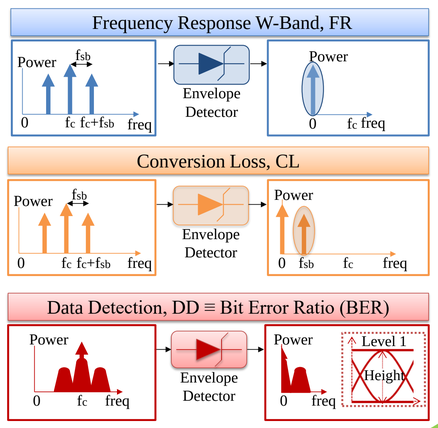




- Planar technology: **microstrip**
- Zero-bias **Schottky diodes** (ACST GmbH)
  - No need of bias.
- Balanced architecture:
  - **Rat race + envelope detector**
  - No harmonic spurious at the output

- Frequency response: 20 GHz input BW
- 16 GHz video bandwidth
- Up to 14 Gbit/s
- 11 dB conversion loss

Publications



Ultra-Low Charge Bunch Arrival-Time Monitor for XFEL and FLASH

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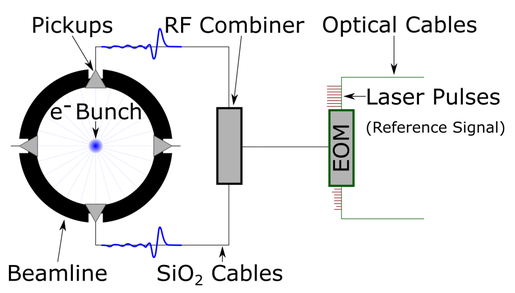
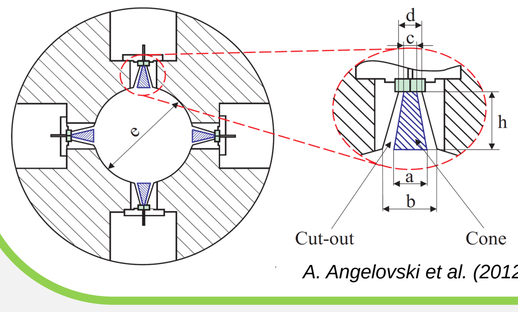
Layout of the State-of-the-Art Arrival-Time Monitor



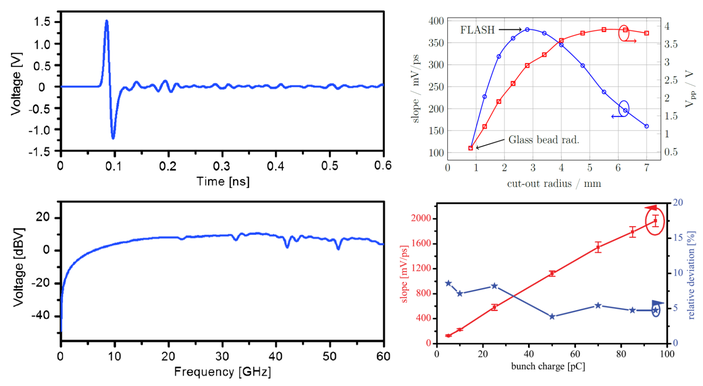
Adapted from H. Dinter et al. (FEL2015)

Current Arrival-Time Monitor Pickup Design



A. Angelovski et al. (2012)

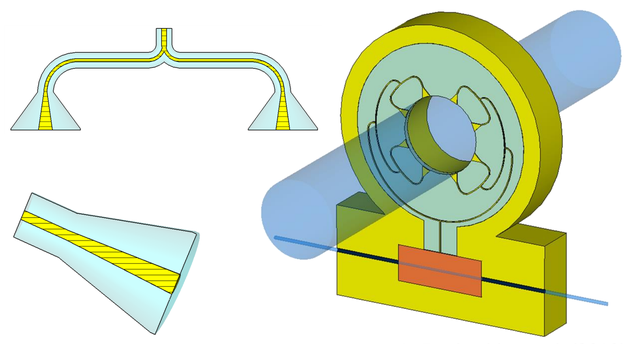
Sensitivity of the Arrival-Time Monitor



A. Angelovski et al. (2012), R. Jakoby (2017) & A. Angelovski et al. (2015)

Trade-off between signal slope at zero crossing ($\propto$ sensitivity) and peak-to-peak voltage ($\propto$ driving voltage for the electro-optical modulator (EOM)). In addition, the slope is proportional to the bunch charge.

Novel Design for Ultra-Low Charge Operation



A. Penirschke et al. (2019)

For sub-10 fs precision at 1 pC:

- 100 GHz bandwidth
- Combination of multiple signals
- Reduction of distance
- Integrated transmission lines

ACKNOWLEDGMENTS

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