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Laser Heater for Dummies

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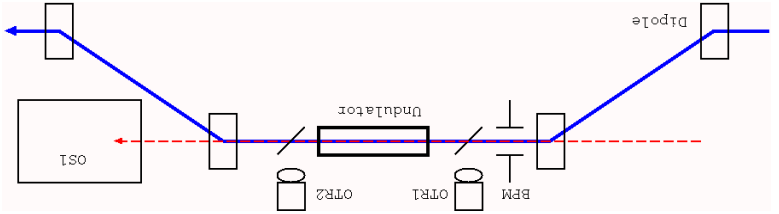
XFEL and the Laser Heater

- Laser heater is 1/1000 or 3m/3km of XFEL



pics from XFEL website

Problem: electrons almost all have same energy and can self-excite resonantly.
Fix it: add noise in a controlled way as not to spoil FEL process.





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Why Uppsala University?

- After closing Celsius and Cryring SU+UU+KTH founded FEL center in 2006.
- In-kind money for the XFEL start-up phase for three projects (~1 MEuro)
  - Magnet measurement, Vacuum, Optical replica
- In collaboration we built and tested the ORS in FLASH (2006-2009)
  - Laser-ebeam interaction, experience with achieving overlap
- Colleagues at DESY suggested that we might take on the laser heater.

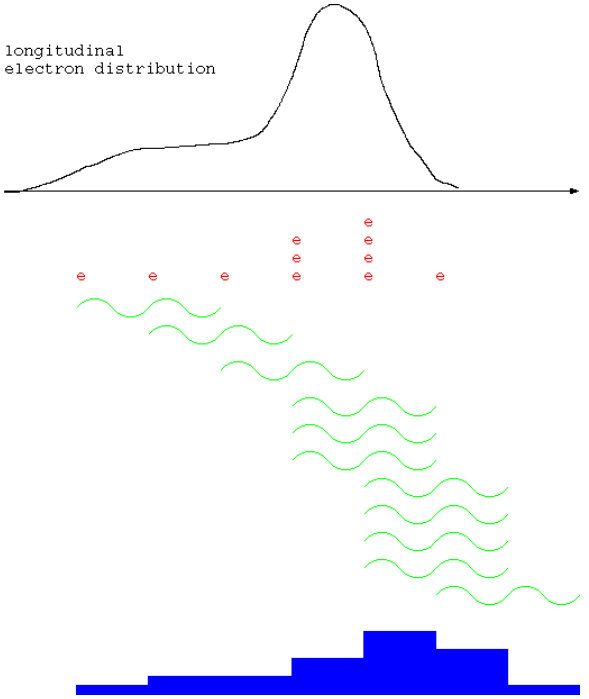
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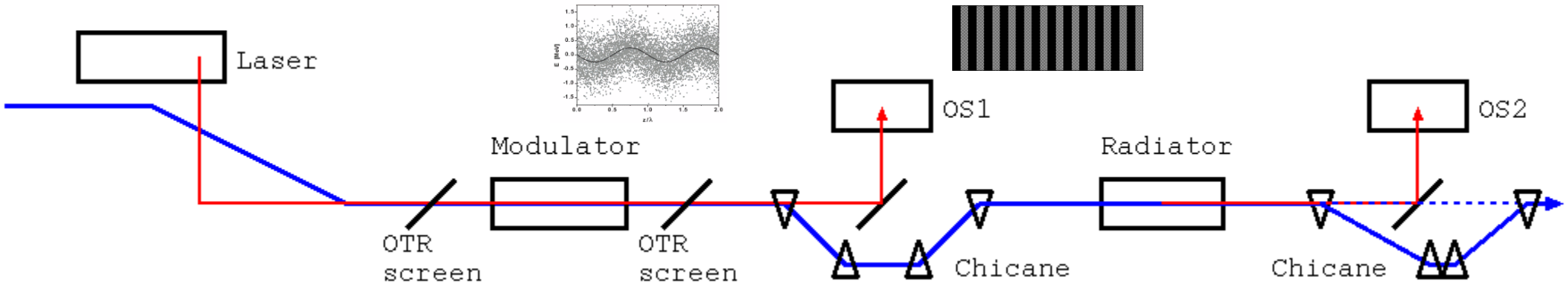
Time

- Feb/Mar 2008: Call from Swedish Research Council. I applied.
- May 2008: Positive decision with request to reduce the scope
- The long wait: nothing happened, and in June 2009 I cancelled my application
  - because I could not with a good conscience guarantee to DESY/XFEL collegues to complete project in the then current time schedule.
- Request to reopen application in October 2009.
- Positive decision in April 2010 with funds for salary for three years and an optional fourth year (which VR defaulted on)
- First money in Oct 2010 (hire Mathias 1/2011)
- Installation and partial commissioning in 2014/5
- First beam in 2016

Optical Replica Synthesizer

- Problem: measure ultra-short bunches in the 10s of fs range
  - too fast for electronics (10 Gs/s, 100 ps)
  - but laser folks know (autocorrelation, FROG)
- Solution: make an optical copy of the electron bunch and analyze that with laser methods.





OTR on OS2-camera while 200 fs laserpulse passes through electron bunch

PHYSICAL REVIEW SPECIAL TOPICS - ACCELERATORS AND BEAMS **11**, 070702 (2008)

Observation of two-dimensional longitudinal-transverse correlations in an electron beam by laser-electron interactions

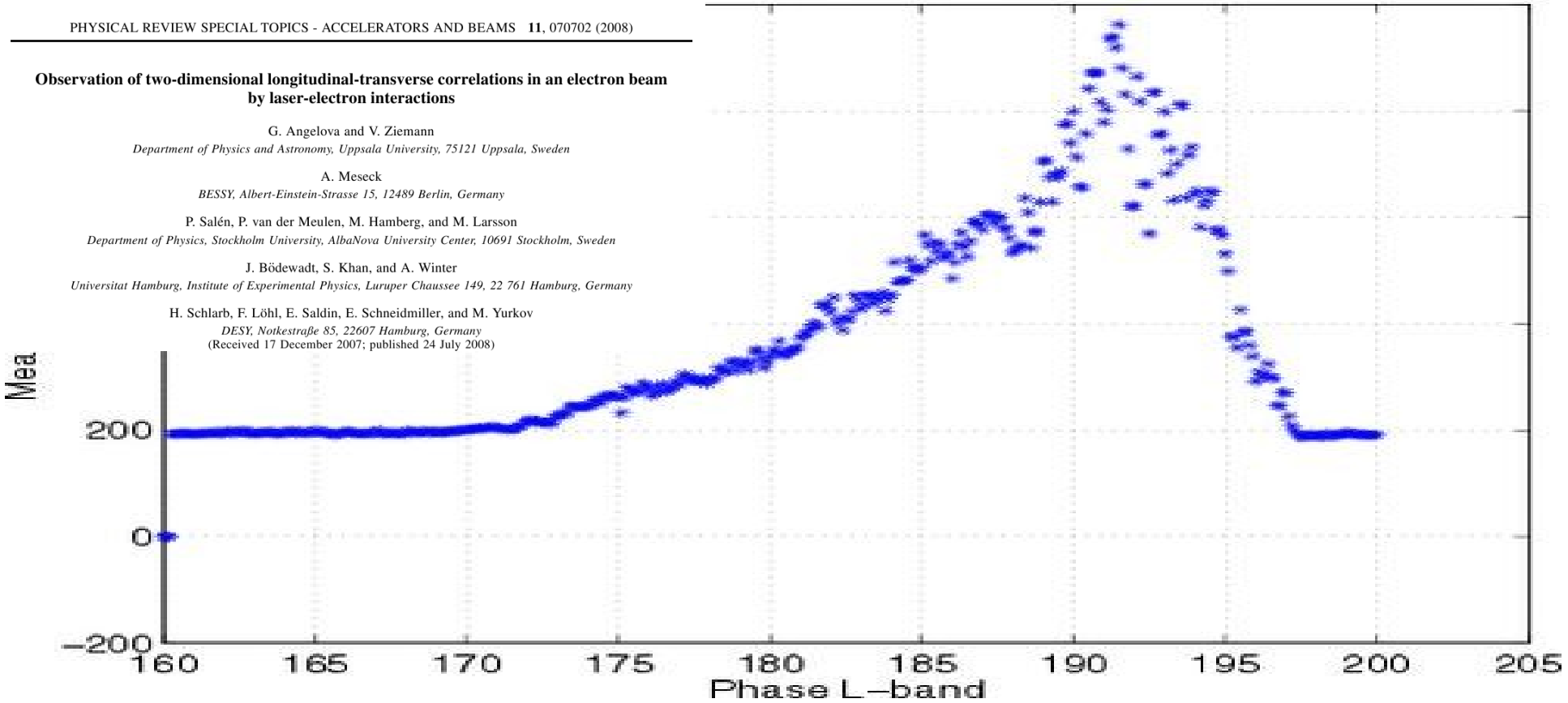
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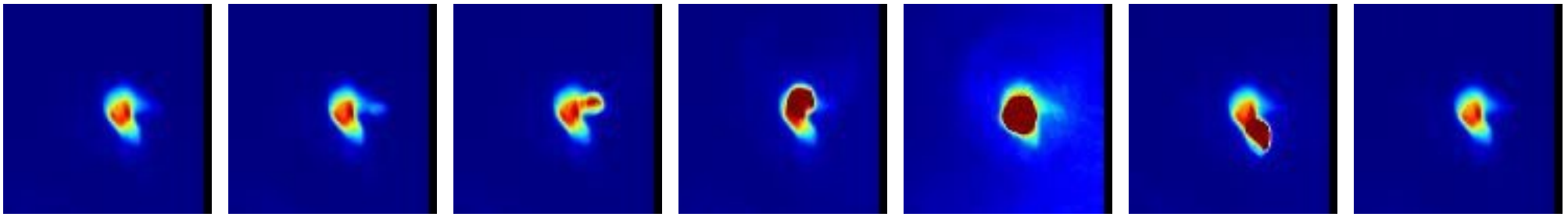
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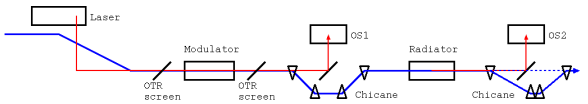
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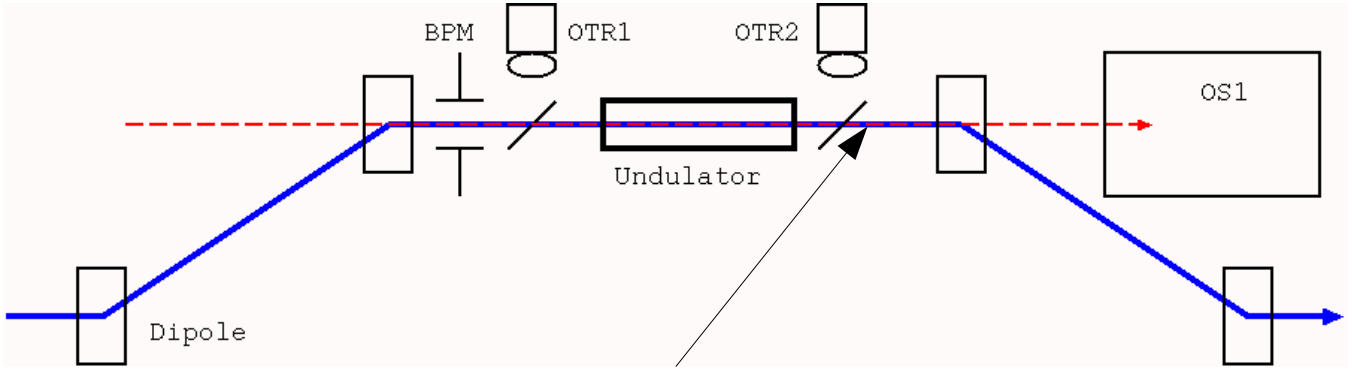


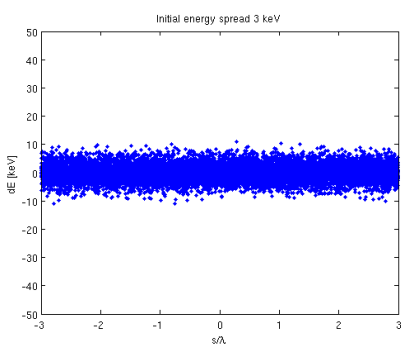


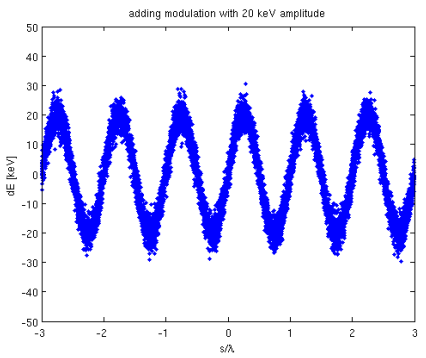
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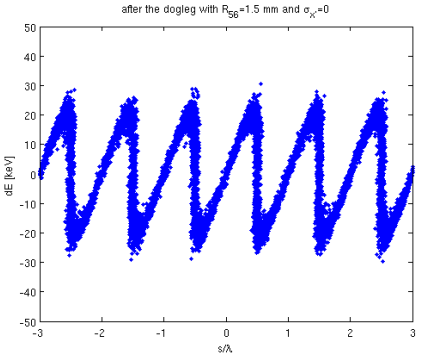
Laser Heater Physics

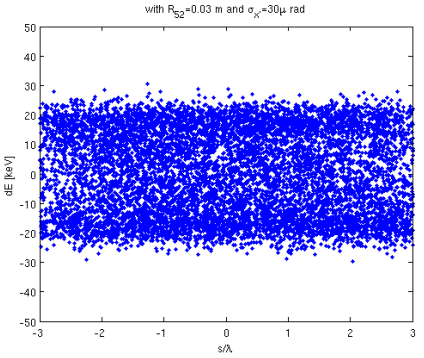
- Pass IR laser over beam in undulator → modulate dE
- R_{52} of 2nd leg of chicane couples 'transverse heat' into the longitudinal plane and smears out the modulation











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Scope: the hardware

