High Repetition Rate Laser/Timing System for Time-Resolved XAFS Measurements at PNC-CAT

Dale L. Brewe

Ed Stern, Ken Beck, Steve Heald, Julie Cross,
Yejun Feng

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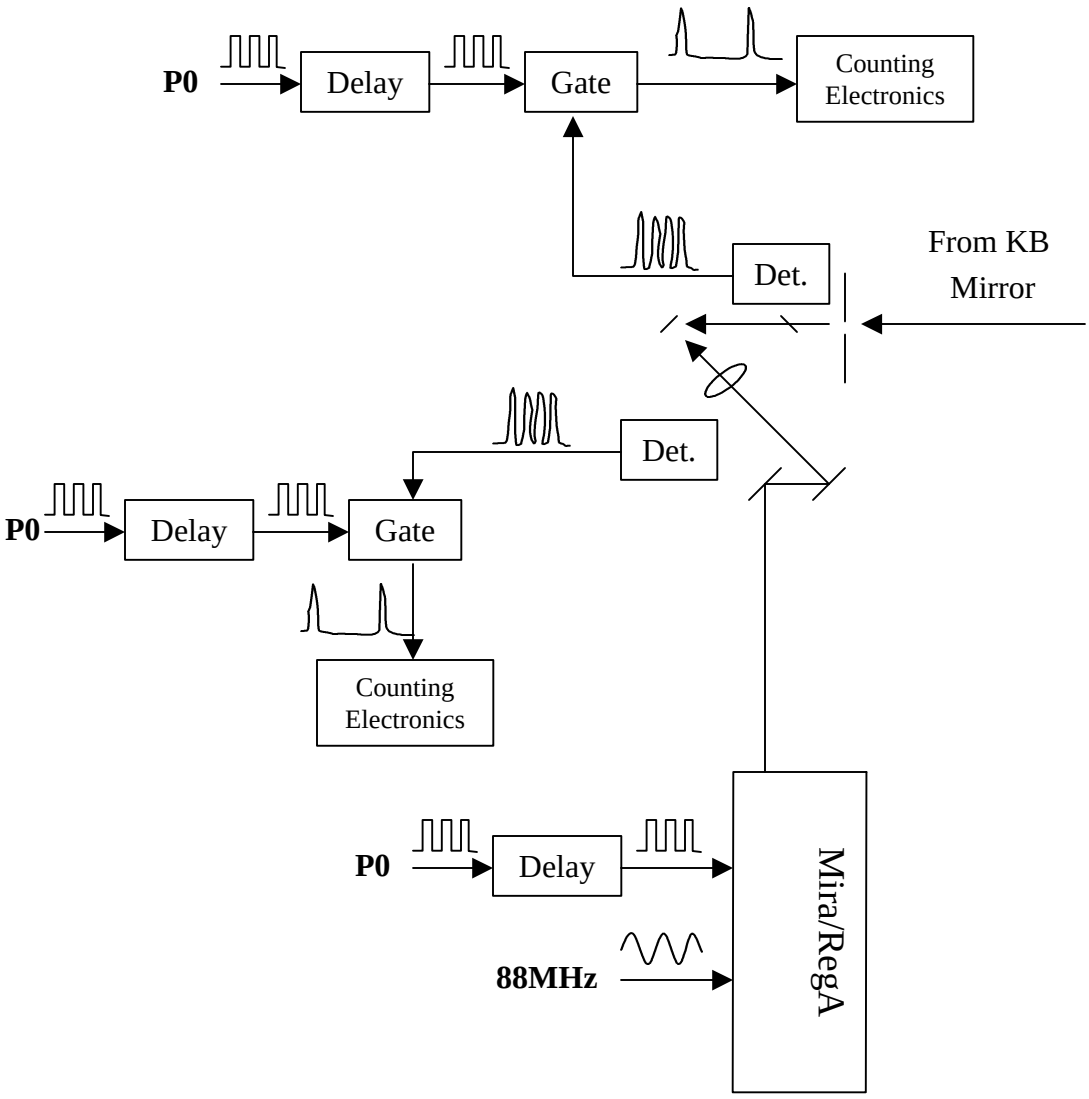
Key Characteristics of System

- Laser triggers at P0 (272kHz) rate w/ ~4μJ / pulse
- High triggering rate allows us to use every bunch at our desired relative timing for greatly improved x-ray flux over typical laser systems (1kHz?).
- X-ray microbeam plus laser focusing provides large laser flux density from relatively small pulse energy and information about laser interaction on a small scale.

Laser Specifications

- Coherent Laser Systems Mira 900F 88MHz mode-locked seed laser
- Coherent RegA 9000 regen amplifier
- Coherent Synchro-Lock controller for sync to ring
- RegA fires @ 272kHz (i.e. P0 freq.)
- ~4μJ/pulse (~1W avg output).
- 200-300fs pulse width
- 800nm wavelength (soon we will have a frequency doubler for 400nm)

Experiment Schematic Diagram



Experiment in Progress

- Time-resolved XAFS of Laser-melted Germanium on a microscale

- Objective: Study kinetics of Germanium melting process on thermal-melting time scales

Timing System Overview

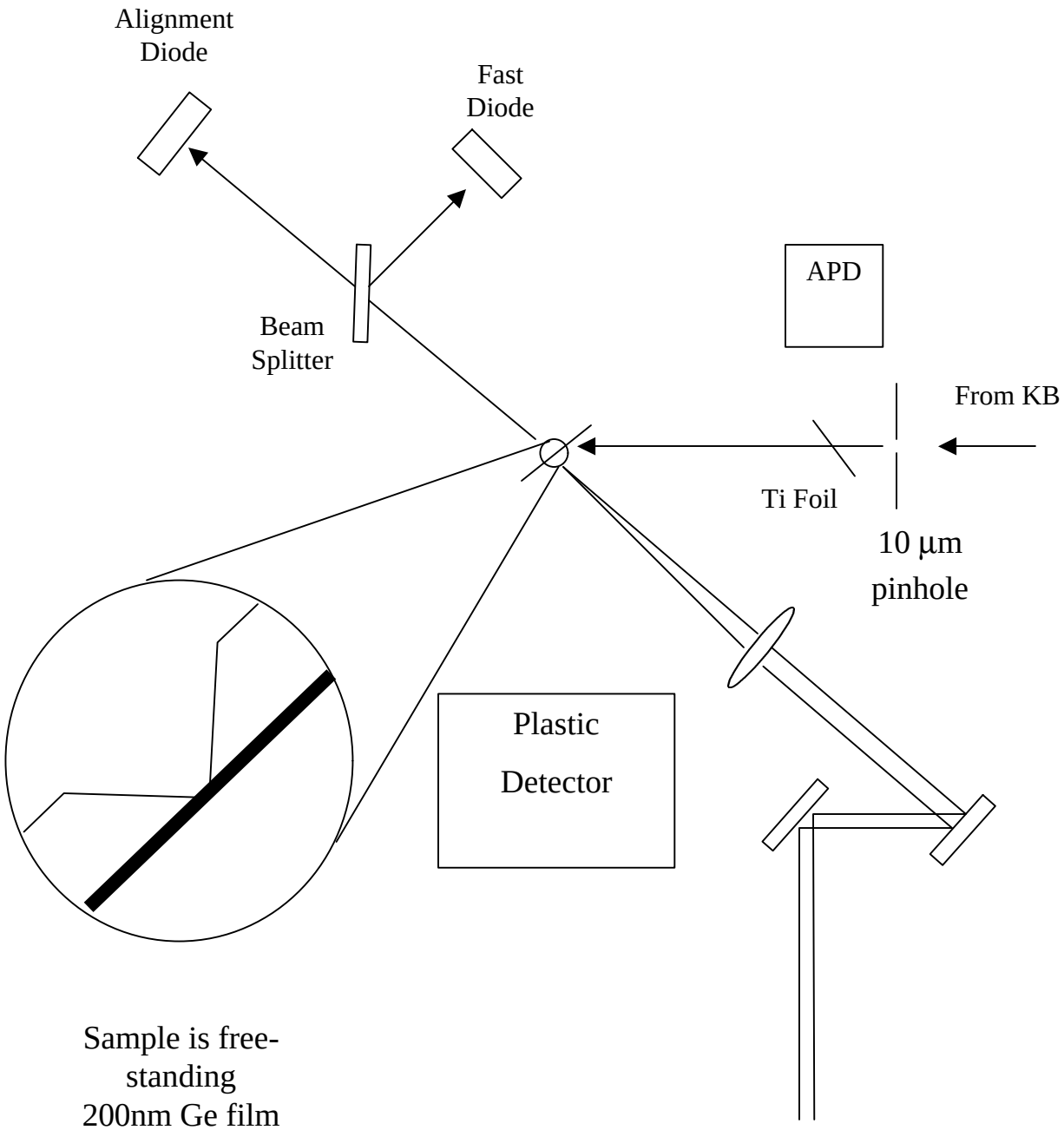
- Synchro-Lock takes 88MHz RF reference from ring (352MHz/4) to sync Mira to ring
- Delayed P0 signal triggers RegA
- Timing changes are made by shifting phase of RF reference and/or changing RegA trigger delay to pick up different seed pulse
- Delayed P0 signals trigger linear gates for fast detector pulses (plastic detector for fluorescence signal, APD for I0)
- Gated detector pulses go to counting electronics

Counting Electronics

- So far, pulse counting w/ single discriminator for each detector - limited to < 272kHz even w/ correction for pulse pileup

- Next step: Lock-in using P0 as reference input frequency. Initial tests show we get ~ several mV signal.

Sample Setup



Sample is free-standing
200nm Ge film
~60μm X
60μm

EXAFS Results