

ERL Laser Jitter Measurement Meeting Notes

6-22-07 - 911B, EAG Conf room

Present: Triveni Rao, Ranjan Grover, John Cupolo, minutes by Dave Gassner

Topic: General discussion to kick off effort to make the sub-ps resolution measurement of Laser light versus master oscillator jitter.

The laser light pulse is expected to hit the ERL photo-cathode near the peak (60-70 degrees) of the 703.5MHz rf voltage oscillation, requirement is accuracy of about 1 degree (+/- 0.5 degrees), which is on the order of 1ps jitter. Laser pulse width 12ps & 30ps, power 35W.

The low level rf group will provide the master clock 703.5MHz & 9.38MHz ($703.5/75 = 9.38$) for ERL Operations. A very stable oscillator will be required for our test set-up. Ranjan says Ilan can provide, it will need to be tested to learn its jitter contribution.

We will be doing jitter measurements with laser light at the fundamental of 1064 nm and second harmonic of 532, (we do not have access to 855 nm) since photo-detectors are more sensitive at these wavelengths. ERL cathode will be hit with 355nm during operations. The laser system jitter characteristics should be independent of the wavelength we decide to use.

New Focus company is a good source for photo-diodes and other related equipment. Should contact Thomas Tsang to see what he has available for some preliminary tests, before we buy ERL dedicated hardware.

The signal level out of the fast photo-diode for this measurement is expected in the millivolt regime. This number is limited by the sensitive area of the photodiode and its sensitivity and cannot be controlled by the laser.

In addition to an rms jitter measurement, frequency component of jitter is desired (Spectrum Analyzer, fast scope FFT, etc. .) to help isolate & reduce jitter sources. It was stated that the laser pulse amplitude and pulse shape variations should not be significant enough to contribute to phase jitter. Amplitude and pulse shape will be measured independently to ensure consistency.

Schedule for measurement: Need measurement capability by **late September**. This is so an October visit to the factory can be made to confirm performance before delivery. Expect laser delivery to BNL by December.

Measurement techniques proposed:

1. Classical Mixer phase detector as used at other facilities for photo-injector commissioning. See various reference papers (Ben-Zvi, Vicaro, Palmer, etc. .)
2. Fast digital oscilloscope, direct measurement.
3. Communications Signal Analyzer (Tek CSA803)

Short-term plan:

Set up initial test in Bldg 535 using CSA803 (Cupolo), quality oscillator (Grover), fast laser with pico-second fast photodiode (Rao).

Inquire with Tektronix if their modern scope can make measurement directly (Cupolo).

Ensure Laser training is up to date.