



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

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# Notes on work on March 25 – April 6, 2022

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Meeting on Undulator Light Interferometry Setup

8 April 2022

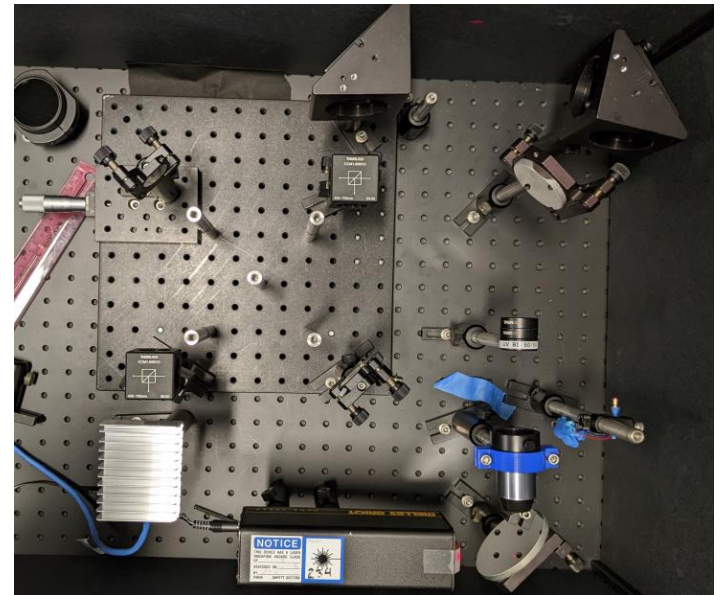
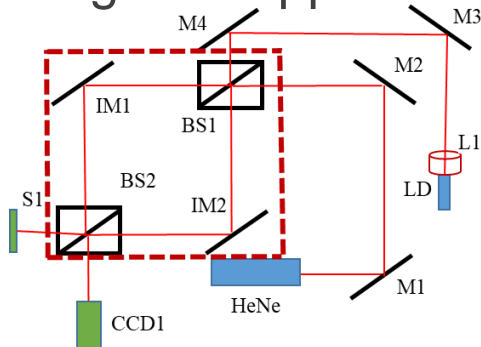
# Content

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- Work at ESB
  - Stability improvement
  - Understanding visibility with the Laser Diode
- Procurement

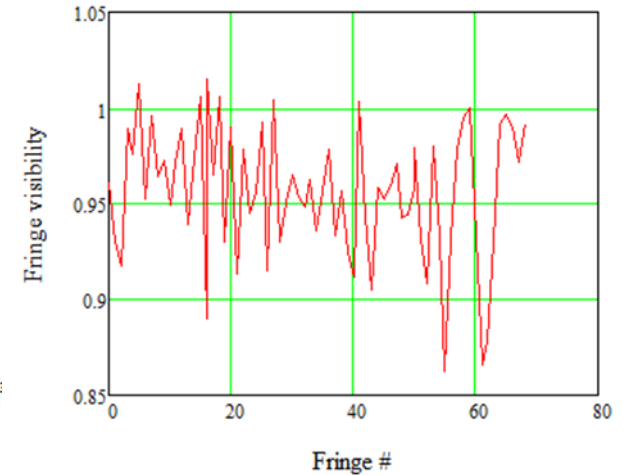
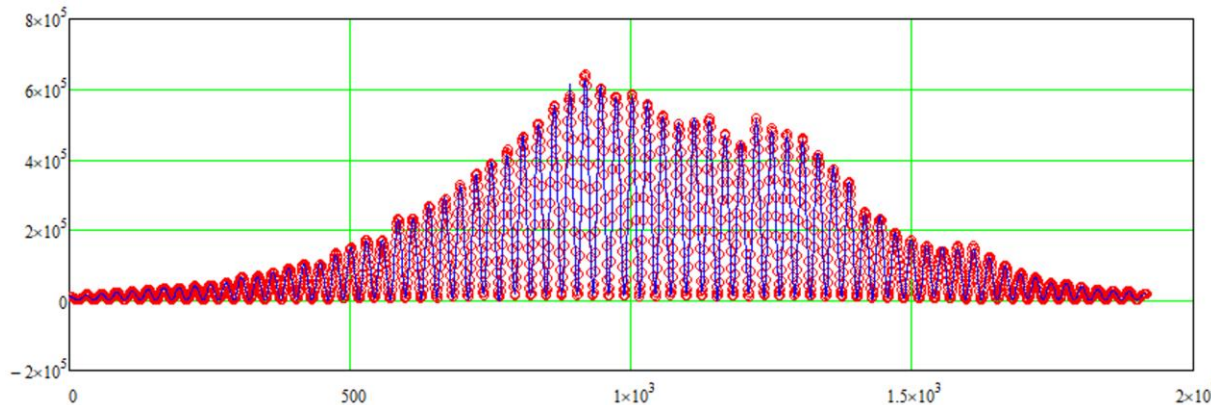
# Work at ESB – vibration damping

- Previous measurements: observed significant jitter due to mechanical oscillations
  - $\sim 0.07 \lambda$  rms as measured with HeNe laser
- Mounted MZI on a separate 1' x 1' breadboard
  - Frequency of mechanical oscillations is proportional to (size)<sup>-2</sup>
    - Thanks, Jamie, for pointing to the formula
  - Installed this breadboard on vibration – damping supports
    - Thanks, Jamie, for finding and purchasing the supports



# Checks of stability with HeNe laser

- Jitter decreased to  $\sim 0.003 \lambda$  rms
  - 2 nm, good enough
- Spatial frequency is determined by the angle between fronts of the light coming from two arms
  - Stable between frames  $\Rightarrow$  angular jitter  $\sim 0.3 \mu\text{rad}$ , good enough
- Measured visibility  $96 \pm 3\%$ , though we saw worse values



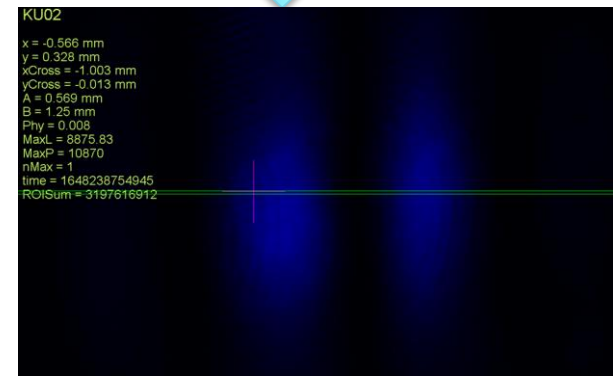
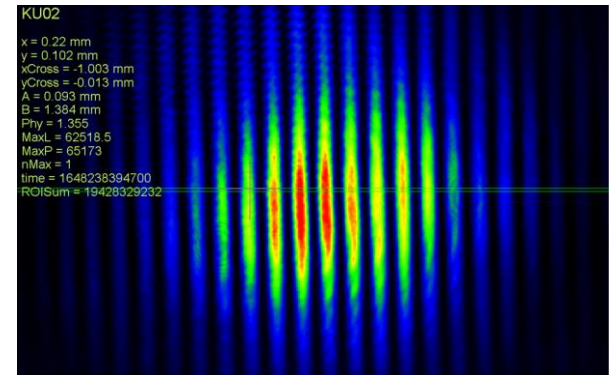
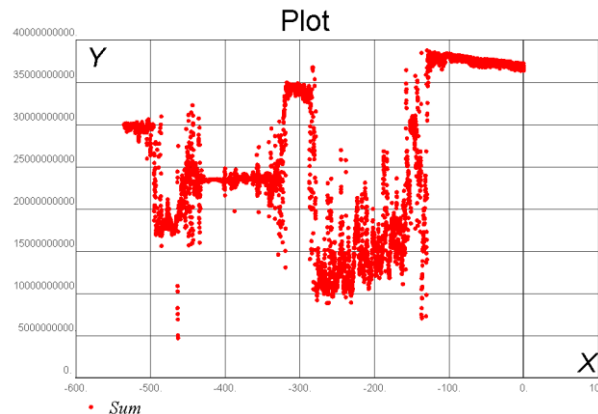
Intensity vs pixel # along the horizontal projection through image center. Fit (blue) and data (red) for the file 2022-03-25-HeNe\_1.txt. 25-Mar-22.

# Attempts of the best alignment

- Minimum angle with HeNe  $\sim 0.1$  mrad
  - Need a finer angular tool; will implement piezo-driven beam splitter mount
  - When MZI is tuned to “black spot”, variation of total intensity are large (a factor of 2); not clear yet why

- With LD, were able to change the total intensity at most by a factor of 5

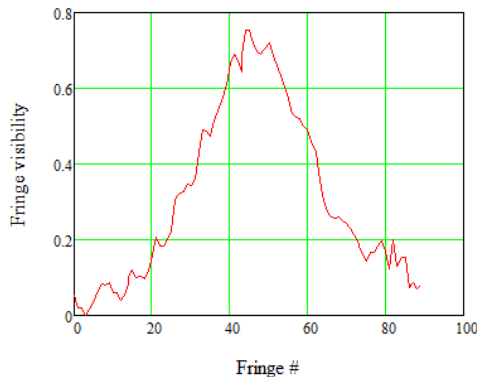
Total image intensity vs frame number while tuning MZI with LD.  $\sim 10$  min total. 4-Apr-22.



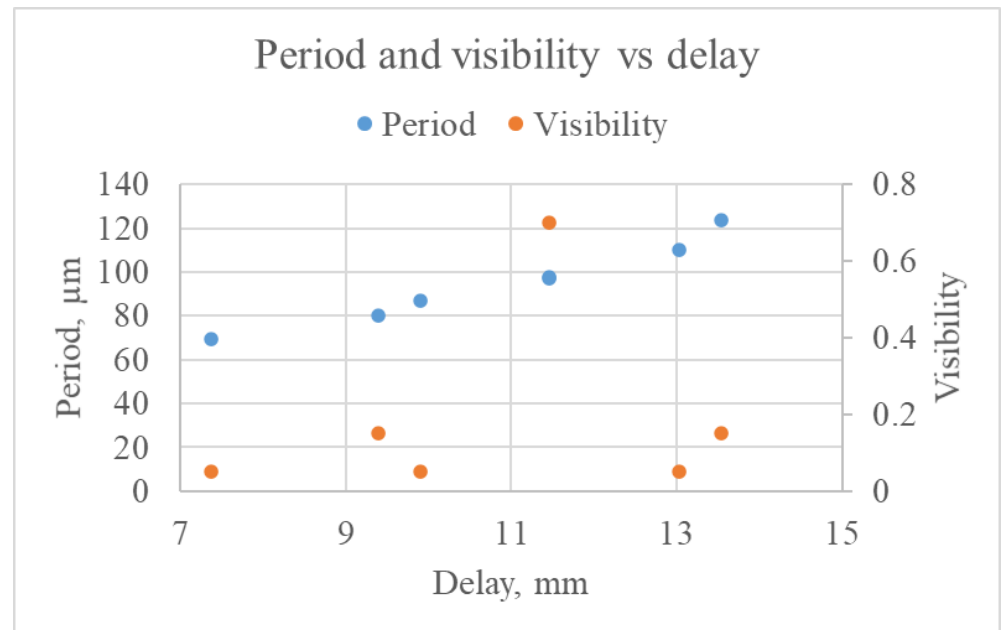
Images with HeNe at different angles. 25-Mar-22.

# Understanding visibility with the Laser Diode

- In the previous weeks, were not able to reproduce ~70% fringe visibility observed in the first attempt
  - Typically, <20%
- March 25: realized that there are several delays with fringes of different visibility, separated by ~2 mm
  - The reason is multiple modes of the LD
  - Looks beneficial for MZI tuning



Fringe visibility curve at optimum tuning. 25-Mar-22.



# Procurement

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- Jamie ordered
  - Motorized linear stage
  - Manual linear stages
  - Differential micrometer
  - Mirrors
  - Neutral filters
- Next
  - Motorized mirror/BS mounts
    - Decided to order separately mounts and piezo motors
      - Will go first with open loop, since close loop motors ~2.5 k\$ each and 5 weeks shipment
  - Reflector – still debating the type
  - Beam splitters, mounts, posts, etc.