NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

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# Optical Multiplexer for Laser Phase Locking

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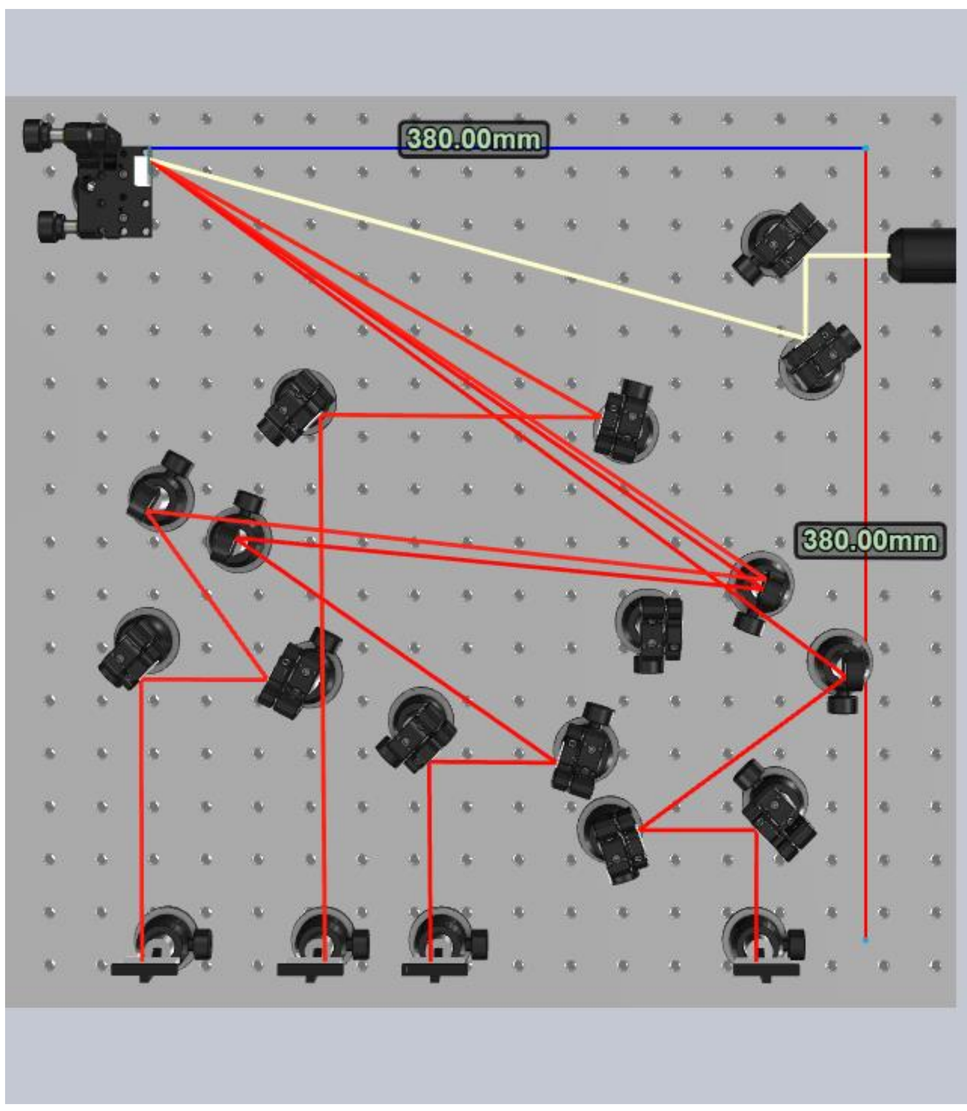
## Introduction

The basic idea of this project is to measure certain wavelengths with a high level of precision. This is done using a self-referenced frequency comb. It references its own frequency to self-generated laser pulses. It doubles the lower frequencies of the comb, so it creates a 'comb' of frequencies with the same frequency difference. Overlapping the comb with a continuous wave laser allows us to phase lock to laser beam to a frequency of the comb. To a comb line, so to speak.

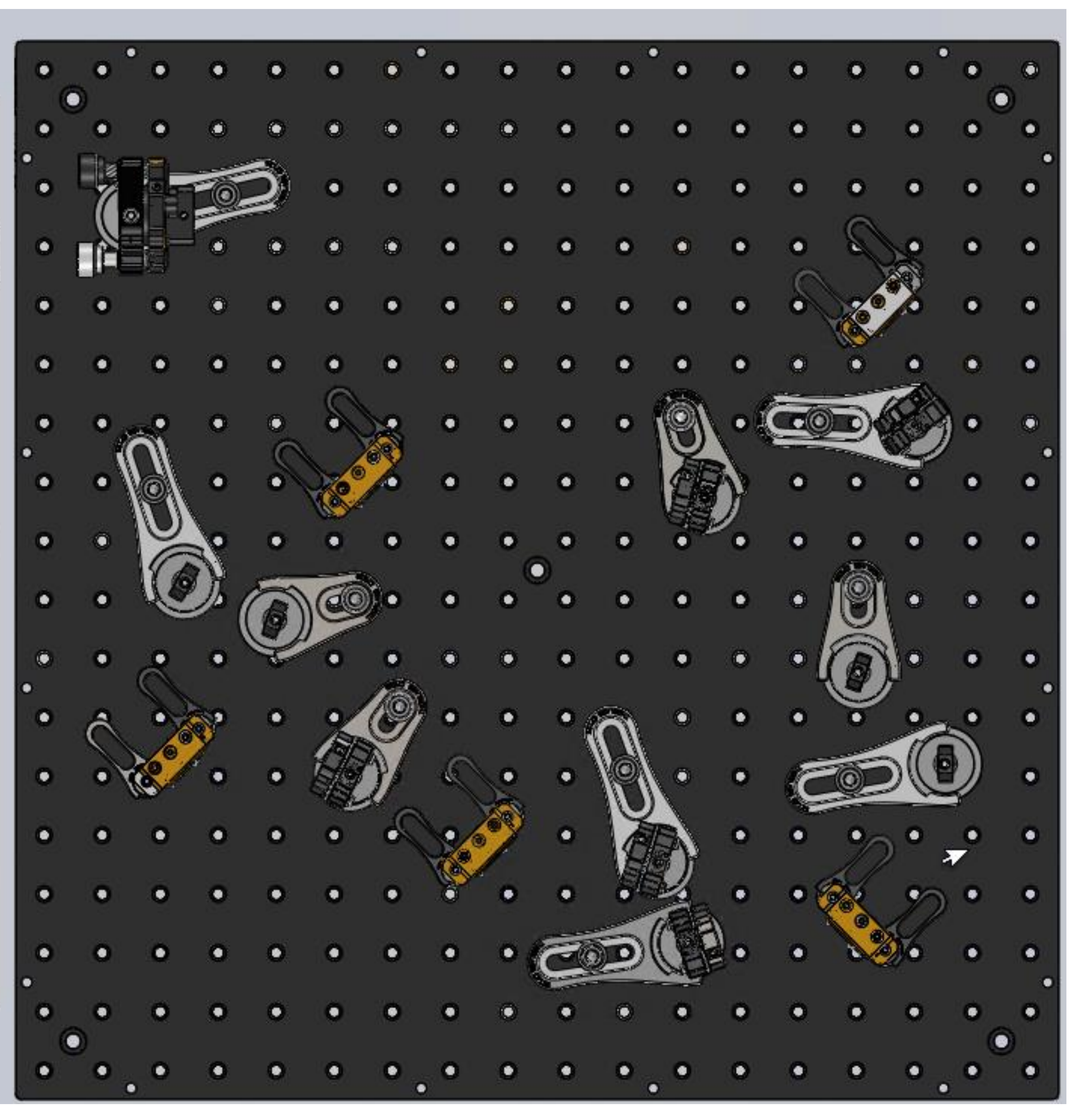
## Practicality

There are a few things to consider when considering the practicality of the project. A frequency comb is expensive and 4 wavelengths are required. So, a setup would be needed to serve our purposes for more than 1 wavelength. There also needs to be a way to merge or separate the lasers' wavelengths from the frequency combs. The reversibility makes it so that the same design can be used for both merging and separating wavelengths.

## 3D Optix Model




## Solidworks Model



3DOptix and Solidworks model side by side. 3DOptix was used for laser positions and Solidworks was used for proper mirror positions as well as output.

## Details

The setup uses a diffraction grating and mirrors that are meant to be as energy efficient with the wavelengths used as possible. Precautions also have to be made with the diffraction grating so that it does not have unwanted orders of refraction from the grating. In this case, the incoming beam is at an angle of 15 degrees.

Frequencies used - 623nm/679nm/688nm/707nm

## Potential Use

High precision measurements are useful for many things. An example would be to use it in a clock.