Introduction: The wavelengths of a red diode laser and the sodium D lines will be determined using a Michelson interferometer.

Procedure:

Set up interferometer so light splits and recombines to form an interference pattern on the viewing screen.

Initially set the movable mirror in a position so the split beams form a washed interference pattern.

Record this initial distance then move the mirror until the interference pattern appears and becomes washed many times. Record the final distance.

For the diode $\lambda = \frac{258}{10}$

Sodium D-lines $\lambda = \frac{589}{10}$, where is the distance the mirror was moved and N is how many cycles.

Setup:

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Laser  \uparrow \rightarrow \text{Splitter} \rightarrow \text{M1: set mirror} \leftarrow \downarrow
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\text{M2: movable mirror}
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\[ \frac{d}{\theta} = \frac{64}{10} \]

\[ d = 6.4 \text{ mm} \]

\[ \Delta d = 0.5 \text{ mm} \]

\[ \Delta \theta = \frac{d}{N} = \frac{6.4}{56} = 0.114 \text{ mm} \]

\[ \lambda = \frac{2 \theta}{N} = \frac{64}{56} = 1.14 \text{ mm} \]

\[ \Delta \lambda = 0.1 \text{ mm} \]

\[ \Delta (d_2 - d_1) = 1 \text{ mm} \]

\[ \Delta N = 56 \]

\[ \Delta \theta = \frac{d}{N} = \frac{6.4}{56} = 0.114 \text{ mm} \]

\[ d_1 = 326.7 \text{ mm} \]

\[ d_2 = 341.3 \text{ mm} \]

\[ \Delta d = 0.5 \text{ mm} \]
\[
\Delta y = \Delta y_2 - \Delta y_1 = 1.02 \text{ mm}
\]

\[
\frac{\Delta x^2}{2} = \frac{\Delta y^2}{2} = 5840 \text{ mm}^2
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\[
L_y = 2 \times \Delta y = 2(5840 \text{ mm}^2 \times 10 \text{ mm}) = 11680 \text{ mm}^2
\]

\[
L = L_1 \times L_2 = 2844 \text{ mm}
\]

\[
d = 2844 \text{ mm}
\]

\[
ds = 284.8
\]

\[
\Delta L = \frac{L}{2} = \frac{2844 \text{ mm}}{2} = 1422 \text{ mm}
\]

\[
\Delta y_1 = \frac{\Delta x}{2} = \frac{1422 \text{ mm}}{2} = 711 \text{ mm}
\]

\[
\Delta y_2 = \sqrt{2844 \text{ mm}^2 - 1422 \text{ mm}^2} = 1422 \text{ mm}
\]

\[
l_2 = m \times x = (m \times 285.6 \text{ mm}) = 285.6 \text{ mm}
\]

\[
l_1 = m \times x = (m \times 288.4 \text{ mm}) = 288.4 \text{ mm}
\]