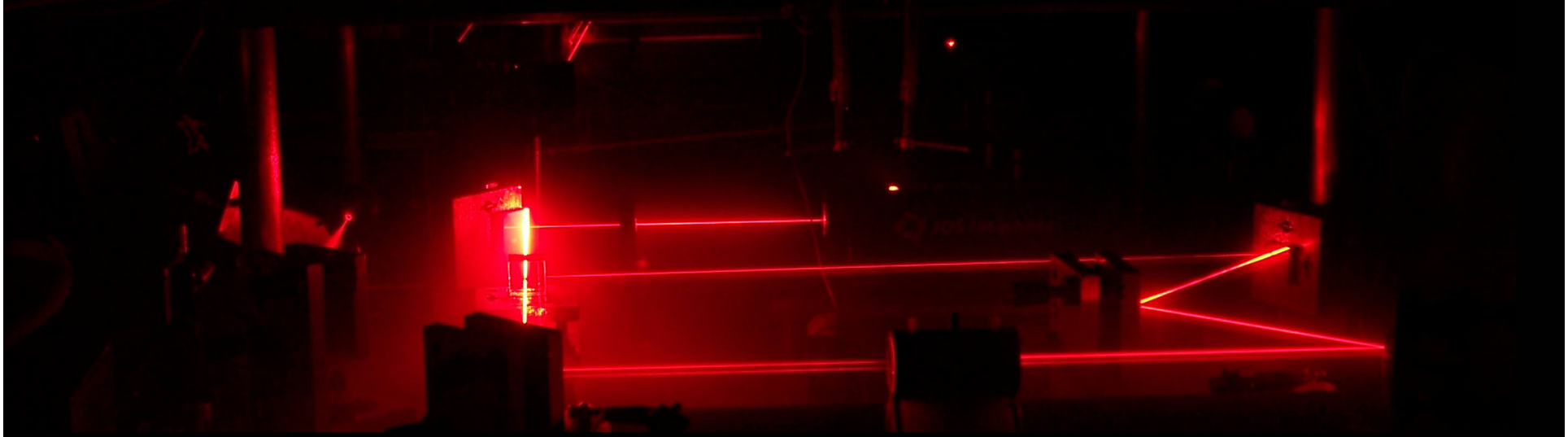
Inexpensive Interferometric Wavemeter for Visible/NIR Lasers



Joshua DiGangi
Yun Ding
Ben McCall
Department of Chemistry
University of Illinois – Urbana/Champaign

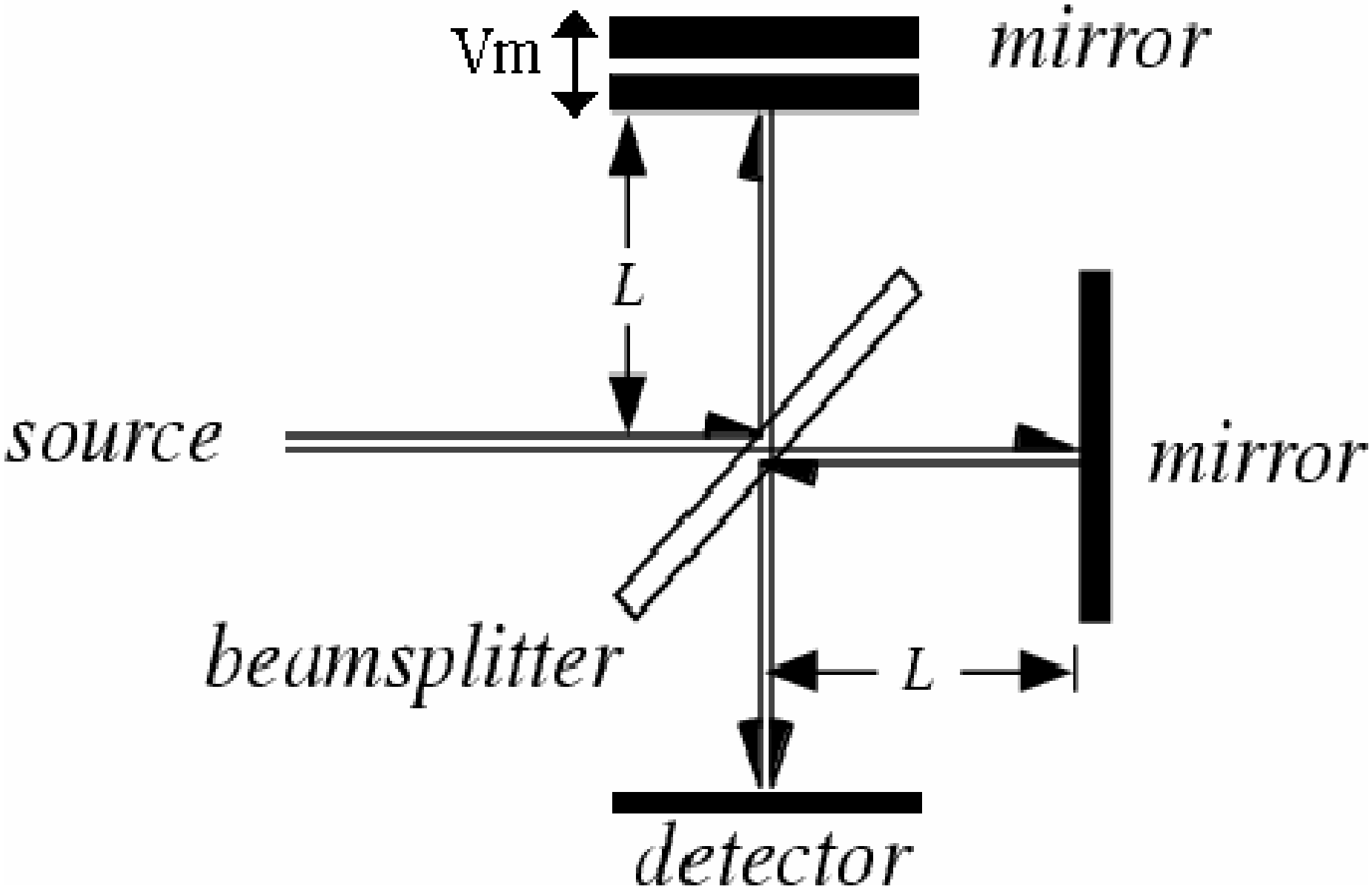
Motivations

- Tunable laser systems require frequency calibration
- Reference cell calibration difficult without a rough measurement
- Commercial wavemeters are often cost-prohibitive
- Simple project for an undergraduate or a first-year graduate student

Our Wavemeter

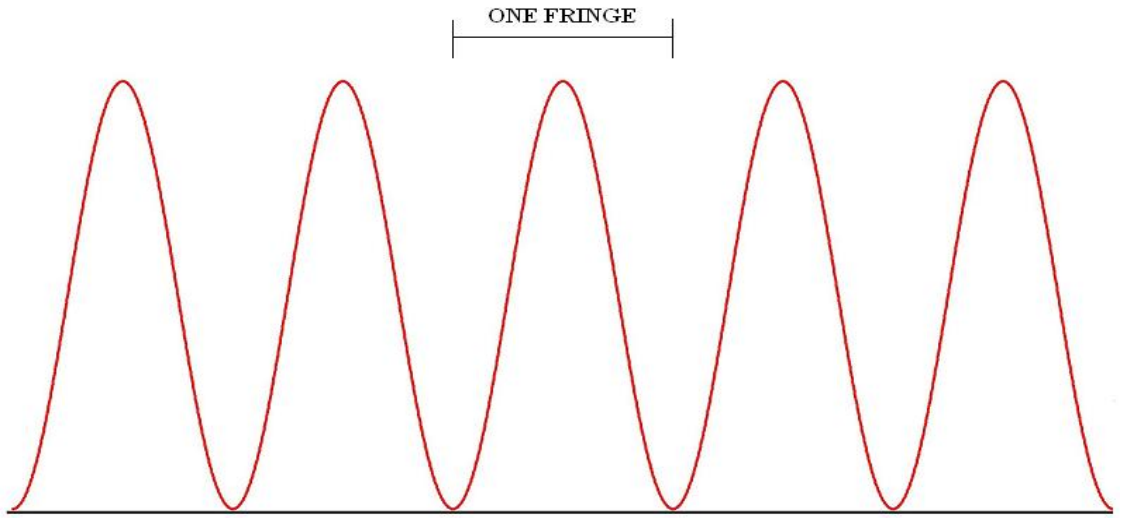
- Based on the design of P.J. Fox et.al.*
  - Cart Propulsion System
  - Computer Interface
- Works with continuous-wave lasers
- Yields accuracy of ±1 pm
- Has an acquisition time of 3-4 seconds
- Currently usable from 400 -1000 nm
- Requires an area of ~2.5’ x 2.5’

* P.J. Fox, R.E. Scholten, M.R. Walkiewicz, and R.E. Drullinger, “A reliable, compact and low-cost Michelson wavemeter for laser wavelength measurement”, Am. J. Phys. **67**, 624 (1999).

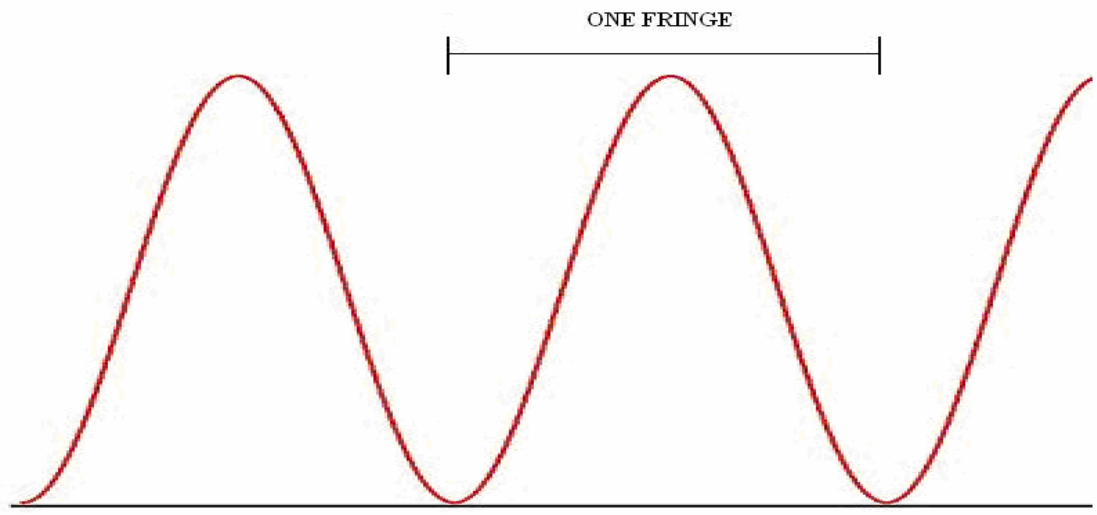


* Motta, Leonardo. "Michelson Interferometer." Eric Weisstein's World of Physics. Ed. Eric Weisstein. **2006**. 17 April 2006. <http://scienceworld.wolfram.com/physics/MichelsonInterferometer.html>

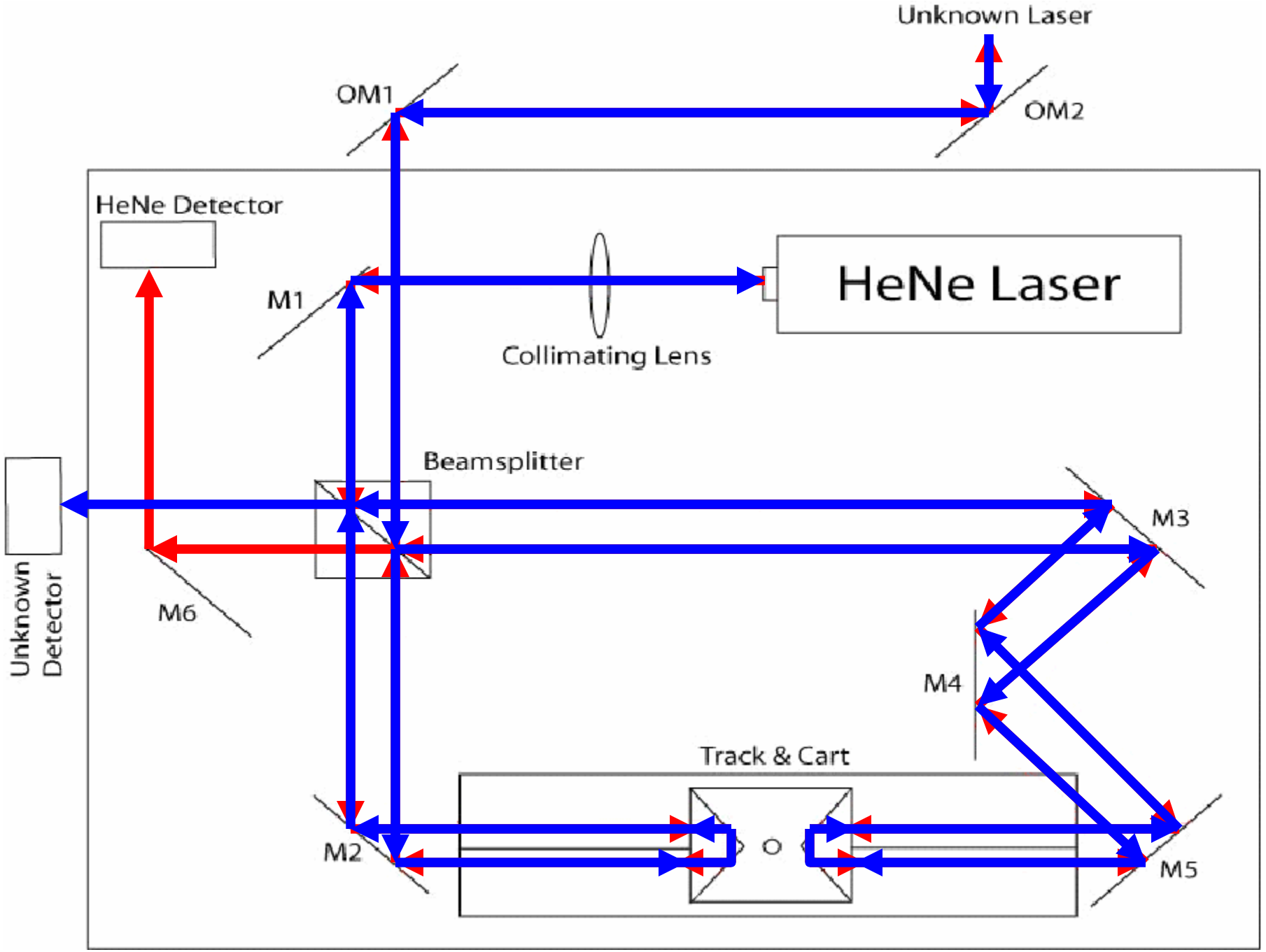
Visible Laser at 500 nm

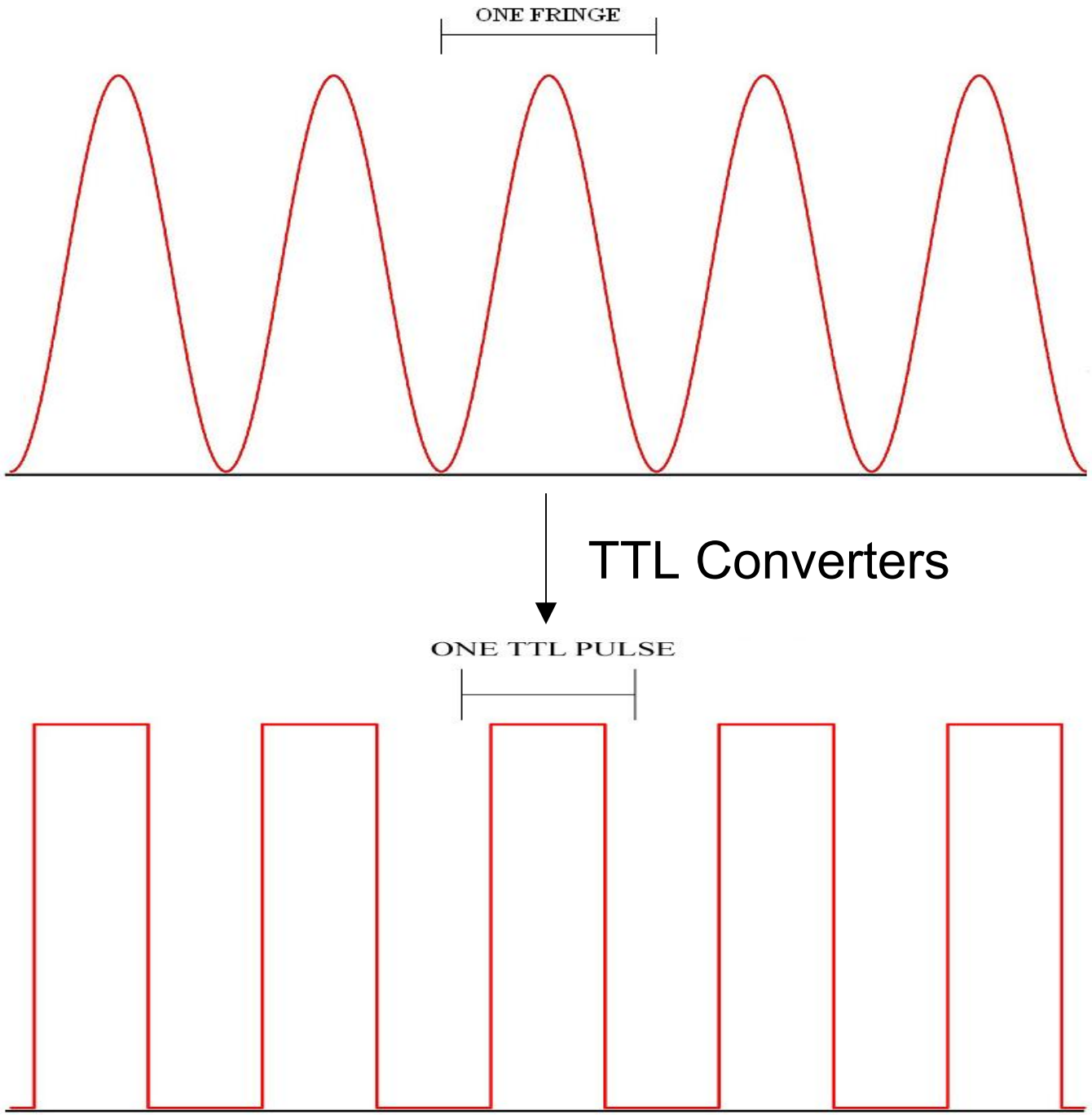


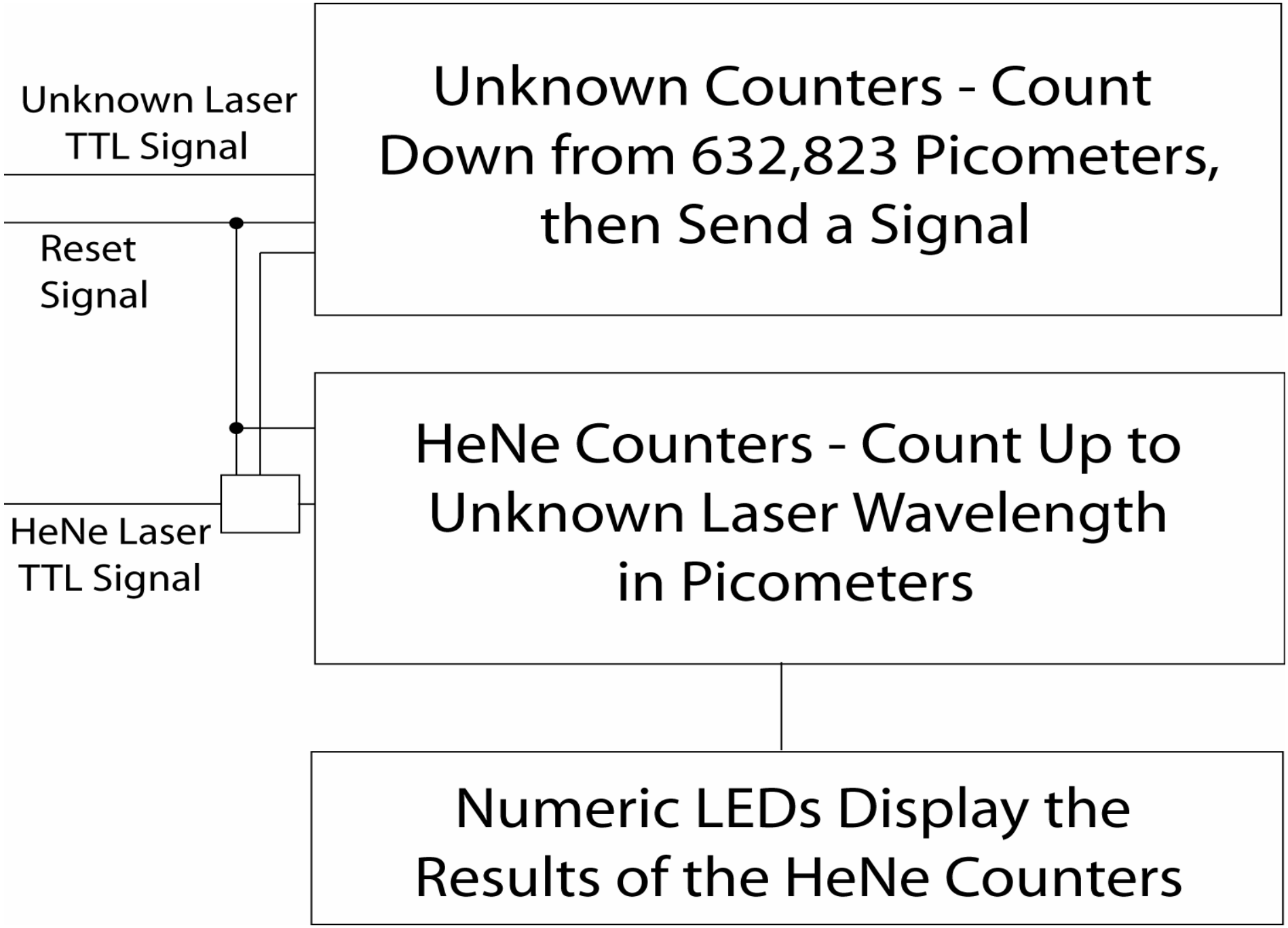
NIR Laser at 1000 nm

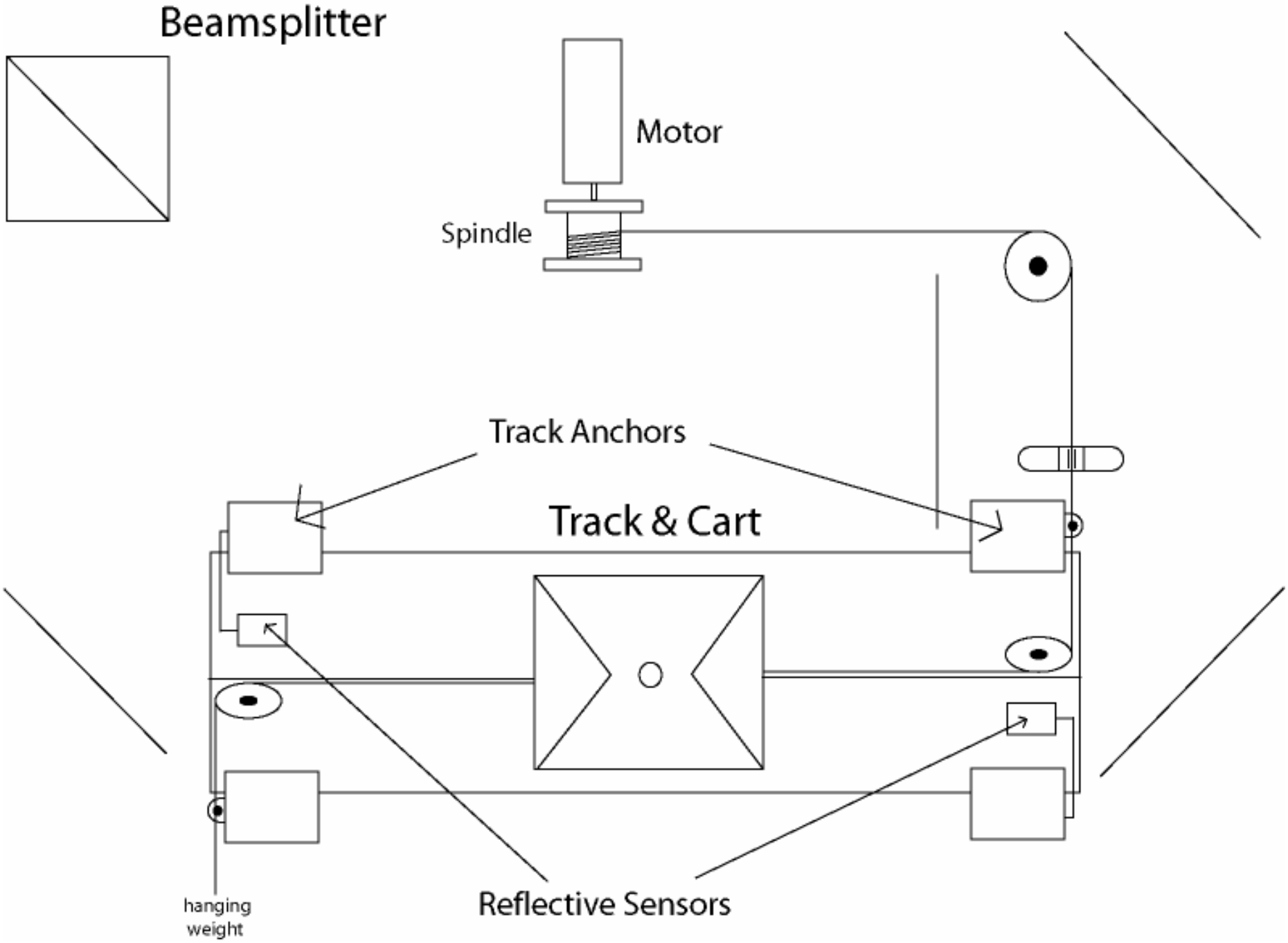


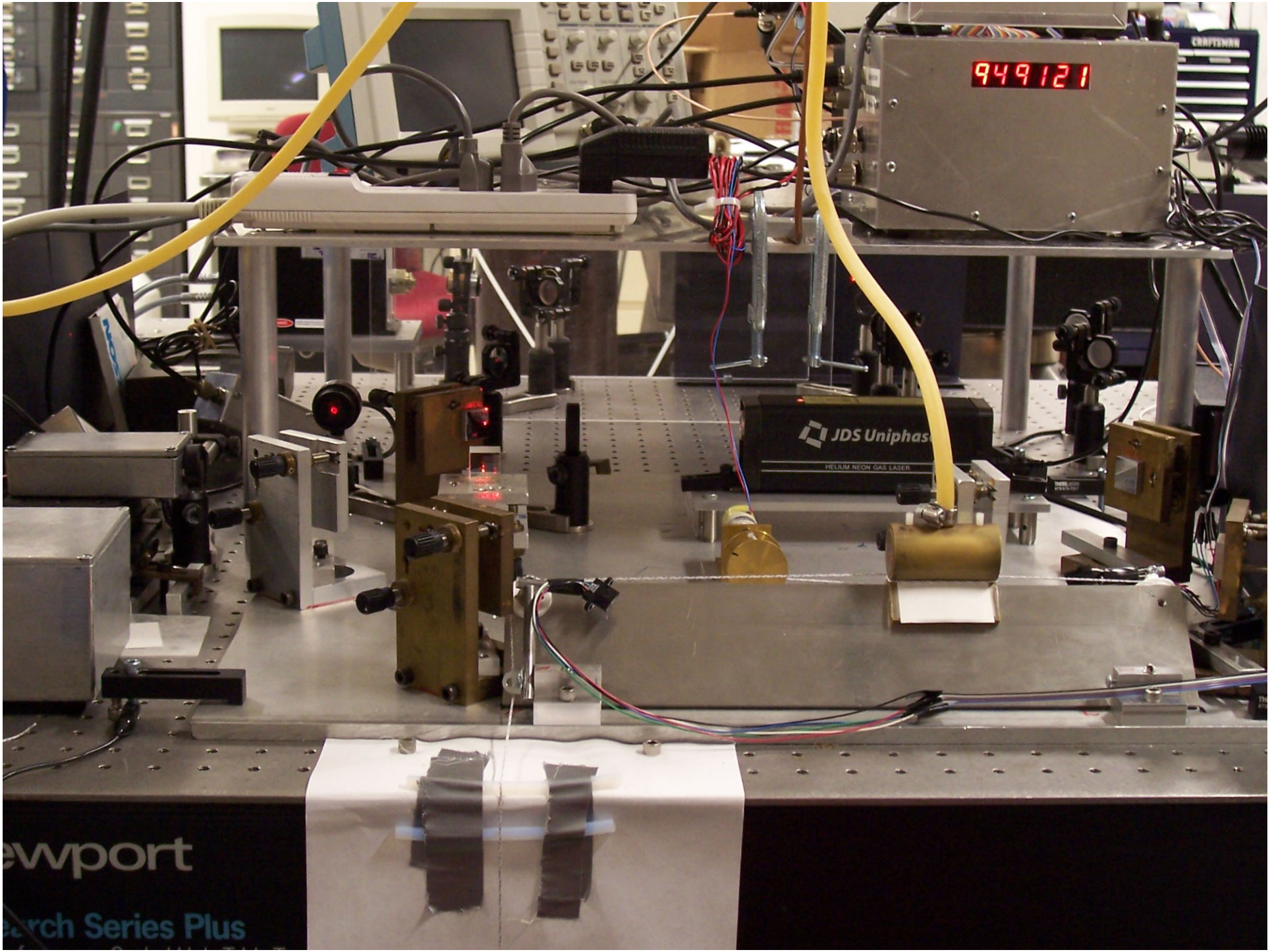
$$N_1 / N_2 = \lambda_2 / \lambda_1$$


Unknown Laser
OM1
OM2
HeNe Detector
M1
Collimating Lens
HeNe Laser
Beamsplitter
M3
Unknown Detector
M6
M4
Track & Cart
M2
M5


ONE FRINGE
TTL Converters
ONE TTL PULSE


Unknown Laser
TTL Signal
Reset
Signal
HeNe Laser
TTL Signal
Unknown Counters - Count Down from 632,823 Picometers, then Send a Signal
HeNe Counters - Count Up to Unknown Laser Wavelength in Picometers
Numeric LEDs Display the Results of the HeNe Counters


Beamsplitter
Motor
Spindle
Track Anchors
Track & Cart
hanging
weight
Reflective Sensors


949121
JDS Uniphase
HELIUM NEON GAS LASER
ewport
rch Series Plus

Computer Interface

- 24-channels of BCD output from the HeNe counters
- National Instruments PCI-6503 DAQ card
- LabWindows program
  - Translates the BCD number to an integer
  - Stores past readings
  - Ignores obvious misreads
  - Sends the most recent reading to main experiment computer

For more information:

- See Joshua DiGangi's BS thesis at http://bjm.scs.uiuc.edu/jdigangi/

Acknowledgements

- McCall Group
- University of Illinois