Your Title Here (e.g. Measurement of the speed of light using a laser distance meter)

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The speed of light is a fundamental physical constant with many counter-intuitive consequences. Its precise value is of use in many applications, including . . .. Using a laser distance meter and a rotating array of mirrors, we determined the speed of light from the change in reported distance as a function of the rotation frequency. We find light travels at $(3.1 \pm 0.2) \cdot 10^8$ m/s in air. The precision of our measurement was limited by uncertainty in spacing between mirrors in the array.

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The notion that there exists an absolute limit on the speed at which light (or anything else, such as matter, or information) can move was introduced over a hundred years ago to explain... [1]. The fascinating, counter-intuitive consequences of this speed limit are collectively referred to as “Special Relativity” [2]. In addition to satisfying curiosity, precise knowledge of the speed of light is important for a variety of technological applications, including... [3].

The first measurement of the speed of light, commonly referred to as c, was made in 1676 by Ole Roemer, who noted a seasonal variation in the periodicity of the phases of Jupiter’s moon, Io [7]. The value obtained, $2.2 \cdot 10^8$ m/s, was limited in accuracy by errors in the accepted values for the diameters of Earth’s and Jupiter’s orbits [4]. To date, the most precise measurement of the speed of light, commonly referred to as c, was made by researchers at the U.S. National Institute of Science and Technology (NIST) using... [6].

Here we report a simple approach to measuring the speed of light in air using paper clips and bubble gum that yields a value of $(3.1 \pm 0.2) \cdot 10^8$ m/s. The precision of this measurement was limited by uncertainty in the spacing between mirrors.

Our approach was based on the one described by R. L. Goldberg [9]. The light from a strobe lamp (ROX-ST1, Roxant) aimed at a fixed 3” diameter front-surface mirror, was reflected onto a similar mirror, facing the first, attached to the end of a string to form a pendulum (Fig. 1). The length of the pendulum thus created was measured with a laser distance meter and verified by tuning the frequency of the strobe lamp until the swinging mirror appeared to be stationary. A detector (model 595391, Phantom YoYo), positioned behind the low point of the swinging mirror’s arc, was triggered by the strobe with a variable delay.

The delay corresponding to maximal intensity at the detector was recorded as a function of distance between the mirrors, over a range from 1 to 100 m. The measurement was repeated five times for each configuration

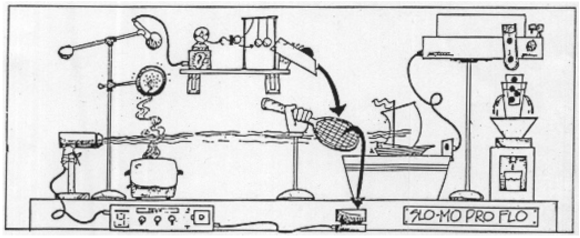

FIG. 1: Schematic of the mirror array and measurement setup. A wad of bubble gum anchors one mirror to the wall, while another mirror swings at the end of a pendulum three meters away. A strobe illuminates the fixed mirror and a detector, positioned behind the mid-point of the swinging mirror’s arc, is triggered a variable time after the strobe,

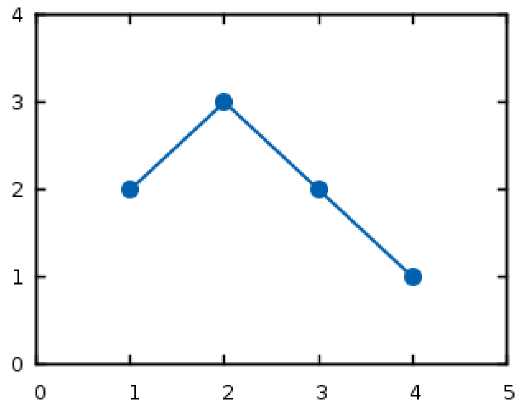

FIG. 2: Fake data included for illustration of report layout. A properly formatted figure would have axis labels and error bars, of course, and a proper functional fit, instead of connected dots, if appropriate.

and 68% confidence intervals were estimated from the standard deviation of these samples.

An example of detected intensity as a function of delay time is plotted in Figure 2. The delay time corresponding to maximum intensity was determined for each mirror separation from a Gaussian fit to the data. Uncertainty in the optimal delay time was derived from the least-squared-error (LSE) fit, taking uncertainties in both intensity and delay time into account.

Optimal delay as a function of mirror separation is plotted in Figure 3. A LSE linear fit to the data yields a slope of $(4.0 \pm 0.9) \times 10^{-9}$ s/m.

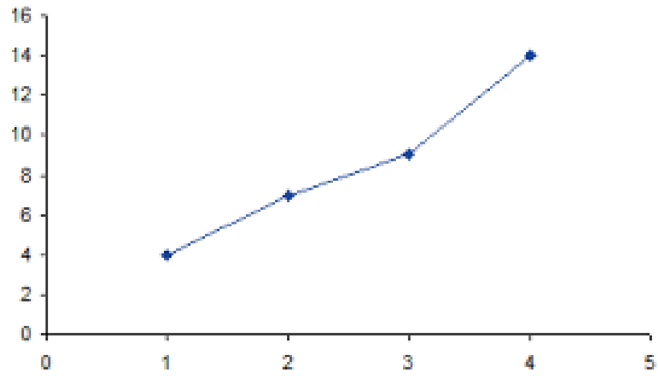

FIG. 3: More fake data included for illustration of report layout. A good caption starts with a descriptive clause, kind of like a title, followed by a sentence or two drawing the reader's attention to the "take home message" of the data displayed. The interested reader will look to the main text to get complete details, so some of the information provided in this caption may be reiterated in the main text.

This result is consistent with measurements reported by G. Gedanken *et al.* [8], who used a setup based on scotch tape and safety pins. The approach used here afforded greater precision, ±15% compared to their ±25%, although both managed to successfully avoid systematic errors imposed by reality. [10]

In summary, we have measured the speed of light to be $(2.5 \pm 0.6) \times 10^8$ m/s. Our measurement suffered systematic errors due to the aging of the bubble gum used to anchor one mirror, and was limited in precision by the resolution of the photodetector. The most marked improvements to this measurement approach would come from...

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[10] It is ok to include footnotes among the references, like this.