The AU–Day–$\sqrt{3}$ Relation: Two Geometric Observations

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Abstract

This note records two independent numerical relations involving the astronomical unit (AU), the mean solar day (86,400 s), the speed of light c, and the geometric constant $\sqrt{3}$.

The first relation produces a geometric approximation of the speed of light with an accuracy of approximately 0.035%.

The second relation links the quantities $100 \cdot AU/86400$ and $c/\sqrt{3}$ with a relative deviation of approximately 2×10^{-9}.

1 Constants

$$AU = 149\,597\,870\,700 \text{ m}$$

$$c = 299\,792\,458 \text{ m/s}$$

$$\text{Day} = 86\,400 \text{ s}$$

$$\sqrt{3} = 1.732050807568877293527446341505872366942805253810 38$$

2 Geometric Speed Approximation

Consider

$$c_{\text{geom}} = \frac{100 \cdot AU \cdot \sqrt{3}}{86400}.$$

Substituting the exact values gives

$$c_{\text{geom}} \approx 299\,897\,121.246 \text{ m/s}.$$

Comparison with the defined speed of light:

$$c = 299\,792\,458 \text{ m/s}.$$

Difference:

$$\Delta c \approx 104\,663.246 \text{ m/s}.$$

Relative deviation:

$$\frac{\Delta c}{c} \approx 3.491 \times 10^{-4}$$

$$\approx 0.03491\%.$$

Thus the combination

$$\frac{100 \cdot AU \cdot \sqrt{3}}{86400}$$

approximates the speed of light at the level of about 0.035%.

3 Light-Time Relation

The Earth–Sun light travel time is

$$t_{\mathrm{AU}} = \frac{AU}{c} \approx 499.00478 \text{ s}.$$

Compare this with

$$\frac{86400}{100\sqrt{3}} \approx 498.83063 \text{ s}.$$

Difference:

$$\Delta t \approx 0.17415 \text{ s}.$$

4 Near-Identity Relation

Now consider

$$X = \frac{100 \cdot AU}{86400}$$

and

$$Y = \frac{c}{\sqrt{3}}.$$

Numerically:

$$X \approx 173\,145\,683.680556 \text{ m/s},$$
$$Y \approx 173\,145\,684.027735 \text{ m/s}.$$

Difference:

$$\Delta = Y - X \approx 0.347179 \text{ m/s}.$$

Relative deviation:

$$\frac{\Delta}{Y} \approx 2.005 \times 10^{-9}$$

or

$$0.0000002005\%.$$

This may be written as

$$\frac{100 \cdot AU}{86400} \approx \frac{c}{\sqrt{3}}$$

with agreement at the level of approximately two parts per billion.

5 Conclusion

Two distinct numerical observations emerge:

1. The quantity
$$\frac{100 \cdot AU \cdot \sqrt{3}}{86400}$$
approximates the speed of light with an error of approximately 0.035%.

2. The quantities
$$\frac{100 \cdot AU}{86400}$$
and
$$\frac{c}{\sqrt{3}}$$
agree to within approximately 2×10^{-9}.

These observations connect astronomical distance, terrestrial time, the speed of light, and the geometric constant $\sqrt{3}$ through simple numerical relations.

The observations are presented as numerical and geometric facts.