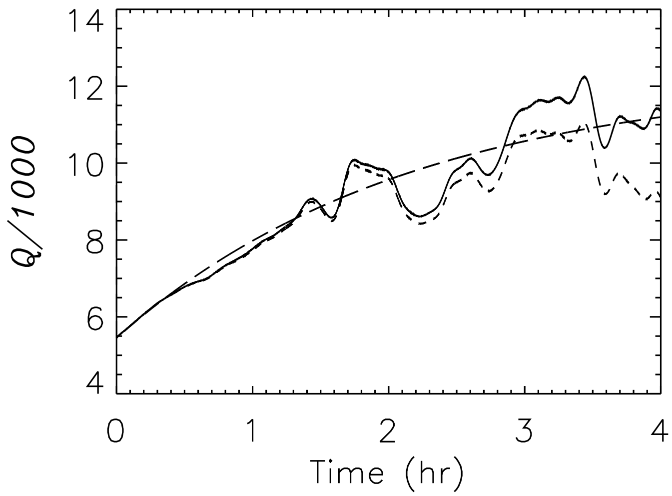

Figure 2: Measured Q using the Compensating Algorithm (solid) and Simple Algorithm (short dashed). The aerodynamic model (long dashed) shown for $q = 12,150$ and $\overline{\gamma} = 1.25$.

remove sample-to-sample noise prior to using the Q algorithm.) This pendulum was known to have a support spring with a slight kink. This resulted in excessive wobble in the bob, which is evident in the data in Fiqure 2.

Aerodynamic Model Drumheller [3] analyzes a pendulum with two types of viscous drag, linear and quadratic. These terms are usually attributed to aerodynamic effects although the analysis allows for a fraction of the linear drag to originate from internal effects in the mechanism. The expression for the drag force on the pendulum yields the follow relationship:

$$\text{drag force} = B(\omega\dot{\vartheta} + \gamma\omega^2|\dot{\vartheta}|\dot{\vartheta}), \tag{13}$$

where the absolute value ensures that the drag always opposes the motion. If the moment of inertia of the pendulum is given by I, the constants B and γ can be used to define the two normalized constants q and $\overline{\gamma}$ as

$$q = I\omega/B, \quad \text{and} \quad \overline{\gamma} = \frac{8}{3\pi}\gamma\omega A_0, \tag{14}$$

where A_0 is the amplitude at which the coast-down is started.

The model predicts that A and Q of the coast-down test will be

$$A/A_0 = \frac{\exp(-\omega\tau/2q)}{1+\overline{\gamma}[1-\exp(-\omega\tau/2q)]} \tag{15}$$

$$Q = \frac{q}{1+\overline{\gamma}(A/A_0)}. \tag{16}$$