XIV IBERO-AMERICAN PHYSICS OLYMPIAD
EXPERIMENTAL TEST

The bifilar pendulum

Aim of the experiment

Determine how the period of a bifilar pendulum depends on the length of its suspension threads and the distance between them.

Introduction

A bifilar pendulum consists of a uniform cylindrical rod suspended horizontally by two inextensible threads of equal length L. The threads support the rod at points equidistant from its midpoint (see Figure 1).

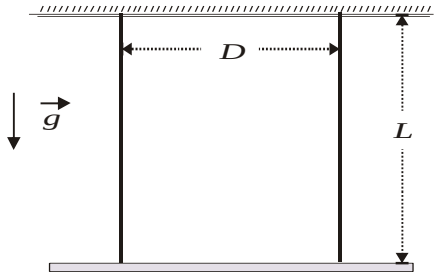


Figure 1

We shall study torsional oscillations of the pendulum, in which the rod oscillates in the horizontal plane. The oscillations must be small (small angles φ and γ, see Figure 2).

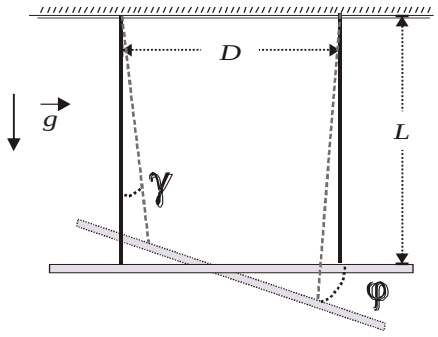


Figure 2

For small oscillations, the period T of the bifilar pendulum depends on both the thread length L and their separation D, in the form

$$T = kL^{\alpha} D^{\beta}$$

where k, α and β are constants.

Equipment

One marked 30 cm steel rod
One measuring tape
Thread
One 30 cm ruler
One bosshead clamp
One long metal rod
4 metal rings
One stand
One stopwatch
One calculator
Millimetre graph paper
Logarithmic graph paper
Plain paper
One pair of scissors

Procedure

1. Using the equipment supplied, assemble the apparatus in Figure 1 to make a bifilar pendulum. Keep the threads parallel and equidistant from the centre of the rod.
   Caution: When you set the pendulum in motion by turning the rod through a small angle φ , its centre must remain at rest; preserve the symmetry.
2. Keeping the thread length L constant, tabulate the oscillation period T and the thread separation D.
3. Plot the data obtained in step 2 and determine β.
4. Keeping the thread separation constant, tabulate the oscillation period T and the thread length L.
5. Plot the data obtained in step 4 and determine α.
6. From the results of the preceding steps, determine the constant k.
   Present your results with their uncertainties.