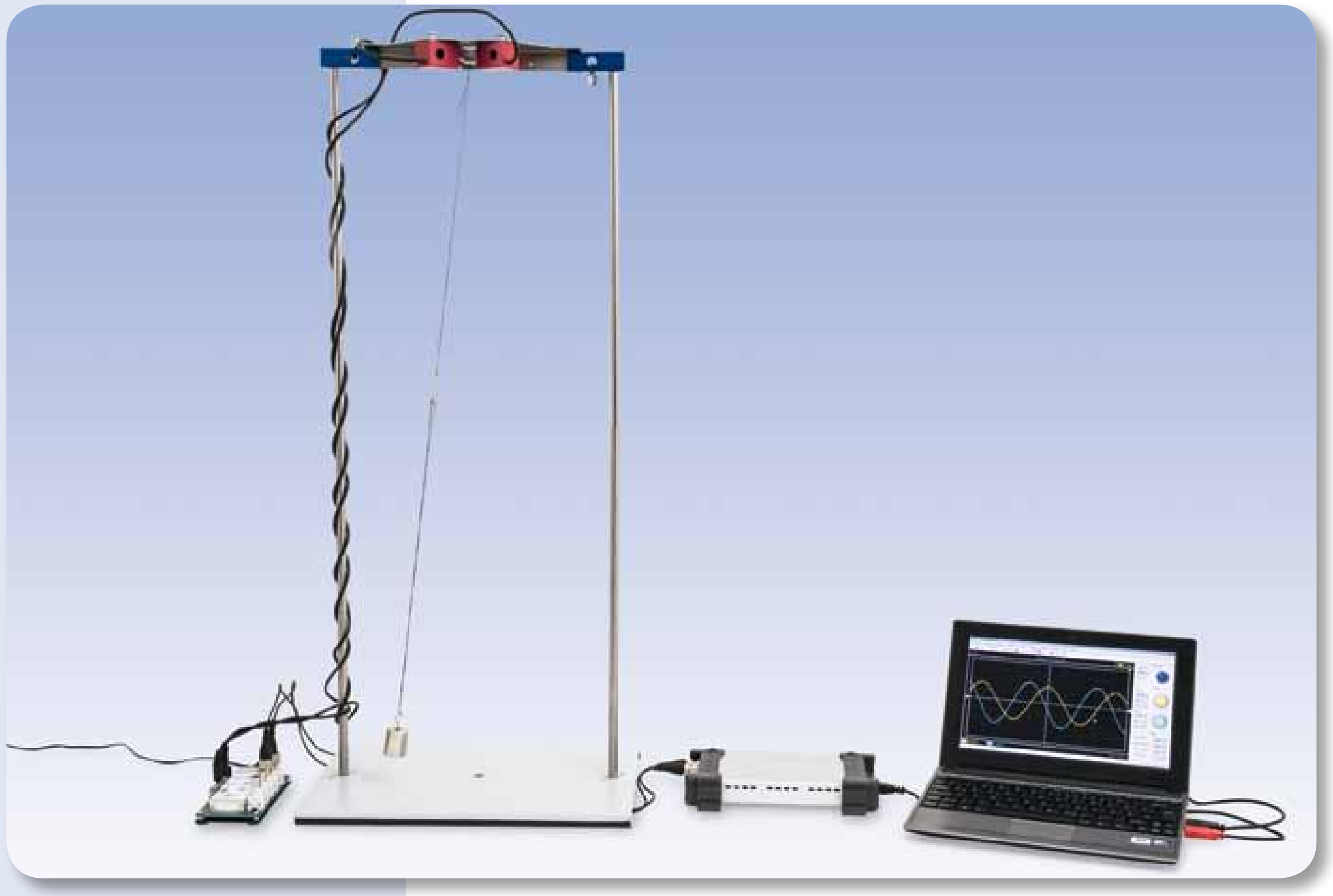
ELLIPTICAL OSCILLATION OF A STRING PENDULUM



EXPERIMENT PROCEDURE:

- **Plot the elliptical oscillation of a string pendulum in the form of two perpendicular components for a variety of initial conditions.**

OBJECTIVE

Description of elliptical oscillations of a string pendulum as the superimposition of two components perpendicular to one another.

SUMMARY

Depending on the initial conditions, a suitable suspended string pendulum will oscillate in such a way that the bob's motion describes an ellipse for small pendulum deflections. If the motion is resolved into two perpendicular components, there will be a phase difference between those components. This experiment will investigate the relationship by measuring the oscillations with the help of two perpendicularly mounted dynamic force sensors. The amplitude of the components and their phase difference will then be evaluated.

REQUIRED APPARATUS

Quantity	Description	Number
1	SW String Pendulum Set	**1012854**
1	SW Stand Equipment Set	**1012849**
1	SW Sensors Set (230 V, 50/60 Hz)	**1012850** or
	SW Sensors Set (115 V, 50/60 Hz)	**1012851**
1	USB Oscilloscope 2x50 MHz	**1017264**

BASIC PRINCIPLES

Depending on the initial conditions, a suitable suspended string pendulum will oscillate in such a way that the bob's motion describes an ellipse for small pendulum deflections. If the motion is resolved into two perpendicular components, there will be a phase difference between those components.

This experiment will investigate the relationship by measuring the oscillations with the help of two perpendicularly mounted dynamic force sensors. The amplitude of the components and their phase difference will then be evaluated. The phase shift between the oscillations will be shown directly by displaying the oscillations on a dual-channel oscilloscope.

Three special cases shed light on the situation:

a) If the pendulum swings along the line bisecting the two force sensors, the phase shift $\varphi = 0°$.

b) If the pendulum swings along a line perpendicular to that bisecting the two force sensors, the phase shift $\varphi = 180°$.

c) If the pendulum bob moves in a circle, the phase shift $\varphi = 90°$.

EVALUATION

The oscillations are recorded by means of a storage oscilloscope and frozen on screen. The amplitude of the components and their phase difference will then be evaluated.

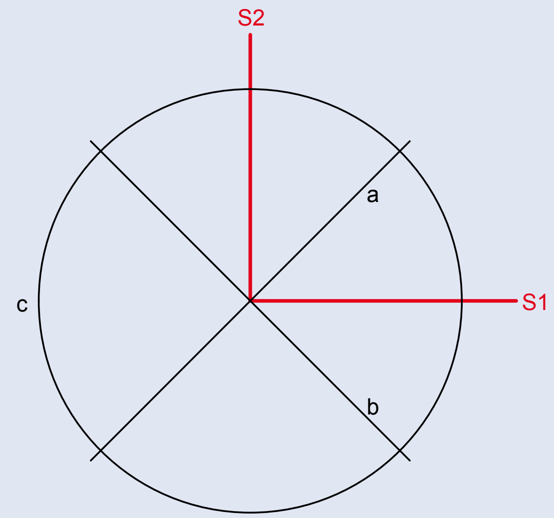


Fig. 1: The alignment of sensors S1 and S2, including the oscillation directions of the string pendulum under investigation

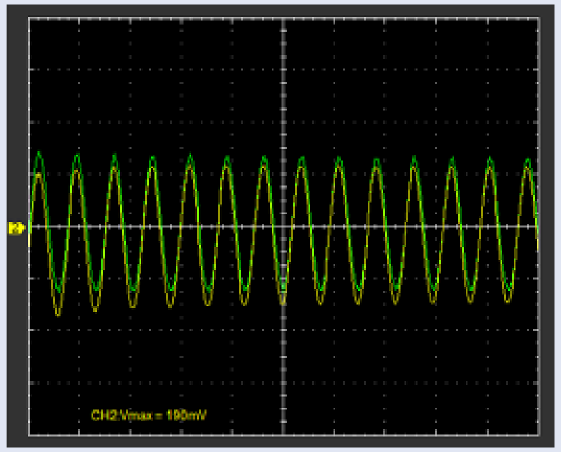


Fig. 2: Oscillation components for a string pendulum swinging along the line bisecting the two force sensors

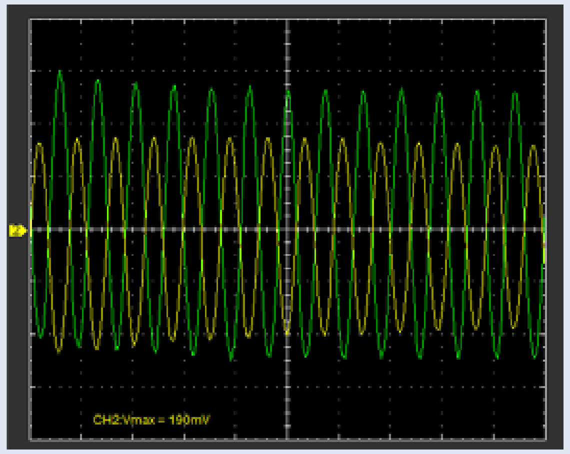


Fig. 3: Oscillation components for a string pendulum swinging along the line perpendicular to that bisecting the two force sensors

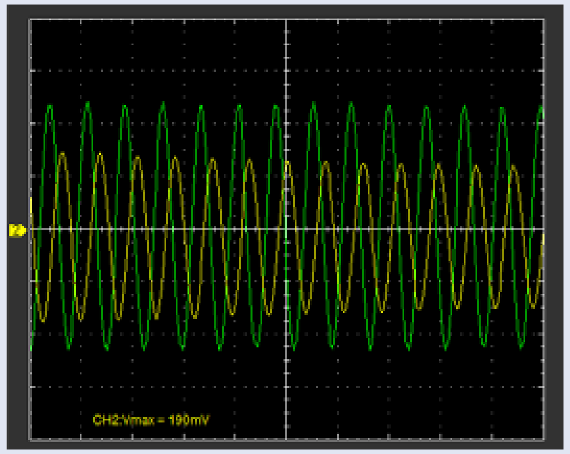


Fig. 4: Oscillation components for a string pendulum describing a circle