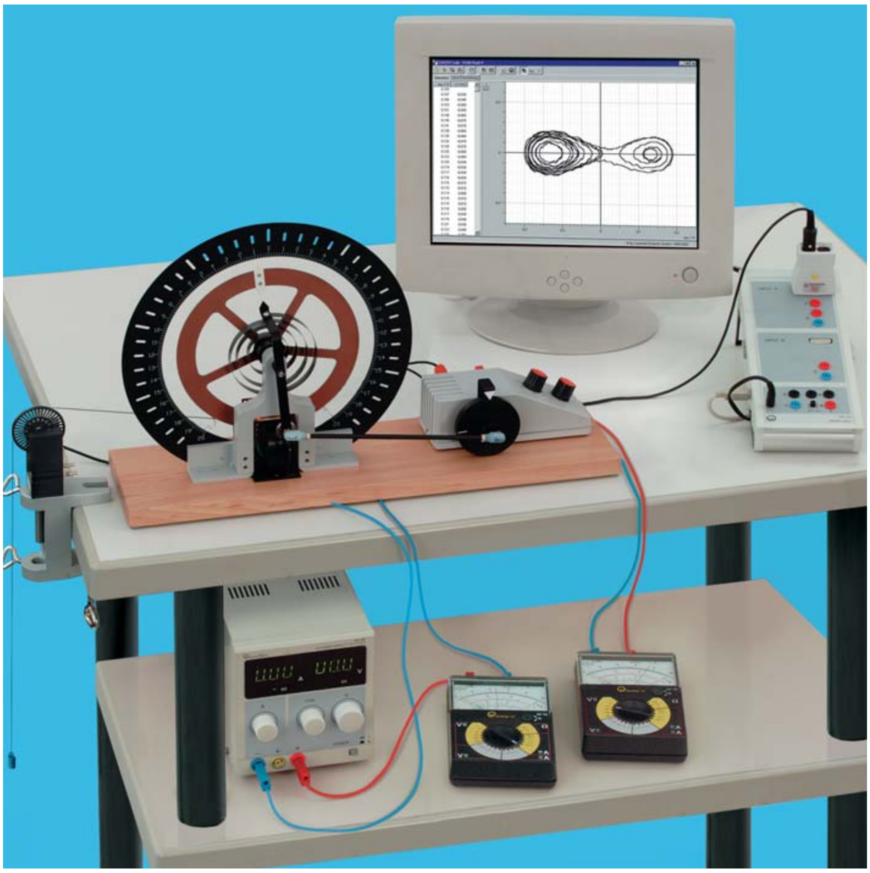


Chaotic rotational oscillations – recording with CASSY (P 1.5.3.4)

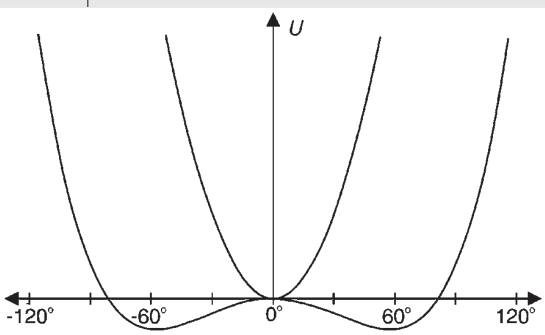
P 1.5.3

Torsion pendulum

P 1.5.3.3 CASSY-S Free rotational oscillations – recording with CASSY

P 1.5.3.4 CASSY-S Forced harmonic and chaotic rotational oscillations – recording with CASSY

Cat. No.	Description	P 1.5.3.3	P 1.5.3.4
346 00	Torsion pendulum	1	1
562 793	Plug-in power supply for torsion pendulum		1
521 545	DC power supply 0 … 16 V, 5 A	1	1
337 462	Combination light barrier	1	1
337 464	Combination spoked wheel	1	1
524 074	Timer S	1	1
501 16	Multicore cable, 6-pole, 1.5 m	1	1
524 010USB	Sensor CASSY	1	1
524 200	CASSY Lab	1	1
531 120	Ammeter, DC, $I \leq 2$ A, e.g. Multimeter LD analog 20	1	1
531 120	Voltmeter, DC, $U \leq 24$ V, e.g. Multimeter LD analog 20		1
301 07	Simple bench clamp	1	1
500 442	Connecting lead, blue, 100 cm	1	1
501 46	Pair of cables, 100 cm, red and blue	1	2
	additionally required: PC with Windows 95/98/NT or higher	1	1



Potential energy of double pendulums with and without additional mass

The computer-assisted CASSY measured-value recording system is ideal for recording and evaluating the oscillations of the torsion pendulum. The numerous evaluation options enable a comprehensive comparison between theory and experiment. Thus, for example, the recorded data can be displayed as path-time, velocity-time and acceleration-time diagrams or as a phase diagram (path-velocity diagram).

The aim of the first experiment is to investigate free harmonic rotational oscillations of the general type

$$\varphi(t) = (\varphi(0) \cdot \cos\omega t + \dot{\varphi}(0) \cdot \sin\omega t) \cdot e^{-\delta t}$$

where $\omega = \sqrt{\omega_0^2 - \delta^2}$

ω_0 : characteristic frequency of torsion pendulum

This experiment investigates the relationship between the initial deflection $\varphi(0)$ and the initial velocity $\omega(0)$. In addition, the damping constant δ is varied in order to find the current I_0 which corresponds to the aperiodic limiting case.

To investigate the transition between forced harmonic and chaotic oscillations, the linear restoring moment acting on the torsion pendulum is deliberately altered in the second experiment by attaching an additional weight to the pendulum. The restoring moment now corresponds to a potential with two minima, i.e. two equilibrium positions. When the pendulum is excited at a constant frequency, it can oscillate around the left minimum, the right minimum or back and forth between the two minima. At certain frequencies, it is not possible to predict when the pendulum will change from one minimum to another. The torsion pendulum is then oscillating in a chaotic manner.