

The Physics Experiments of Robert Wichard Pohl (1884–1976)

For decades, Robert Wichard Pohl taught his famous lectures of introductory physics in the old lecture hall of the Physics Institute at Goettingen University. These lectures became the foundation for three volumes entitled „Introduction into Physics“. Now, using Professor Pohl's original instruments in the same lecture hall in which he taught, this set of videos captures his extraordinary ingenuity and once more brings to life Pohl's great experimental skills.



Simple pendulum in a rotating reference frame

Video title: Simple pendulum in a rotating reference frame

Signature: C 14830

Series title: The Physics Experiments of Robert Wichard Pohl (1884-1976)

Abstract: The demonstration of inertial forces in accelerated frames of reference. These forces do not occur in reference frames which are not accelerated (inertial frames). Rotating frames of reference are also accelerated even when the angular velocity is constant. In such a frame, the Coriolis force acts on moving objects in a direction perpendicular to their motion. For freely moving objects, this leads to a curved path. Such paths, in the form of rosettes, will be shown for a simple pendulum swinging on a rotating chair.

Source: Pohls Einführung in die Physik - Mechanik, Akustik und Wärmelehre. Lüders, Klaus; Pohl, Robert Otto (Hrsg.) 19. Aufl., 2005, Springer Berlin Heidelberg New York; p. 94, 95

Key words: Mechanics, accelerated frames of reference, rotating frames of reference, simple pendulum, Coriolis force, rosette traces

Goal of the experiment: The demonstration of inertial forces in accelerated frames of reference. These forces do not occur in reference frames which are not accelerated (inertial frames). Rotating frames of reference are also accelerated even when the angular velocity is constant. In such a frame, the Coriolis force acts on moving objects in a direction perpendicular to their motion. For freely moving objects, this leads to a curved path. Such paths, in the form of rosettes, will be shown for a simple pendulum swinging on a rotating chair.

Experimental setup: The experimenter sits on a slowly rotating chair (in order to maintain a constant angular velocity, two large weights are attached on meter-long arms which increase the chair's rotational inertia). Before him is a small table with a pendulum suspended above it on a string. The pendulum bob contains an ink well with a small hole at its bottom, initially sealed with the finger. When it is opened, the ink jet records the trace of the bob on a sheet of blotting paper.

Experiment: The chair with the experimenter is set into motion. Two experiments are performed:
1. The pendulum is removed from its equilibrium position. When it is released, it traces the pattern of a rosette characteristic for this starting position: the pendulum misses its equilibrium position, and creates sharp corners at its maximum displacements. This experiment is in principle identical to that of the Foucault pendulum (exp. C 14832), with the earth being the rotating reference frame, the only difference being that the earth rotates ten thousand times more slowly than the rotating chair in the lecture hall.
2. The pendulum is kicked away from its equilibrium position. The rosette trace is again curved, but it now goes through the equilibrium position, and its structure is more like that of a leaf.

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Production and Distribution: IWF Wissen und Medien gGmbH, <http://www.iwf.de>, © IWF Goettingen 2006

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