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.

Gyrocompass

Video title: Gyrocompass

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

Abstract: To demonstrate the principle of a gyrocompass using a bicycle wheel on a rotating chair.

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Key words: Mechanics, gyroscope, compass, precession, accelerated frames of reference, rotating frames of reference, Coriolis force

Goal of the experiment: To demonstrate the principle of a gyrocompass using a bicycle wheel on a rotating chair.

Experimental setup: A bicycle wheel in a fork is mounted on a chair. The fork is free to rotate around its axis which is inclined 45 degrees away from the vertical. As the chair rotates, the center of the wheel moves on a circle. The motion of its axle is observed by an experimenter on the chair, and also by a stationary observer (the movie camera).

Experiment: With the chair at rest, the wheel is started to spin, its angular momentum vector pointing in an arbitrary direction. When the chair is rotated, the axle of the wheel begins to oscillate. The oscillation is damped, and after a few periods, the axle of the wheel (which indicates the direction of its angular momentum) points towards the axis of rotation of the chair. When the chair is made to rotate in the opposite direction, the wheel flips 180 degrees, and after a few periods of oscillation again points towards the axis of the chair. This is the principle of the gyrocompass which is used to determine the meridian at any point of the globe (at the latitudes of 45 degrees above and below the equator, respectively, in these examples).

Using the lecture hall as the reference frame at rest, the experiment is described as follows: The rotation of the chair causes a precession which brings the axis of the wheel into the meridian plane. In this orientation, the corresponding torque becomes ineffective since the fork does not permit a rotation of the axis of the wheel in the meridian plane. Using the rotating chair as the reference frame, one would say that the Coriolis force acting on the moving parts of the spinning wheel causes the torque which also vanishes in the equilibrium orientation.

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