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.

Conservation of angular momentum using a rotating chair

Video title: Conservation of angular momentum using a rotating chair

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

Abstract: To demonstrate the conservation of angular momentum around the vertical axis of a rotating chair.

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Key words: Mechanics, rotational inertia, angular velocity, angular momentum and its conservation

Goal of the experiment: To demonstrate the conservation of angular momentum around the vertical axis of a rotating chair.

Experimental setup: A man sitting on a rotating chair with very little friction uses weights, a spinning wheel, and a wooden hammer with a long handle to demonstrate the vector nature of the angular momentum as well as its conservation in the absence of external torques. This setup allows to limit the observation to a single (the vertical) component of the angular momentum.

Experiment:

1. The rotating chair is set into motion, with the man holding two 5 kg weights with stretched arms. By bringing the weights to his chest, the rotational inertia of man and chair is reduced, and the angular velocity increases. By stretching the arms again, the chair slows down.

2. With the chair at rest, the man receives a bicycle wheel spinning around its axle, which is held horizontally. Hence, the vertical component of the entire angular momentum of chair, man, and wheel is zero and should stay zero as the direction of the wheels axle is changed. This is indeed the case: As the axle is rotated upward into the vertical direction, the chair begins to rotate in the direction opposite to that of the spinning wheel. Rotating the axle downward makes the chair change its spin.

3. With the chair initially at rest, the hammer is first rotated around a vertical, then around a horizontal axis. The former leads to rotation of the chair in the opposite sense: The angular momentum around the vertical axis stays constant (zero). Rotation around a horizontal axis leaves the chair motionless: Since it cannot rotate around a horizontal axis, no angular momentum can be exchanged with the chair. Through a combination of both rotations, a continuous rotation of the chair can be achieved. A closely related experiment is performed by a cat which is dropped onto the floor, head first: By using its tail as „hammer", it always manages to land on its feet (so we have been told).

Scientific Contributors:

Klaus Lüders	Department of Physics, Free University Berlin, Germany
Robert Otto Pohl	Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, USA
Gustav Beuermann	I. Physical Institute, University Goettingen, Germany
Konrad Samwer	I. Physical Institute, University Goettingen, Germany

Editor:	Walter Stickan	**Sound:**	Frank Polomsky
Camera:	Kuno Lechner	**Video Editing:**	Abbas Yousefpour
Assistant:	Verena Gruber	**Technical Assistant:**	Joachim Feist

Production and Distribution: IWF Wissen und Medien gGmbH, http://www.iwf.de,

IWF Wissen und Medien gGmbH
Nonnenstieg 72, D-37075 Goettingen
Phone: +49 (0) 551 5024 0
www.iwf.de

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