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The Allais-pendulum reconsidered (on "Shadow over Gravity" of Nov, 27th 2004.)

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The Institute for Gravity Research (IGF, Am Heerbach 5, D-63857 Waldaschaff, Germany), has performed experiments with a paraconical or Allais pendulum (the type described as "a short, stiff version of the famous Foucault pendulum" by G. Schilling) from 2005 to 2007. By now, the measurements are completed and the IGF can make some contributions to the discussion on this item.

Nobel-laureate M. Allais claimed, that he detected irregularities in a paraconical pendulum's motion during the solar eclipse of 1954 [1]. Instead of only oscillating in Y-axis direction when extorted thereto for a length A, such a pendulum will also oscillate in X-axis direction with amplitude 2a due to small disturbances during the start process. Thus, the pendulum's oscillation plane is forced to rotate slowly clock- or counter-clockwise with respect to the X-Y-plane. This is called the Airy effect. However, M. Allais found, that this rotation got faster during the solar eclipse and empirically found an equation describing his observation [2]:

$$\omega = -\Omega + \tfrac{3}{8}\sqrt{g/l}\;\; a/l\; A/l\; (\tfrac{1}{2}\sin(2(-(+)\omega t + (-)\chi))).$$

In this equation, $-\Omega$ denotes the part of rotation ω caused by the Foucault effect, the rest the part of the Airy effect. But, according to M. Allais, the χ within the last term is an unknown parameter describing the rotation of a spatial anisotropy somehow correlated with luni-solar events or constellations. This parameter χ, after all, led some scientists to the conclusion, that existing gravitational theory must altered.

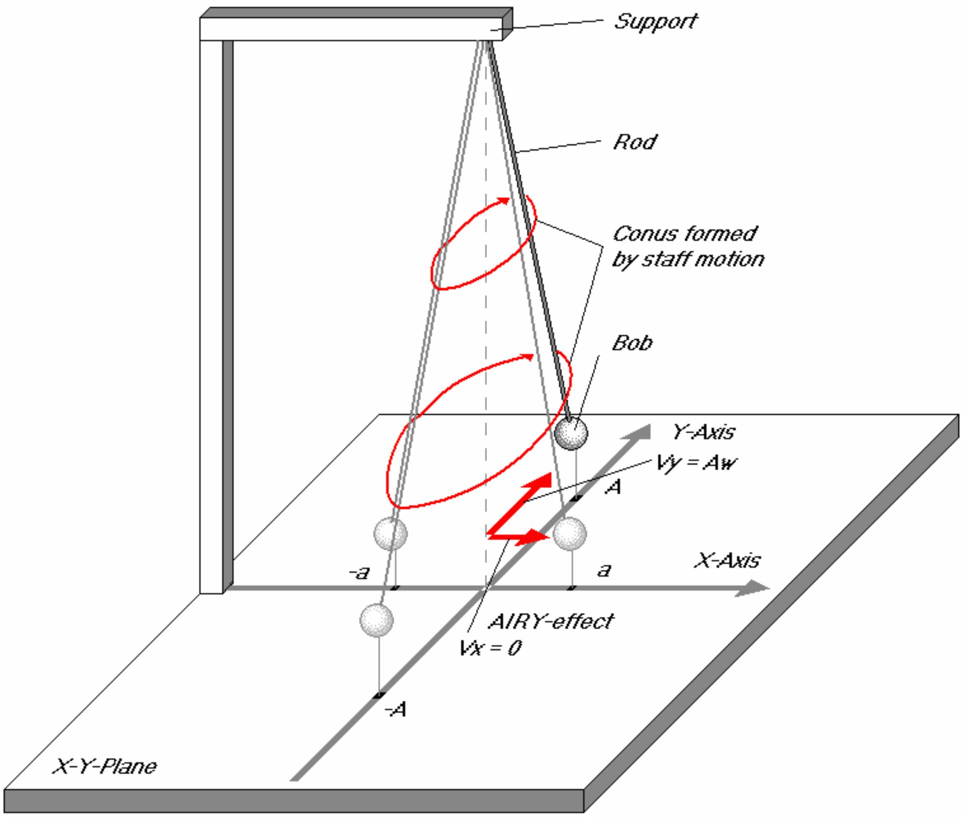

Fig. 1) Sketch of the working principle of the Paraconical Pendulum

The IGF pendulum was launched to rotate for 27 min and then brought back into its start position, extorted and launched again. Thus, 24 measurement cycles were performed each day. Resulting data had uncertainties below 1 %. During 3 min 50 s following the moment of start, the rotation of the bob was clockwise. This was clearly caused by the Foucault effect $-\Omega$. Thereafter, the Airy effect with M. Allais' χ took over more and more. The bob started to rotate erratically clock- or counter-clockwise with differing velocities. Actually, there was no hint for any correlation with celestial bodies or their constellations. Most of the observed fast rotations ω (60.57 %) showed no lunar, solar or luni-solar influences whatsoever. Instead, the IGF pendulum reacted on seismic disturbances as on earthquakes in Greece, off the Japan coast or even the only 10 km distant explosion of a bomb left over from World War 2 [3, 5].
Assuming for a moment that M. Allais was right in finding a spatial anisotropy changing in time by influence of celestial bodies or their motions, the shortest period of χ rotation must anyway be near or equal half of Earth's 24 h spin period as is demonstrated by ocean's tides. Therefore, ω should be near 30 deg / h. But the IGF pendulum showed rotations ω with up to 40 deg / h during most of all days of measurements (78.0 %).
These results agree firmly with explanations for the Allais effect cited by G. Schilling ("small seismic disturbances", etc.) and with comments in books on gravity research [4].
But what is about M. Allais' equation of motion for a paraconical pendulum's bob? A similar equation for ω can be derived by calculating the equation of motion for a body moving under harmonic force laws $Fx(y) = -m\omega^2 x(y)$ on a plane and disturbed by a small force $fx = \alpha m \omega^2 y$. Assuming a start extension $Vy = A\omega$, the equation for the body's motion on the plane is [6]:

$$L = \tfrac{1}{2}\, m\, \omega\, A^2\, \alpha\, (\tfrac{1}{2}\sin(2\omega t) - \omega t)$$

$$\omega = \sqrt{g/l}\; \alpha\, (\tfrac{1}{2}\sin(2\omega t) - \omega t)$$

Substituting α with the coefficient known from the Airy effect $\tfrac{3}{8}$ a/l A/l and adding the Foucault effect rotation $-\Omega$ to the whole system, the last equation changes to:

$$\omega = -\Omega + \tfrac{3}{8} \sqrt{g/l}\;\; a/l\; A/l\; (\tfrac{1}{2}\sin(+(-)2\omega t) - (+)\omega t).$$

Probably, the last term ωt of this equation just masqueraded as the 2χ-term in M. Allais' equation and led to the idea of an existing spatial anisotropy. However, it is just a term from a pendulum equation under special conditions and no hint for any kind of new physical laws.
The resulting theoretical trajectory of the pendulum's bob is very close to those found in the IGF experiment: an ellipse in the X-Y-plane, which becomes more and more distorted or rotated due to the Airy effect. The Foucault effect rotation is left out for clarity.

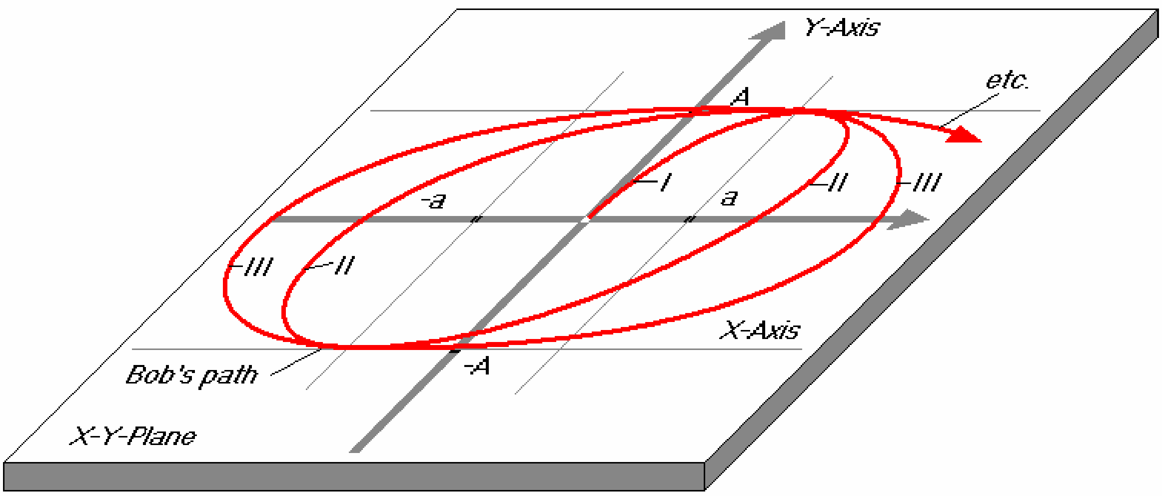

Fig. 2) Qualitative trajectory of the pendulum bob's trajectory in the X-Y-plane

Referring to these IGF results, one may conclude that there is no need for alterations in the laws of gravity in order to explain the behaviour of paraconical pendulums before, while or after solar eclipses. The fast rotations noted by some observers were most probably caused by weak or distant earthquakes or manmade disturbances (So there is no “skeleton in Einstein’s closet” awaiting discovery – Sorry).

References:

[1]	Corliss, W. R.;	The Sun and Solar System debris The Sourcebook Project
[2]	Allais, M.;	The „Allais Effect“ and my experiments with the paraconical pendulum 1954-1960 Memoir for NASA, 6-18.11.1999
[3]	Zentgraf, E;	Personal notice November 2007
[4]	Chen, Y. T.; Cook, A.;	Gravitational Experiments in the Laboratory Cambridge University Press
[5]	Junker, T;	Personal notice November 2007
[6]	Kagermann, H; Köhler, W;	Aufgabensammlung Theoretische Physik, Teil 1: Mechanik Verlag Zimmermann-Neufang – Ulmen