

Weber's Electrodynamics and Mach's Principle in the 21st Century

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The year 2004 marked the 200th anniversary of Wilhelm E. Weber (1804–1891) birth and 2005 is the 150th anniversary of Carl Friedrich Gauß' (1777–1855) death. They developed an extremely important collaboration in electromagnetism while working at Göttingen University. The exhibition "From Magnetism to Electrodynamics" at Hamburg University in 2005 is an important event in honor of these two brilliant scientists.

In this short paper we want to call attention to a few scientists who are developing nowadays a relevant experimental and theoretical work following the footsteps of Weber. Influenced by Ampère's force between current elements (1820–1826), Weber presented in 1846 a unified force law between point charges in relative motion from which he could derive the known laws of electrostatics, magnetism and electromagnetic induction. His force law included a constant "c" which was later on measured by Weber and Kohlrausch in 1855/56, indicating a direct connection between electromagnetism and optics. Weber also worked with a similar force law between masses in relative motion interacting with one another gravitationally.

In recent years there has been a renewed interest in Ampère's force between current elements and in Weber's law as applied to electromagnetism and gravitation. It has been shown that this force law leads to a complete mathematical implementation of Mach's principle (1883) according to which the inertia of any body is due to its gravitational interaction with the distant bodies in the cosmos. Other topics studied nowadays include longitudinal forces, exploding wire phenomena, railguns, unipolar induction, propagation of electromagnetic signals in wires and in space, effective inertial mass depending on the potential where the particle is located, anisotropy of inertia, force exerted by a resistive wire carrying a steady current upon an external point charge at rest relative to it, centrifugal electrical force etc.

Below we list a few scientists with whom we had some kind of contact and who are working in some of these areas, divided by the countries where they live. References to their papers can be found in our books "Weber's Electrodynamics", "Inductance and Force Calculations in Electrical Circuits" and "Relational Mechanics" (see details in the homepage <http://www.ifi.unicamp.br/~assis>).

More information can be found, for instance, in the Web of Science

(<http://isi02.isiknowledge.com/portal.cgi/wos>)

or in Google Scholar (<http://scholar.google.com/>).

Germany (K. H. Wiederkehr, H. J. Treder, H. H. von Borzeszkowski, J. P. Wesley, G. Galeczki, P. Marquardt), USA (T. E. Phipps Jr., D. E. Spencer, C. W. Lucas Jr., F. J. Müller, P. Graneau, C. Dulaney, L. Hecht, J. Fukai, C. K. Whitney, P. B. Eby, R. Sansbury, D. F. Bartlett, W. F. Edwards, O. Jefimenko), UK (D. F. Roscoe, N. Graneau), Argentina (J. Guala-Valverde, J. Tramaglia, R. Rapacioli), Ireland (Al Kelly), Kazakhstan (V. F. Mikhailov), France (C. Blondel, O. Costa de Beauregard, P. Cornille), Italy (U. Bartocci, M. M. Capria), Greece (P. T. Pappas, P. G. Moyssides) etc. These scientists guarantee that the research on these topics will remain alive and thriving well into the 21st century!

Humboldt fellowship in the Institute for History of Science of Hamburg University, August 2001 until November 2002

Owing to a hint of my host professor Dr. Karin Reich during my one and a half year's stay at the Institute for History of Science in Hamburg, which I was granted by the Humboldt-Stiftung, I translated the *INTENSITAS* (1832), Gauß' basic work for absolute measurements, into Portuguese language:

A INTENSIDADE DA FORÇA MAGNÉTICA TERRESTRE REDUZIDA A MEDIDA ABSOLUTA. Übersetzt auf der Grundlage der Ausgabe von Dorn 1894 von A. K. T. Assis. In: *Revista Brasileira de Ensino de Física* 25 (2003), Nr. 2, p. 226–249.

The three treatises mentioned below were written and published in close cooperation in addition to some other essays:

Assis, A.K.T.; Reich, K. and K.H. Wiederkehr: Gauss and Weber's Creation of the Absolute System of Units in Physics. In: *21st Century, Science and Technology* (2002), S. 40–48.

Assis, A.K.T.; Reich, K. and K.H. Wiederkehr: Weber quoting Maxwell. Zur Auseinandersetzung zwischen der Weberschen Theorie der Elektrizität und der aufkommenden Maxwellschen Elektrodynamik. In: *Mitteilungen der Gauß-Gesellschaft* 40 (2003), S. 53–74.

Assis, A.K.T.; Reich, K. and K.H. Wiederkehr: On the Electromagnetic and Electrostatic Units of Current and the Meaning of the Absolute System of Units. In: *Sudhoffs Archiv* 88 (2004), Heft 1, S. 10–31.

Acknowledgements

This paper is dedicated to Karl-Heinrich Wiederkehr, the world leader in the knowledge of Weber's life and work. He has spent decades of his life researching Weber's electrodynamics and related topics. I have profited greatly from many exchanges of ideas with him. I hope his energy, dedication and enthusiasm will continue to inspire other young scientists to delve into this fundamental area of research which can pave the way to a better science in this new century.