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Highlights

School on Quantum Metrology and Fundamental Constants Held at Centre de Physique des Houches, France

November, 2007 - An international school on « Quantum Metrology and Fundamental Constants » was held at Centre de Physique des Houches in France, from 1 to 12 October 2007. The school was organised by LNE and METAS, the National Metrology Institutes (NMIs) of France and Switzerland respectively. In addition to LNE and METAS, the school was sponsored by two regional organisms “Nanosciences - Ile de France” and “Région - Rhône Alpes” sponsored and the French Ministry of Foreign Affairs. The school was intended for young researchers between 25 and 40 years old (PhD students, postdoctoral position or permanent staff) coming from universities, research centers and NMIs.
The school gathered 83 participants (48 students, 32 lecturers and 3 organisers, see Fig 1 and 2 below) from 20 countries. One third of the participants came from the academic area, the two other thirds came from NMIs. The program included 33 lectures (50 min) and two poster sessions (about 4 hours each, 43 posters) during which the students presented their work. A debate closed the school by going back to the key questions presented at the beginning of the school.
Detailed program, slides of the lectures and posters are available at:
http://www.metas.ch/LesHouches/lectures.htm

Fig.1 1st week

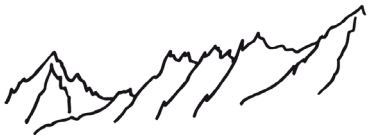
Fig. 2nd week

The aim of the school program was to present the implications of quantum mechanics in the field of metrology and to give an outlook on possible developments. The lectures successfully reviewed the SI, fundamental physical constants, quantum standards and quantum metrology techniques, by covering both theoretical and experimental aspects. Major subjects were tackled, such as the present and future SI, the

constants of Nature and their determinations (□, R_∞, h, N_A, k_B …) through different sets of experiences (measurement of g-2, h/m ratios, watt balances, X-ray crystal density measurements of Si spheres, quantum metrological triangles, test of the Einstein relation …), and the adjustment of the values of the fundamental constants by the CODATA group. Great progress and very recent results have been reported both on the determination of constants and on the maintenance of fundamental units (atomic fountains, optical clocks, electrical quantum standards, thermometers based on Coulomb Blockade and on shot noise, ...). Universality tests have been discussed. There were general lectures which have not yet been given a the other schools on metrology. They dealt with the main manufacturing techniques in micro and nanotechnology, the general methods for ultra low noise measurements, the use of mathematical tools in data analysis (Allan Variances) or for uncertainty evaluation (recent method involving distribution propagation by means of Monte Carlo simulation) and specific measurement techniques used in several domains (thermometry, electricity, spectrometry …) and implying quantum devices such as SQUIDs.

The school has resulted in a very fruitful meeting of two communities (atomic and solid state physics), which usually don't come together. As expected, the different (« opposite ») sensibilities and points of view have been expressed during these two weeks, mainly focused on the confidence questions about quantum phenomena, their exactness, and on the key issues about the future reform of the International System of units (SI) with the ultimate goal of defining all units in terms of fundamental constants.

Proceedings of peer-reviewed lectures will be published in 2008 in the series of European Journal of Physics - Special Topics, edited by EDP Science and Springer.

LES HOUCHES 

Contact : Organizing committee
François PIQUEMAL – Tel. : (33) 1 30 69 21 73 – francois.piquemal@lne.fr