Physics in The Netherlands

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English contains a number of expressions where the word "Dutch" has a negative connotation. Wars between the Dutch and the English in the 17th century must be responsible for this. However, there is one definite exception: Dutch physics, which in the United States is synonymous with **statistical physics** reflecting the impact of intellectual giants such as Lorentz, Kamerlingh Onnes, Van der Waals and Zeeman, all of whom have laboratories named after themselves.

Statistical physics remains one of the strong points of physics research in The Netherlands. Examples include the work on light induced drift (Woerdman, University of Leiden — see box: The Optical Piston) and on atomic hydrogen (Walraven, University of Amsterdam), simulations of crystals (Frenkel and Ernst, University of Utrecht) and the widely acclaimed work on the physics of colloids by Vrij (also at the University of Utrecht).

One of the reasons for the success in The Netherlands of experimental work in "small science" fields like statistical physics is the fact that Dutch instrument makers are among the best in the world. They form part of a long tradition going back to the likes of Van Leeuwenhoek, Van Musschenbroek and Stevin.

Atomic physics and **quantum electronics** are two other fields of small science to which Dutch physicists have contributed greatly. Among the many possible examples of topics that have yielded remarkable results we have the study of the localization of light (Lagendijk, University of Amsterdam — see box). One should also not forget measurements of the wave function of electrons (see box: Electron Wave Function Measured) and of the onset of melting in solids (H.B. Van Linden van den Heuvell and colleagues and Van der Veen and Frenken respectively, at the FOM — Institute for Atomic and Molecular Physics, Amsterdam).

Important results have also been reported by groups working in **condensed matter physics** including, for instance, quantized conductivity between point contacts (discovered by Van Wees and coworkers, University of Delft and Philips, Eindhoven), the production of sandwiched high T_c superconducting films (Rogalla, University of Enschede) and theoretical work on these new ceramic superconductors (Sawatzky, University of Groningen).

But Dutch physicists have also been working for a long time in the fields of **high energy physics** and **nuclear physics**. The names 'tHooft and Van der Meer immediately jump to mind. Nuclear physicists at NIKHEF in Amsterdam helped gather evidence that nucleons are smaller outside the nucleus than when packed together with other nucleons inside it. However, recent work suggests that the effect may be less dramatic than was thought first.

Young Dutch postdocs in theoretical high energy physics seem to be swarming in such numbers all over the world that The Netherlands is apparently exporting not only flowers, bulbs, cheese and astronomers but also high energy physicists.

Structure

There is probably no other country with more research laboratories belonging to large companies per square kilometre than The Netherlands. In addition to hosting dozens of small industrial laboratories, it is the base for the research centres of commercial giants such as Philips, Shell, Unilever, DSM and AKZO. Several sizeable technological institutes, financed to some extent

The Optical Piston

Light induced drift can occur when a gas mixture (*e.g.* Na:Ar) is illuminated by a laser beam. If the laser is tuned to one of the Doppler wings of the Na absorption line, the Na atoms will move through the buffer gas as a result of velocity selective excitation combined with the state dependent collisional interaction between the Na and Ar atoms. A group at the University of Leiden led by H. Woerdman has been working on this phenomenon and on a whole range of related light induced kinetic effects.

The optical piston is a dramatic manifestation of light induced drift. A mixture of Na and Ar vapour, homogeneously filling a capillary, is illuminated by a beam from a CW dye laser tuned in near resonance with a Na absorption line. The laser light pushes the Na atoms together into a steep front (the Na vapour is optically thick) which slowly travels through the capillary.

The figure gives a series of photos demonstrating the optical piston. The laser beam passes from left to right through a 15 cm long capillary containing the gas mixture. The bright spot in successive frames, starting at the top, taken every 30 seconds indicates the location of the high density Na front as it travels down the capillary. The part of the capillary that has been swept clear by the piston weakly fluoresces; the right-hand side of the capillary is dark since the laser light cannot penetrate into this region.

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