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## EPS HISTORIC SITES

# Kamerlingh Onnes Laboratory and Lorentz Institute Leiden, The Netherlands 'The coldest place on earth'

On 9 February 2015, the site of the former Physics Laboratory of Leiden University was officially recognised as one of the 'EPS Historic Sites' of the European Physical Society. On that day EPS president-elect Christophe Rossel unveiled the commemorative plaque near the present-day entrance to the complex (since 2004 the location of Leiden University's Law Faculty).

The tablet is only a few meters away from the bronze bust of the man who made the building famous: Heike Kamerlingh Onnes. The text of the plaque reads:

### European Physical Society – EPS Historic Site

#### *Kamerlingh Onnes Laboratory and Lorentz Institute*

Here, in 1908, Heike Kamerlingh Onnes first succeeded in liquefying helium. This opened up a wide field of low-temperature experiments, and led to the discovery of superconductivity in 1911.

Here, in 1896, Pieter Zeeman discovered the splitting of atomic spectral lines by a magnetic field. Hendrik Lorentz interpreted this as an effect of the magnetic force on the oscillation of hypothetical charged particles, which later became known as electrons.

In 1859, a complex was built to accommodate the chemistry, physics and anatomy departments of Leiden University, in the heart of Leiden on Steenshuur, the location which has now been honoured by the EPS. Eight years later, a new building arose at the back side of the complex. This was the new Physiological Laboratory, led by Willem Einthoven, the inventor of the electrocardiograph.

### Two explosions

And so at last the gaping hole was filled which an exploding gunpowder ship had left by ruining dozens of houses along Rapenburg, on 12 January 1807. It was a devastating explosion which, as Carlo Beenakker (Lorentz Institute) so aptly put it at the official ceremony on last February 9, was followed around the turn of the century by a second blast – meaning the



sparkling research produced by Leiden's physicists.

Physics in Leiden had already begun to sparkle in 1873, when Johannes Diderik van der Waals obtained his doctorate in Leiden with a thesis entitled *Over de continuïteit van den gas- en vloeistoestand* (On the continuity of the gaseous and liquid state). The equation of state and the law of corresponding states which he formulated in this pioneering study were at the heart of a programme later carried out by Heike Kamerlingh Onnes, who had been appointed Professor of Experimental Physics in Leiden in 1882. Heike was a man of vision, patience, stamina, great organizational skills, diplomacy, guts and a gift for getting his way, all of which he used to create from scratch a cryogenics laboratory second to none in the world – a forerunner of Big Science.

### Coldest place on earth

On 10 July his programme led to a first major success when he succeeded in liquefying helium at a temperature of 4 kelvin (and by evacuating the helium in an attempt to solidify it, Kamerlingh Onnes achieved a temperature of approx. 2 kelvin that same day). Leiden held on to its monopoly position on liquid helium until 1923 and remained 'the coldest place on earth' into the 1930s. In 1911 Kamerlingh Onnes and his research staff (including Gilles Holst, the first

director of Philips Research or NatLab as it was then called) also discovered superconductivity. A century later, this discovery was distinguished with a 'Milestone Award' by the IEEE. For his pioneering helium research, Kamerlingh Onnes received the Nobel prize in 1913.

### Theoretical breakthroughs

In addition to these experimental feats, Leiden made considerable theoretical contributions in the post-Van der Waals era. In 1877 Hendrik Antoon Lorentz was appointed Professor of Theoretical Physics, one of the first in Europe to hold such a chair. His research concerned the interaction between light and matter. In the 1890s he published his 'electron theory' based on the atomistic structure of electricity. When in 1896 Pieter Zeeman, assistant to both Kamerlingh Onnes and Lorentz, discovered the effect of a magnetic field on the D spectral line of sodium (initially a broadening of the line, followed by splitting in later more accurate experiments), Lorentz came up with an explanation based on his electron theory within days. The polarization of light from the edges of the sodium line which Lorentz had also predicted in passing was actually observed by Zeeman in a follow-up experiment. In 1902 the two physicists were awarded the Nobel prize for the discovery of the so-called 'Zeeman effect' and Lorentz' explanation.

▲ The Kamerlingh Onnes building and a part of the canal where in 1807 a gunpowder ship exploded, destroying many houses and making place for the laboratory.

▼ Jan van Ruitenbeek, president of the Dutch Physical Society (left) and Christophe Rossel, president-elect of the EPS, near the commemorative plaque

### More Nobel prizes

In 1912 Lorentz left to become *curator* of the Physics Cabinet at Teylers Museum in Haarlem. His successor in Leiden was Paul Ehrenfest, a colourful physicist who organized weekly colloquia to discuss the latest developments in the field of theoretical physics with great gusto and without mincing words – the Colloquia Ehrenfestii still exist. Among Ehrenfest's students were Samuel Goudsmit and George Uhlenbeck, who discovered the electron spin in 1925. Another student was Jan Tinbergen, who obtained his doctorate under Ehrenfest with a thesis on an econometric subject in 1929. Forty years later he became the first Nobel prize winner in this new discipline. All these theoretical physicists operated from their own institute, located next to the boiler house of the Physics Laboratory – it was renamed Kamerlingh Onnes Laboratory in 1932. When the Physiological Laboratory moved to new premises in the 1960s and made way for new buildings to house the Physics Department, the Leiden theoreticians were given their own *Instituut-Lorentz* on the third floor.

The list of pioneering scientists in Leiden who engineered the 'second blast' on Steenshuur would not be complete without Willem Einthoven. In 1903 this physiologist developed an extremely sensitive and fast string galvanometer, making it the core of a device used to record heart sounds: the electrocardiograph. Einthoven received the Nobel Prize for Physiology in 1924.

Six Nobel Prizes within the space of 25 years on a piece of land measuring less than a hectare: worthy of an 'EPS Historic Site'! ■

■ Dirk van Delft  
Leiden University

