The *annus mirabilis* 1905

In 1905 Einstein publishes a total of twenty-six scientific articles, including his dissertation on molecular dimensions. This is an astonishing amount of work, even if the majority are just brief reviews with which he earns a little extra income. Three of his works, though, about the light quantum hypothesis, the Brownian motion, and the electrodynamics of moving bodies each unleash a scientific revolution. In yet another work this year, he derives a relationship between the energy and mass of a body. Its representation is arguably the most famous equation in the world, $E = mc^2$. These works and their repercussions dramatically alter the understanding of space and time, of matter and radiation. The year 1905 marks the transition from classical to modern physics. Today's modern physics is still characterized by the tension between quantum theory and relativity theory. Both have their genesis in Einstein's revolutionary works.

The revolutionary

How is it possible to achieve so many scientific breakthroughs with such far reaching consequences in so many different fields, fields that, at first glance, have very little to do with one another? An answer to this question must take into account both the history of science as well as Einstein's exceptional perspective on this body of knowledge. The tensions inherent in the classical physics that Einstein learns in his early studies come to a head at the turn of the century. They emerge in problems lying at the borderlines between mechanics, electrodynamics, and thermodynamics. Einstein's breakthrough comes with his novel interpretation of the solutions proposed by the masters of classical physics for these borderline problems. His perspective on the borderline problems is initially characterized by his search for a conceptual unity in physics, which he hopes to find on the basis of an atomic theory. In order to broaden the scope of the atomic hypothesis and find proof for the reality of atoms, Einstein develops statistical mechanics based on Boltzmann's kinetic theory of gases between 1902 and 1904. This provides clues about observable fluctuations and eventually leads Einstein to interpret the long-known Brownian motion as such a fluctuation phenomenon. Based on considerations of statistical physics, he can further show that Planck's formula for thermal radiation's energy distribution is not concordant with the classical idea of radiation as a wave phenomenon in a continuous aether. With the assumption of atomic light quanta Einstein manages to find a new, albeit only partial interpretation of Planck's formula as well as explain peculiarities in the interaction of radiation and matter.

In contrast, the attempts to transfer the relativity principle of mechanics to electrodynamics with the aid of an atomic theory of radiation go awry. Einstein undertakes such attempts, among other reason, to explain the interaction between a magnet and a coil, independent of assuming which of the two moves in relation to the aether. Einstein is caught between having to accept the validity of Lorentz's electrodynamics and being unable to accept its assumption of aether. As an outcome of this predicament Einstein formulates new conceptions of space and time in his theory of relativity.