Selected Topics in Physics (Prof. K. Franke) June 16th, 2013
Talk by Valentin Müller

Raman scattering

The awakened giant

In 1928, C. V. Raman discovered the inelastic scattering of light, which is nowadays known as *Raman scattering*. The Nobel committee soon recognized the importance of his results and awarded him the Nobel prize in 1930. The intention of this talk will be to provide a feeling for the variety and importance of applications which utilize Raman scattering.

We will start with briefly discussing two approaches towards explaining the physical principles behind Raman scattering. The classical approach treats the target molecule as an oscillating dipole, which is driven by the electric field of the incident light wave. A frequency beating with molecular vibrations is then responsible for the frequency shift of the re-emitted light. However, a complete understanding of the effect is only possible with the quantum-mechanical approach, which will be introduced as well.

The second part of the talk will start with an overview over some possible applications. The focus will then lie on *Raman spectroscopy*, which is arguably the most important and promising implementation of the Raman effect. It correlates the observed frequency shifts with the vibrational spectrum of the sample. Since this vibrational "fingerprint" is unique for most molecules it can be used to identify unknown substances. Portable Raman scanners are already in use by US narcotic squads and airports to detect drugs. Finally, we will get to know a possibility to overcome the problem of relatively weak Raman signals: Surface-enhanced Raman spectroscopy.

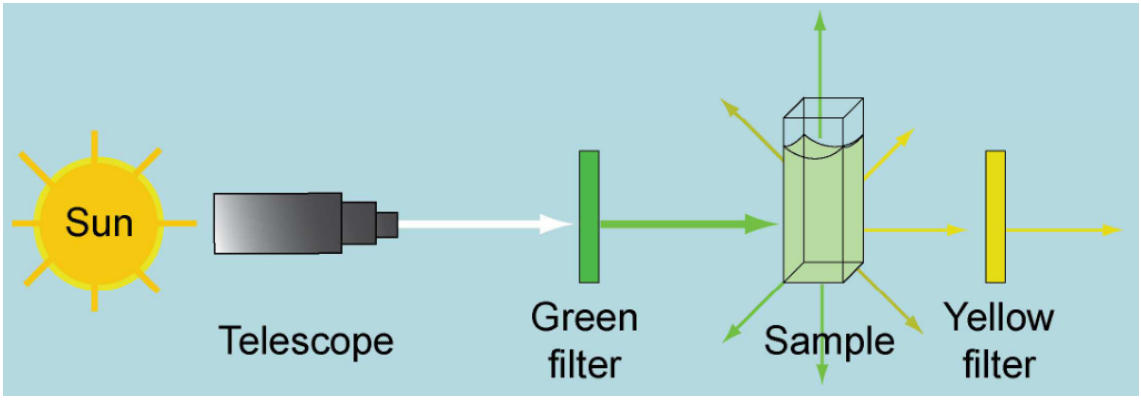

Figure 1: Schematic diagram of the original setup which led to the discovery of the Raman effect. (This picture is taken from Bailo, E. (2009): *Nanoscale Tip-enhanced Raman Scattering (TERS) for Biomolecular Analyses.* (Doctoral dissertation). Technische Universität Dortmund.)