

# Physikalisches Kolloquium



**Thursday, 23.01.2020, 16:15, HS 100**  
**Reception with coffee & cookies 15:45**  
(For university staff: please bring your own cup for sustainability reasons)

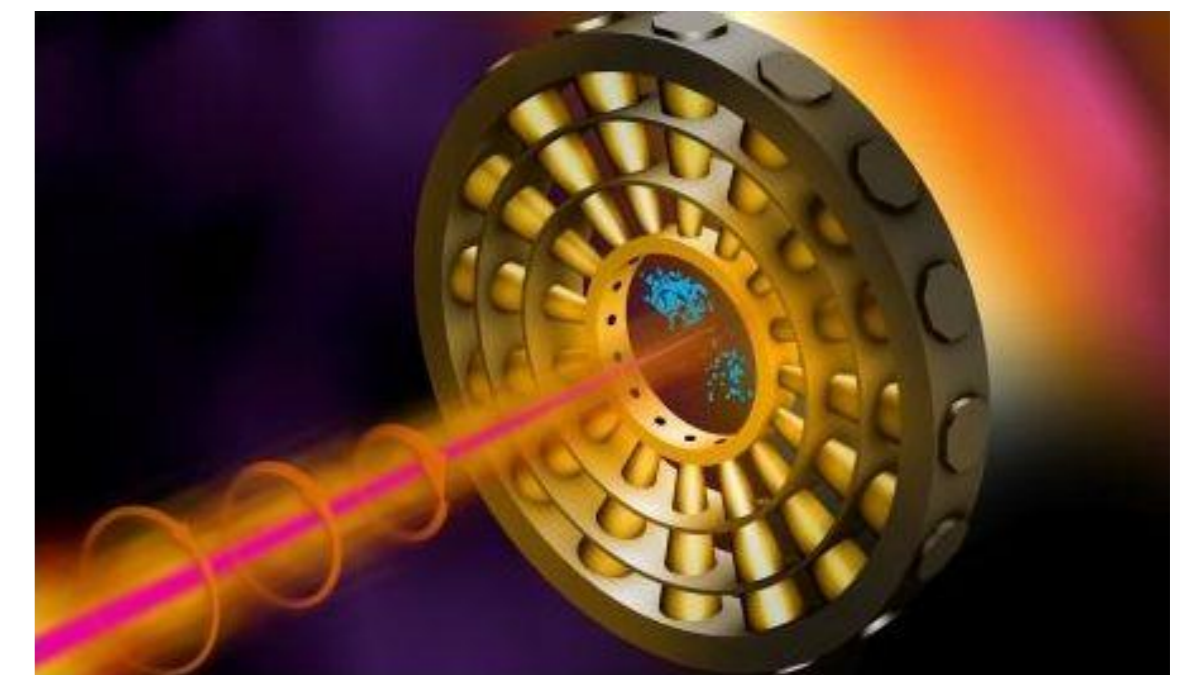
**Prof. Dr. Thomas Feurer, IAP, University of Bern, Switzerland**

## *Nonlinear X-Ray Phenomena*

### **Abstract**

X-ray Free Electron Lasers have brought us a step closer to observing nuclear and electronic motion in real time and at atomic length scales. Their ultrashort pulses allow for dynamical studies of light-matter interaction in any medium on relevant space- and time-scales, from vibrations in molecules to phonons in strongly correlated solids, via nonlinear spectroscopy. In the extreme case of attosecond X-ray pulses we may even be able to observe electronic motion in real time.

Today, most of these lasers produce bursts of amplified noise, i.e. their pulses fluctuate randomly from shot to shot. I will discuss our efforts to experimentally verify what has been predicted via elaborate simulations and also ways to fully characterize such pulses on a single shot basis. A further use of such pulses for X-ray nonlinear spectroscopies relies on a dramatic improvement of longitudinal coherence. To date there are two viable schemes to improve the longitudinal coherence, either via external seeding or via self-seeding. In the remainder of the talk I will discuss two experiments, both involving nonlinear X-ray processes, which are possible only when exploiting the longitudinal coherence. The first one is concerned with X-ray transient grating experiments, an exciting tool since decades in the optical regime to study different types of transport phenomena. With X-rays we now can exploit the short wavelength to access k-parameters potentially throughout the entire Brillouin zone. The second experiment demonstrates highly asymmetric parametric down-conversion of X-ray photons in order to produce pairs of entangled photons consisting of an X-ray and a visible photon. In both cases I will present proof of principle experiments and try to give a perspective as to where they may lead.



**All of you interested in physics are cordially invited!**