SYEN 1: Entanglement in Experiments

Time: Monday 16:30–17:10 Location: Audimax

Invited Talk SYEN 1.1 Mon 16:30 Audimax

Squeezed and entangled light - now exploited by all gravitational-wave observatories — •Roman Schnabel — Institut für Laserphysik und Zentrum für Optische Quantentechnologien, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

Since 2010, the gravitational-wave (GW) detector GEO600 has been using light with a squeezed quantum uncertainty in basically all of its searches for GWs. The successful nonclassical sensitivity improvement that was achieved with the squeeze laser built in my group [1] triggered the implementation of squeeze lasers also in Advanced LIGO and Advanced Virgo. Since April 1st, 2019, these observatories have provided an increased GW event rate of up to 50% that is due to the exploitation of squeezed states of light [2,3,4]. Injecting a squeezed laser field into an interferometer generates strong entanglement between the light fields in the two arms [5]. The entanglement is actually the quantum resource that reduces the measurement noise behind the differential arm length signal below the semi-classical limit. In this talk, I explain how squeezed and high-quality entanglement (Einstein-Podolsky-Rosen-entanglement) has been produced in my laboratories over the past 15 years, with the goal to improve GW observatories and to enable otherwise impossible applications.

[1] LIGO Scientific Collaboration, Nature Physics 7, 962 (2011);
[2] M. Tse et al., Phys. Rev. Lett. 123, 231107 (2019);
[3] F. Acernese et al., Phys. Rev. Lett. 123, 231108 (2019);
[4] R. Schnabel, Annalen der Physik 532, 1900508 (2020);
[5] T. Eberle et al., Phys. Rev. A 83, 052329 (2011).