

Project:

Multi-particle entanglement in critical and distributed quantum systems

Quantum mechanical systems such as atoms or field modes of light can exhibit correlations that are in a sense stronger than attainable in classical physical systems. Entanglement, which manifests itself in such genuine quantum correlations, can indeed be viewed as the most radical and furthest departure of quantum from classical mechanics. In the field of quantum information science, entanglement is at the heart of most applications and protocols and is commonly regarded as the resource to accomplish quantum information processing tasks. The theory of entanglement aims at fleshing out this resource character, and at understanding the specific role this key ingredient plays in quantum information science. Very recently yet, it has become evident that the methods that have been developed in the field of quantum information science may lead to significant new insights into the understanding of quantum systems embodying a large number of or infinitely many constituents, for example concerning their critical behaviour. Conversely, the study of many body systems may lead to novel implications for quantum information science. This project aims at innovating tools to understand multi particle entanglement in critical and distributed systems in its various aspects. More specifically, the key aim of this research is to study distributed many body quantum systems with respect to 1) the role of quantum correlations in critical phenomena and phase transitions 2) their statistical properties 3) their potential for applications in quantum information processing and 4) the possibilities of quantum information applications with multi mode light.. Key steps will be the understanding of the role of superselection rules in the scaling of entanglement and correlation lengths, the establishment of an entanglement holographic principle, the development of novel measurement based quantum computation schemes that make use of only a very restricted set of measurements and the development of new applications of quantum information science with multi mode light with quantum optical methods.

Comments:

The main topic, quantum entanglement, is timely and important. Within this topic, the proposal is standing very high, making connections to neighbouring domains and has a true interdisciplinary character. It has potential impact in both fundamental and applied physics.

This is a highly impressive proposal, adventurous and daring. It contains a large list of subjects, that span many different problems, some purely theoretical and fundamental, some leading to technological applications.

The host institution is one of the top 3 laboratories in the UK, and a most adequate location for this research.

Nationality: German / Swedish

Address: Institute of Physics, University of Postdam, Am Neuen Palais 10,
Postdam D-10115, Germany

Current institution: Institute of Physics, University of Postdam

New institution: Imperial College of Science, Technology & Medicine

Media Enquiries:



Jens Degett, ESF Communications Director

European Science Foundation, Strasbourg, France

Tel: +33 (0)3 88 76 71 32 – Fax: +33 (0)3 88 37 05 32 Email: jdegett@esf.org

