

IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Gravity and Fundamental Physics (1)

Author: Prof. Claus Lämmerzahl
ZARM Fab GmbH, Germany, claus.laemmerzahl@zarm.uni-bremen.de

WHAT IS SPECIAL ABOUT QUANTUM TECHNOLOGY?

Abstract

Quantum technologies become more and more important. There is, for example, a European Research flagship on Quantum Technologies, one is talking about using quantum computers in the near future for solving real problems for the first time, one plans to use quantum cryptography having the advantage that it cannot be decoded, there was a Chinese mission which realized the entanglement of quantum states on a satellite with states on the Earth, one is building quantum sensors for geodesy, positioning, and navigation, and one now will base the international system of physical units on quantum realizations replacing analogue units like the Paris kilogram prototype which still is in use. Why there are so many activities in the direction of quantum technology?

Quantum technologies are based on quantum systems. The speciality of quantum systems lies in the fact that they are unique. They can be uniquely characterized by a finite number of rational numbers. As a consequence, by giving some rational numbers, everybody in the universe can build a particular atom and extract a particular frequency which then may serve as universal time standard, for example. Furthermore, quantum systems are given. They cannot be machined and need not to be machined. They are everywhere in the universe uniquely and unchangeably given. The "only" work left for physicists is to read out the characteristic frequencies or other unique properties of the given quantum systems.

This uniqueness, complemented by the special features of the measurement process and the linear evolution of the quantum systems then makes such systems perfect for all the purposes and applications described above. In this talk we will describe these unique features, their fundamental consequences, as well as their practical applications. We also address the role of the fundamental physical laws.