

## Summary for general public

Current research in physics of particles and fields explore a wide range of energies and the measurements have to be performed with very high accuracy. Spectrum of energies is needed to investigate the structure of matter at different scales of size and precision is required in order to measure subtle and elusive phenomena.

One of the few experimental endeavours at low energy in particle physics is KLOE-2, an experiment performed at the Italian National Laboratory in Frascati near Rome, with participation of the group of Polish physicists from the National Centre for Nuclear Research and the Jagiellonian University. This research is pursued using the DAPHNE accelerator, called the European Phi Factory, where electrons and positrons are collided at energy of 1020 MeV. This energy corresponds to the  $\phi$  resonance mass. Due to that, the probability of collisions is high and the resonance decay products have well-defined properties.

Research pursued by the group aims to elucidate a couple of fundamental issues. First, it is going to determine the frequency of production of some rare mesonic states in order to understand their structure and discriminate between models describing them. Their quark structure can be very exotic, different than that of ordinary mesons, or even they may consist of only gluons – objects carrying strong interactions and similar rather to the radiation than matter. The second is investigation if the world of weak interactions is the same after time reversal or after reflection in a mirror. These problems are nowadays studied in depth in many processes and energy scales. They are crucial for our understanding not only the theory of interactions but also structure of the Universe. Another issue is the validity of the basic feature of the quantum mechanics, namely the existence of decoherence of quantum states, i.e. whether or not superposition of states persists during time evolution or is disturbed due to interactions with gravity.