Circadian rhythms have been detected in almost all organisms. They have developed under the selective pressure of a periodic environment and result from the adaptation to cyclical changes in light intensity, temperature and food availability. Thus, physiological and biochemical processes are rhythmic, with a period of about 24 h; animals also show rhythmic behavior. These rhythms are maintained under constant temperature and darkness, a condition referred to as DD. Light/dark conditions (LD) entrain circadian rhythms, thus their period becomes equal to 24 h. Circadian rhythms and their endogenous generators, so-called circadian clocks, have mostly been studied in mice and in the fruit fly *Drosophila melanogaster*. These studies have shown that the molecular mechanism of the clock in *D. melanogaster* is very similar to that in mice. Thus, results obtained in studies on the fruit fly can be translated to understand the mechanisms of rhythmic change in physiological processes in mammals, including humans.

Circadian neuronal plasticity is one of the most important mechanisms regulating daily changes in behavior, like sleep and activity, as well as processes of memory and learning. *D. melanogaster* is a particularly good model for neuroscience research, because of reduced ethical concerns and the available arsenal of molecular tools. Furthermore, daily changes can be observed in many neuronal parameters, such as morphology, axonal size, dendritic tree size and shape, branching complexity of processes and number of synapses. These rhythms are very important for normal brain function. It has been shown that clock gene mutants have abnormalities in neuronal morphology and branching of motor neurons, which affects their function.

Autophagy is a self-degradative process which plays a role in removing misfolded or aggregated proteins, clearing damaged organelles, but also in changes of cell membrane size and shape. Autophagy delivers cytoplasmic cargo to the lysosome through the intermediary of a double membrane-bound vesicle (autophagosome), that fuses with the lysosome to form autolysosome, where cargo is degraded by protease. Products of degradation are transported back to the cytoplasm, where they can be re-used. Autophagy-related genes (Atg) and TOR are involved in the regulation of this process.

The main aim of this project is to study the role of the process of autophagy in different oscillator cells and how it impacts on the regulation of circadian rhythms in the pacemaker of the fruit fly *Drosophila melanogaster*.