Summary

Astrocytes play an important role in integrating and modulating neuronal transmission, demonstrated typically in hippocampal preparations. Not much is known about both the inter-astrocytic form of communication, the Ca^{2+}-waves and the crosstalk with neurons in cortical areas. The aim of this study was to characterise prerequisites and mechanisms of Ca^{2+}-wave propagation and the reactions to neuronal activity in acute slices of mouse cortex.

First I could show that, in contrast to white matter, Ca^{2+} wave propagation in cortex relies on functional gap junctions between astrocytes. It was also demonstrated that astrocytes are highly coupled in this area. The extend of coupling can be reduced under pathophysiological conditions, which may lead to altered Ca^{2+} wave propagation. Furthermore I could detect ATP release from astrocytes which was independent from the propagation of Ca^{2+} signals.

Secondly I observed that the neurotransmitters (NO or glutamate) involved in neuron-astrocyte signalling differ depending on the cortical region. Furthermore I demonstrated selective astrocyte responses to signalling within the same population of neurons in the somatosensory cortex. While stimulation of the thalamic input led to Ca^{2+}-signals in astrocytes along the excitatory pathway, astrocytes stayed silent after spontaneous excitatory neuronal oscillations.

Taken together, it is evident that both inter-astrocytic and neuron-astrocyte communication mechanisms differ among brain regions. This adds another facet to the emerging picture of astrocytes being a heterogeneous population of cells. The results also strengthen the view of astrocytes as integrative components of information processing in the brain and as a source of neuromodulatory substances influencing physiological and pathophysiological processes.