Circadian regulation of neuronal and glial cell activity and plasticity in the fly's visual system

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The visual system of flies show several circadian rhythms which have been detected in the retina photoreceptors and in interneurons and glial cells of the first visual neuropil, the lamina. These rhythms have been detected in three fly species; *Musca domestica*, *Calliphora vicina* and *Drosophila melanogaster*. In the lamina two monopolar cells, L1 and L2, show circadian plasticity in size of nucleus, dendrites and axons. This cyclical structural plasticity is correlated with the locomotor activity pattern of each species. In *D. melanogaster* the locomotor activity and the size of the L2 dendritic trees increase in the morning and in the evening. In contrast to neurons the lamina glial cells shrink when neurons are swollen. In addition to circadian plasticity of neurons and glial cells, the number of synaptic contacts between the photoreceptor terminals and L1 and L2, and glial cells oscillate during the day. All structural rhythms in the lamina seem to be controlled by "clock genes" and in result of circadian inputs from three groups of the clock gene expressing cells: clock neurons of the brain, the retina photoreceptors and glial cells. These inputs affect expression of synaptic proteins, activity of ion pumps and dynamic changes of the cytoskeleton.