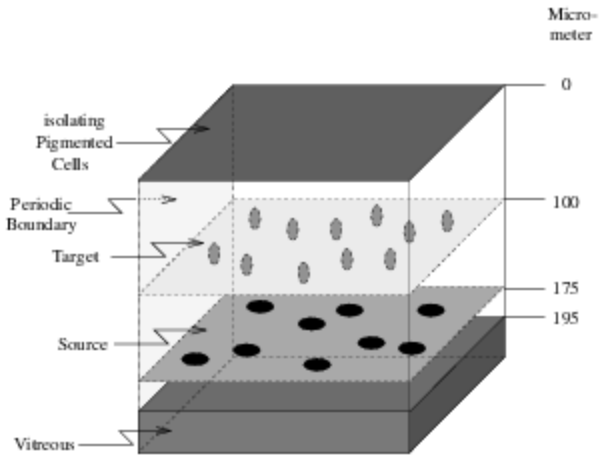
ANALYSIS OF DOPAMINE DIFFUSION IN THE EXTRACELLULAR SPACE OF THE RETINA

Bernd Wichern, Pal Rujan
Fachbereich Physik & ICBM
Carl-von-Ossietzky Universität Oldenburg
26111 Oldenburg, Germany

Dopamine diffuses in the extracellular space of the retina. In our work we consider as an example the retina of the clawed frog, *Xenopus laevis*, where the only source of dopamine is represented by amacrine cells located in the IPL, but where dopamine receptors can also be found in the OPL. We determine the dopamine concentration by solving a modified diffusion equation with numerical methods. We developed a one and a three dimensional model, in both cases the diffusion equation is solved on a lattice. We are interested in non equilibrium states so we have to allow a variability in the rate of release both in space and time. Interesting questions are the following:

- How big is the time delay on the side of the receptors as a result of the diffusion process?
- What is the effect of diffusion on changes of the concentration in the region of the OPL when the rate of dopamine release changes?
- What aspects of the release patterns, both in the time and space domain, are "visible" for the cells in the OPL and what is lost?

For the three dimensional case we developed an interactive program to visualize the changes in dopamine concentration. The distribution of sources and measuring points can be determined by mouse click. The picture below shows the geometry of the lattice:



Our results for the steady state distribution are consistent with experimental data (Witkovsky P. (1993): Extracellular Dopamine Concentration in the Retina of the Clawed Frog, Xenopus laevis *Proc. Natl. Acad. Sci. USA*, **90**, 5667-5671). The minimal time untill significant concentration changes reach the target is in the range of 50 seconds, indicating that dopamine can evoke only very slow light adaptions.