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The PhD project was focused on the photophysics of a photoswitchable fluorescent protein called Dronpa, and how Dronpa could be applied in fluorescence microscopy with a better than diffraction-limited or 'super' resolution.

For some time now single-molecule fluorescence microscopy has revealed that even apparently structurally simple fluorophores display a highly complex and dynamic emission behavior, with individual molecules rapidly cycling between fluorescent and nonfluorescent states.

Photoswitches such as Dronpa take this to the extreme, by allowing the researcher to selectively force the molecules to reside in either the fluorescent or nonfluorescent state by irradiation with light. During the PhD project I found that the Dronpa photoswitching is very efficient, even at the single-molecule level, but is characterized by a complex photophysical picture involving several transition pathways.

The detailed control over the fluorescence emission allowed by photoswitching opens up new possibilities for fluorescence microscopy with a diffraction-unlimited resolution, with comparatively 'gentle' experimental procedures suitable for biological samples. I demonstrated that photoswitching could be successfully used in superresolution microscopy, and determined the optimal photophysical parameters required to achieve good results. During a stay at the Riken Brain Science Institute, Japan, I further set up a system that allows for the fast and systematic screening of potential photoswitches. There is no doubt that the combination of photoswitching and superresolution will extend fluorescence microscopy to the nanoscale.

Given the ubiquity of this technique in the life and materials sciences, its impact in science, and eventually society, will be profound.