Dynamic protein interactions control toxin injection through the bacterial type III secretion system

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Bacteria manipulate eukaryotic target cells by injecting proteins through type III secretion systems (T3SS), large molecular machines. In contrast to the well-defined, engine-like structures that come to mind, many biological molecular machines are dynamic and adaptive.
To understand these dynamic protein interactions, which are difficult to study, we used proximity labeling, a new method especially suited for these transient interactions. Combining these studies with live cell microscopy, single particle tracking, proteomics and molecular dynamics modelling, we found that large parts of the T3SS, including the membrane-spanning core apparatus, exchange subunits, and that bacteria modulate these dynamics in order to optimize the assembly and function of the T3SS, and ultimately the outcome of the interaction with eukaryotic cells. In addition to these new findings, I will show how we can exploit protein dynamics by using optogenetics to control the activity of the T3SS, a new approach for the biotechnological and medical application of bacterial molecular machines.