The biological system fd-virus can be used as a model system to study the dynamics of the self-organized anisotropic particle suspensions. Because of their strong anisotropy and their exceptional monodispersity, these viruses can form different liquid crystalline mesophases (chiral nematic, smectic and columnar). Moreover, the colloidal scale of these viruses enables the imaging of individual rods by fluorescence microscopy, as well as smectic layers by differential interference contrast (DIC) microscopy.

In the present work, the dynamics in the concentrated phases (smectic and columnar) has been studied by fluorescence microscopy. The dynamics of the viruses in the smectic phase is of particular interest because the viruses can “jump” from a layer to another one (this mass transfer between smectic layers is called permeation) with a frequency dependant on the ionic strength and the biological rod concentration. The influence of the stiffness of the rods is also studied using a mutant virus with a higher persistence length. Finally, a surprising fractional jump behaviour has been evidenced in the columnar phase.

![Image](A) Fluorescence microscopy image superimposed to a DIC image showing labeled viruses in their smectic layers. With time, the virus jumps from one layer to another one. The scheme illustrates the interlayer diffusion of individual rods in a lamellar phase. (B) Typical motion of a virus in the smectic phase in the direction normal of the rod axis (L being the layer spacing). The horizontal red lines indicate the residence time of a particle in each layer.

---