What happens with a little groats bead dropped in an oil? It falls down. What happens with two such beads dropped together? Some things are inevitable - they fall down, too. But, amazingly, not only down. These two beads drift to the side, as if one of them was running away from the other, while the other was stubbornly keeping the distance. Three beads? Of course, they fall down. However, depending on how they start their way down may appear as dancing. Without words, these little inanimate objects communicate with each other and they do it using oil as messenger. This fluid mediated communication is called hydrodynamic interactions and is responsible for many interesting phenomena such as prey-predator signaling in the world of zooplankton. Clearly, the more complex are the objects, the more complicated would be their motion. So if a rigid, circular bracelet of beads is laid on the oil surface, it settles down, but if we make the simplest possible knot on it - a trefoil knot - it starts to rotate while settling down.

Yet another issue brings the complexity of a knot. Knots alone have been interesting, in particular for mathematicians, for many years. For sailors or climbers proper knot on the rope is a matter of life. There exist a hierarchy of knots, ordering them from the simplest one to more complex. This complexity is given in numbers by calculating the number of crossings in the loop. Trefoil knot has three crossings and, except for its mirror image, is the only knot with this number of crossings, but there are 7 different ways to make a knot with 7 crossings. What is remarkable, is that when we put in a race in viscous fluid fibers of equal length knotted in all kinds of ways they fall down orderly: the more complex a knot is (the further in knot hierarchy), the faster the fiber falls.

In our project we would like to study the behaviour of flexible microfibers settling down in a viscous fluid. We will investigate the dynamics of closed fibers in the shape of entangled, or in other words, knotted loops. Using numerical simulations to solve the equations of motion of our model fibers, accompanied by simple experiments of sedimenting knotted fibers, we hope to analyze systematically factors affecting their motion under constant gravity force. The fibers will be modeled as bracelets of beads connected by springs. What interests us is how the rigidity of springs influences the shape of such bracelet? Will it keep its extended geometry or will it collapse? If it retains the extended shape will the knotted fiber rotate? If so, how the strength of the springs would affect this rotation? And finally, how the complexity of its shape affects the motion? We wish to find out whether there exist any stationary configurations for the knotted flexible fibers.

Interestingly, living organisms are quite good producers of knotted structures. The basic fiber is a circular DNA - a covalently closed DNA molecule. During recombination processes, that is processes were the DNA fragments are exchanged, accompanied or controlled by various site-specific enzymes, many different knotted DNA structures may appear. The dynamics of nanometer sized molecules in gel under constant electrostatic force is hydrodynamically equivalent to the dynamics of microfibers settling down in oil under constant gravity force. For this equivalency, it is simply important, that the inertial forces acting on a particle were much smaller than the viscous forces of the fluid. Thus the knowledge of the gel migration speed of various types of knotted DNA molecules allows to study the order of the recombination reactions.

On the other hand, even fluid itself can *create* a knotted structure - scientists found out, that the evolution of some knot-shaped vortexes can lead to a stable vortex structure. This stable structure and its periodic motion amazingly resembles the motion of knotted fibers under constant force. With this broad context, our project aims at deeper understanding of the dynamics of flexible fiber sedimentation.