

# A mechanical model for a presentation of liquid crystal phases and phase transitions

R. Repnik<sup>1,\*</sup>, N. Vaupotič<sup>1,2</sup>

*1 Department of Physics, Faculty of Natural Sciences and Mathematics, University of Maribor, Slovenia  
2 Jozef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia*

Physics in primary and secondary schools is far from being popular. There are several reasons for this, one of them certainly being the fact that there are not enough examples of application included into teaching. In Slovenia the majority of topics in the present physics curriculum are at least a hundred years old and as such not interesting from the student's point of view, although, on the other hand, all the concepts taught are necessary to understand the contemporary Physics.

Liquid crystals present a modern topic that is very suitable to be included into the teaching of physics [1-4], because students are exposed to numerous applications of liquid crystals in every-day life. When teaching liquid crystals, it is essential to explain well the liquid crystal phases. For that purpose a mechanical model was constructed to visualize the main liquid crystal phases (nematic, smectic-A, smectic-C) and phase transitions. The mechanical models are three transparent plastic boxes with wooden rods inside, attached on vertical strings. By stretching the strings by a control wheel the rods can change their position and/or orientation. By suitable arrangements we succeeded to simulate the following phase transitions: isotropic to nematic, nematic to smectic-A and smectic-A to smectic-C (Fig. 1).



Fig. 1: From left to right: a mechanical model of liquid crystal; phase transitions: isotropic  $\rightarrow$  nematic, nematic  $\rightarrow$  smectic-A, smectic-A  $\rightarrow$  smectic-C.

We also focused on the comparison between a two-dimensional (2D) visualization of the liquid crystal phases in and a real three-dimensional structure. The 2D visualization is obtained by shining the light through the model and observing shadows of the rods on a screen. The model was tested in schools and the analysis shows that it is suitable for use both in primary and secondary schools.

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## References:

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\* presenting author; E-mail: robert.repnik@uni-mb.si