used by Ried and colleagues[3]. An intriguing open question is whether ordinary quantum mechanics is the only physical theory that allows us to discover such dependencies through ideal measurements. Luckily, the tools to tackle this question are already in place: both the framework of causal networks[8] and the notion of ideal measurement[9,10] have been recently extended from quantum mechanics to arbitrary physical theories.

Another natural question is: what is special about those causal dependencies that can be characterized just in terms of ideal measurements? In quantum mechanics, Ried and colleagues[3] provide the answer when the causal dependence is a probabilistic mixture of common cause and cause–effect relationships, showing that quantum coherence and entanglement are necessary features. The case of more general causal dependencies, as well as correlations in quantum networks containing more than two measurements, remains a subject of future research. Even more broadly, the ideas introduced by Ried *et al.*[3] could find applications in the study of exotic quantum gravity scenarios featuring a non-fixed causal structure[11–13]. In all of these cases, the abundance of open questions, as well as the rapid emergence of new counterintuitive results, reveals that causality in quantum mechanics is a much richer and more surprising area than previously thought. ❐

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FLUID DYNAMICS

Sticky stitches

Drizzle syrup over your pancakes and you may notice a coil developing where the fluid thread hits the surface. This well-known phenomenon — the 'liquid rope-coil effect' — results from the interplay between the syrup's viscosity and gravitational and inertial forces.

Similarly, a viscous liquid rope falling onto a moving surface (or from a moving nozzle) can produce a pattern that deviates from a straight line. In fact, several different patterns have been observed for such systems — nicknamed fluid-mechanical sewing machines because the generated motifs resemble common stitch patterns. Pierre-Thomas Brun and colleagues have now come up with a model that reproduces the experimentally obtained patterns and predicts additional features (P-T. Brun *et al., Phys. Rev. Lett.*, in the press; preprint at http://arxiv.org/abs/1410.5382).

The typical paths traced out by a viscous liquid thread on a moving belt are loops (translated coils), alternating loops, meanders and straight lines. Their periodicities come from the intrinsic frequencies of the tracing processes, which have been found to be multiples of the coiling frequency for the static (non-moving surface) case. Brun *et al.* performed numerical simulations of the sewing machine, taking viscosity and gravitation into account, but with inertia artificially switched off. Remarkably, the resulting phase diagram (with dimensionless nozzle height and surface speed as phase variables) contained all possible types of pattern, suggesting that inertial forces weren't playing a significant role.

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This conclusion prompted the authors to devise a geometrical model in which the path drawn by the falling liquid rope was described by a set of equations for the position of the contact point and the local curvature of the path. The equations arise from considering the shape of the pendant thread (dictated by gravity and viscosity) and the coupling between the fluid and the moving surface.

The solutions of the geometrical model matched the outcomes of the full simulations very well. In addition, the authors discovered a new pattern with coils wide apart from one another (the 'W-pattern'), as well as hysteretic effects: the transitions between different regimes when changing the surface velocity occurred at different speeds for acceleration and deceleration.

Apart from uncovering the physical processes underlying fluid-mechanical sewing machines, the findings of Brun *et al.* are relevant to a variety of industrial applications like the manufacture of non-woven fabrics or the automated production of cake decorations. They also enable an understanding — or even simulation — of the drip painting technique used by Jackson Pollock.

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