Applied and Computational Mathematics Seminar

Title: A drop sliding down an inclined plate: the Guinea pig for the problem of contact lines in hydrodynamics

Speaker: Eugene Benilov (University of Limerick)

Date: Fri 17th January 2025 at 2:00PM

Location: E0.32 (beside Pi restaurant)

Abstract: We examine drops steadily sliding down an inclined plate. The dynamics of the drop's contact line (the curve where the liquid, substrate, and air come into contact) is described by the Navier-slip boundary condition, which is the most frequently-used model of contact lines. It includes an undetermined parameter, the slip length, reflecting physically the size of the region near the contact line where the liquid can slip against the substrate. We assume that the drop is thin, and the radius of its base is smaller than the so-called capillary scale. These assumptions enable us to derive an asymptotic expression for the drop's velocity, match it to the available experimental data, and thus determine the value of the slip length .

It turns out that, for certain fluids including water, the Navier-slip boundary condition works only if $\lambda \sim 10^{-70}$–10^{-110} m... which doesn't make sense physically, as is supposed to be comparable to the intermolecular distance for the fluid's vapor, i.e. $\sim 10^{-8}$ m. This result is corroborated by similar conclusions of other researchers, with the implication that the problem of contact lines has yet to be resolved.