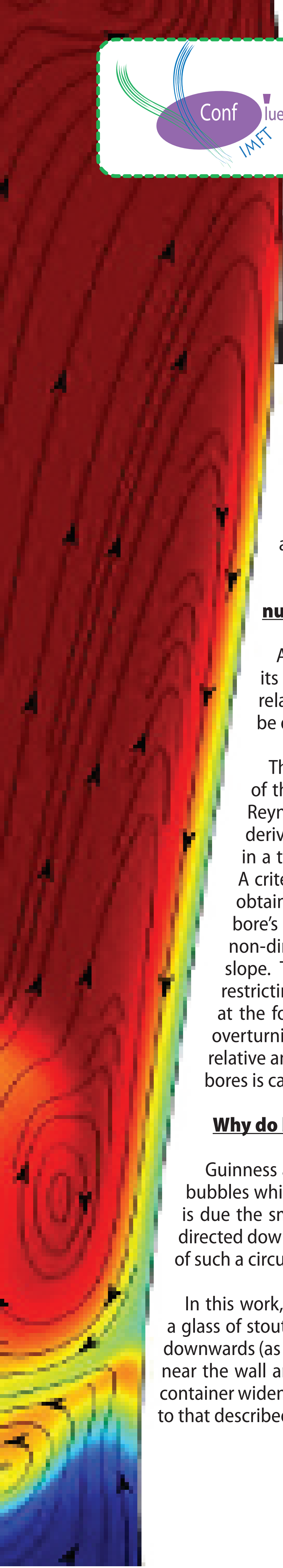

Vendredi 3 avril à 10 h 30

Institut de Mécanique des Fluides
Amphithéâtre Nougaro
Allée du Pr. Camille Soula, Toulouse

Fundamental and applied fluids research in Ireland

Eugene Benilov

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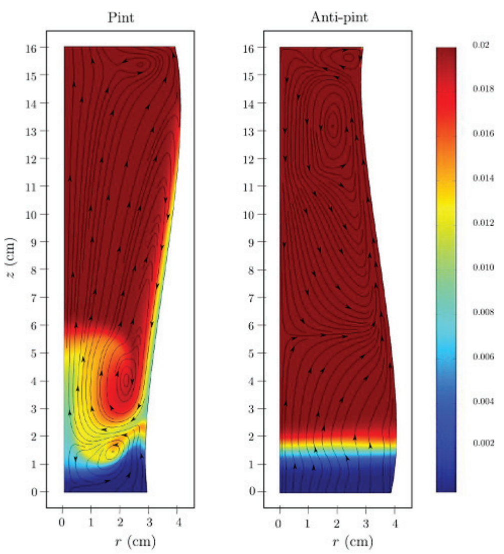
In this talk, I will outline two typical problems currently examined by Irish fluids researchers: one from the fundamental fluid dynamics and another, on the applied side.

Liquid films with order-one Reynolds numbers

A free-surface flow is generally characterised by its Reynolds number and the slope of the interface relative to the substrate. If both are small, the flow can be described by the lubrication approximation.

The present paper explores flows with a small slope of the free surface (i.e. liquid films), but an order-one Reynolds number. A set of asymptotic equations is derived and used to examine hydraulic jumps (bores) in a two-dimensional flow down an inclined substrate. A criterion of existence of steadily propagating bores is obtained for the (η, s) parameter space, where η is the bore's downstream-to-upstream depth ratio, and s is a non-dimensional parameter characterising the substrate's slope. The criterion reflects two different mechanisms restricting bores. If s is sufficiently large, a 'corner' develops at the foot of the bore's front – which, physically, causes overturning. If, in turn, η is sufficiently small (i.e. the bore's relative amplitude is sufficiently large), the non-existence of bores is caused by a stagnation point emerging in the flow.



Numerical simulations of bubbly flows for the pint and anti-pint. The curves show the streamlines for the bubbles, the color shows the void fraction f. Observe the region of reduced f near the wall of the pint.

Why do bubbles in Guinness sink?

Guinness and other stout beers show the counter-intuitive phenomena of sinking bubbles while the beer is settling. Previous research suggests that this phenomenon is due the small size of bubbles in stouts and the presence of a circulatory current, directed downwards near the glass's wall and upwards in the interior. The mechanisms of such a circulation, however, remained unclear.

In this work, simulations and experiments are used to demonstrate that the flow in a glass of stout depends on the shape of the glass (see the figure below). If it narrows downwards (as the traditional stout glass, the 'pint' does), the flow is directed downwards near the wall and upwards in the interior and sinking bubbles will be observed. If the container widens downwards (this kind of glass is dubbed 'anti-pint'), the flow is opposite to that described above and only rising bubbles will be seen.

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