Proposition de sujet d'alternance 1A
2025-26

Laboratoire:	Institut de Recherche sur les Phénomènes Hors Équilibre (IRPHE)	
Titre du sujet :	Drop Impact Dynamics: Implications for Surface Erosion	
Candidat* : (nom prénom)		
Encadrant ** (s) :	Premier tuteur	Second tuteur
Nom :	BOEDEC	DESCHAMPS
Prénom :	Gwenn	Julien
Qualité *** :	Maître de Conférences	Maître de Conférences
Localisation :	Château Gombert	Château Gombert
Coordonnées *(e-mail/tel)*	Gwenn.boedec@univ-amu.fr	Julien.deschamps@univ-amu.fr
Déplacements possibles **** :	Pas de déplacements	

** si vous avez déjà sélectionné un alternant*
*** un co-encadrement est possible.*
**** l'encadrement devra être assuré de préférence par un permanent du laboratoire, au minimum titulaire d'un Doctorat.*
***** au cas ou dans le cadre de son travail l'alternant serait amené à se déplacer vers un second laboratoire.*

Descriptif du sujet et de la mission :

The impact of liquid drops on solid surfaces plays a crucial role in a wide range of applications: inkjet printing, spray formation, erosion of natural environments, or damage to artificial structures (e.g., wind turbine blades, turbine components, aircraft wing edges). Although this topic is longstanding, it has shown significant developments over the past 20 years (Yarin, 2006; Josserand & Thoroddsen, 2016). Recent studies have advanced our understanding of the transition between different impact dynamics namely spreading, where the drop remains intact, and splashing, where the drop breaks apart, as well as the forces associated with droplet impact (Mitchell et al., 2019; Gordillo et al., 2018), which revealed a universal shape for the temporal profile of the force exerted on a flat surface in the inertial regime. Despite extensive research on the impact of individual droplets on solid surfaces, the mechanisms underlying erosion remain poorly understood.

The objective of the internship is to experimentally and/or numerically study the influence of cavity geometry on impact dynamics and the resulting mechanical stresses. In particular, droplet impact within a cavity generates significantly stronger forces than impact on a flat surface, often accompanied by "explosive splash" phenomena (see figure below).

Validation pour mise en ligne ECM :

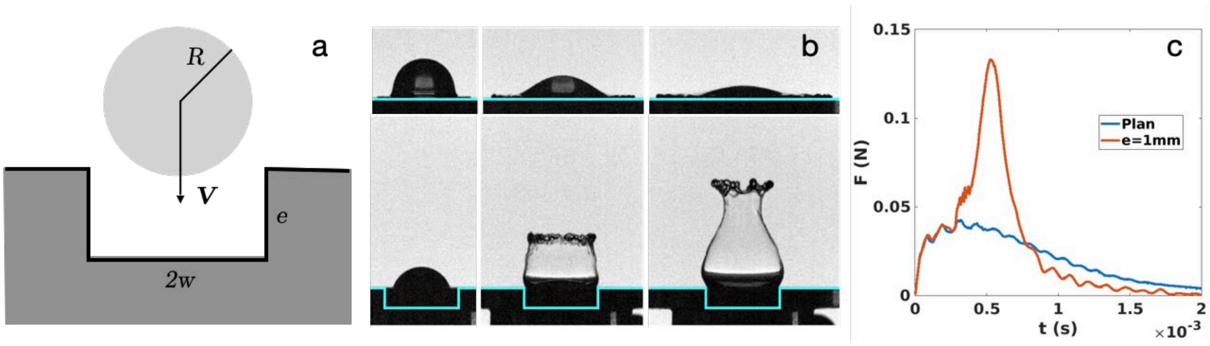

Figure : (a) Typical situation studied (b) Impact of a 3.5 mm diameter droplet on a flat surface (top pictures) and on a cavity (bottom pictures) of 1 mm depth and 4 mm in diameter. The shape of the cavity is indicated by the blue lines. (c) Measured forces for the two cases shown in (b)

Particular attention will be given to the evolution of the liquid film within the cavity after impact, by developing original optical visualization methods through transparent tubes.

Depending on the intern taste, the study may also be oriented towards the establishment of a connection between the impact of a single droplet and the erosion phenomenon resulting from repeated impacts of droplets on a friable material. Preliminary studies have already revealed a wide variety of erosion-induced cavity shapes in plaster, depending notably on the droplet impact frequency.

References:

Gordillo et al, 2018, Dynamics of drop impact on solid surfaces: evolution of impact force and self-similar spreading, https://doi.org/10.1017/jfm.2017.901

Josserand, & Thoroddsen, 2016, Drop impact on a solid surface. Annual review of fluid mechanics, https://doi.org/10.1146/annurev-fluid-122414-034401

Mitchell et al., 2019, The transient force profile of low-speed droplet impact: measurements and model, Journal of Fluid Mechanics, https://doi.org/10.1017/jfm.2019.141

Yarin, 2006, Drop impact dynamics: Splashing, spreading, receding, bouncing, Annu. Rev. Fluid Mech., https://doi.org/10.1146/annurev.fluid.38.050304.092144