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APS-DFD 2021 - GFM POSTER

Fragmentation of a high speed pulsed jet: thin sheets and their numerical demise

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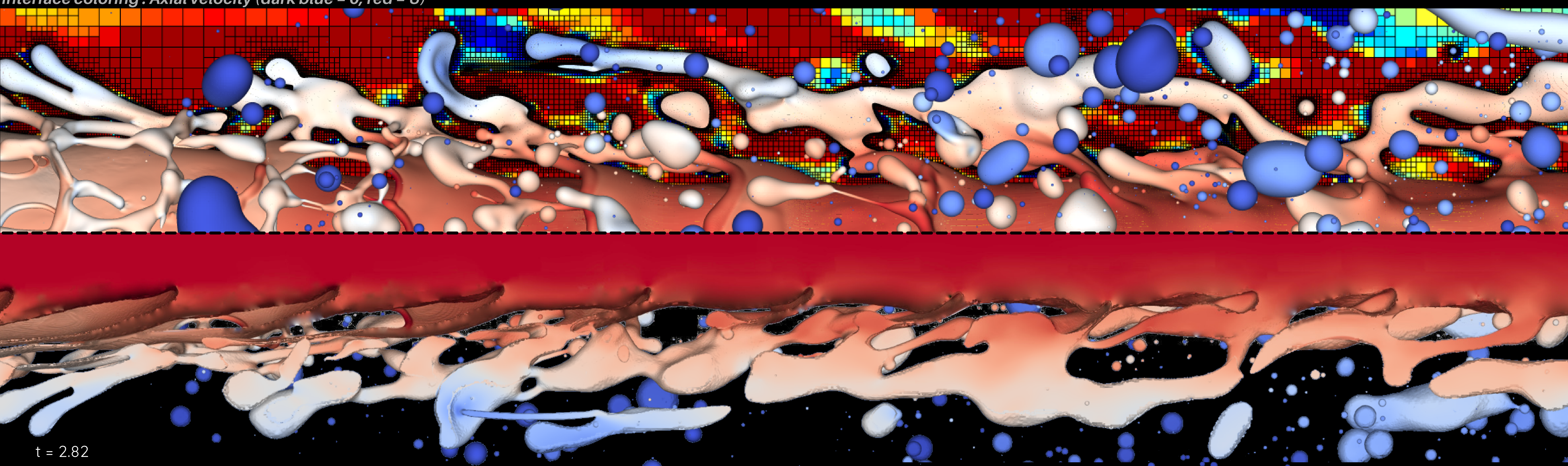
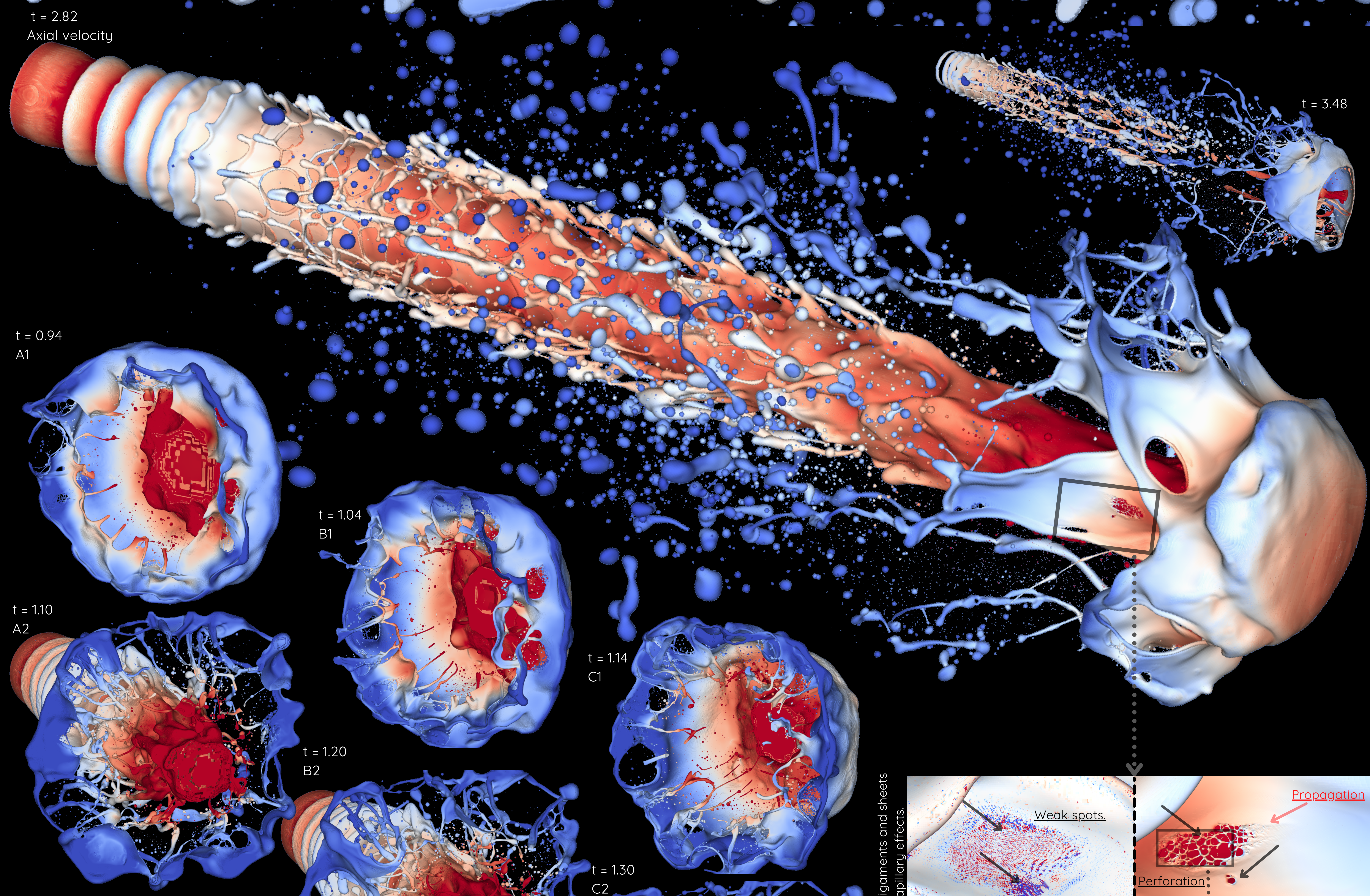
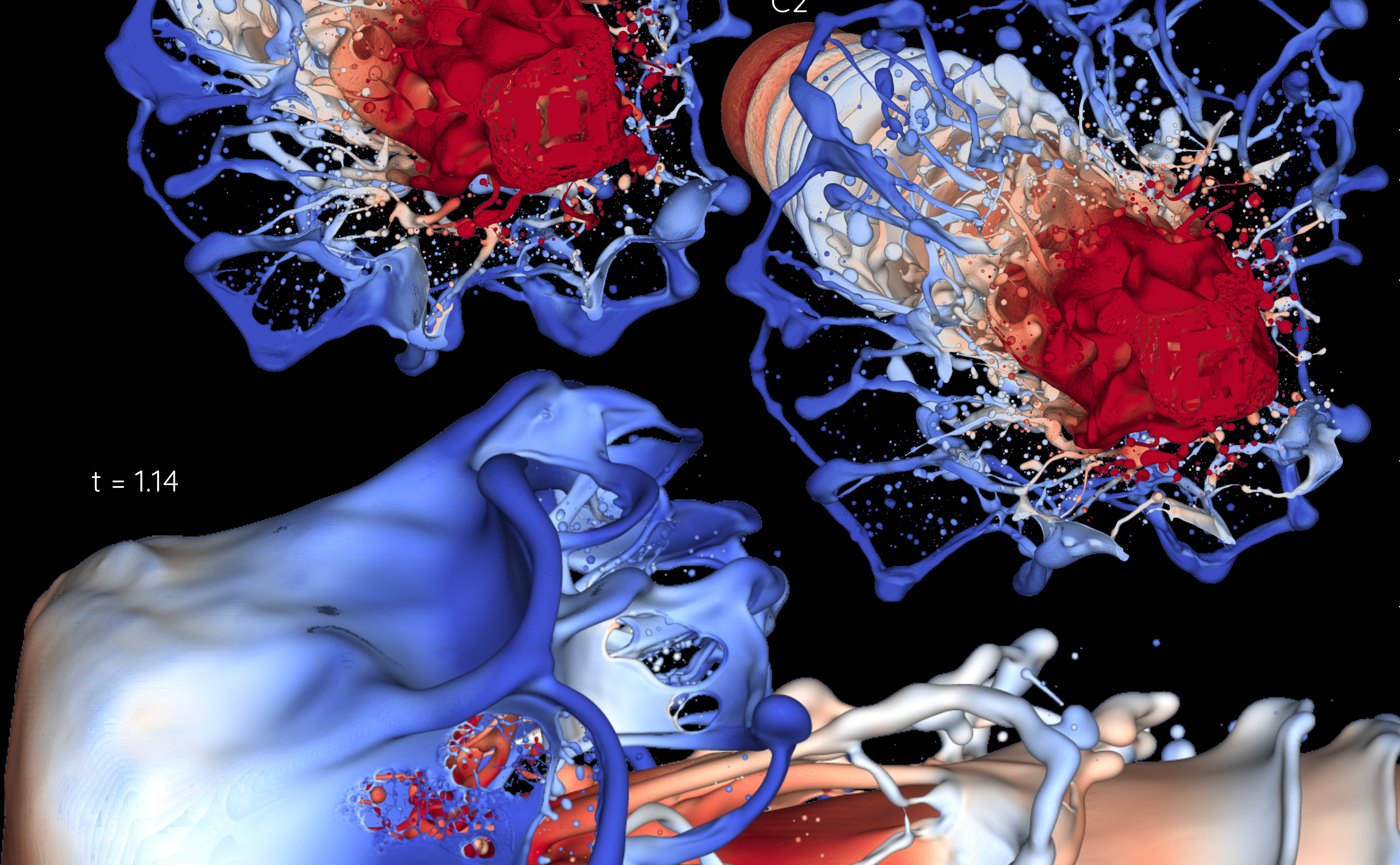
Simulation of a pulsating dense cylindrical liquid oil jet injected into a stagnant air phase is performed using the Volume of Fluid method. Extremely high refinement (maxlevel 14, D/Δ = 915 points per diameter), equivalent to 4400 billion cells on a uniform grid.

Re=5800, We=222.2, density ratio=25, St~0.2778

Background : vorticity & octree adaptive mesh refinement.
Interface coloring : Axial velocity (dark blue = 0, red = U)

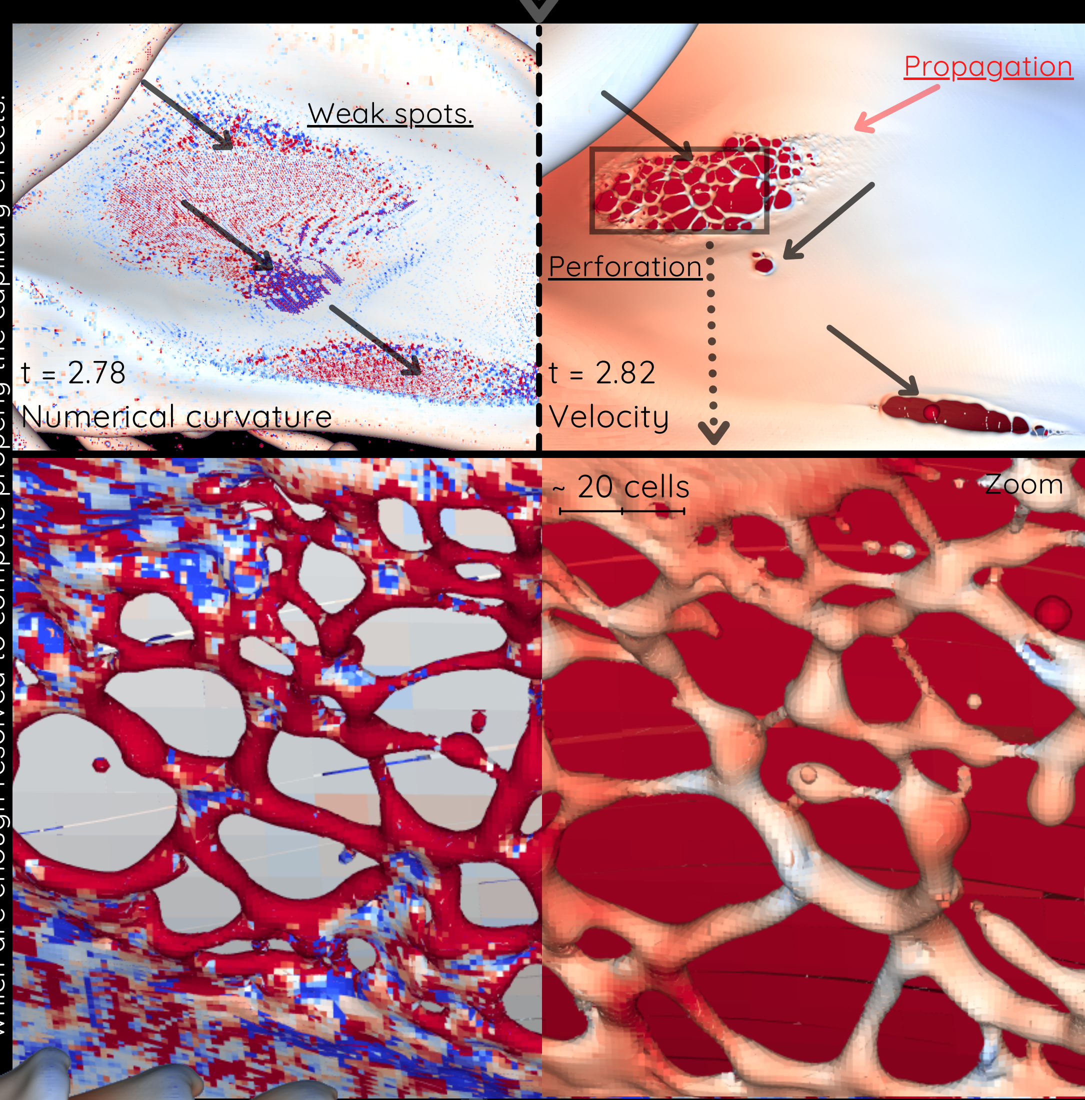






Colour gradient along sheets and ligaments show they are being stretched. (A1;B1;C1)
Sheets are perforated either by impacts or when the sheet is thinner than a few grid cells. (A2;B2)
The holes expand and the sheet collapses, leaving ligaments. (B2;C2)
Droplets originating from ligament breakup near the jet core impact the jet head from behind. (C1;C2)
If a liquid layer becomes thinner than a few cells, the numerical curvature oscillates and triggers perforation, this leads to ligament networks with a short lifetime (delta t~0.02).

A smooth numerical curvature indicates the droplets, ligaments and sheets which are enough resolved to compute properly the capillary effects.



We acknowledge support from ERC Adv grant TRUFLOW, and PRACE and GENCI grants of CPU. Simulations performed on Irene-Rome at TGCC, France.