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Three Dimensional Velocity Field of Vortices Impinging on a Wall Obtained by Scanning Particle Tracking Velocimetry

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The interaction of a concentrated vorticity filament (e.g. a vortex ring) impinging on a solid boundary exhibits a complex dynamical behaviour rooted in the interplay of the vortex filament with the induced strain field together with the shear layer of opposite vorticity generated close to the wall. Two distinct scenarios develop depending on the angle of impingement with the wall normal direction. For wall normal impingement, the original vortex exhibits multiple localized breakdowns along the toroid axis, which are triggered by the localized engulfment of the primary vortex of weaker and opposite vorticity, which rolled up from the shear layer. For inclined impingement, a similar mechanism causes a single symmetric pair of vortex breakdowns to originate at the point of closest contact and propagate to the less perturbed part of the vortex further away from the wall. We apply classical 3D PTV, however, a scanning technique used for the data acquisition together with a high-speed camera allows increasing the particle density and therefore the spatial resolution.

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