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Vortex ring refraction at large Froude numbers[1] KERRY KUEHN, MATTHEW MOELLER, MICHAEL SCHULZ, DANIEL SANFELIPPO, Wisconsin Lutheran College — We have experimentally studied the impact of an initially planar axisymmetric vortex ring, incident at an oblique angle, upon a gravity-induced interface separating two fluids of differing densities. After impact, the vortex ring was found to exhibit a variety of subsequent trajectories, which we organize according to both the incidence angle, θ_i, and the interface strength, defined as the ratio of the Atwood and Froude numbers, A/F. For grazing incidence angles ($\theta_i \gtrsim 70$ deg.) vortices either penetrate or reflect from the interface, depending on whether the interface is weak or strong. In some cases, reflected vortices execute damped oscillations before finally disintegrating. For smaller incidence angles ($\theta_i \lesssim 70$ deg.) vortices penetrate the interface. When there is a strong interface, these vortices are observed to curve back up toward the interface. When there is a weak interface, these vortices are observed to refract downward, away from the interface. The critical interface strength below which vortex ring refraction is observed is given by $\log_{10}(A/F) = -2.38 \pm 0.05$.

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