Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Breakup and reconnection of two coaxial counter-rotating helical vortices ALESSANDRO CAPONE, FABIO DI FELICE, ALESSANDRO MAIOCCHI, JAIS MOHAMED, FRANCISCO ALVES PEREIRA, CNR-INM Institute of Marine Engineering, Rome 00128, Italy — Our experiments examine the interaction between two coaxially aligned helical vortices induced by two counter-rotating propellers of slightly different diameters operating in a water tunnel. We observe the interaction between the two coherent structures through high-speed visualizations performed in low pressure conditions that trigger the onset of cavitation in the vortex cores, thus enabling their imaging. We document the observations with PIV measurements at different phase angles between the two helical systems and for different ratios between the upstream flow and the rotation speed. The results show that the two helical systems merge and breakup in the region of closest distance and strongest vorticity. This event is followed by a reconnection process that bridges the broken parts, resulting in the formation of isolated vortex rings advected by the accelerated flow from the propeller system. These periodically generated vortex rings, spatially organized in an alternating pattern, have a sawtooth appearance and show evidence of entrainment, stretching and roll-up due to the velocity gradients along the radial direction. Residual vorticity threads are also observed that intermittently bridge consecutive rings, as a result of momentum transfer.

Francisco Alves Pereira
CNR-INM Institute of Marine Engineering, Rome 00128, Italy

Date submitted: 31 Jul 2019 Electronic form version 1.4