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From Newton's bucket to rotating polygons: experiments on surface instabilities in swirling flows TOMAS BOHR, BJARNE BACH, MALENE VESTED, ANDERS ANDERSEN, Physics Department, Technical University of Denmark, ERIK LINNARTZ, Physics of Fluids Group, University of Twente — We present an experimental study of "polygons" forming on the free surface of a swirling turbulent water flow in a partially filled cylindrical container, where the rotation of the bottom plate and the cylinder wall is controlled independently. Thus we can move from a rigidly rotating "Newton's bucket" flow to one where bottom and cylinder walls are rotating oppositely and the surface is turbulent but flat on average. Between those two extremes, we find polygonal states in two distinct bands. Further, we find a "monogon," a figure with one corner, roughly an eccentric circle rotating in the same sense as the cylinder. We show that the system has a surprising multi-stability and excitability, and that small details can change the stability of polygon states. We investigate accurately the rotation of the plate compared to that of the polygon. Although the the frequency ratios can be close to rational, we do not find phase locking.

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