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X-ray Imaging of Memory in Air Bubble Pinch-Off NATHAN KEIM, James Franck Institute, U. of Chicago, KAMEL FEZZAA, Advanced Photon Source, Argonne Nat'l Laboratory, SIDNEY NAGEL, James Franck Institute, U. of Chicago — We report on studies of underwater air bubble pinch-off. Previously, we have shown that this pinch-off is a singularity with memory, in which azimuthal symmetry may be broken by tilting the nozzle or by blowing bubbles from a slot-shaped nozzle, and that 2- or 3-lobed perturbations to the pinching neck's cross-section are remembered as small vibrations of the neck shape.[1] This is consistent with the model of Schmidt et al.[2] Even modest perturbations to the initial bubble shape can cause the neck to develop concavities late in its collapse, as shown by Turitsyn et al.[3] Using high-speed X-ray phase contrast imaging at the Advanced Photon Source, we have observed these concavities, as well as the Worthington jet. Tilting a nozzle by as little as 1° suppresses jet formation outside of a small region near pinch-off. Further experiments show that placing walls near the bubble also creates azimuthal perturbations, and that the vertical motion and vertical asymmetry of the neck at its minimum radius are due primarily to the neck's impedance of gas flow.

[1]Keim & Nagel, DFD 2008 AH.1
[2]*Nat. Phys.***5**, 343
[3]arXiv:0902.0393v1

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