

Abstract Submitted  
for the MAR17 Meeting of  
The American Physical Society

**Universality of granular shock fronts** YASIN KARIM, ERIC CORWIN, Univ of Oregon — We experimentally study quasi 2d dilute granular flow around asymmetrical intruders. By directly measuring the grain flow field around various shapes we extract the functional form of the granular shock front. We demonstrate the universality of the shock front shape and its invariance with respect to intruder shape. The shock fronts are described by inverted catenaries whose centers and peaks are sensitive to obstacle symmetry. The consequent shift of the catenary results in dramatic changes in lift force on the intruder which we also measure. We model this lift by accounting for contributions from 1) weight of trapped beads between the shock front and the intruder, 2) collisions from freely falling grains and 3) reaction force from grains being ejected from the trapped region.

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Date submitted: 10 Nov 2016

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