Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

On the cusps bordering liquid sheets JOSE MANUEL GORDILLO, Universidad de Sevilla, HENRI LHUISSIER, Université Paris Diderot, EMMANUEL VILLERMAUX, IRPHE, Aix-Marseille Université, France — The rim at the edge of a steady radially expanding liquid sheet, or bordering a hole expanding in a liquid film, is naturally indented. It presents a collection of cusps at the tip of which the liquid concentrates and is ejected. An experimental description of these cusps for a stationary flat inviscid Savart sheet, formed by the normal impact of a jet with diameter d and velocity u against a solid disk, is given. We identify the stable node-jet structure responsible for the deflection of the incoming flow at the rim and demonstrate how the cusps are the structures that accommodate for both mass and momentum conservation at the sheet edge. Their shape, their number around the sheet, and the residual momentum carried by the ejected liquid are computed. Our model reproduces the experimental observations, correcting the classical interpretation of Savart's experiments first given by Taylor, who proposed that the radius of the sheet is given by $R = dWe/16$, with a Weber We number based on d and u. Indeed, Taylor's picture disregards that the sheet is not circular, that the liquid is ejected with a non-vanishing remnant radial momentum at the sheet edge and, hence, that the actual radius of the sheet is smaller than R.

Jose Manuel Gordillo
Universidad de Sevilla

Date submitted: 28 Jul 2014 Electronic form version 1.4