Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

The influence of inertia on the efflux velocity: From Daniel Bernoulli to a contemporary theory ANDREAS MALCHEREK, University of the German Armed Forces — In 1644 Evangelista Torricelli claimed that the outflow velocity from a vessel is equal to the terminal speed of a body falling freely from the filling level h, i.e. $v = \sqrt{2gh}$. Therefore the largest velocities are predicted when the height in a vessel is at the highest position. As a consequence the efflux would start with the highest velocity directly from the initiation of motion which contradicts the inertia principle. In 1738 Daniel Bernoulli derived a much more sophisticated and instationary outflow theory basing on the conservation of potential and kinetic energy. As a special case Torricelli's law is obtained, when inertia is neglected and the cross section of the opening is small compared to the vessel's cross section. To the Authors knowledge, this theory was never applied or even mentioned in text books although it is superior to the Torricelli theory in many aspects. In this paper Bernoulli's forgotten theory will be presented. Deriving this theory using the state of the arts hydrodynamics results in a new formula $v = \sqrt{gh}$. Although this formula contradicts Torricelli's principle, it is confirmed by all kind of experiments stating that a discharge coefficient of about $\beta = 0.7$ is needed in Torricelli's formula $v = \beta\sqrt{2gh}$.

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Date submitted: 11 Jun 2015 Electronic form version 1.4