Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Vortex sound generation during vortex reconnection YOSHIFUMI KIMURA, Nagoya Univ., KEITH MOFFATT, Univ. of Cambridge — A formula is derived for the quadrupole vortex sound pressure generated by two tilted hyperbolæ in a tent-shaped configuration. This model, which was recently proposed by the authors as a model for vortex reconnection, exhibits nearly self-similar Leray scaling for the minimum separation of the hyperbolæ and the maximum velocity and axial strain-rate toward a finite-time singularity. The formula shows that if the length-scale of the system follows exactly the self-similar development $\sim (t_c - t)^{1/2}$, then the far-field quadrupole sound pressure vanishes. A non-vanishing quadrupole will therefore provide a sensitive indication of any departure from self-similarity. Also, if the vortices eventually reconnect through the action of viscosity, the time-dependence of the length-scale must differ significantly from that of the self-similar state, and any departure from self-similarity will then generate sound. Furthermore, as t passes through t_c, there is an interchange of vortex pairs resulting in rotation of the quadrupole axis by $\pi/2$, an effect that could in principle be detected. This prediction agrees with the numerical result that the sound emission at superfluid vortex reconnections is in the form of an intense, localized and directional pulse.

Yoshifumi Kimura
Nagoya Univ.

Date submitted: 09 Aug 2020 Electronic form version 1.4