Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

A numerical investigation of the wake structure of vertical axis wind turbines ELIAS BALARAS, ANTONIO POSA, MEGAN LEFTWICH, The George Washington University — Recent field-testing has shown that vertical axis wind turbines (VAWT) in wind farm configurations have the potential to reach higher power densities, when compared to the more widespread horizontal axis turbines. A critical component in achieving this goal is a good understanding of the wake structure and how it is influenced by operating conditions. In the present study the Large-Eddy Simulation technique is adopted to characterize the wake of a small vertical axis wind turbine and to explore its dependence on the value of its Tip Speed Ratio (TSR). It will be shown that its wake significantly differs from that of a spinning cylinder, often adopted to model this typology of machines: the displacement of the momentum deficit towards the windward side follows the same behavior, but turbulence is higher on the leeward side. An initial increase of the momentum deficit is observed moving downstream, with central peaks in the core of the near wake for both momentum and turbulent kinetic energy, especially at lower TSRs. No back-flow is produced downstream of the turbine. The interaction between blades is stronger at higher values of the TSR, while the production of coherent structures is enhanced at lower TSRs, with large rollers populating the leeward side of the wake.

Elias Balaras
The George Washington University

Date submitted: 30 Jul 2014 Electronic form version 1.4