Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

**Sparse energetically dominant frequencies in direct numerical simulation of turbulent pipe flow: origin and application to reduced-order models**[1] FRANCISCO GOMEZ, HUGH M. BLACKBURN, MURRAY RUDMAN, Monash University, BEVERLEY J. MCKEON, MITUL LUHAR, RASHAD MOARREF, California Institute of Technology, ATI S. SHARMA, University of Southampton — The idea of constructing reduced-order models for canonical wall-bounded turbulent flows based on exploiting the sparse energetically dominant frequencies observed in direct numerical simulation of pipe flow by Bourguignon *et al.* (2013, *Phys. Fluids*) is examined. The resolvent analysis of a pipe flow is extended in order to consider the influence of finite domain length on the flow dynamics, which restricts the possible wavespeeds in the flow. This analysis shows that large sparse amplifications take place when one of the allowable wavespeeds is equal to the local wavespeed via the critical layer mechanism. A connection between amplification and energy is presented through the similar features displayed by the most energetically relevant flow structures, emerging from a dynamic mode decomposition of direct numerical simulation data, and the resolvent modes associated with the most amplified sparse frequencies. These findings support the viability of reduced-order models based on the selection of the most amplified modes arising from the resolvent model, with the potential to drastically decrease the computational costs required to represent turbulent flows.

[1]This work was supported by ARC grant DP130103103 and AFOSR grant FA9550-09-1-0701 (ML, RM, BJM).

Francisco Gomez Carrasco
Monash University

Date submitted: 30 Jul 2014 Electronic form version 1.4