Contribution ID: **108** Type: **Oral Presentation**

PLENARY: Recurrent flows: The clockwork behind turbulence

Thursday, 14 July 2016 08:00 (1 hour)

Abstract content
   (Max 300 words)
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Turbulence is THE unsolved problem of classical physics. For almost two centuries we have had the equations that describe the motion of fluids, but partial differential equations are in principle infinite-dimensional dynamical systems, numerical simulations track millions of computational degrees of freedom - what are we to make out of all this data? Well, in the world of moderate Reynolds numbers, everyday turbulence of fluids flowing across planes and down pipes a velvet revolution is taking place. Experiments are almost as detailed as the numerical simulations, DNS is yielding exact numerical solutions that one dared not dream about a decade ago, and dynamical systems visualization of turbulent fluid's state space geometry is unexpectedly elegant. What emerges is a picture of low-Reynolds turbulence as a walk among a set of unstable invariant solutions.

We shall take you on a tour of this newly breached, hitherto inaccessible territory. The talk is aimed at anyone who had ever wondered why - if no cloud is ever seen twice - we know a cloud when we see one? And how do we turn that into computation? Now, once you get home, you can do it yourself: all results and numerical software are available through our group's collaborative e-book ChaosBook.org and open-source Computational Fluid Dynamics codes available on Channelflow.org and Openpipeflow.org.

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Session Classification: Plenary

Track Classification: Fluid Dynamics