

# What is new?

## Is there substantive progress?

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### Yes! .... Some recurring themes

#### Concepts and approaches

- New
  - HIT-SI
  - RMF + FRC
  - Pulsed High Density FRC
- Different
  - Merge CT
- Improvements
  - Low aspect ratio RFP
- Orthogonal to tokamaks
  - Magnetized Target Fusion
  - Gas Dynamic Trap (mirror)
- **What impedes progress?**
  - << tokamaks
    - Money
    - Man years of effort
  - Waiting a long time for fusion energy
  - Need for simple, less ambiguous experiments
- **Physics issues**
  - Flow:  $v$ , also viscosity  $v\nabla^2v$  (ignored to date)
  - MHD in astrophysics
  - Self organization
  - Role of “anomalous” dissipation processes

- Relaxation with
  - finite beta
  - driven dissipative systems
  - cyclic helicity recharge, relaxation
  - relaxation to either spheromak or FRC but not in between?
- Existence of  $B_{\text{toroidal}}$  in FRC
- 3 dimensional data sets + theory + computations
- active suppression of instability impedes relaxation: is this useful ?
- **Theory questions**
  - Multi fluid
  - 6D phase space
  - Tendency to use eg Fourier spectrum to describe 3D structures
    - Should instead search for normal modes, if there are any
    - Singular Value Decomposition techniques
- **Computation - from a super computing standpoint at LANL**
  - 3-D
  - PIC, multi fluid, non linear
  - Include reasonably realistic boundaries?
  - Micro – macro coupling?
  - Include micro physics
    - Stiff PDE systems
  - Still lacking rigorous experimental benchmarks

- Verification – are we computing the right physics?
- Validation – do the computations match the experimental data?
- **Technology**
  - Experimental developments
    - Flow measurements
    - Breach the radiation barrier
  - Electronics
  - Imaging
  - DAQ
- **Fusion path**
  - Break from a steady state paradigm in favor of intrinsically pulsed
  - Energy confinement time  $\tau_E$  vs power \*  
 $\tau_E = \text{energy}$
  - Pulse length vs repetition rate
  - Isolation from boundaries
  - Direct energy conversion
  - Divertor type concepts
  - Steady state has disadvantages
    - Wall load
    - Impurity accumulation