What is new?
Is there substantive progress?

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 $\nu\nabla^2 v$ (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_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 = energy
    - Pulse length vs repetition rate
    - Isolation from boundaries
    - Direct energy conversion
    - Divertor type concepts
    - Steady state has disadvantages
        - Wall load
        - Impurity acccumulation