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CAVS

- Humans and Interfaces
- Materials and Mechanics
- **Modeling and Simulation**
- Power and Energy

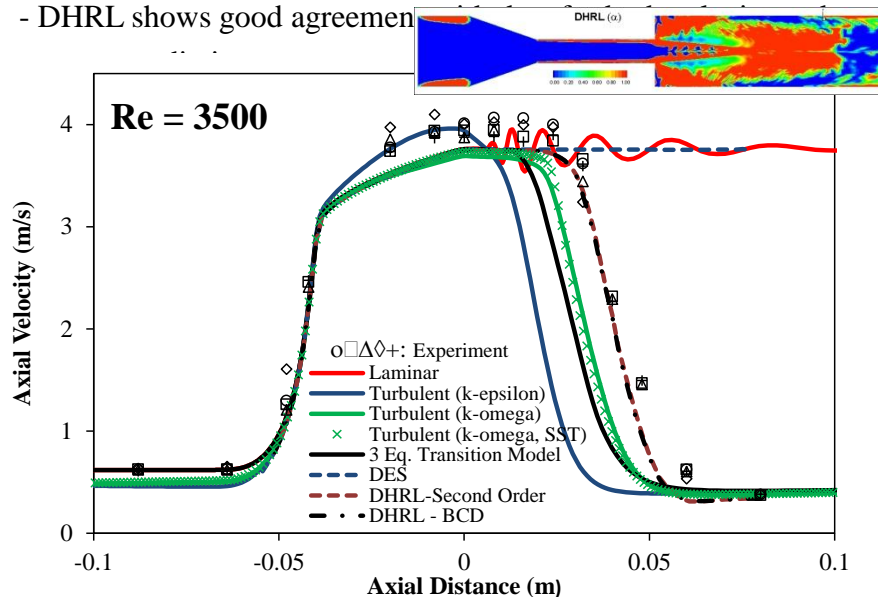
Research Interest

- Turbulence Modeling
 - LES (Backscatter, Scale variance, Multi-scale)
 - Hybrid RANS/LES (Bhushan and Walters, 2012)
 - Wall-Functions (Ship Hydrodynamics)
 - Spectral Gap Energy Transfer
- High Performance Computing
 - Larger Grids, Faster Turnaround Time

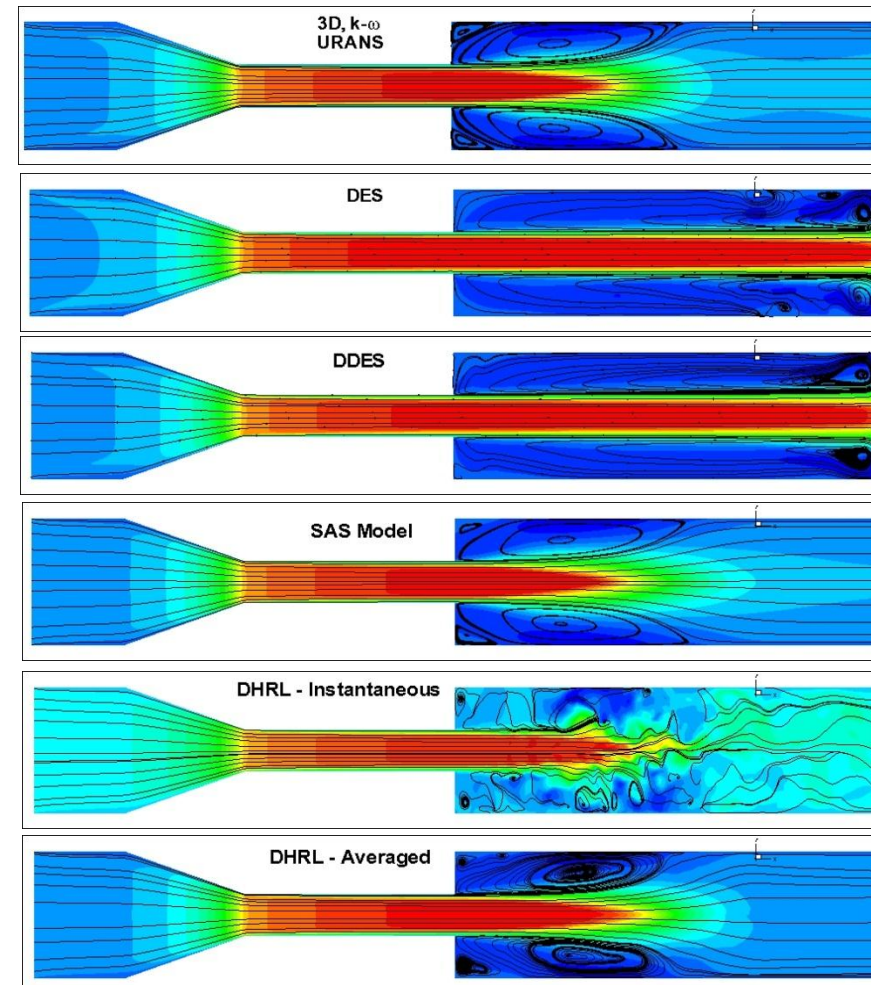
Hybrid RANS/LES Validation Case: FDA Nozzle

➤ $Re = 3500$ Case:

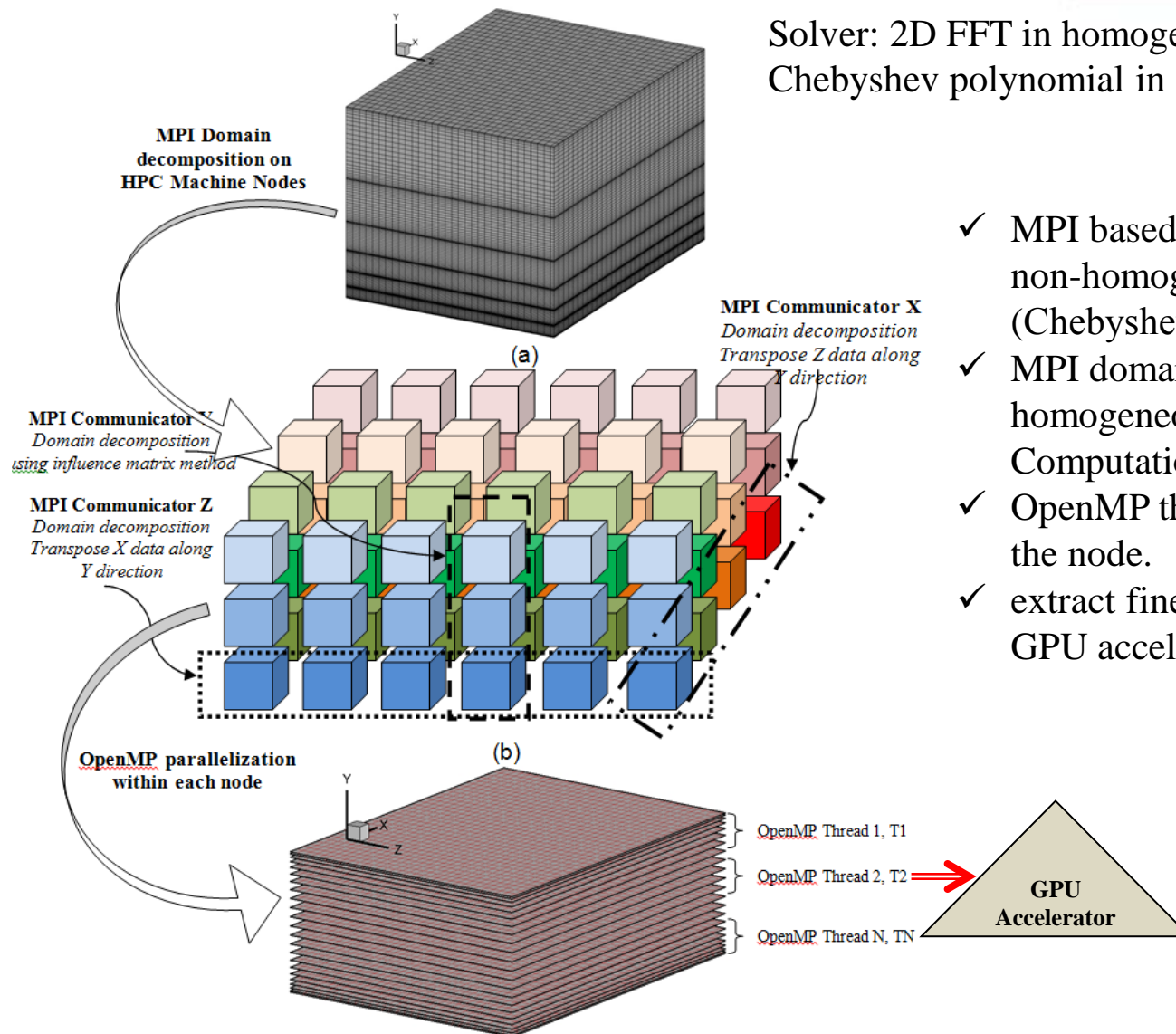
- Both DES and DDES fail to trigger resolved turbulence, and flow behaves like Laminar solution
- SAS results are similar to RANS
- DHRL shows good agreement



Variation of axial velocity at the nozzle centerline is compared with the experimental data at $Re = 3500$



Streamwise velocity contour and flow streamline predicted for $Re = 3500$



Solver: 2D FFT in homogeneous directions and Chebyshev polynomial in on-homogeneous direction

- ✓ MPI based domain decomposition in the non-homogeneous x_2 -direction (Chebyshev's Polynomial)
- ✓ MPI domain decomposition in homogeneous x_1 - x_3 directions (FFT Computation).
- ✓ OpenMP thread parallelization within the node.
- ✓ extract fine-grain parallelism using GPU accelerator,

- MPI/OpenMP scaling up to 8K processors for 800M grids
- Shared Memory Parallelization is bottleneck
- GPU ???

