# Dilute Gas-Solids Flows
# Modeling Challenges – R. D. Patel and Group

**Modeling**

- Need transition from dense to dilute in a single model
  - Many dilute flows have denser regions at entrance (e.g. in a riser) and in industrially important situations there is rarely all dilute flow
  - The wall region may be quite dense (core-annular flow in risers)
  - Entrance region often critical because it serves as feed zone for process reactors
  - Drag law that is continuous from dense to dilute
- Models that include particle size distribution
  - Not clear how important this is for dilute flows; it is important for dense flows (fluidized beds, standpipes, etc.)
- Resolve whether or when turbulence is important for dilute gas-solids flows
  - Appears to be unimportant for risers
- How to handle exit region of riser
- Alternative to assumed single cluster size
- Resolve wall boundary conditions
  - Simple assumptions may not capture key effects, e.g. shape of solids flux distribution near wall as measured by extraction probe
- For industrial scale computations generally have to settle on larger cell size
  - Resolve whether granular temperature equation becomes less relevant

**Experiments**

- Need for detailed measurements – pressure, velocity of gas and solids, void fraction
  - At different scales for the same particles
  - Effect of solids entrance geometry and preconditioning
  - Effect of gas feed nozzles – geometry and placement
- Better non-intrusive diagnostics
  - Resolve meaning of “standard“ measurements, e.g. extraction probes
- Detailed measurements near wall – particles and gas