Combustion – Looking Forward

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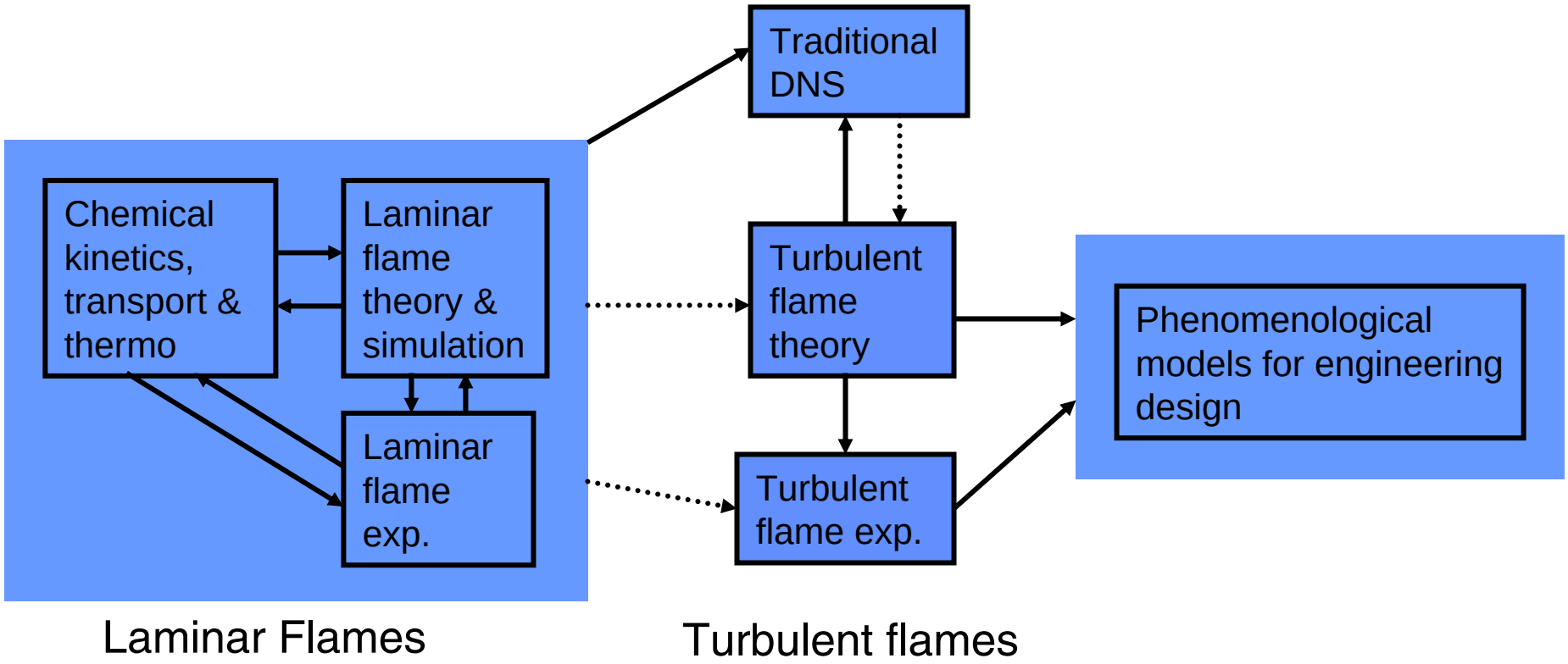
Key drivers

- Turbines for stationary power generation
  - IGCC coal combustion
  - Burn syngas or hydrogen
  - Lean premixed burners
- New design concepts for I/C engines for transportation
  - Alternative fuels
  - Mixed mode combustion
  - Low temperature / high pressure combustions

- Need to differentiate effects of chemistry and transport at the engineering design level

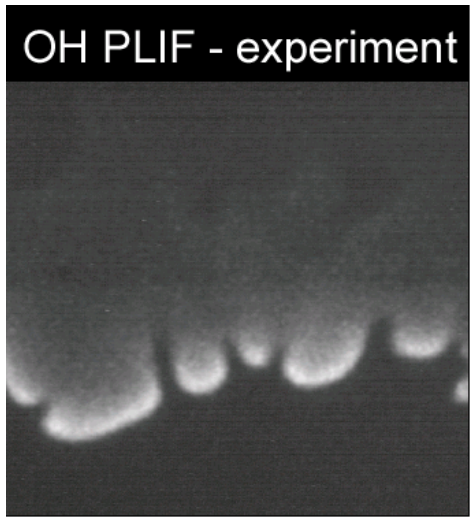
Traditional approach to premixed combustion

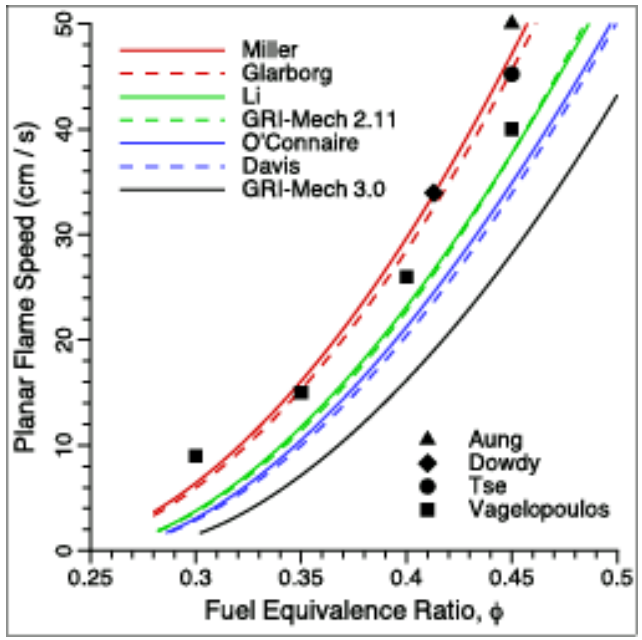


- Traditional approach based on flamelet concept
  - Turbulent flames are locally one-dimensional
  - Role of turbulence is to wrinkle the flame
- No feedback mechanism from turbulent experiments to chemistry / transport

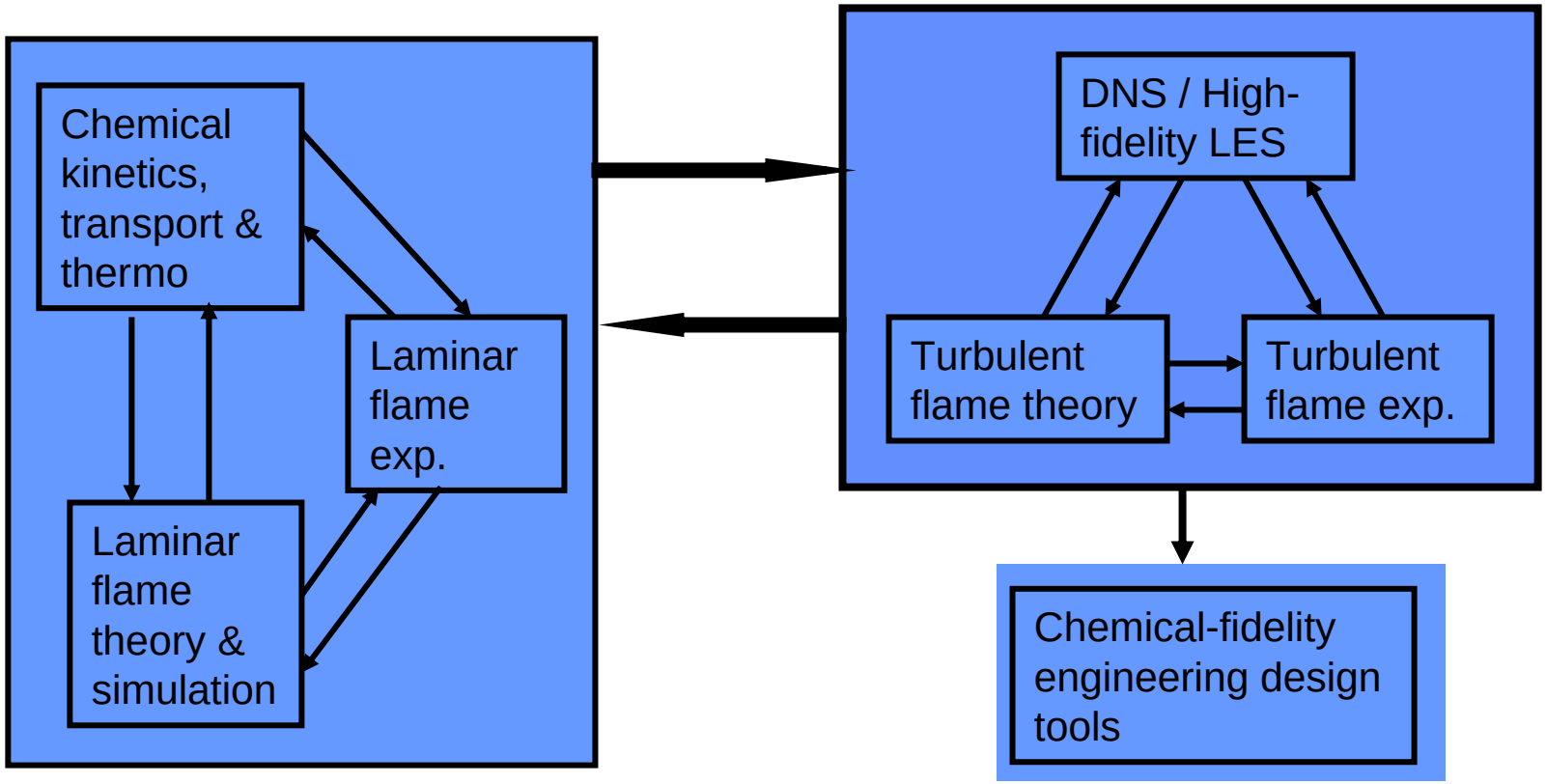
Good news / Bad news

- Bad news
  - Combustion may not occur in a flamelet mode
  - Chemistry / transport not well understood at the desired design conditions
    - Laminar flame experiments not always feasible at lean conditions
  - Measurements very difficult at high pressure
- Good news
  - Simulations of turbulent flame experiments with realistic chemistry and transport is now feasible (DNS / high-fidelity LES)
- We need to change how we approach the overall problem to effectively exploit this type of capability





New strategy



- How do we build feedback from turbulent experiment / simulation to basic chemistry
- How do we use “heroic” simulations to develop improved turbulence models for engineering design