Recap

- Equilibrium (or shifting equilibrium) flows: everywhere in nozzle, recombination to local equilibrium conds. { composit. temp. press.

- Frozen flows: composition everywhere in nozzle fixed @ values attained @ end of CC

EQ flows deliver max. energy of restitution → highest Isp

Frozen flows → NO " " " → lowest Isp

→ recombination includes "combustion", e.g. H & O → H_2O + heat !!

Real flows: partial equil, or non-equil.

Ex. energy distribution for equil. flows in fig. 12.4

Ex. of real flows in fig. 12.5 & 12.6

$H_2 + O_2$ very close to equil. flow

JP4 + O_2 close to frozen flow

- chemical times & velocities affect this

time constants for rxn