Numerical Simulation of Liquid Oxygen Droplet Combustion in Hydrogen in Microgravity

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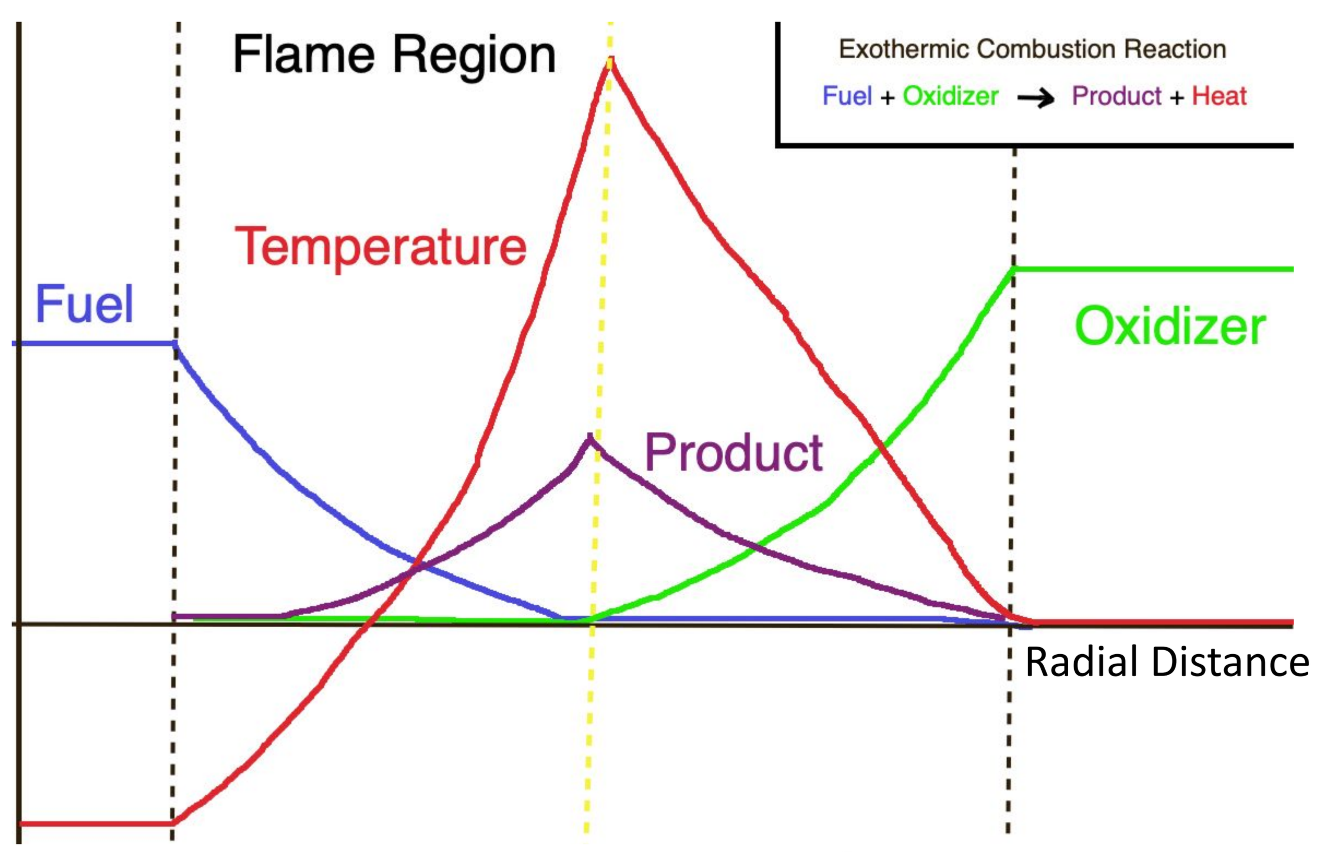
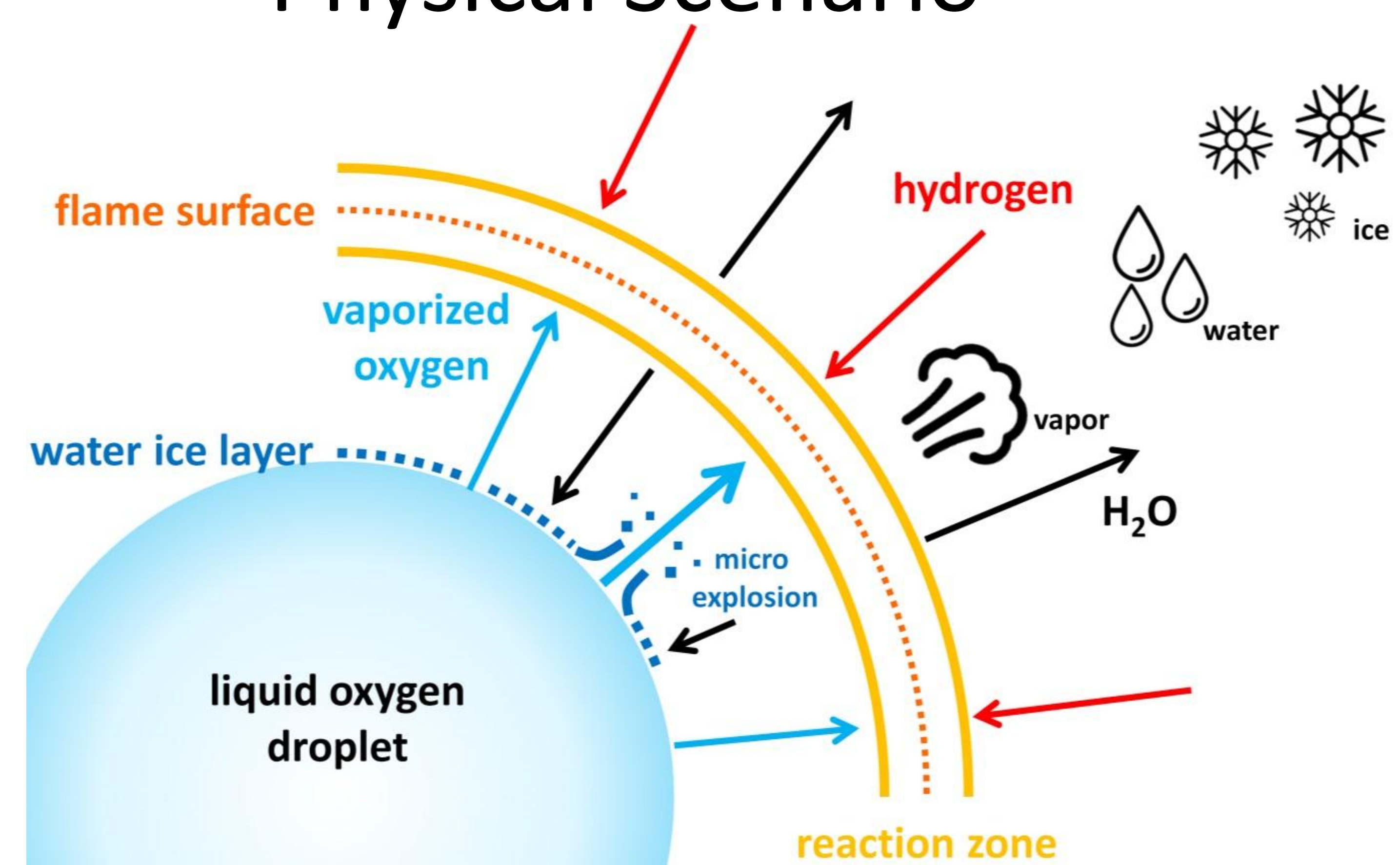
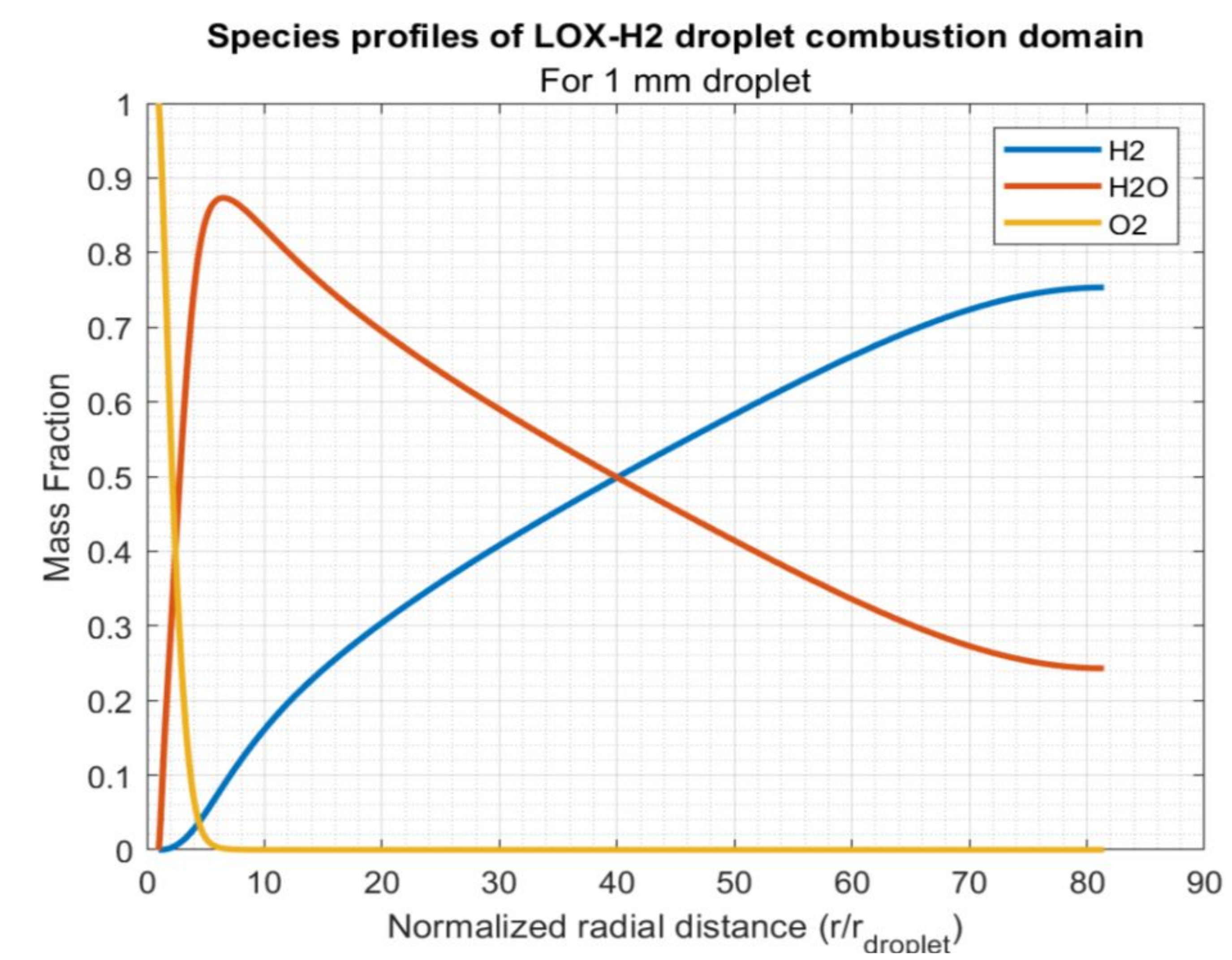
- The LOX-H2 system is widely used in rocket propulsion due to its high performance
- In rocket applications, the hydrogen typically vaporizes, while the oxygen remains liquid upon injection, thus the problem of the combustion of liquid oxygen droplets in gaseous hydrogen is of fundamental interest

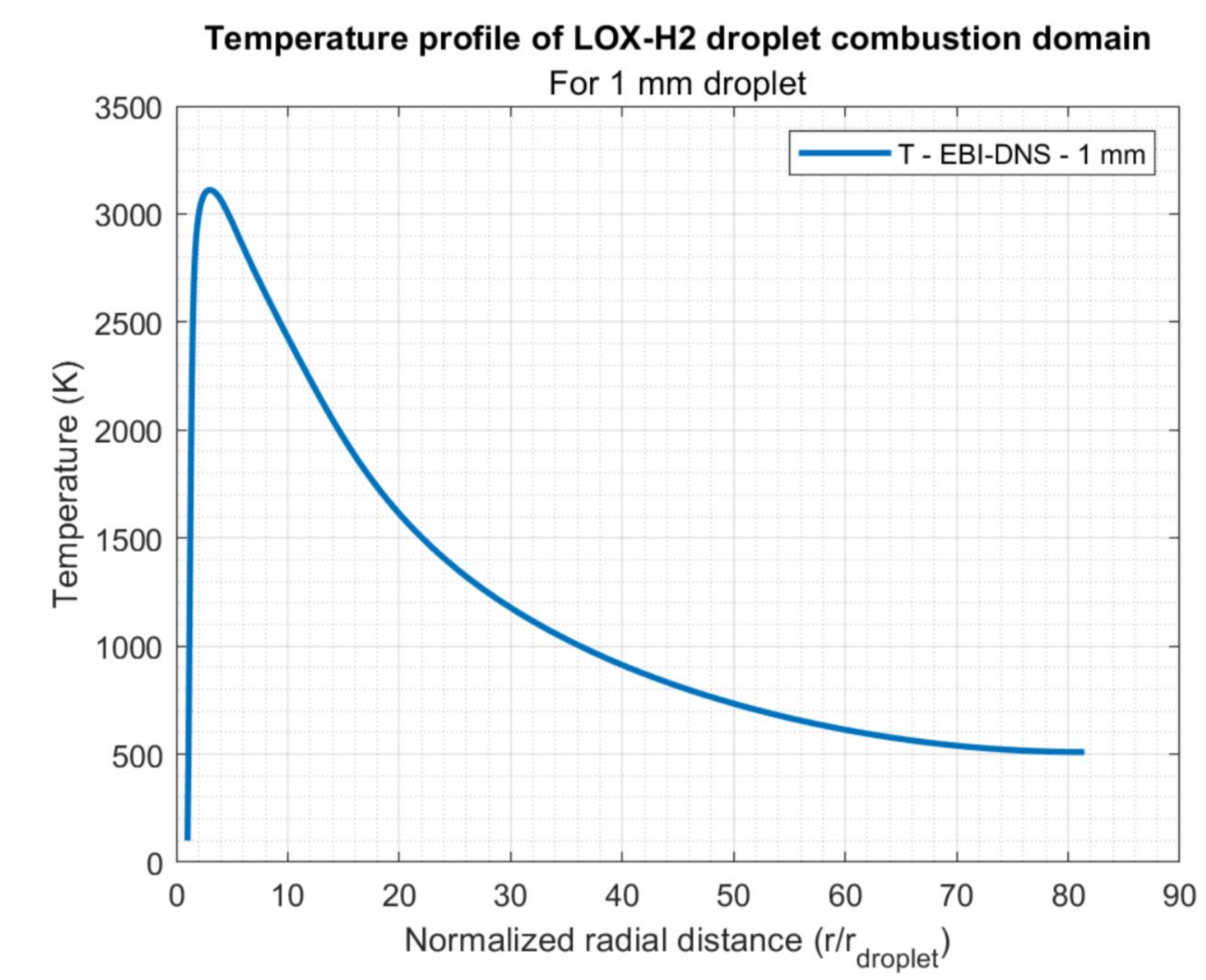
Overview of Flame Geometry



Physical Scenario







Numerical flame simulation results EBI-DNS (Ponduri 2023)

- Numerical modeling of the combustion of a single LOX droplet in gaseous H2 is investigated to compliment microgravity experiments conducted at ZARM
- Modeling Goals: flame structure, temperature, combustion time, chemistry
- Additionally: Couple the flame model with droplet evaporation + Radiation + Ice Formation
- Methods: Karlsruhe Institute of Technology's EBI-DNS for the flame, coupled with RWTH Aachen liquid droplet phase simulator

Results to Date:

- The EBI-DNS model results in more accurate flame temperatures than earlier versions of OpenFOAM
- The computed flame stand-off distance is comparable to that observed in the experiments
- The calculated heat transfer is approximately 70% of that indicated by the experimental results, suggesting significant radiative heat transfer