PRESLHY

WP4 – Ignition: UU update

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Pre-normative REsearch for Safe use of Liquid HYdrogen

Physical model for MIE evaluation

UU model description

- The MIE is determined as the energy needed to heat up a sphere of the mixture at initial temperature T_i to that of the flame T_b (Lewis and von Elbe, 1961):

$$E_{min} = \frac{1}{6}\pi d^3 \rho_u c_{p,u}(T_b - T_i)$$

  - ρ_u and $c_{p,u}$ are the density and specific heat of the unburnt mixture
  - *d* is the diameter of the critical flame kernel considered as:

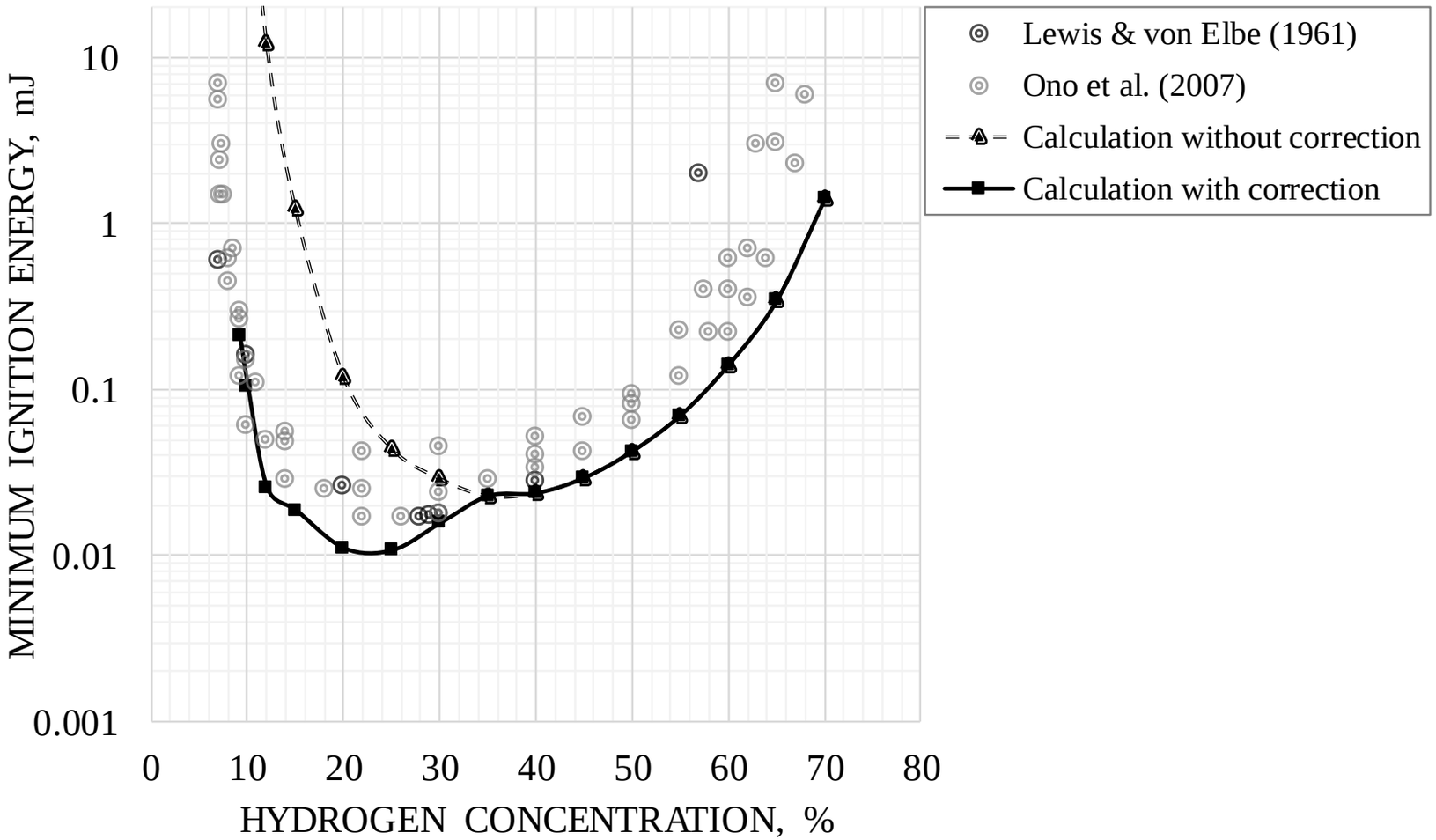
$$d = 2.5\delta_L^B, \quad where \;\; \delta_L^B = 2\delta \frac{k_b/c_{p,b}}{k_u/c_{p,u}} \quad \textit{(Poinsot et al., 2005)}$$

- Unstretched laminar flame speed and mixture properties are calculated using Cantera and Chemkin software.
- Correction of the laminar flame speed to include effect of selective diffusion and flame stretch, based on experimental data by Zimont and Lipatnikov (1995), Lamourex et al. (2003) and Alekseev et al. (2015).

Results

UU research on spark ignition in H2-air mixtures

- Determination of MIE for warm mixtures with H2 in air: 11-50% by vol.

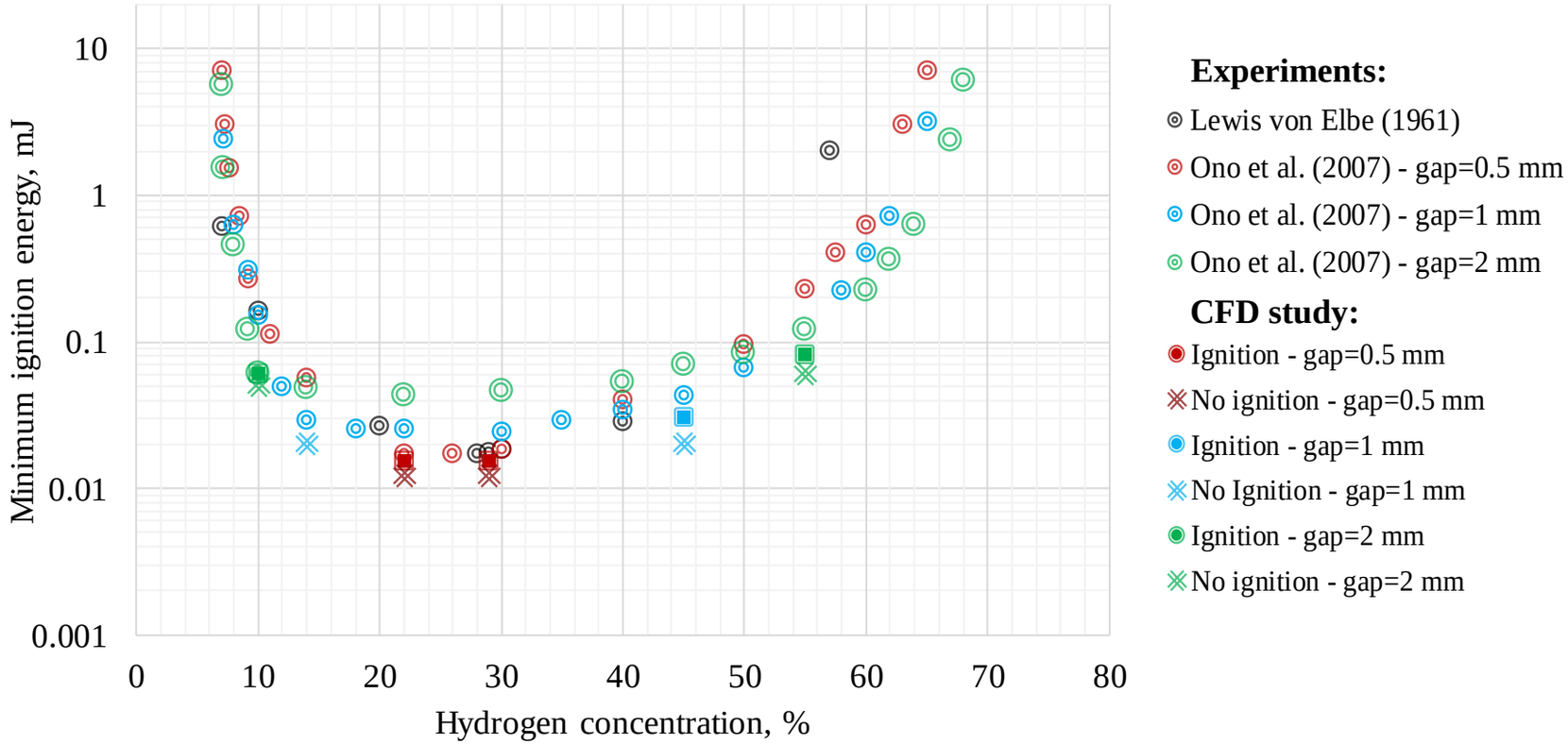


Numerical evaluation of MIE

UU research on spark ignition in H2-air mixtures

- Development of a CFD model to determine the Minimum Ignition Energy by spark for mixtures at ambient temperature with H2 content in air within 10%-55%.
- Final application to mixtures at cryogenic temperature.

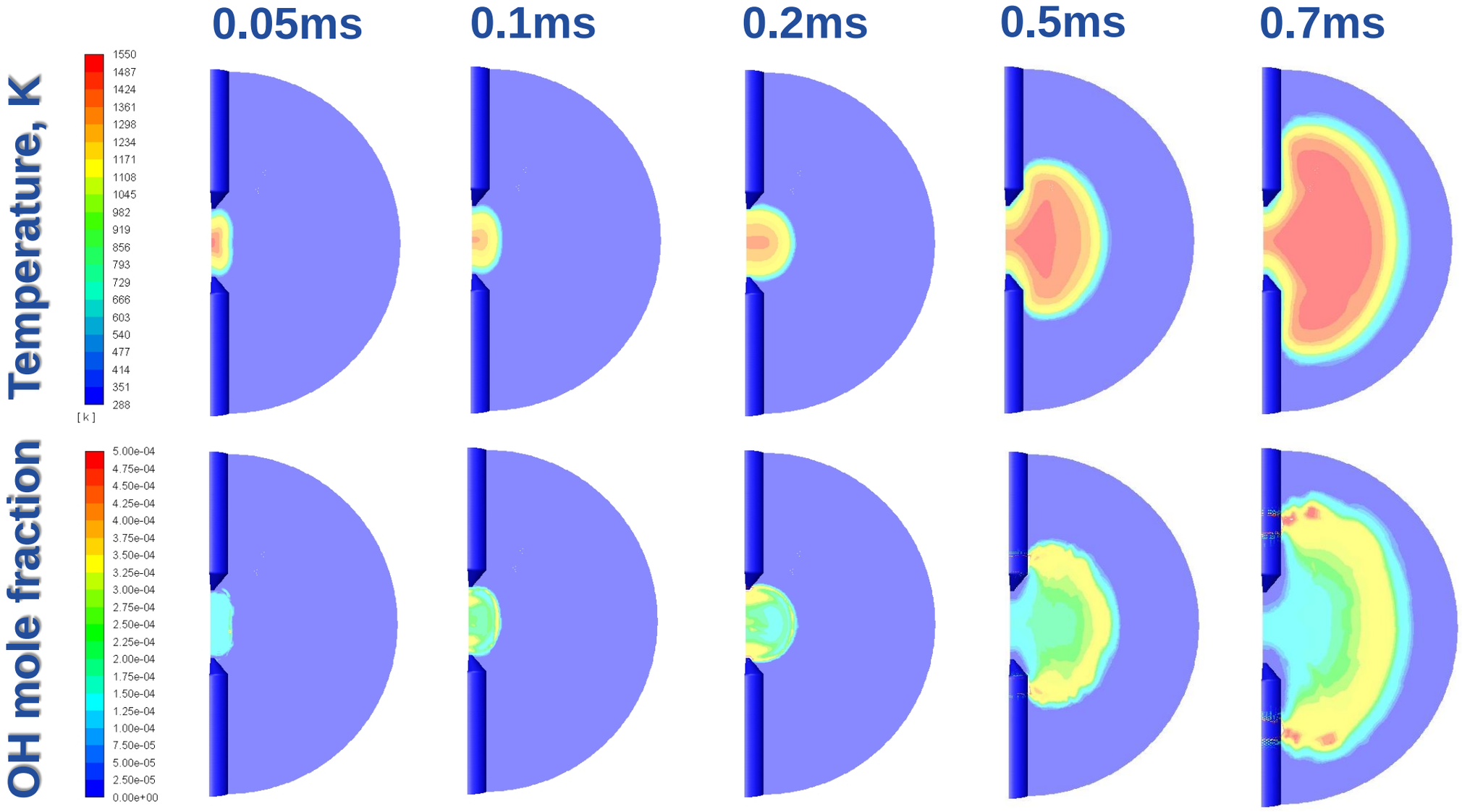
Results: MIE for spark channel radius of 100μm and electrodes radius of 0.1 mm.



Numerical evaluation of MIE

Flame kernel development – H2=55% by vol in air and Lgap=2mm

Results: MIE for spark channel radius of 100μm and electrodes radius of 0.1 mm



Thank you for your attention!

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