Laminar and turbulent burning velocities of hydrogen mixtures at high pressure, including quenching and DDT

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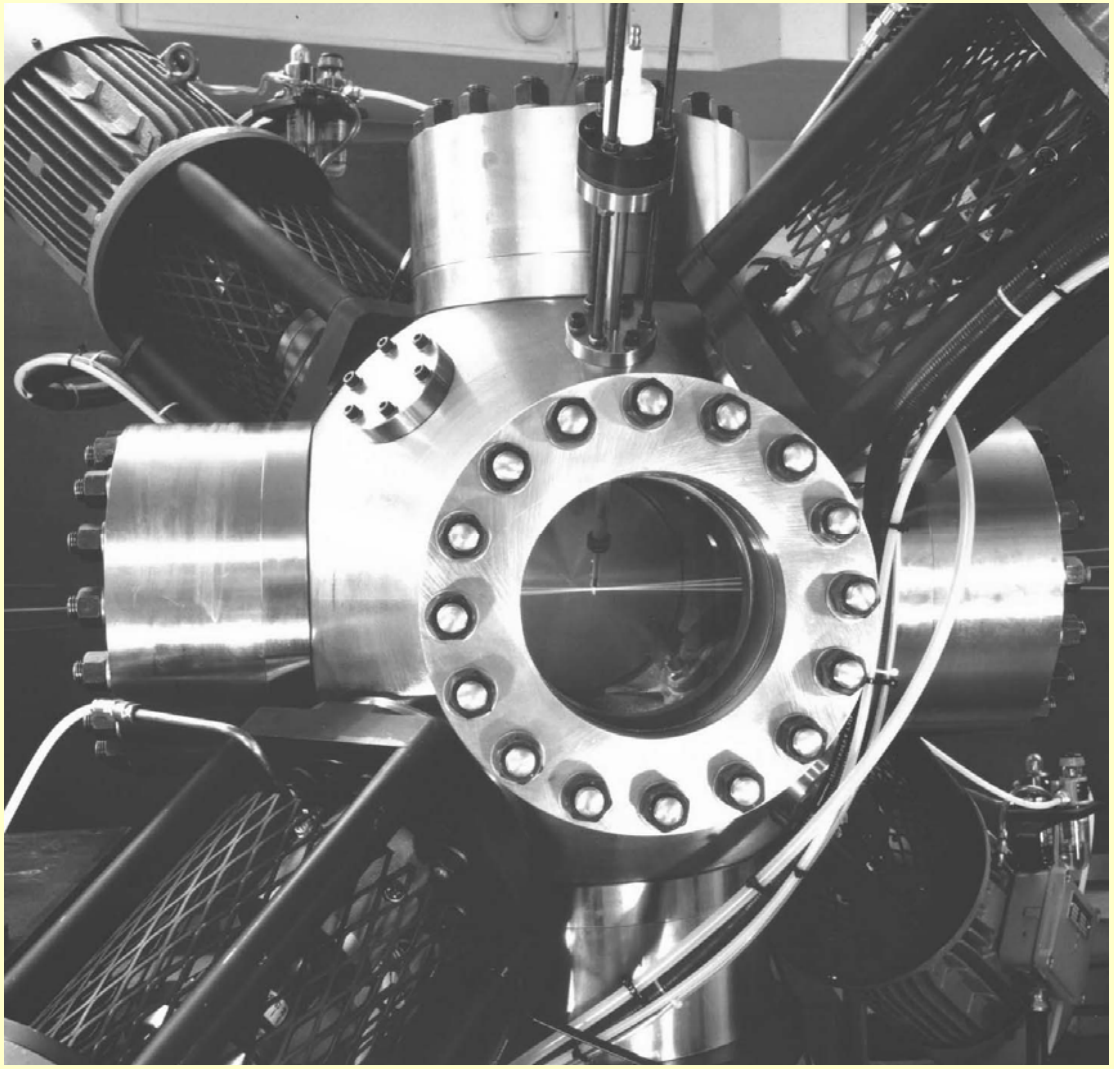
Explosions and Burning Velocities



Explosions and Burning Velocities

$$u_n = \frac{\rho_b}{\rho_u}\left[\frac{\partial r}{\partial t} + \frac{r}{3p\gamma_b}\frac{\partial p}{\partial t}\right]$$

$$u_n = \frac{\partial r}{\partial t} - \left(\frac{R^3 - r^3}{3p\gamma_u r^2}\right)\frac{\partial p}{\partial t}$$

Explosions and Burning Velocities

$$u_n = \frac{R\left(\frac{p_0}{p}\right)^{\frac{1}{\gamma_u}} \frac{\partial p}{\partial t}}{3\left(p_e - p_o\right)\left\{1 - \left(\frac{p_o}{p}\right)^{\frac{1}{\gamma_u}} \left[\frac{p_e - p}{p_e - p_o}\right]\right\}^{2/3}}$$

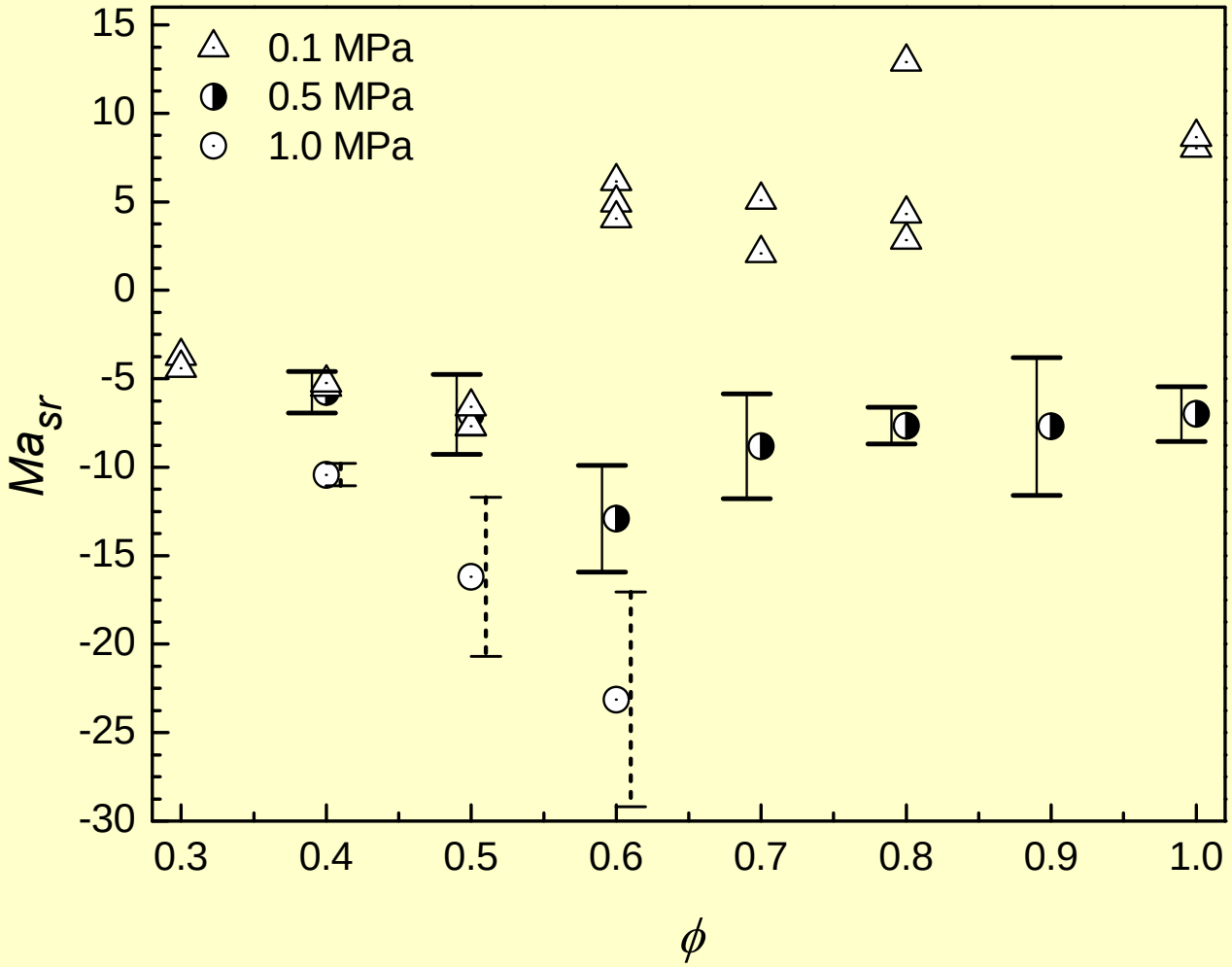
Laminar Burning Velocity and Flame Stretch Rate

$$\frac{u_\ell - u_n}{u_\ell} = K_s Ma_s + K_c Ma_c$$

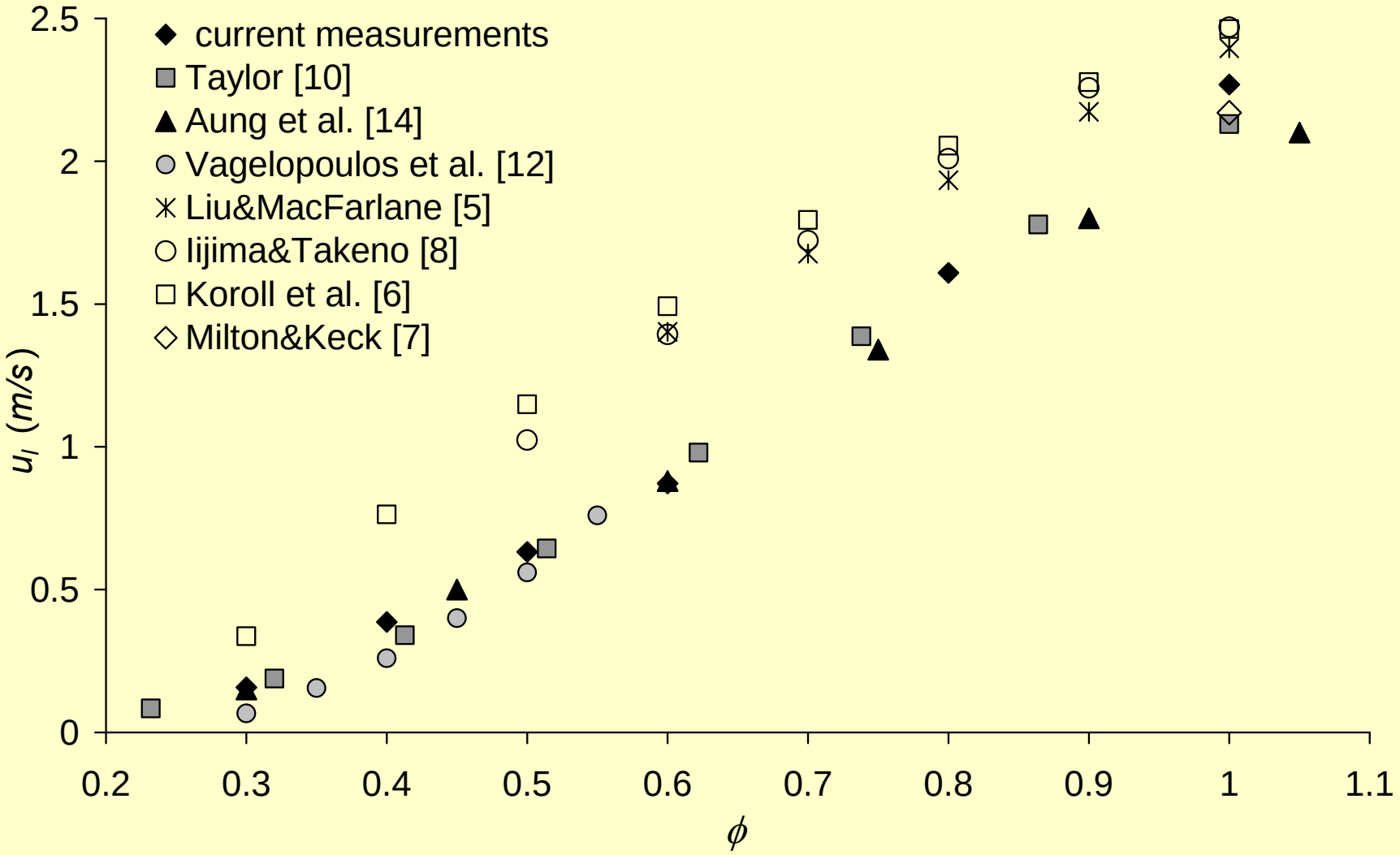
$$K = \alpha \delta_\ell / u_\ell$$

Laminar Burning Velocity and Flame Stretch Rate

Markstein Number at Different Pressures

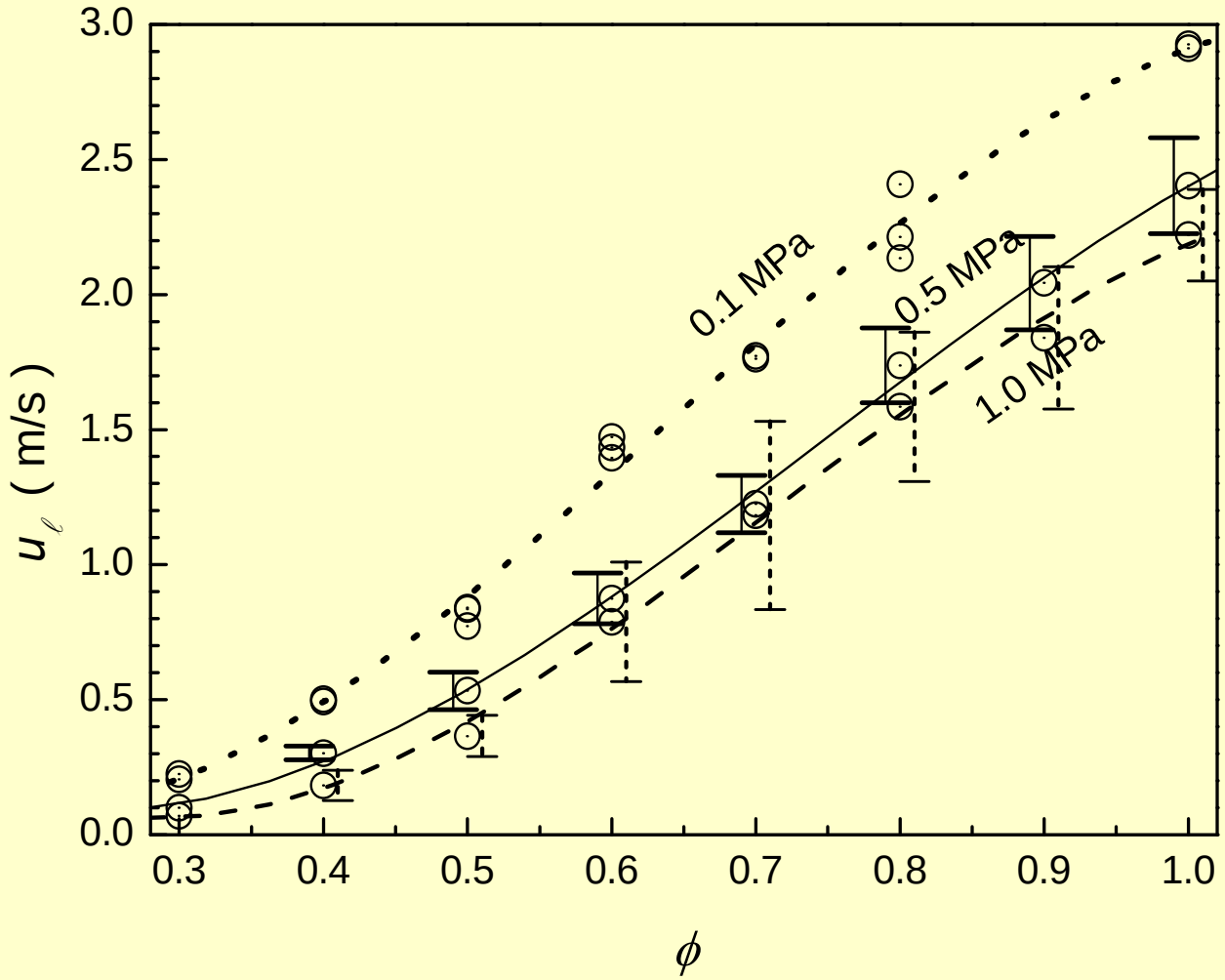


Laminar Burning Velocity and Flame Stretch Rate

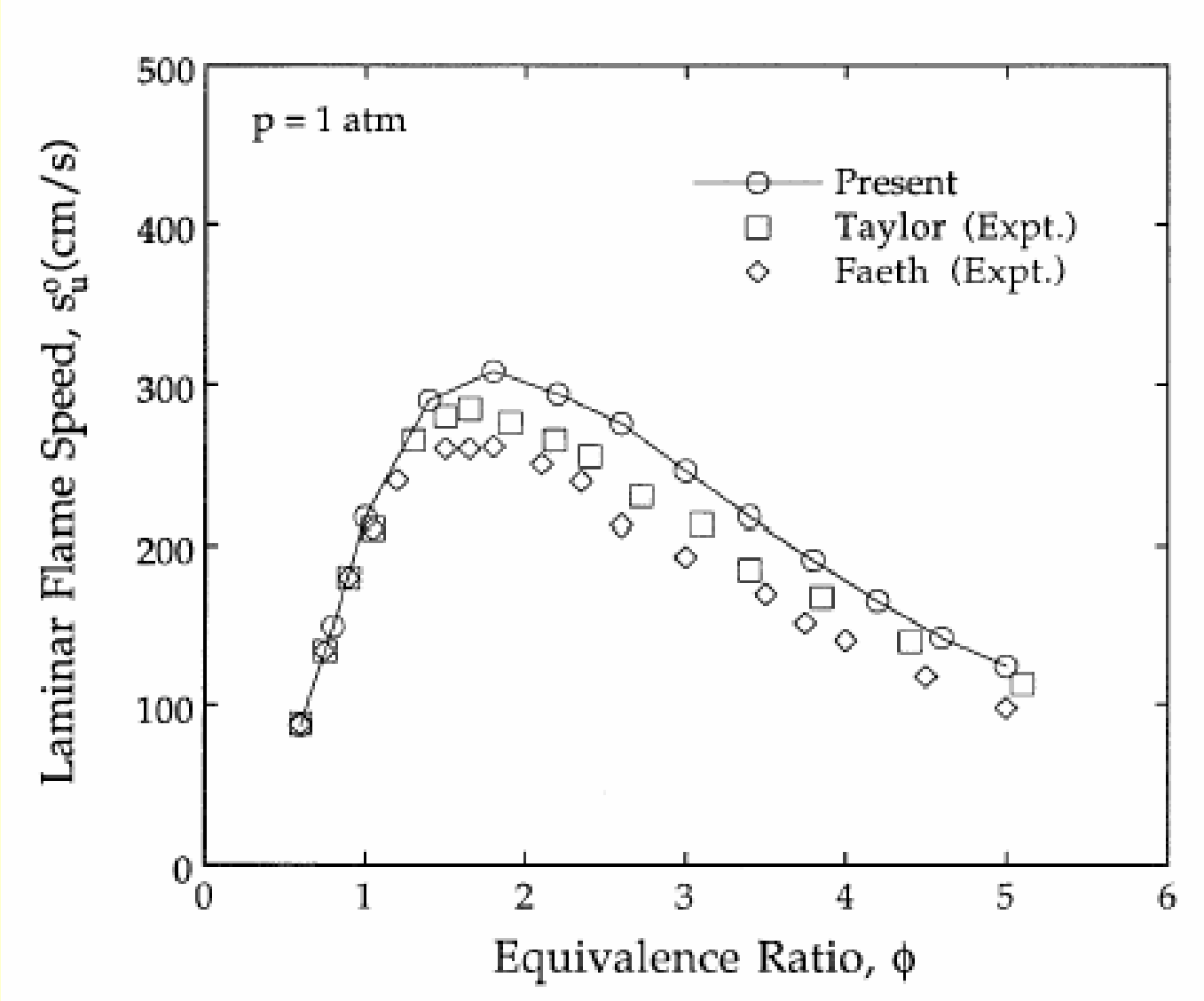


Laminar Burning Velocity and Flame Stretch Rate

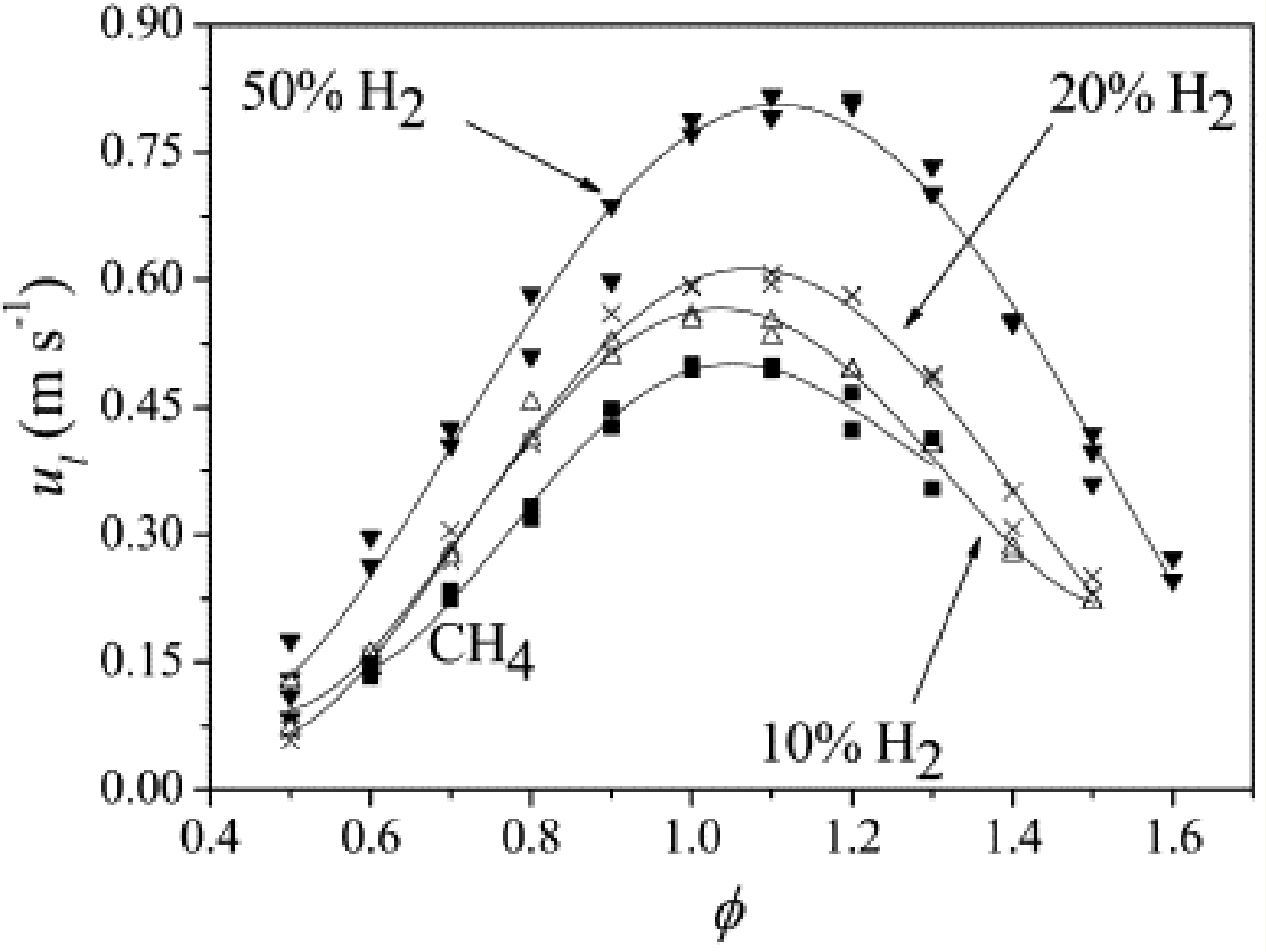
Burning Velocity at Different Pressures



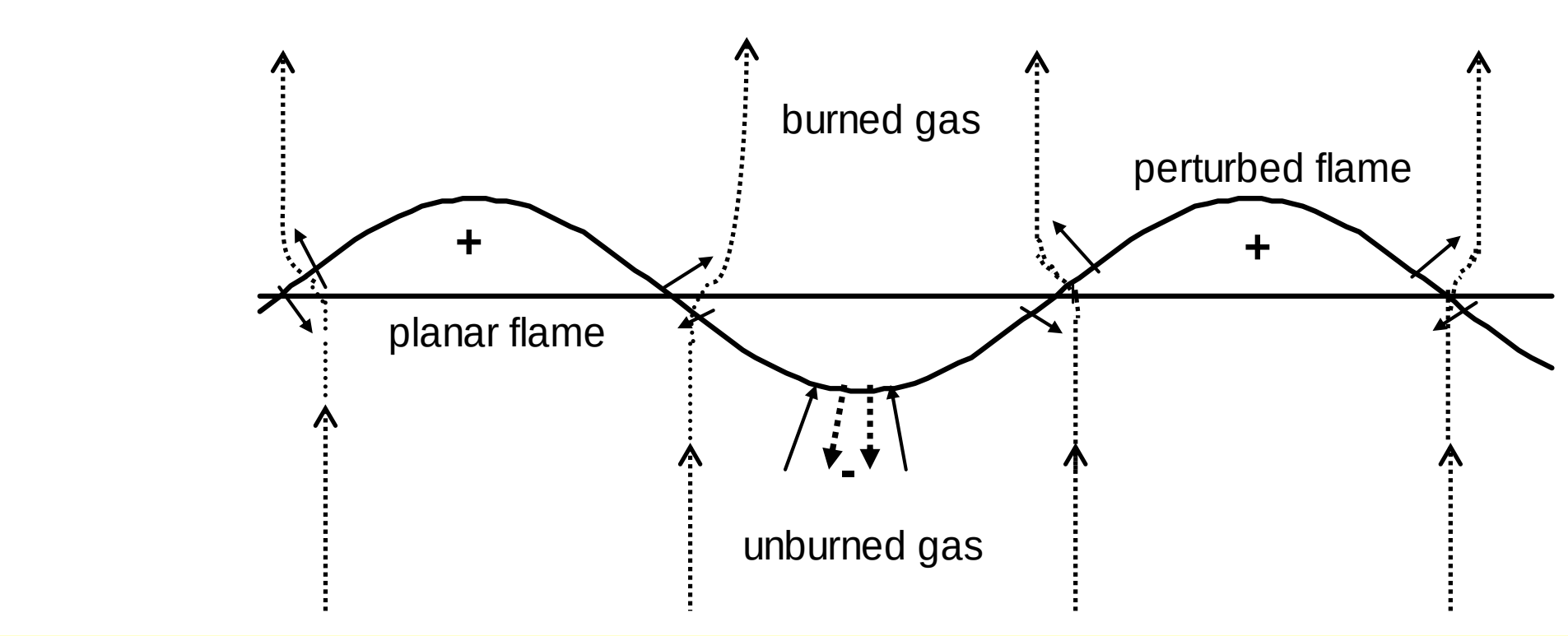
Laminar Burning Velocity and Flame Stretch Rate



Laminar Burning Velocity and Flame Stretch Rate

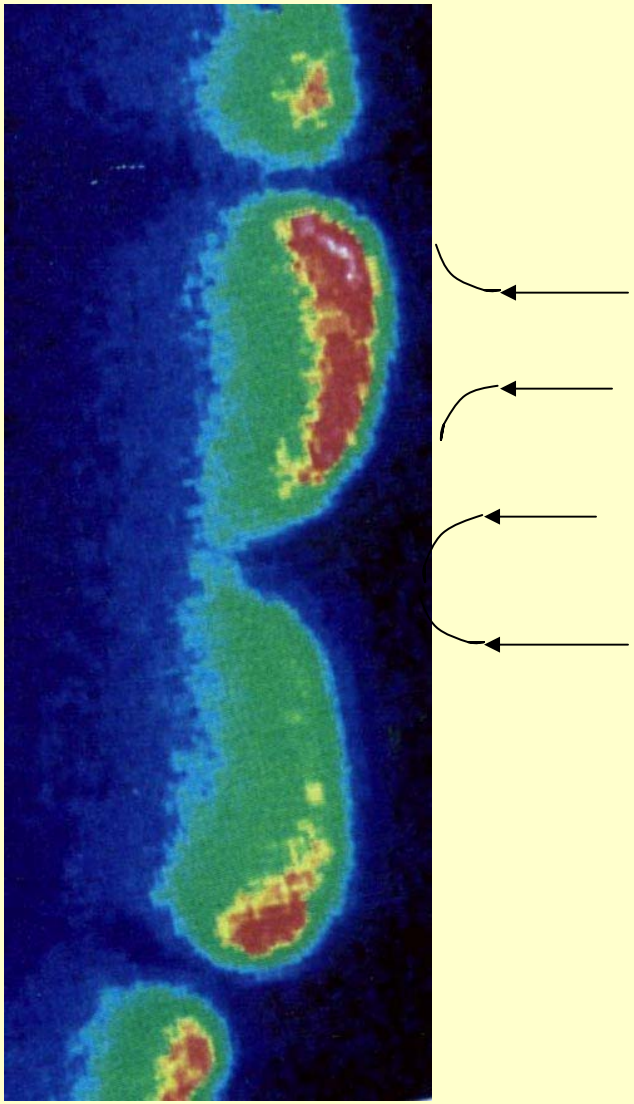


Flame Instabilities: DLTD



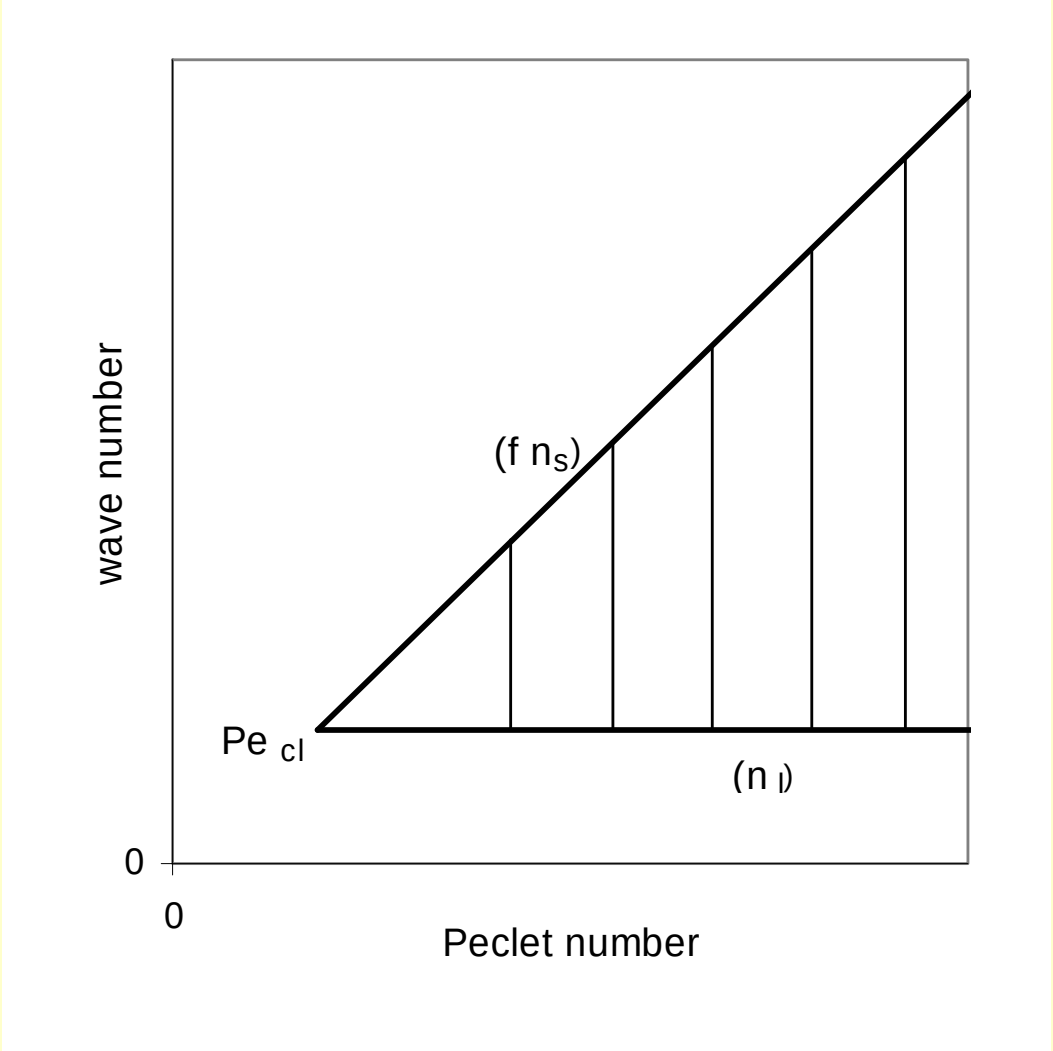
$$Le = k / \rho C_p D$$

D-L T-D: LIF Image, Low Le



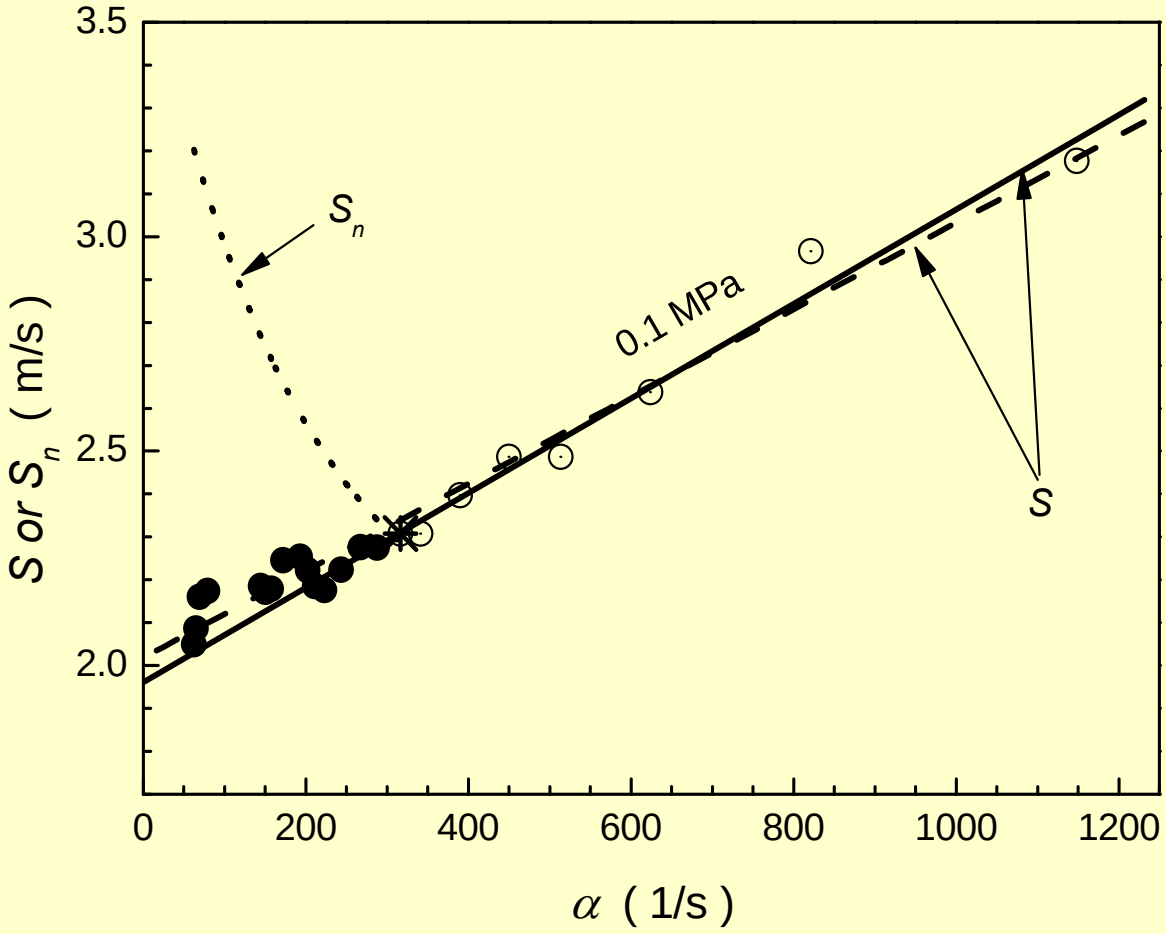
Unstable Spherical Flame Propagation

Instability Peninsula

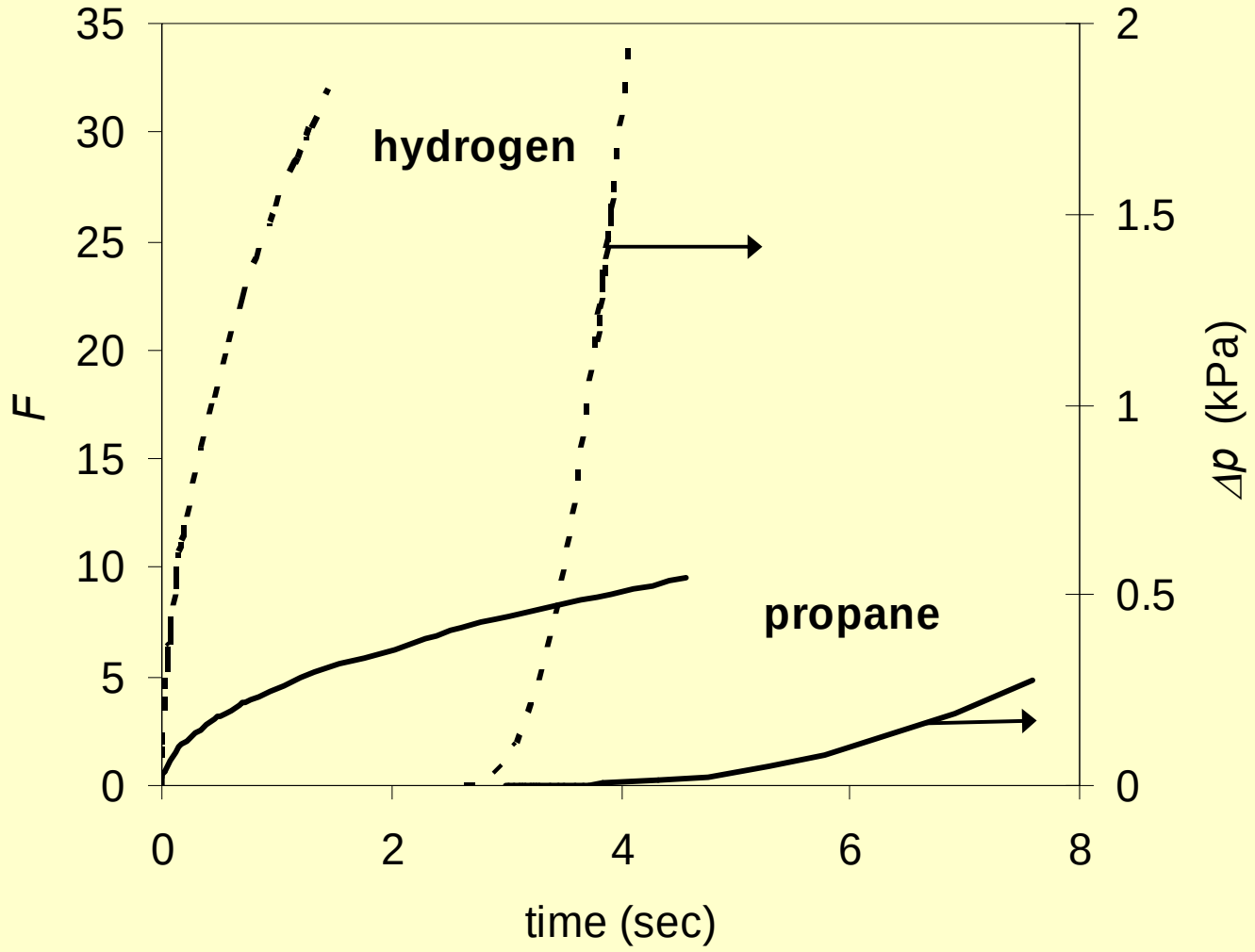


Unstable Spherical Flame Propagation

Flame Speed Variation with α

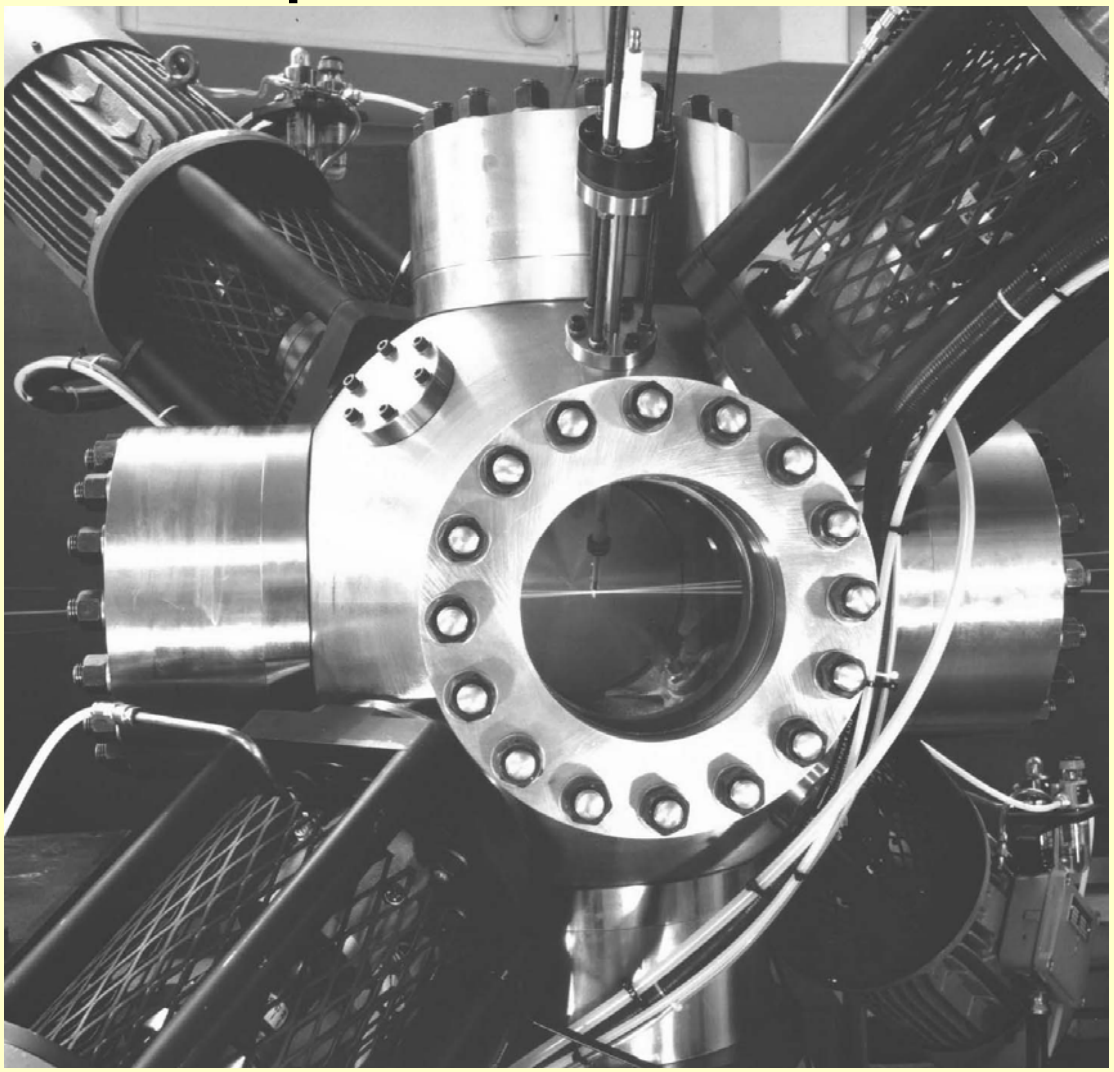


Unstable Spherical Flame Propagation to 100m

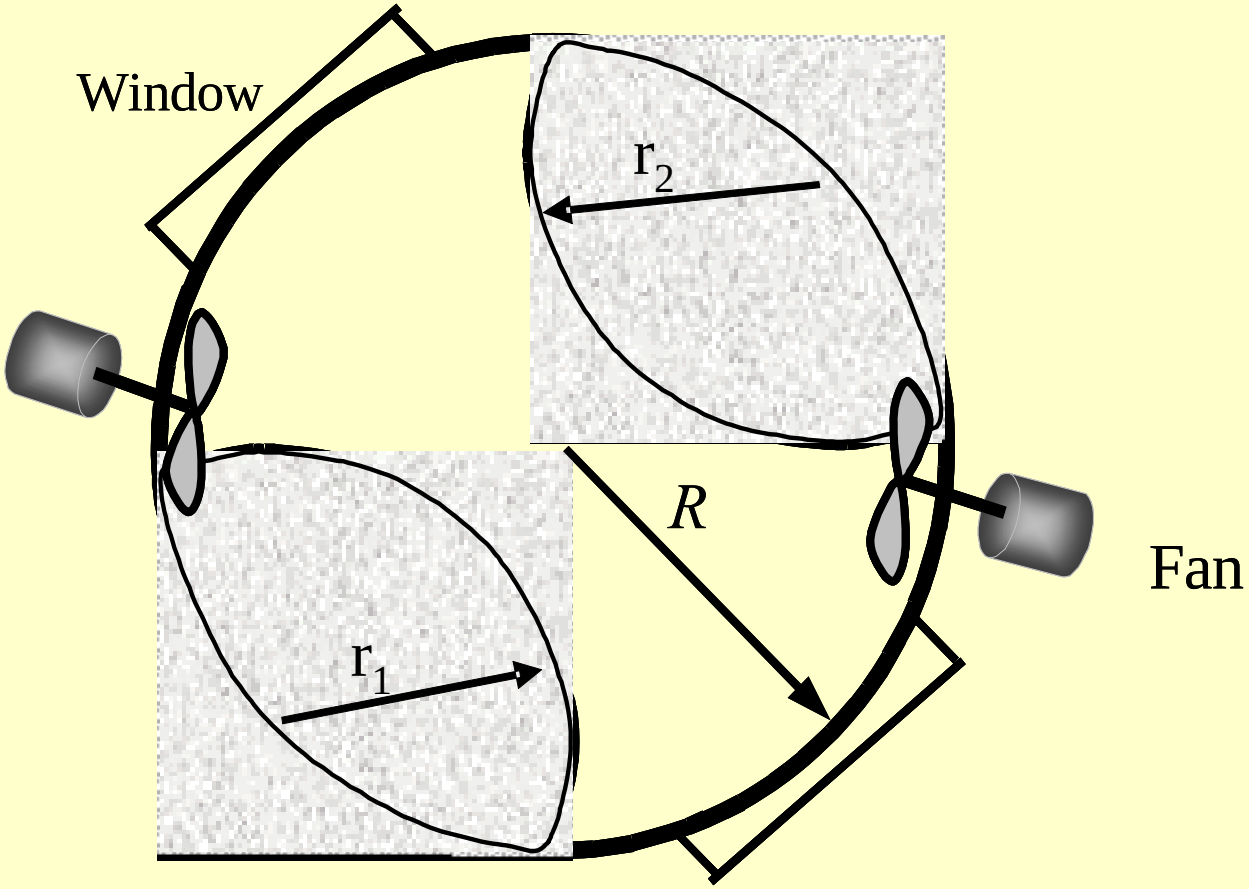


Bomb Implosions

Spherical Bomb

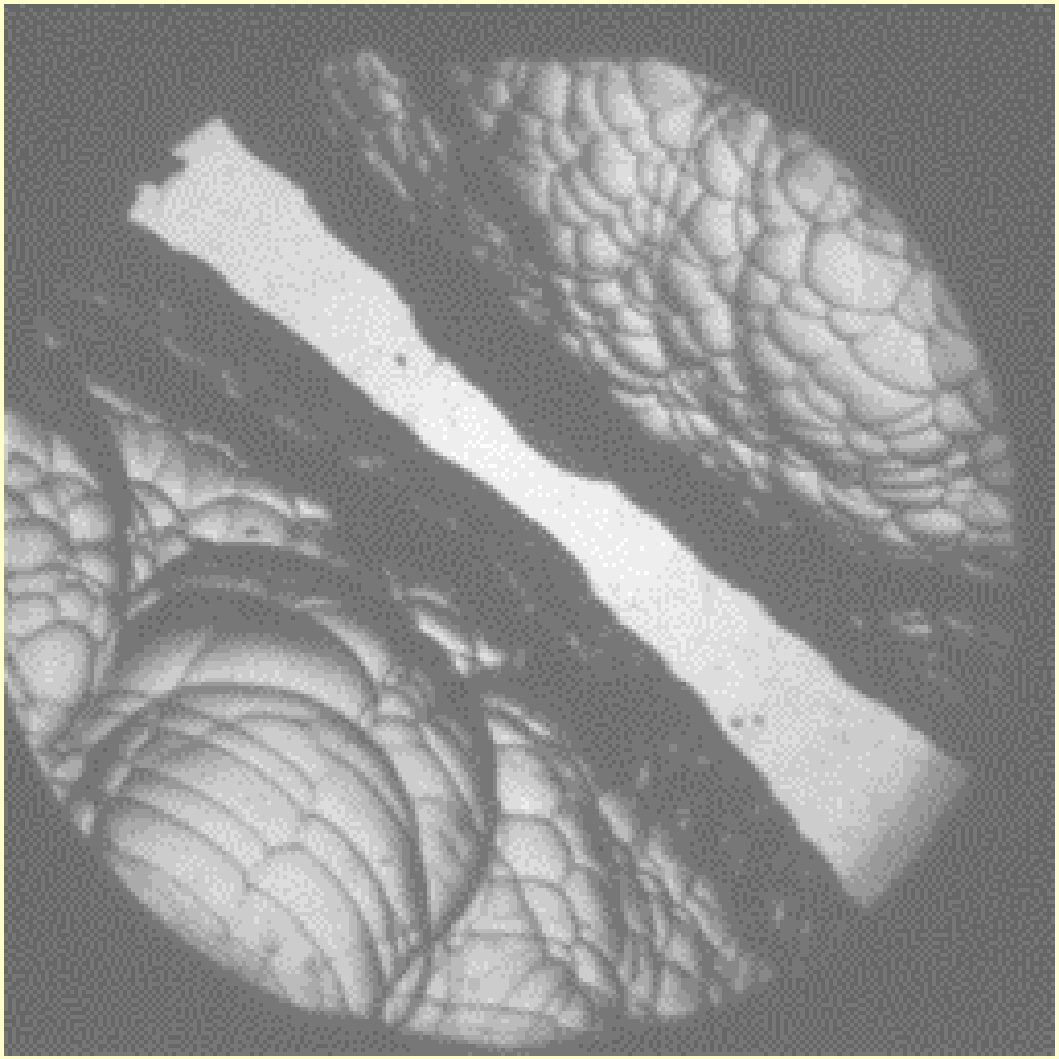


Implosion Technique for High Pressure Measurements

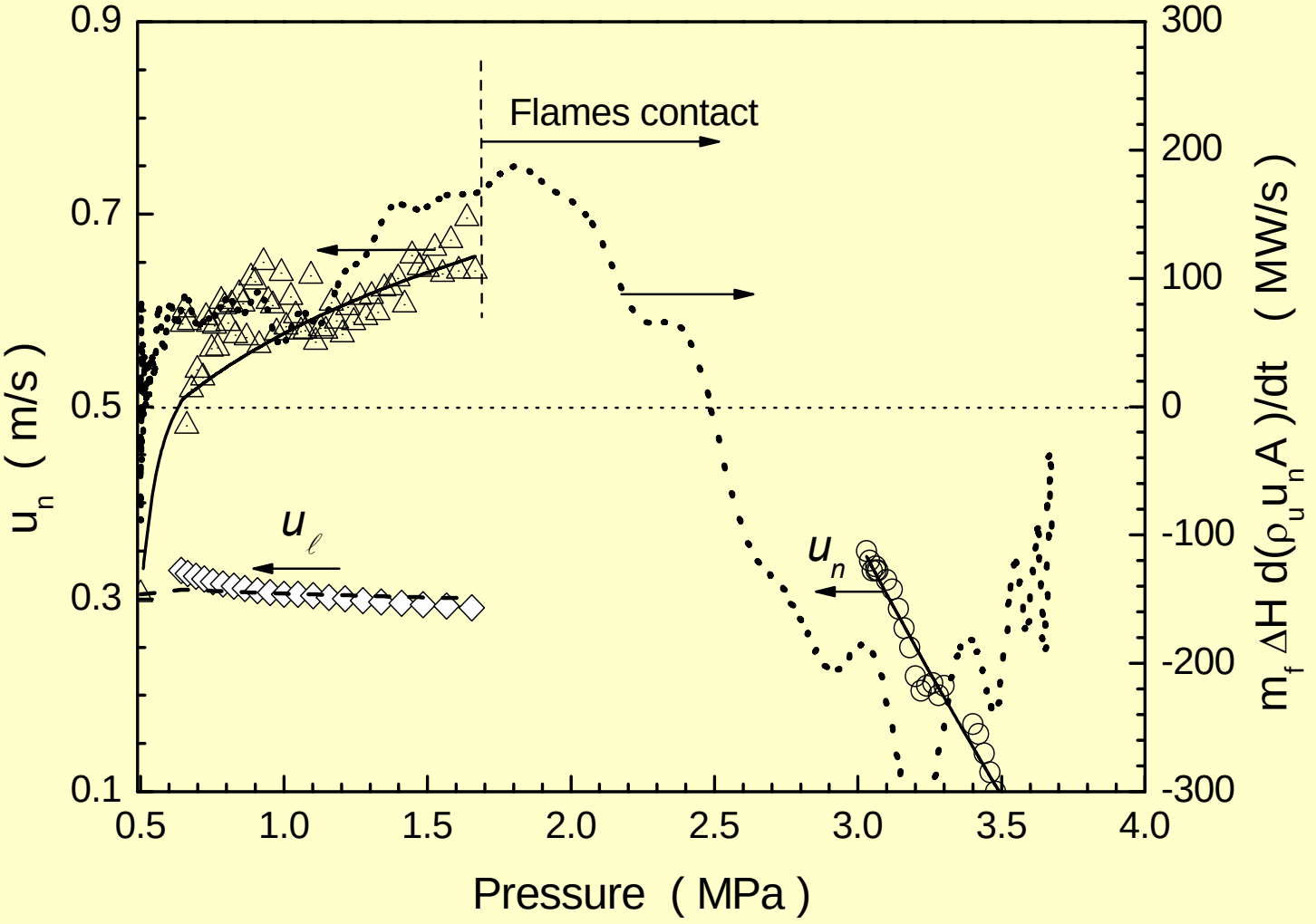


Bomb Implosions

Unstable twin kernels



Burning Velocities and Rate of Change of Heat Release Rate



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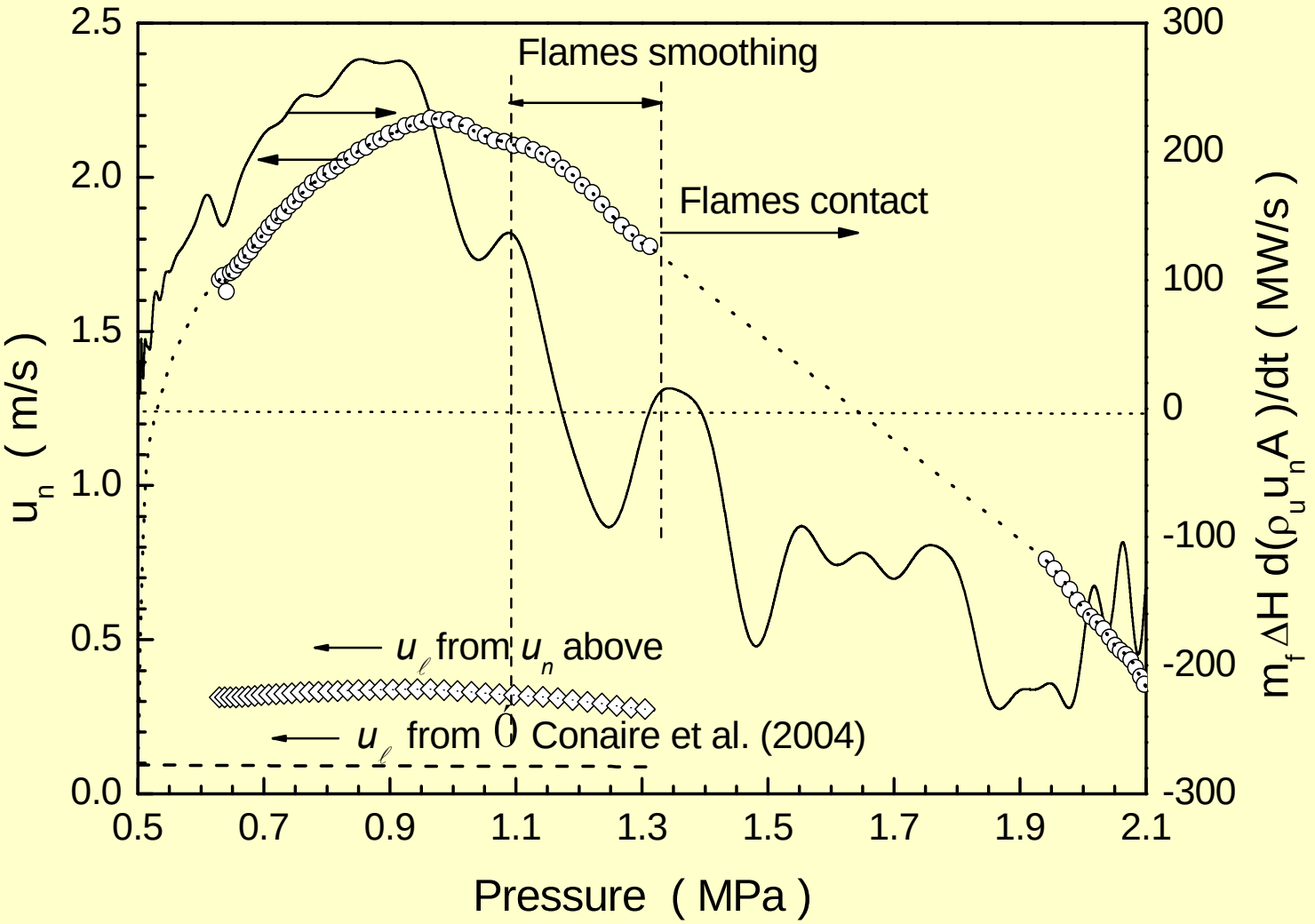
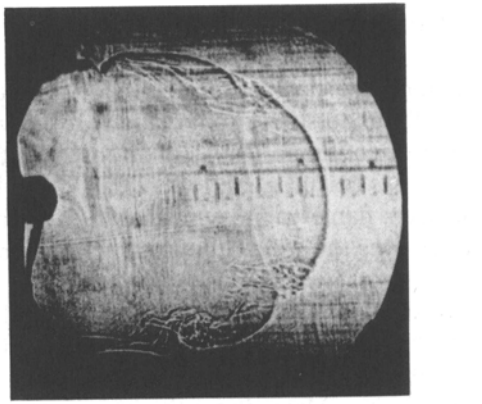
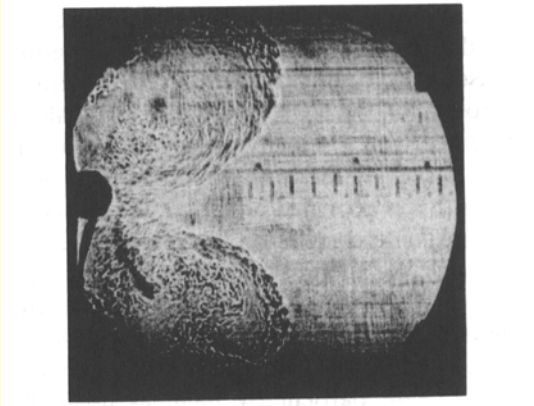


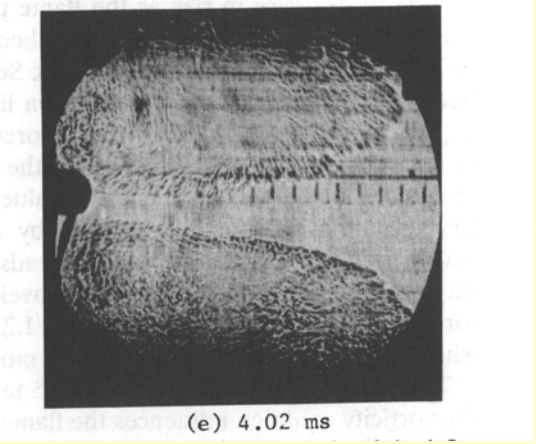
Taylor Instability



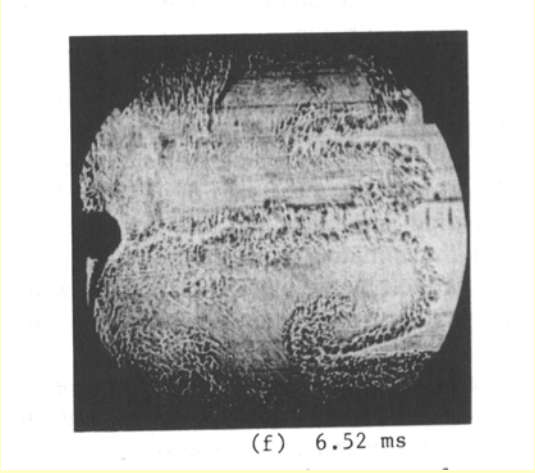
(b) 0.73 ms



(d) 2.8 ms



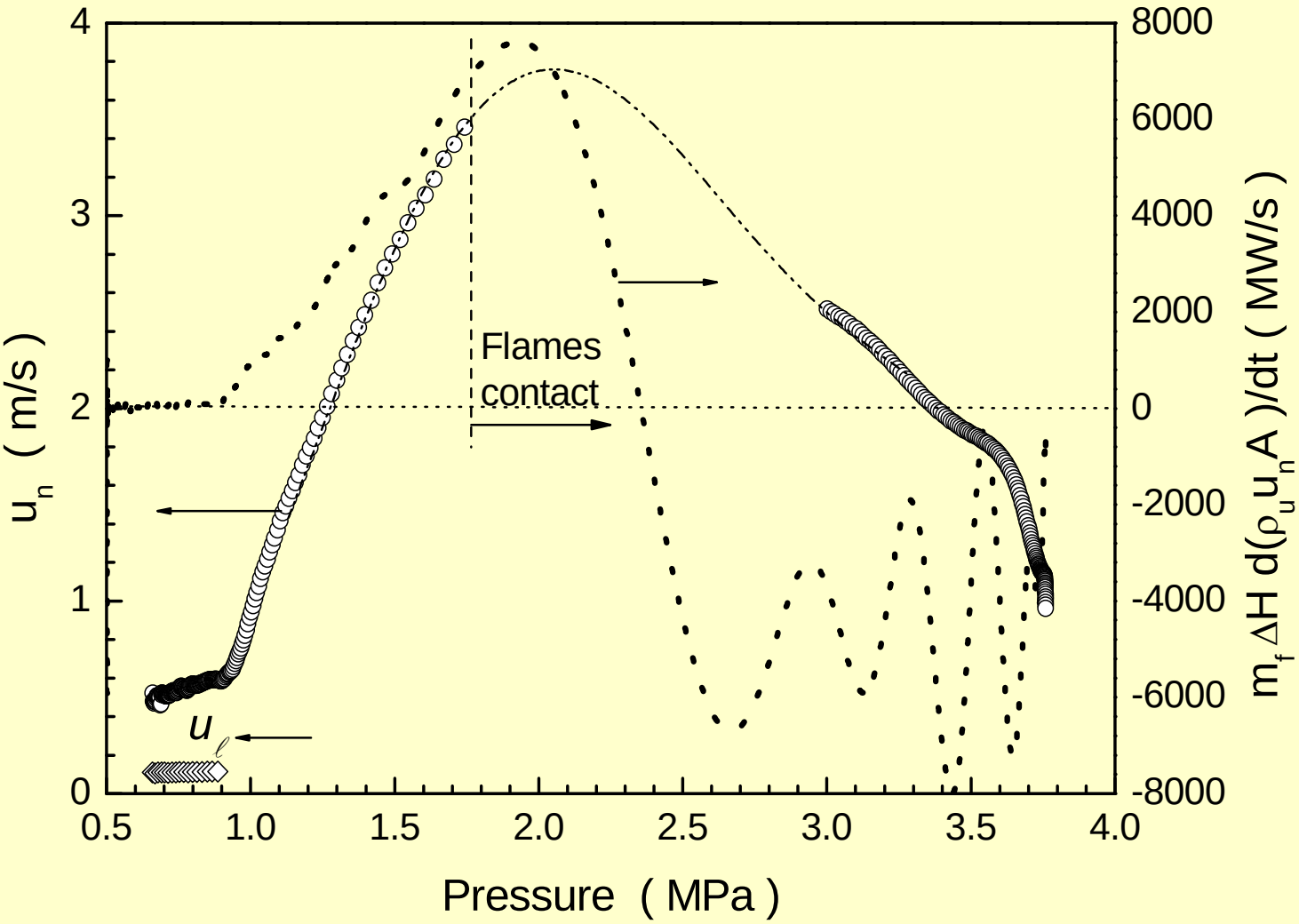
(e) 4.02 ms



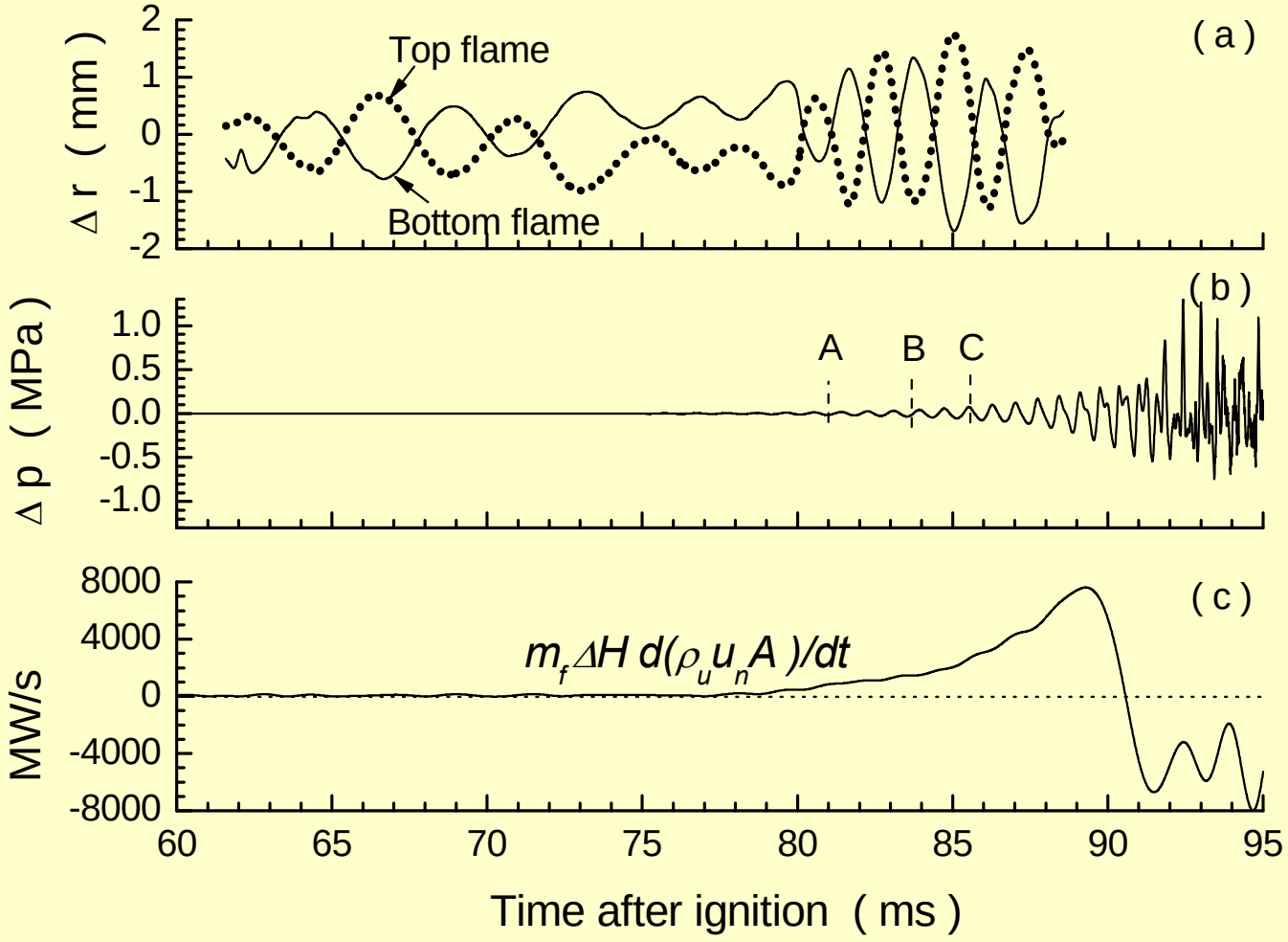
(f) 6.52 ms

$$\nabla(1/\rho)\times\nabla p$$

Burning Velocities and Rate of Change of Heat Release Rate



Burning Velocities and Rate of Change of Heat Release Rate

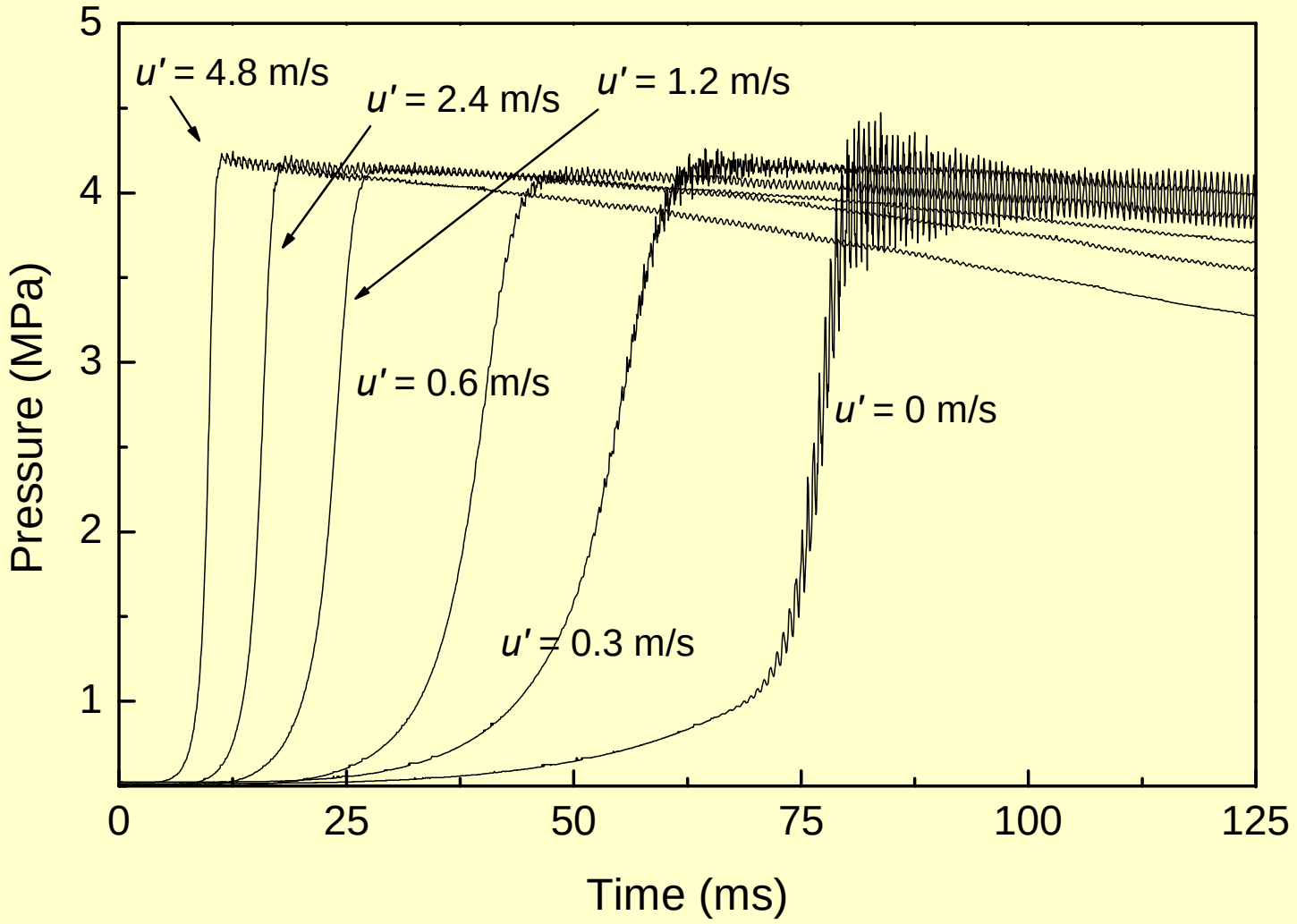


Summary of Implosion Results

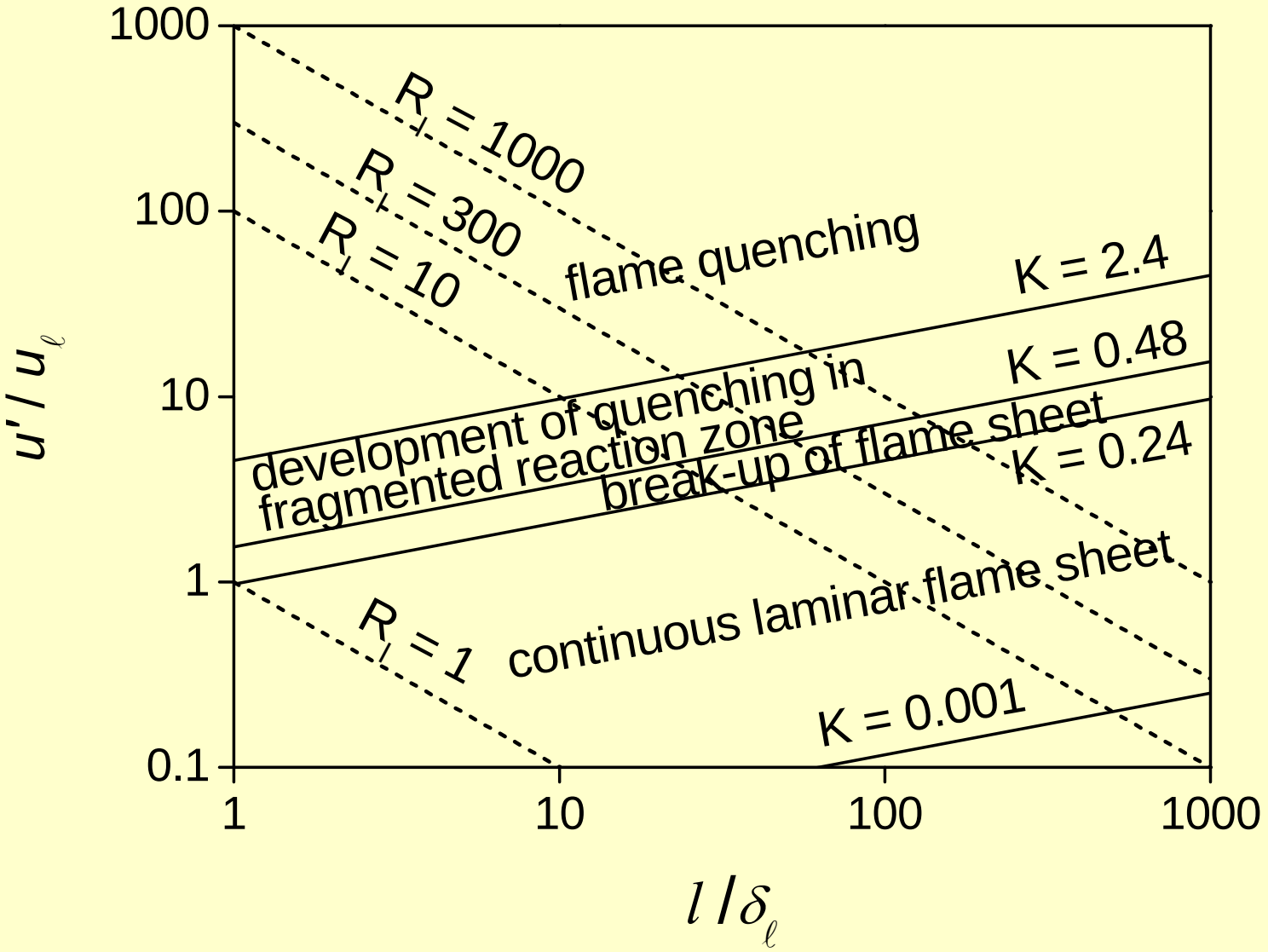
Mixture	Ma_{sr}	*max* *F*	Δp kPa	
C_8H_{18} $\phi = 1.0$	2	2.2	0	DLTD
H_2 $\phi = 1.4$	-11	6.4	0.8	DLTD PA,RT
C_8H_{18} $\phi = 1.6$	-20	37.5	300	DLTD, RT, PA SA

Δp

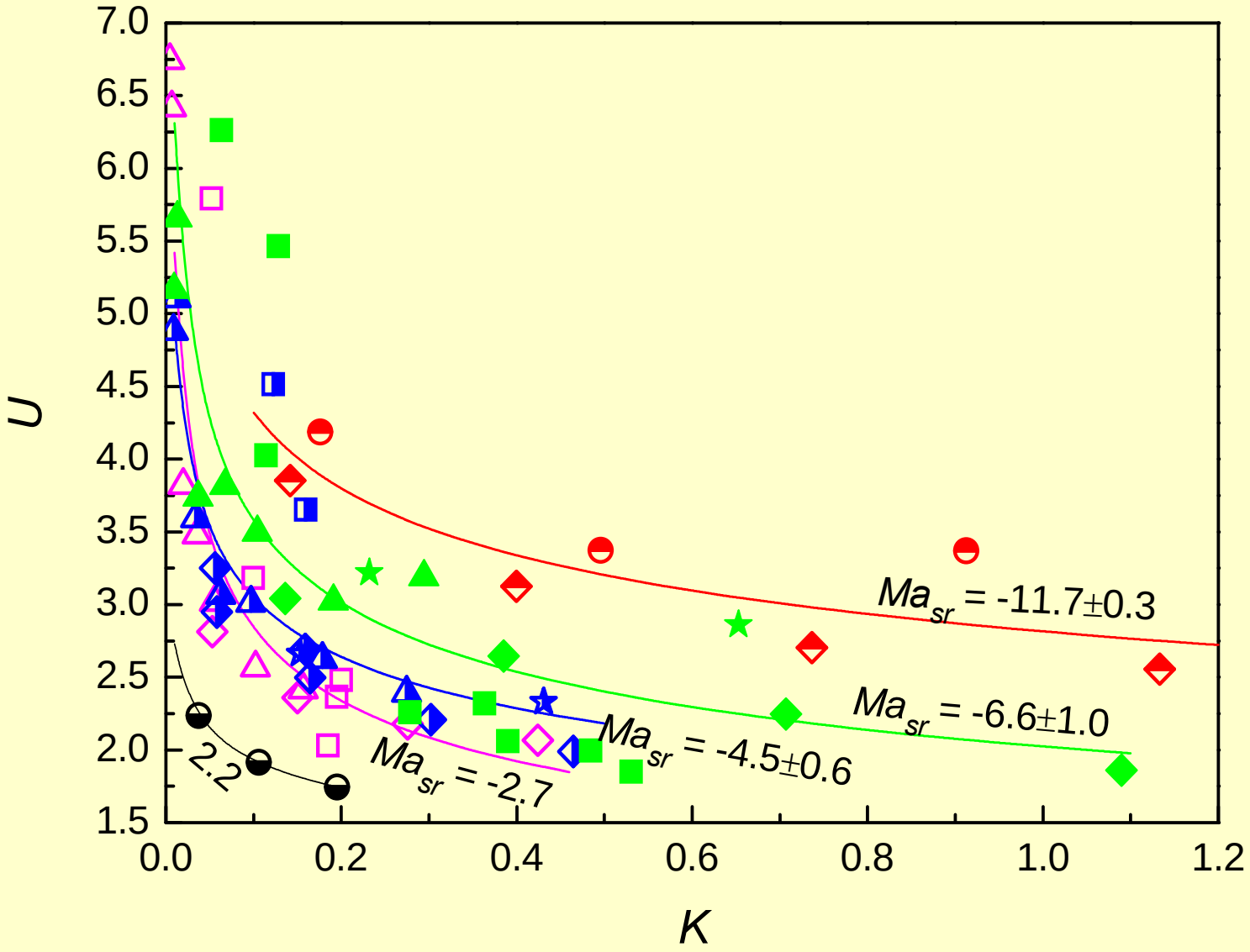
Influence of Turbulence upon Instabilities



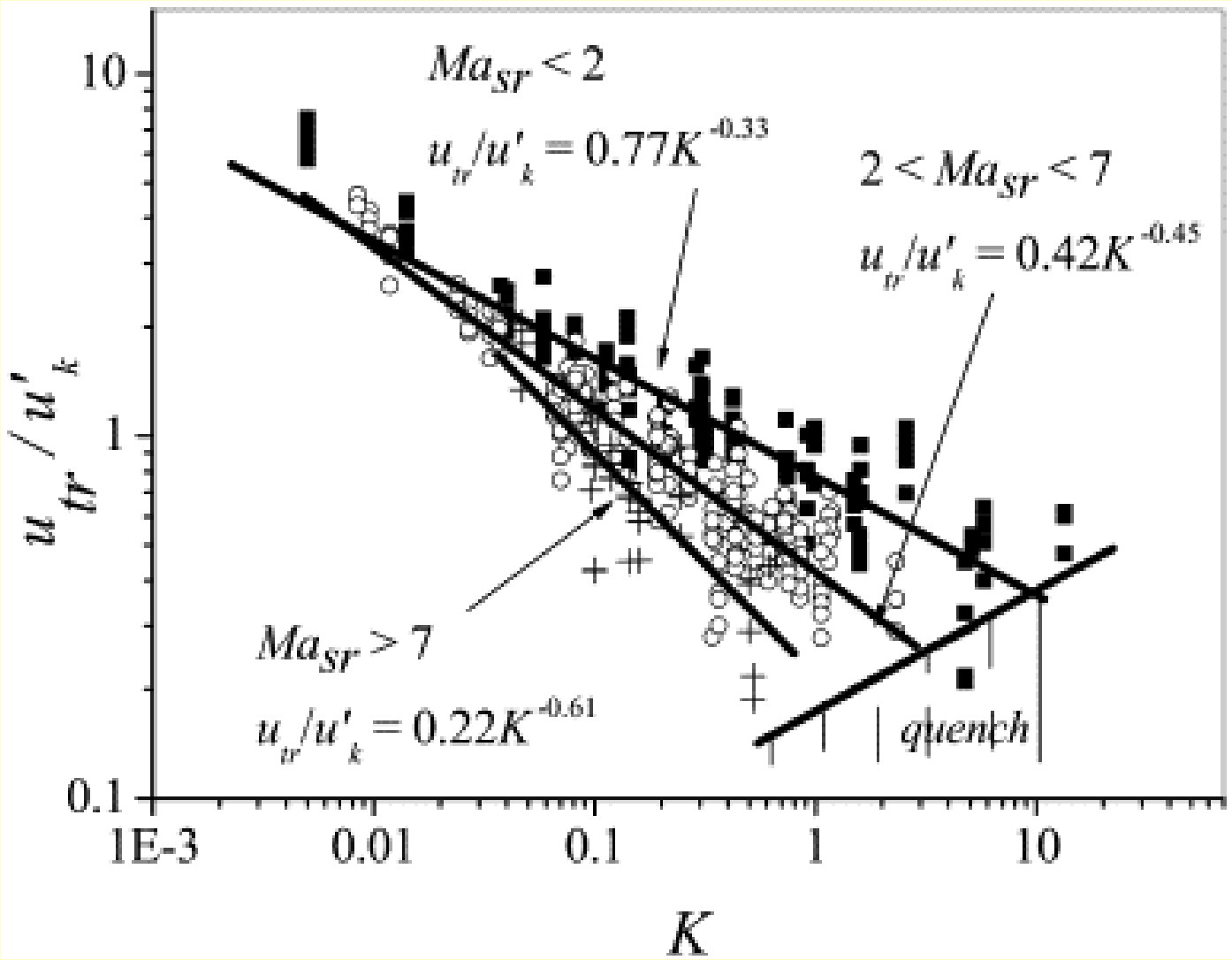
Regimes of Premixed Turbulent Combustion



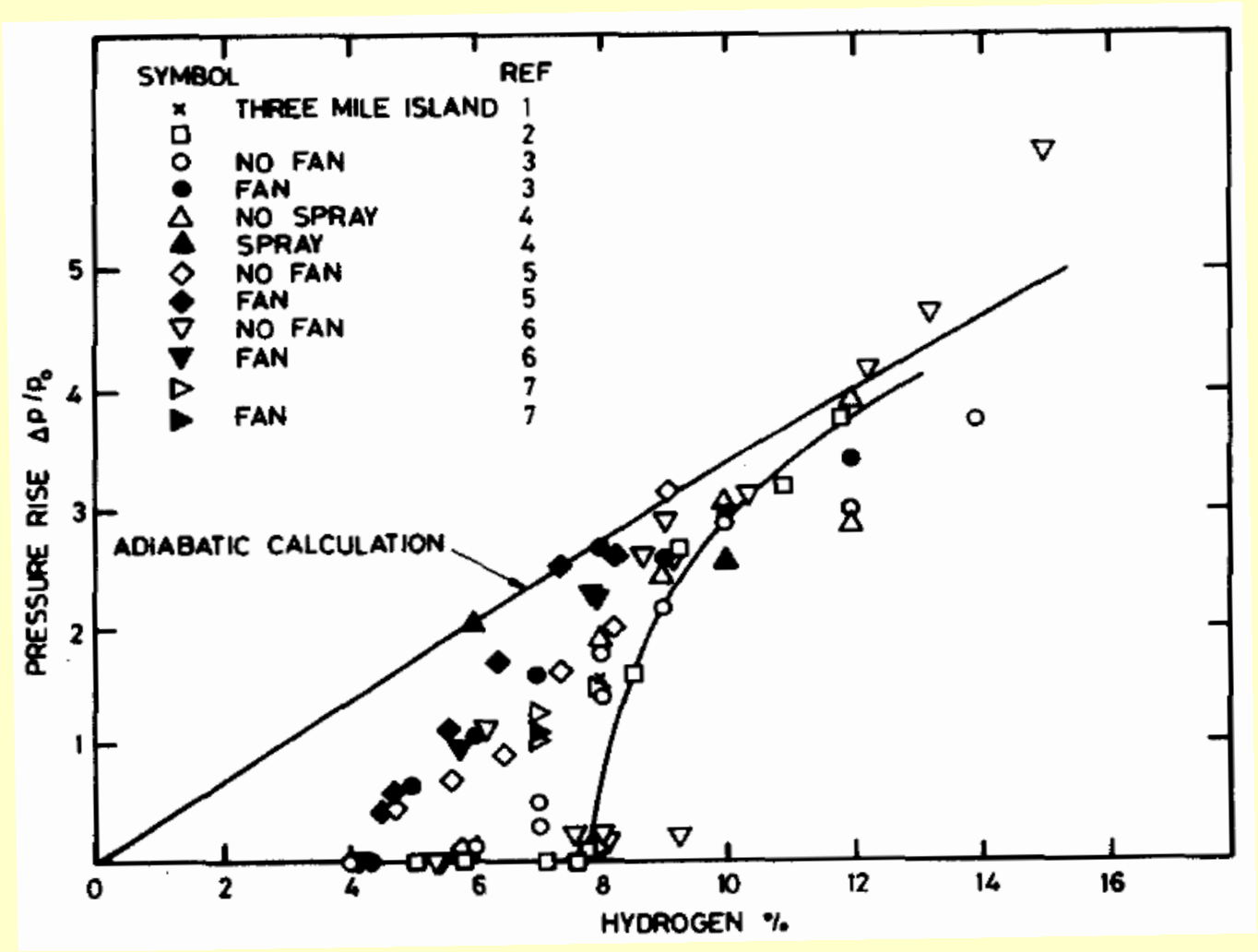
Turbulent Burning Velocity Correlation



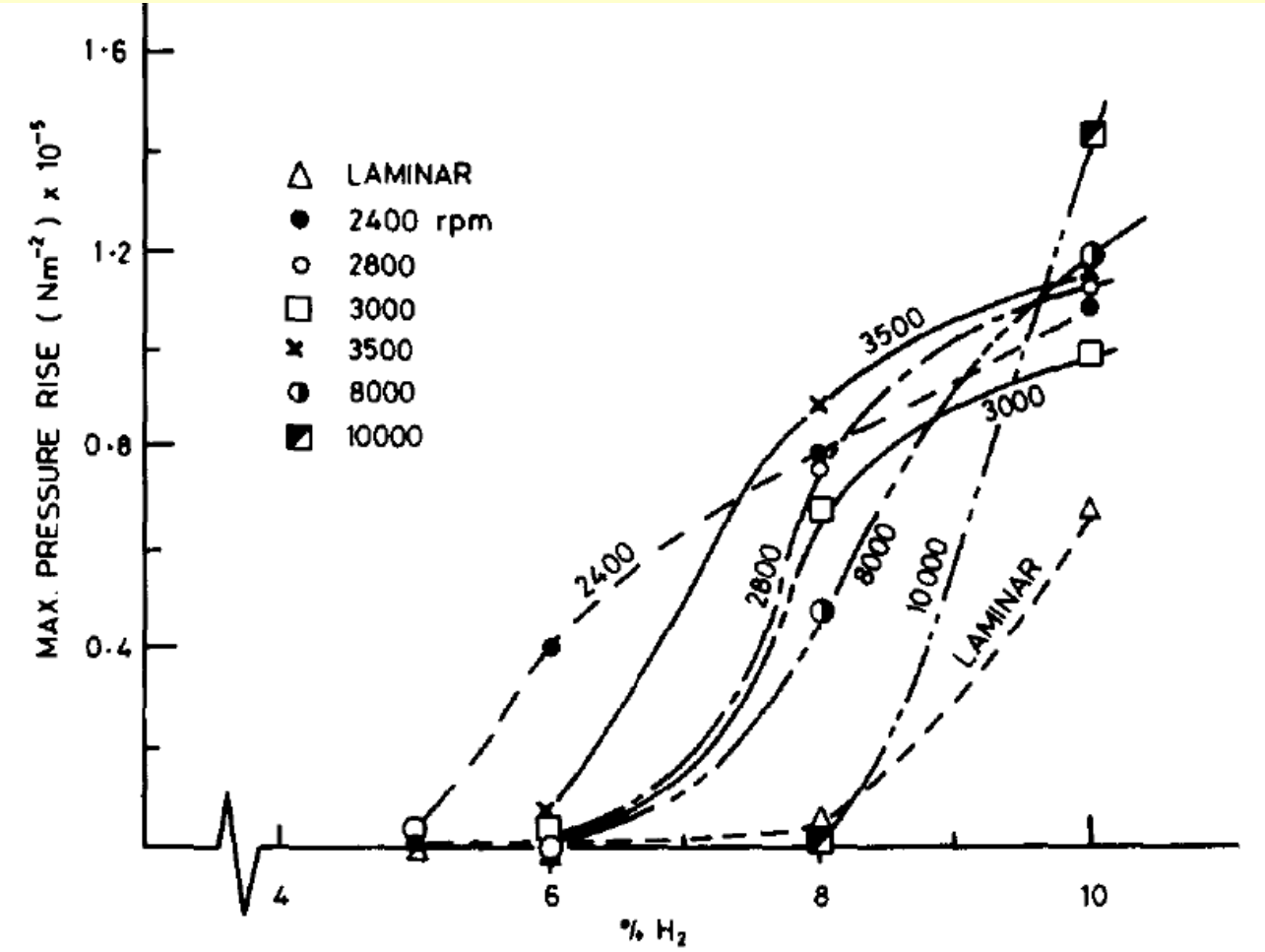
Turbulent Burning Velocity Correlation



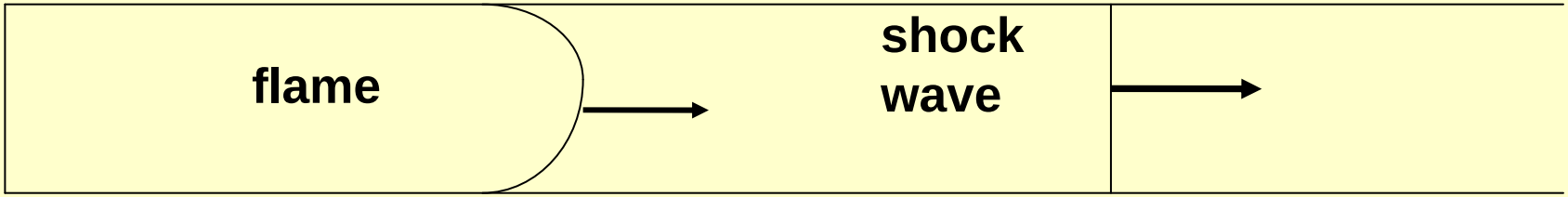
Hydrogen Explosion Data

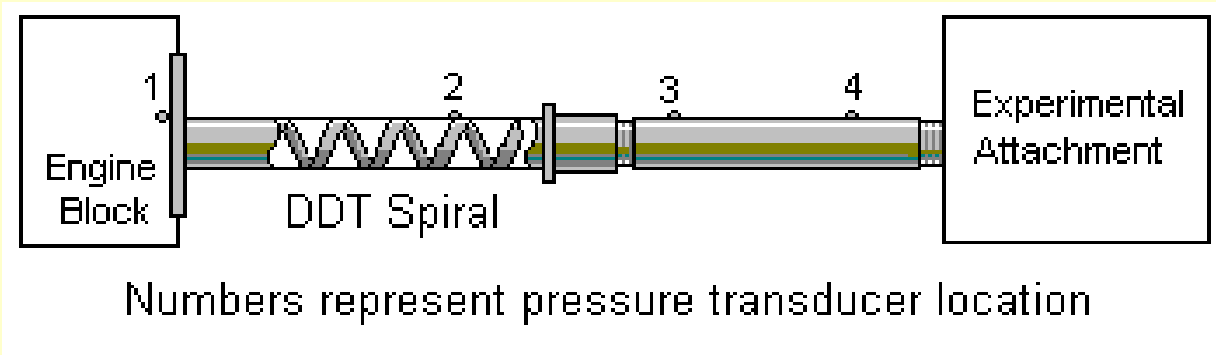


Hydrogen Explosion Bomb Data

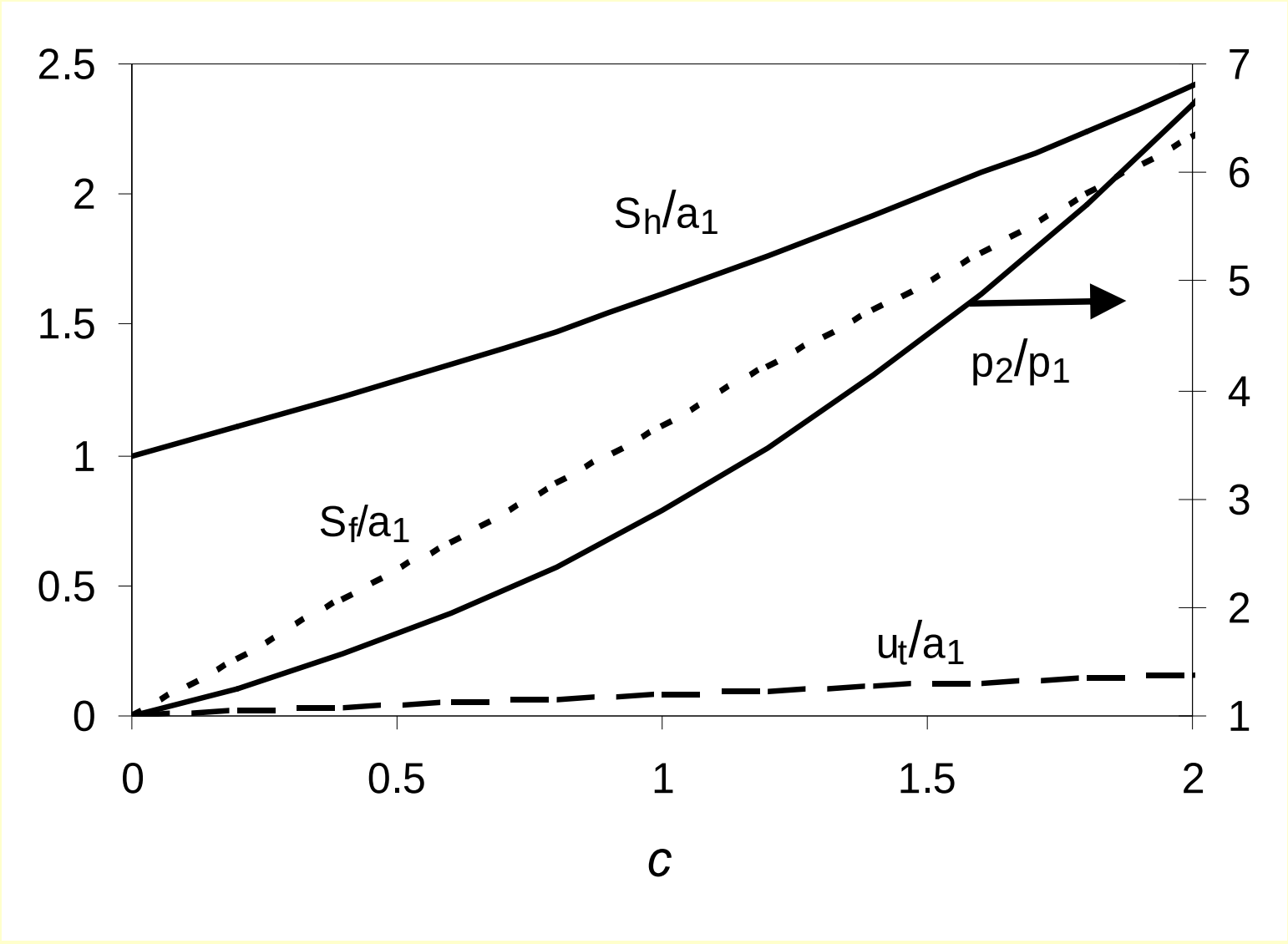


DDT One Dimensional Model

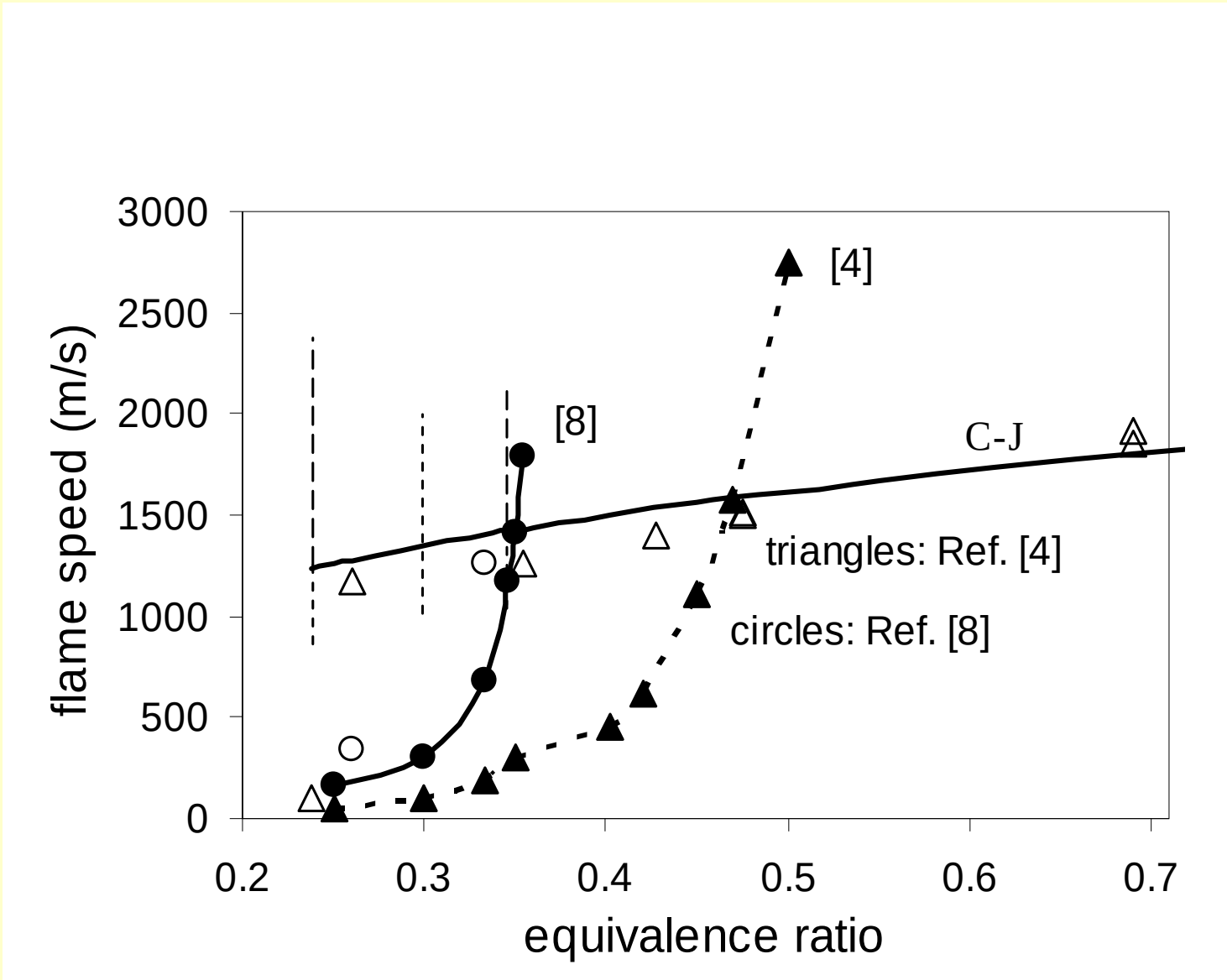




Solutions of Equations



H_2-air: larger and smaller ducts



Temperature and Pressure after Shock in Larger Duct