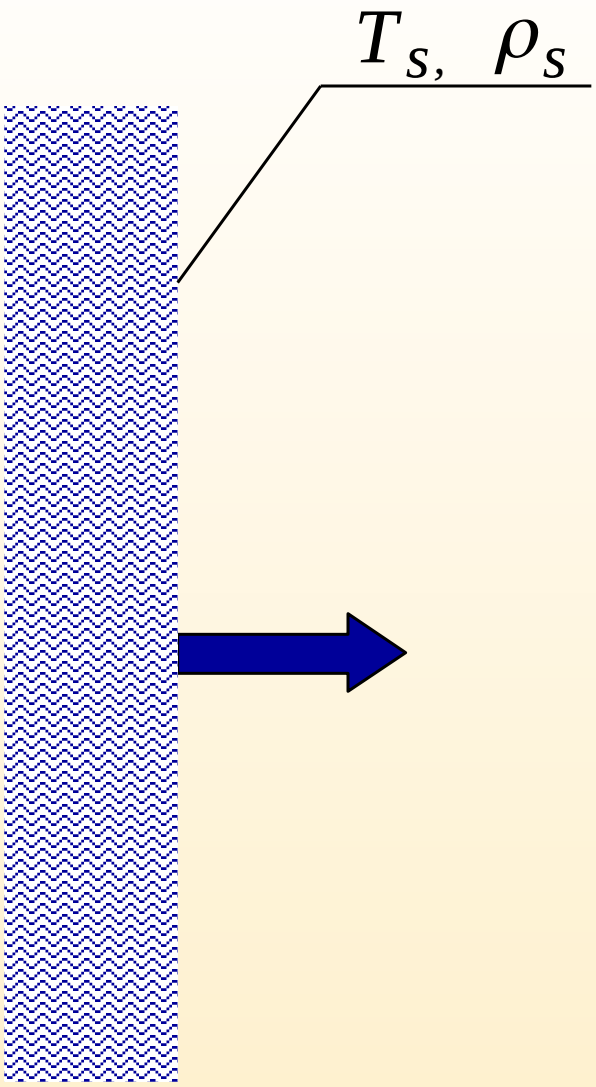
Franco-British INTERREG IIIa (Project Ref 162/025/247)
Final monitoring meeting: 11 June 2007

A kinetic algorithm for modelling the droplet evaporation process in the presence of a heat flux and background gas

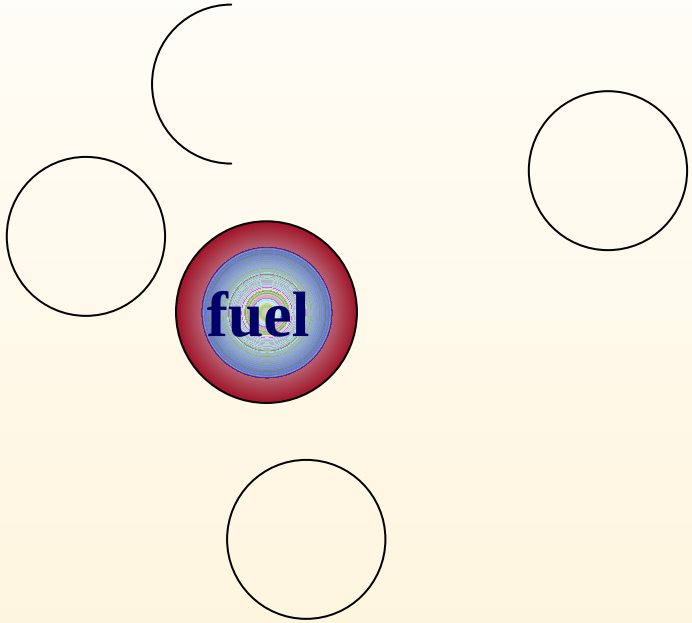
N. Shishkova[1] and *S. S. Sazhin*[2]

[1] Low Temperature Department, Moscow Power Engineering , Institute, Krasnokazarmennaya 14, Moscow 111250, Russia

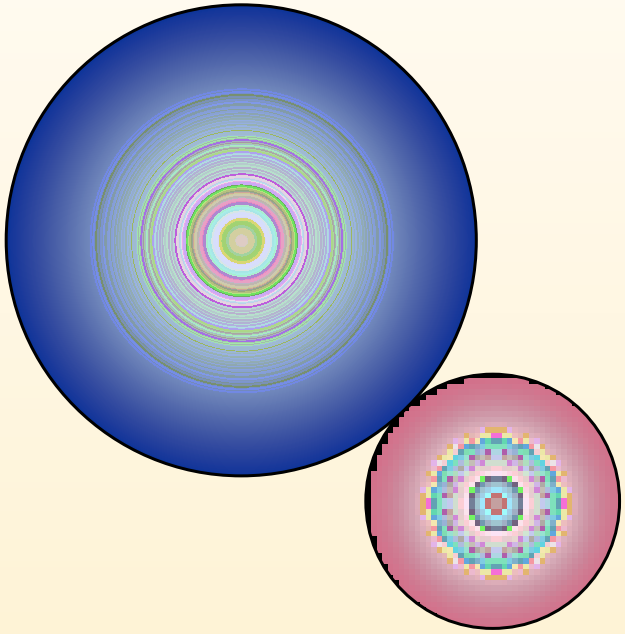
[2] Internal Combustion Engines Group, University of Brighton, Cockcroft Building, Brighton BN2 4GJ, U.K.



de


fuel

Collision of molecules



Boltzmann equations

$$\frac{\partial f_a}{\partial t} \quad a\frac{\partial f_a}{\partial x} \quad J_{aa} \quad J_{ab}$$

$$\frac{\partial f_b}{\partial t} \quad b\frac{\partial f_b}{\partial x} \quad J_{ba} \quad J_{bb}$$

Evaporation coefficient

$$\beta = \frac{}{\rho\sqrt{\frac{}{2\pi}}} = 1$$

Hydrodynamic equations (stationary droplets)

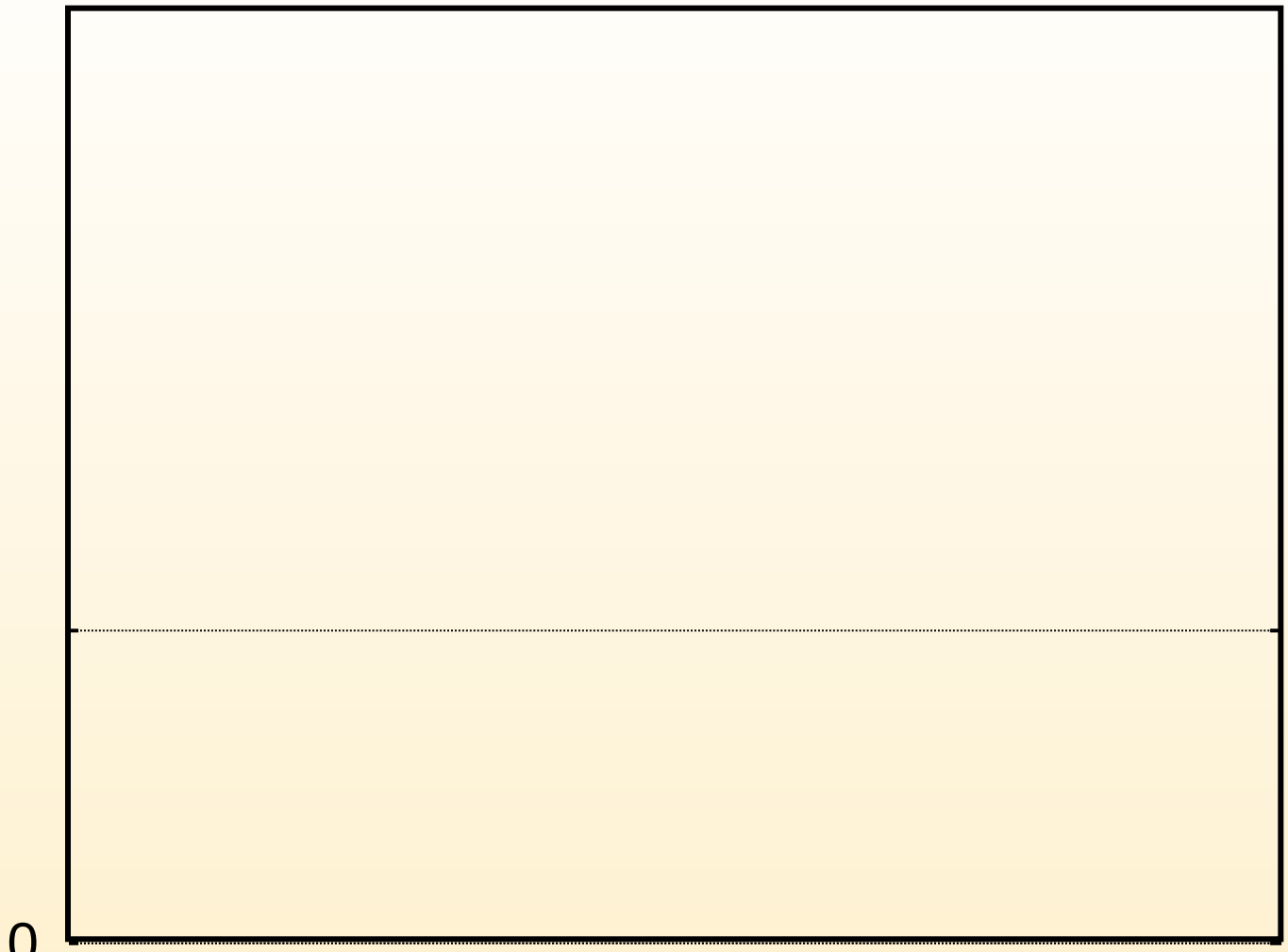
Thickness of the kinetic region

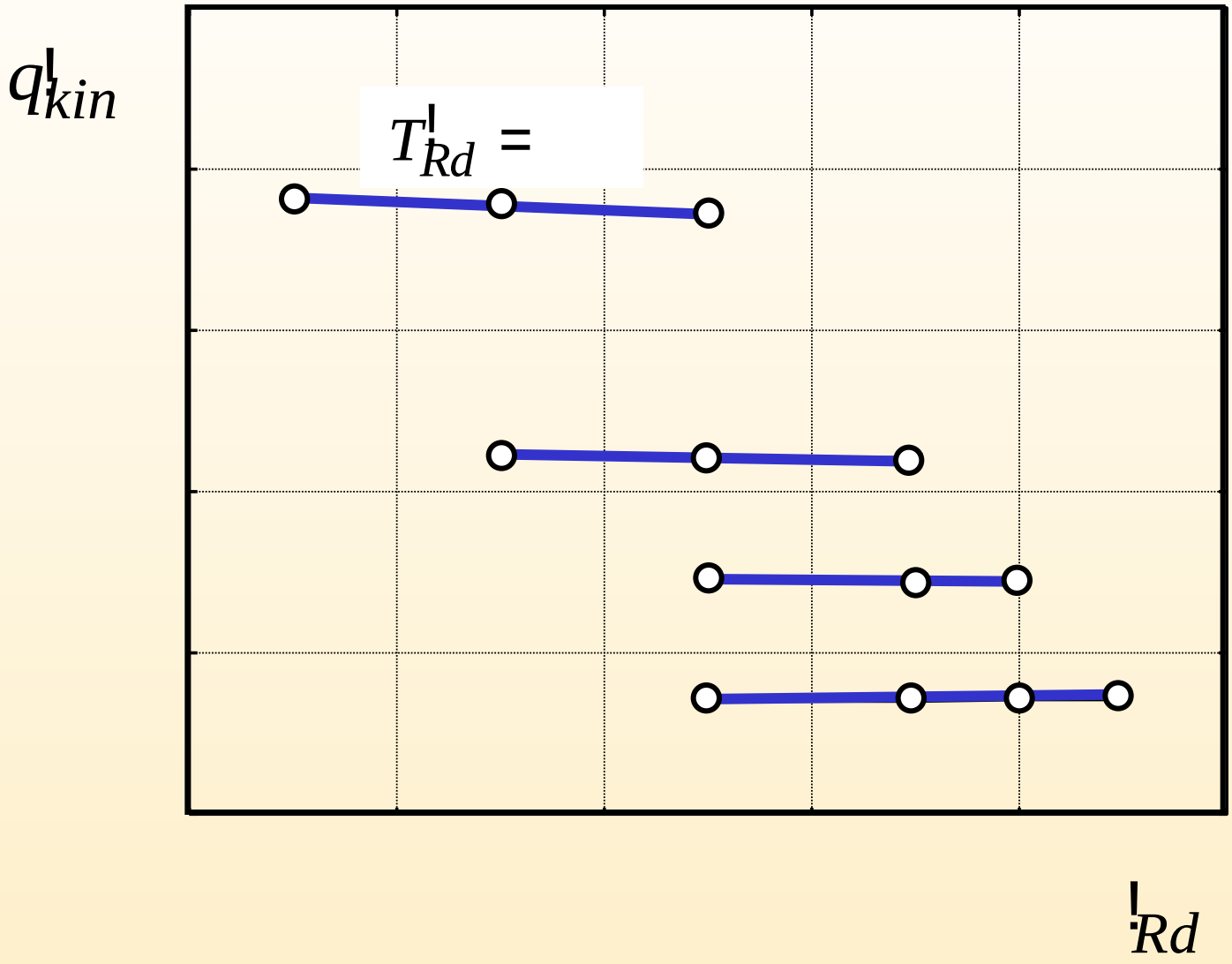
$$\delta_{Rd} = \quad !_c$$

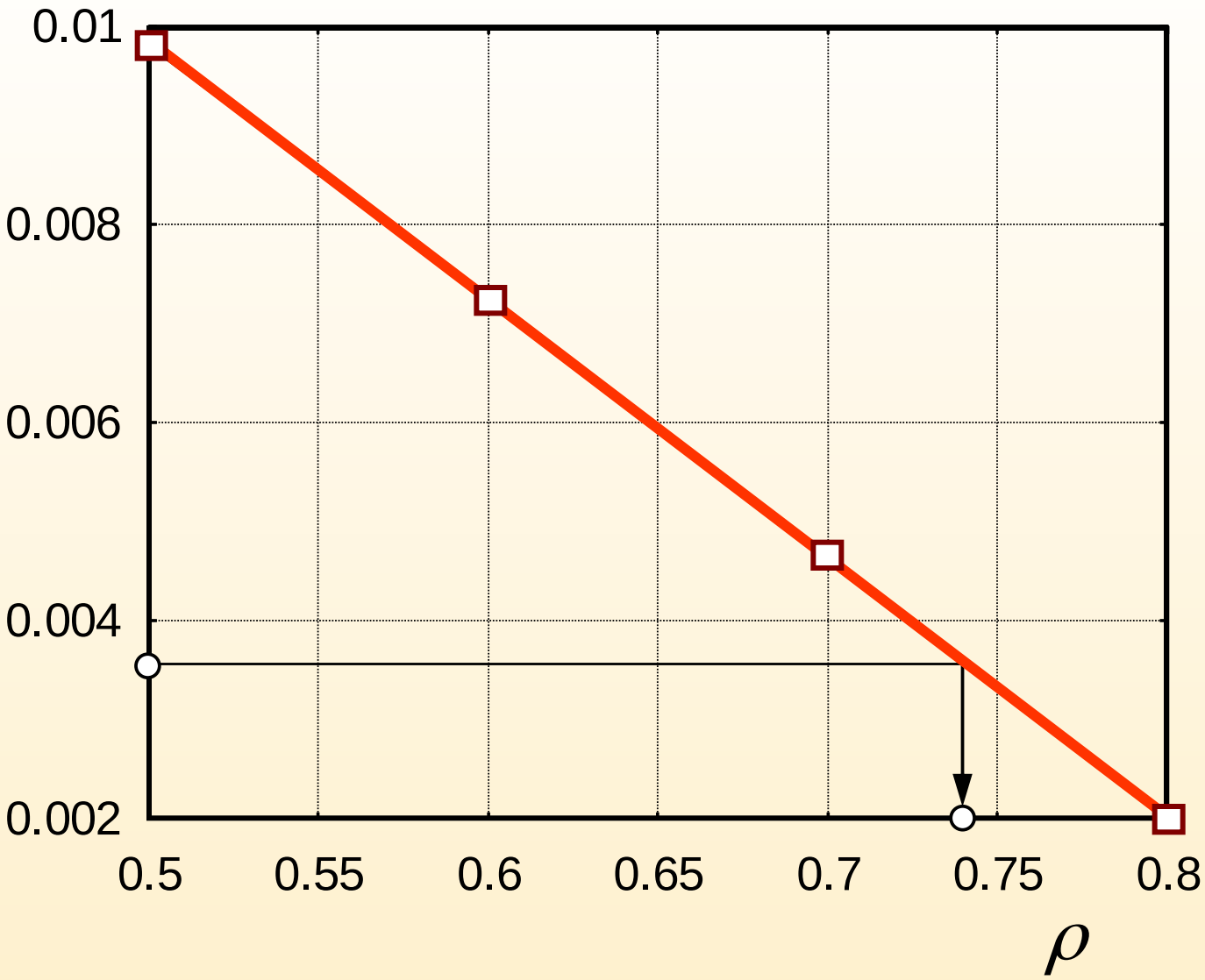
Matching conditions

$$j_{kin} = j_{hyd}$$

$$=$$


0


q_{kin}
T_{Rd} =
T_{Rd}


0.01
0.008
0.006
0.004
0.002
0.5
0.55
0.6
0.65
0.7
0.75
0.8
ρ

0

; ~ / ; ~ ( )/( )

Conclusions

•A new kinetic model for droplet heating and evaporation into a high pressure background gas (air) is suggested. This model is based on the introduction of the kinetic region around evaporating droplets, where the dynamics of molecules is described in terms of the Boltzmann equations for vapour and air. Both mass and heat transfer processes in this region are taken into account.

•The model is applied to calculation of heating and evaporation of fuel droplets in Diesel engine-like conditions.

•The kinetic effects are important in the case when the gas temperature raises to 1000 K and 1500 K. In this case, for droplets with initial radii 5 μm the predicted evaporation time in the presence of the heat flux in the kinetic region is about 14% longer than predicted by the hydrodynamic model.

Unsolved problems

- **The value of the evaporation coefficient**
- **The contribution of inelastic collisions**
- **The validity of the Boltzmann equation for dense gas**

Thank you for your attention

Any comments or suggestions

would be highly appreciated

A kinetic algorithm for modelling the droplet evaporation process in the presence of a heat flux and background gas

N. Shishkova[1]