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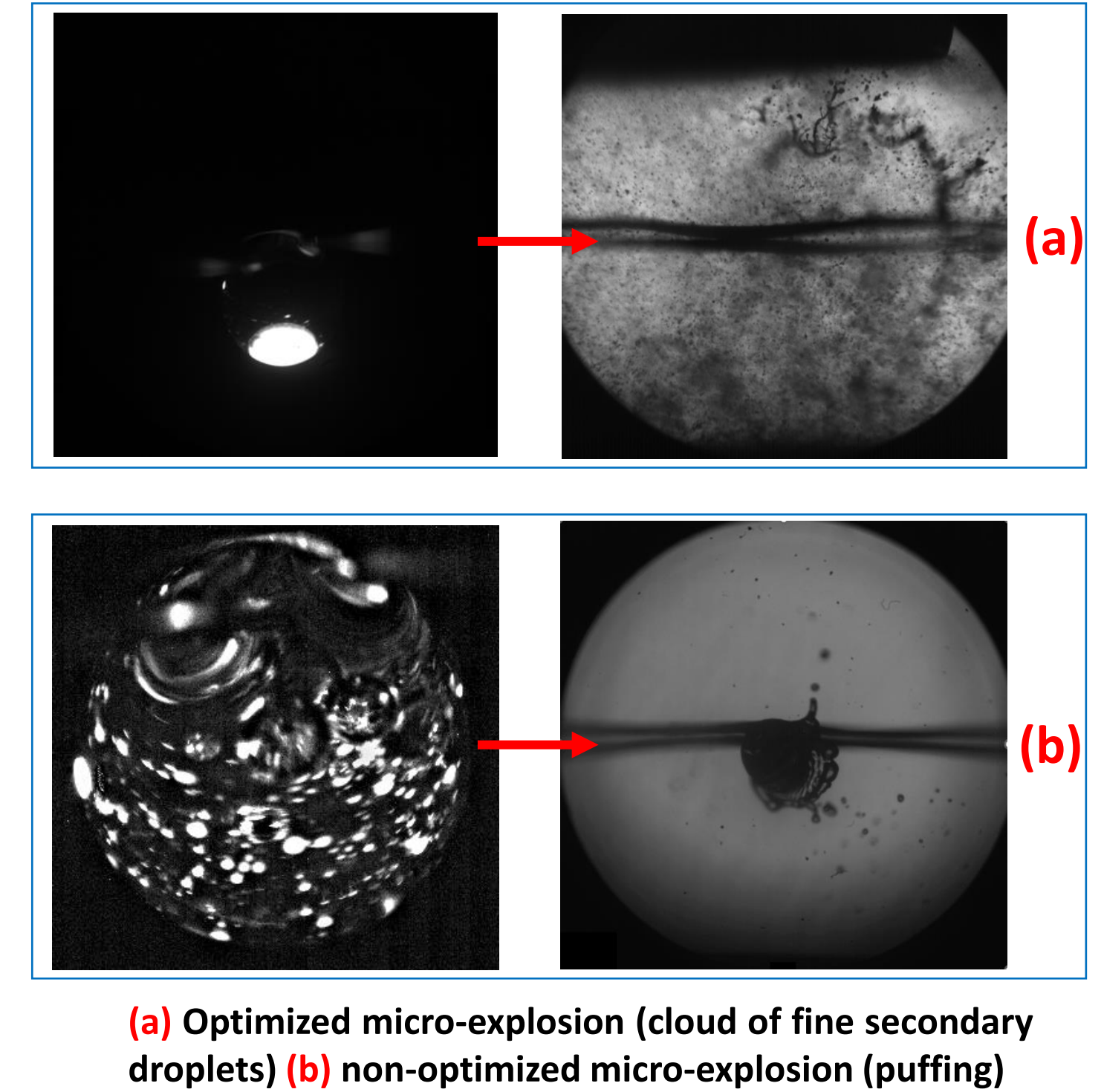
EXPERIMENTAL STUDY OF EMULSION DISPERSED PHASE TEMPERATURE UNDER RADIANT HEATING USING 2CLIF METHOD

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INTRODUCTION

Micro-explosion of W/O emulsions droplets can help to achieve combustion with **high efficiency** while **reducing pollutants emissions**

- Micro-explosion is the fragmentation of a drop in a **cloud of fine secondary droplets** due to water phase-change
- This phenomenon depends on **different parameters** such as the composition of the emulsion, the temporal evolution of the granulometry (coalescence) and the type of heat flux
- First step of the study showed that **coalescence promotes micro-explosion occurrence**
- Internal convective motion has been observed. Temperature field measurement within the two phases are under investigation

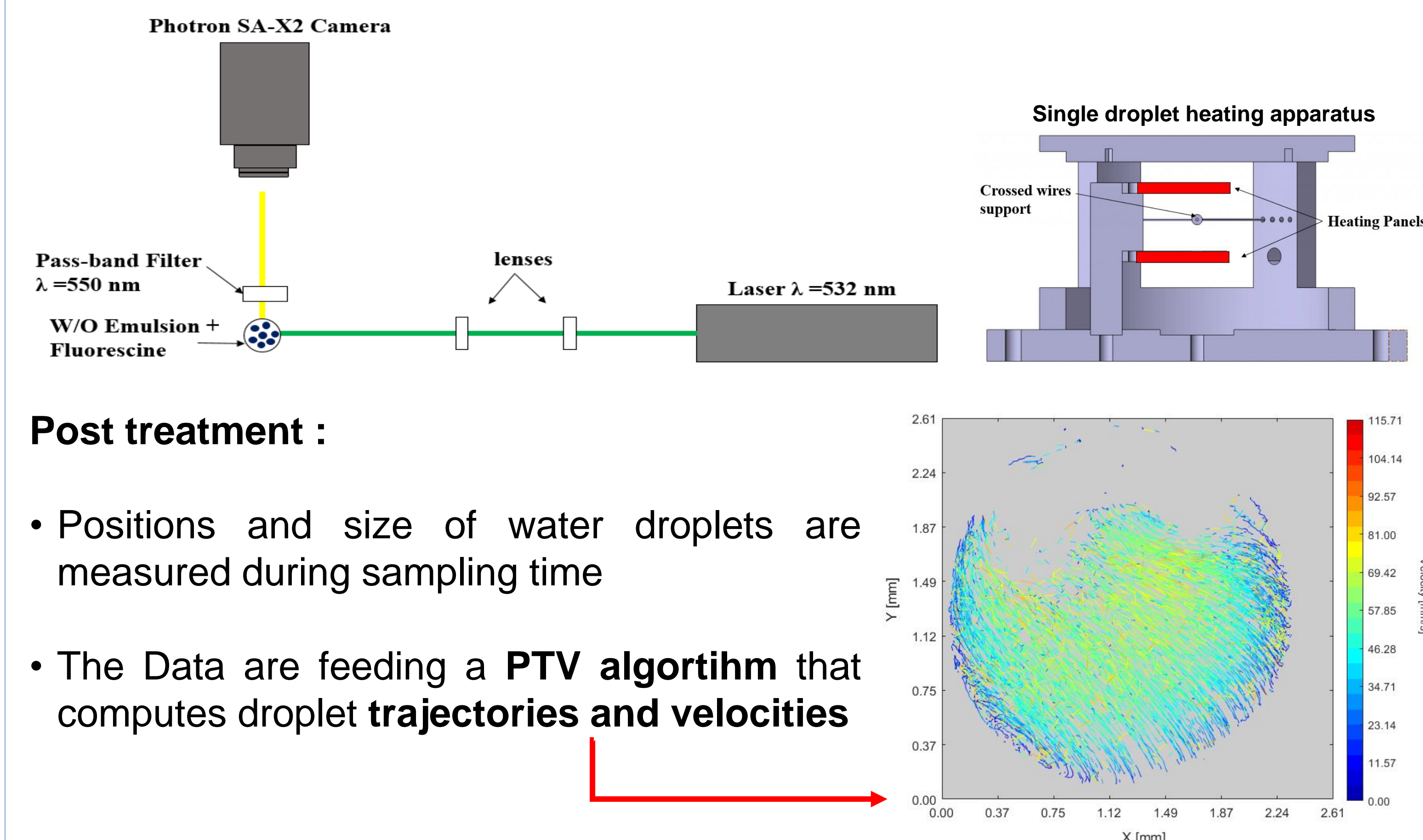


FIRST STEPS OF THE INVESTIGATION

Experimental Setup (1C LIF)

Objectives:

- Visualization of the dispersed (water) phase **motion** during the heating of the droplet
- Measuring the **impact of coalescence on micro-explosion rate**



Post treatment :

- Positions and size of water droplets are measured during sampling time
- The Data are feeding a **PTV algorithm** that computes droplet **trajectories and velocities**

Results

- A **dimensionless indicator** is used to quantify the intensity of the motion

$$I = \frac{1}{f_z} \frac{\|\vec{v}_i\|}{D_i}$$

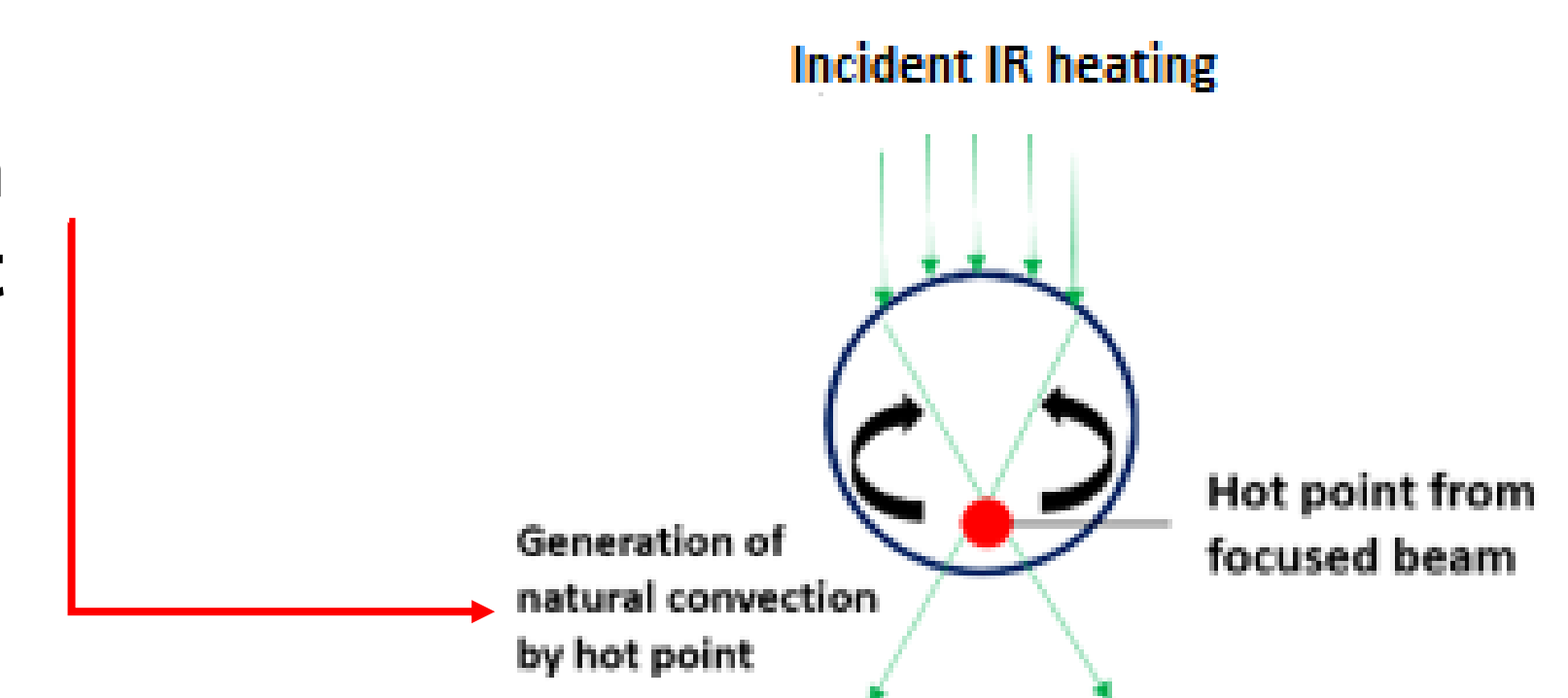
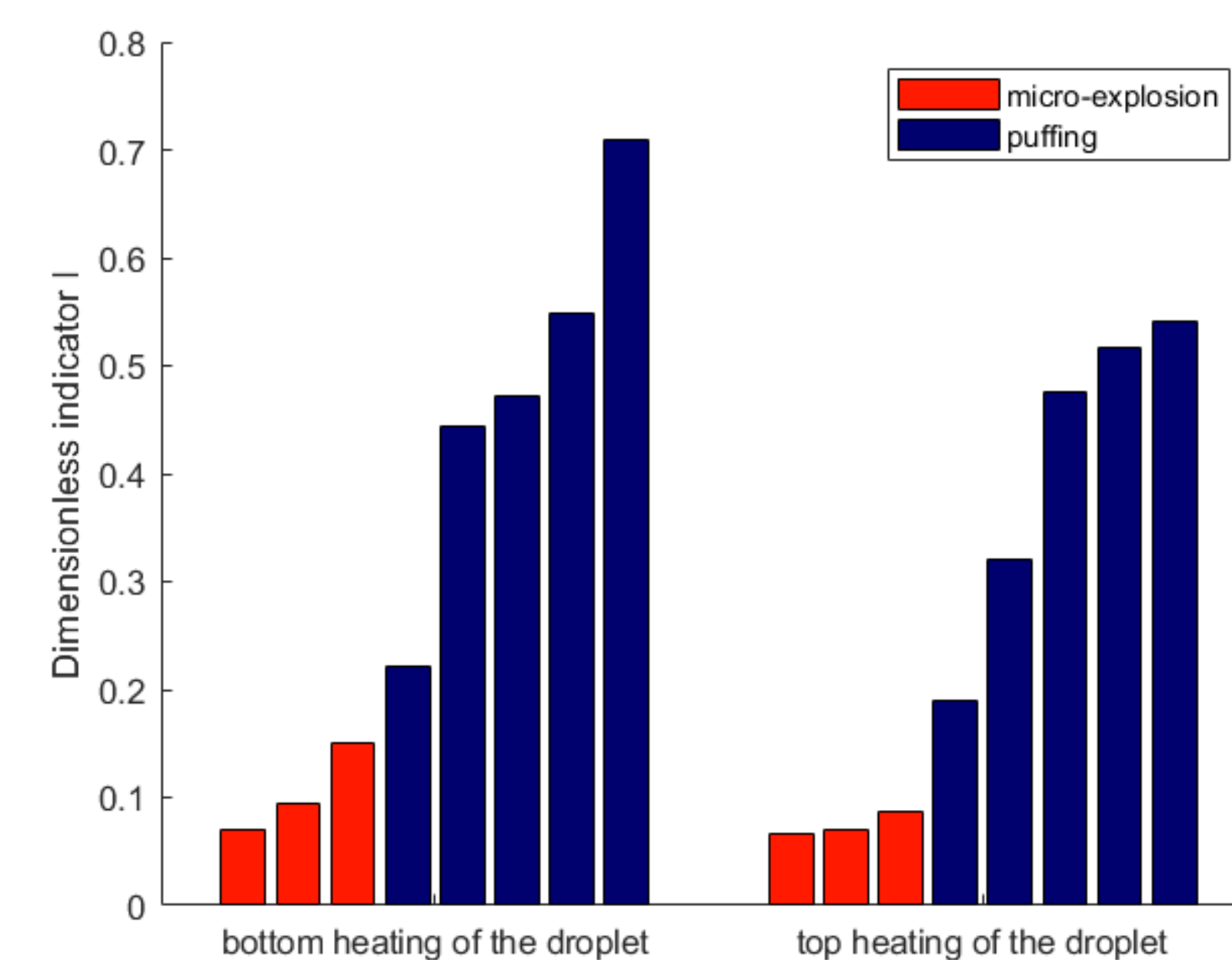
- \vec{v}_i : identified droplet velocity
- D_i : identified droplet diameter
- f_z : acquisition frequency

- For **small values of I** (weak convective motion with high coalescence rate), **ME is obtained**

- For higher values of I (**strong motion** of the water droplets), **ME never happens and coalescence is inhibited**

- Fine emulsions undergo strong internal motion, **which inhibits coalescence**

- Internal motion is observed even when the heat source located **at the top of the droplet**



TEMPERATURE MEASUREMENTS WITHIN THE WATER PHASE

calibration 2C LIF in test cell

Temperature measurement within water is made possible by the **Ratiometric 2C LIF method** :

- Since fluorescence **is a function of the temperature**, it can be computed from the intensity of the image :

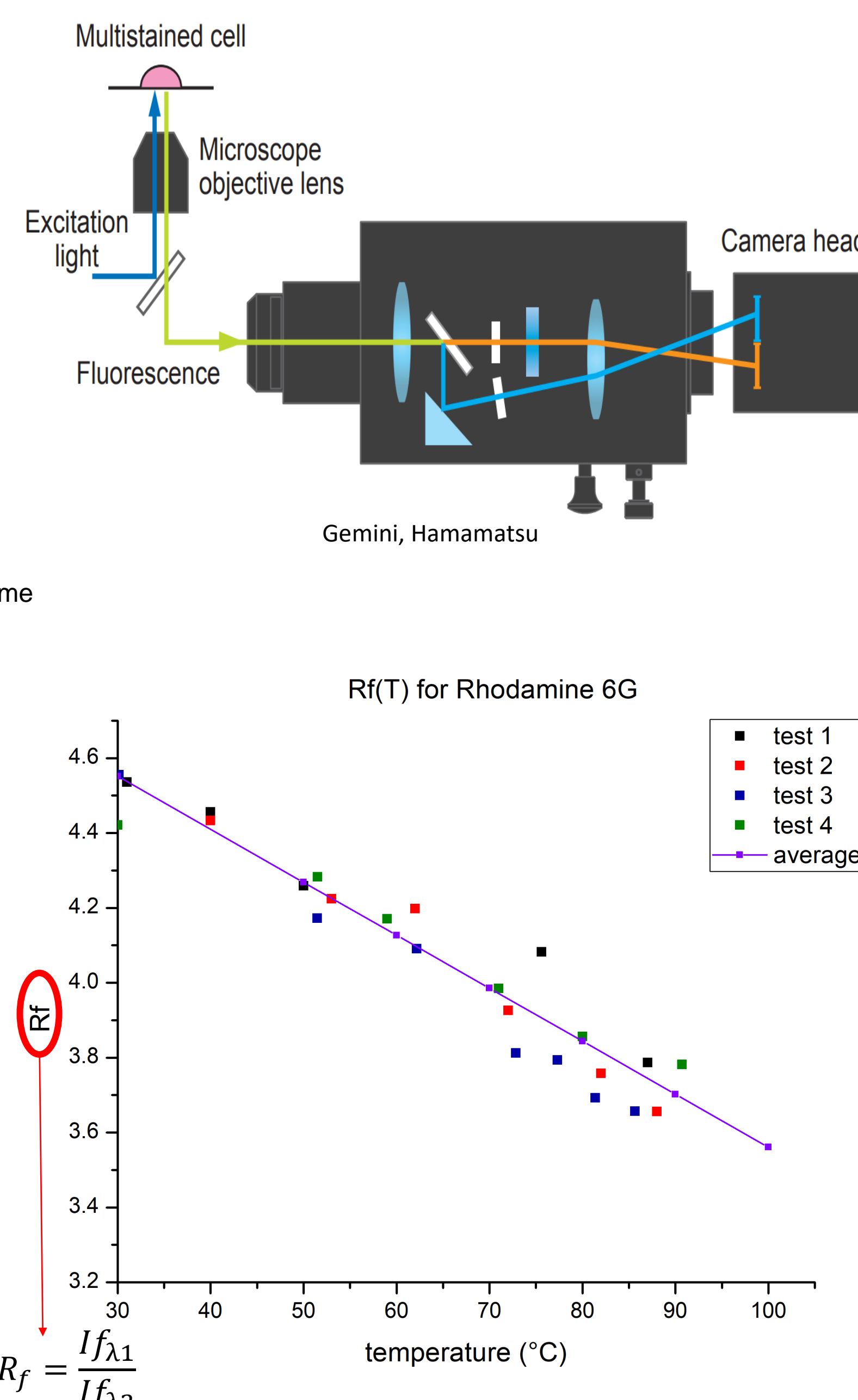
$$If_{\lambda} = \int_{\lambda-\Delta\lambda}^{\lambda+\Delta\lambda} K_{opt} K_{spect} C I_0 v_{meas} e^{S\lambda/T} d\lambda$$

- With :
- K_{opt} the optical path cste
 - K_{spect} dye properties resulting cste
 - C the dye concentration
 - I_0 the incident laser intensity
 - v_{meas} the measurement volume

- In that case, **ratio of two collection wavelengths** is used in order to be free from the **dependency on others parameters** (such as v_{meas})

- Several dyes such as Fluorescein, Rhodamine B and Rhodamine 6G are tested

- Rhodamine 6G showed best response (**monotonous with variation interval large enough**)



Temperature of dispersed water microdroplets

- Dispersed water droplets **temperature evolution** has been made possible by the use of LIF2C technique

- The droplets undergo **temperature cycles** (heated when close to the heat source and cooled while moving further)

- Current limitations on the reliability of measurements for temperatures $> 100^\circ\text{C}$ due to calibration setup

- Next steps of the investigation : calibration for temperatures $> 100^\circ\text{C}$

- Temperature measurements in the **continuous phase**

