SUPER RESOLUTION: ESSENTIALITY OF TIME TO OVERCOME ABBE'S DIFFRACTION LIMIT

Dominic H. Filion, Eric Massicotte, Philippe St-Onge, Simone Terouz and Richard Cimon
Microscopy, Cytometry and Histology Core Facilities and Specialized Equipment
Institut de Recherches Cliniques de Montréal
110, Avenue des Pins Ouest, Montréal (Québec) CANADA
E-mail: dominic.filion@ircm.qc.ca

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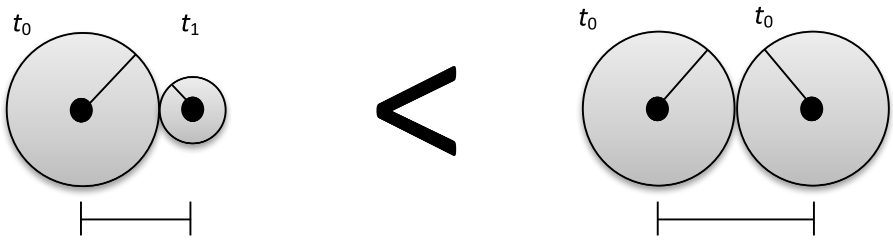
Super resolution techniques are nowadays common techniques to obtain better details and see objects beyond the Abbe's diffraction limit [1]. To our knowledge, these techniques are classified in 3 groups which are (A) structured illumination [2], (B) stochastic – PALM-related [3] and (C) STED-related [4] (under the name of *RESOLFT*). Unfortunately, the increased resolution is explained via different equations [3-4]. We would like to have only ***one*** explanation on how this increased resolution is achieved. We will present these three techniques and demonstrate how ***time*** is necessary to obtain such a resolution which overcomes the diffraction limit. We will discuss resolution, concentration of probes, fluorescence, depletion and saturation processes to propose a new explanation for the so-called *dark state*. We will conclude by explaining how saturation can lead to an equivalent mathematical relation between PALM-related and STED-related techniques.

A simple schematic, as shown below, explains how the resolution can be increased from two different emitting sources having different states at different times (t_0 and t_1). This simple example applies to all super resolution techniques including, structured illumination, STED-related and PALM-related techniques. It also demonstrates how objects, which are closer than the Abbe's diffraction limit, needs ***time delay*** to be distinguished.

SUPER RESOLUTION at t_0 and t_1 **ABBE'S RESOLUTION (FIXED TIME t_0)**



$$d_{SR} = \frac{\lambda}{2NA} \cdot f(t)$$

$$d_{Abbe} = \frac{\lambda}{2NA}$$

References
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