# Brillouin Microscopy for Life Sciences

Claudia Testi [a], Panagiotis Vergyris [a], Emanuele Pontecorvo [b], Giancarlo Ruocco [a]

[a] Istituto Italiano di Tecnologia, Center for Life NanoScience, Roma, 00185, Italy
[b] CrestOptics S.p.A., Roma, 00167, Italy
e-mail: Claudia.testi@uniroma1.it

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Biochemical stimuli are often thought as the unique forces involved in cellular signaling and reactions, but they are not the only ones. Indeed, mechanical forces have been recently found to play a pivotal role in driving basic processes in cellular function, development as well as disease [1]. This approach has given rise to the new field of "Mechanobiology", in which one of the major challenges is the comprehension of the molecular mechanisms at the basis of cells response to mechanical inputs. Similarly, it is of central importance the determination of the elastic properties (elastic moduli, viscosities, stress and strain) of the cells themselves.
Most of the experimental techniques used in the investigation of the mechanical properties of biological matter rely on the "response" approach that measures the system reaction upon the perturbation by an external force. The key drawback of this simple approach lays in the unavoidable contact between cells and the agent applying the force. On the contrary, according to the fluctuation-dissipation theorem, the same response can be obtained via the measure of the spontaneous fluctuations of the physical variables conjugated to the mechanical forces, i.e. the density fluctuations [2]. This is the principle at the basis of the Brillouin scattering, in which the mechanical properties of a system are determined through the measure of its spectrum of density fluctuations (figure 1) in a contactless fashion [3].

The Brillouin Microscopy setup is being built in our laboratory and will be ready to analyze biological samples in the next month.
Here, we will explore this emerging technology by describing the underlying biophysical principles and discussing the interpretation of Brillouin spectra arising from heterogeneous biological matter.
Moreover, we will (i) emphasize the advantage of the Brillouin scattering in the investigation of the mechanical properties of biological systems with respect to other contact techniques; (ii) clarify the main problems that nowadays prevent the systematic use of the Brillouin microscopy; (iii) suggest possible future technical development that could open the way for a wide spreading of the Brillouin microscopy as a standard bio-imaging technique.

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