LIGHT SHEET INTEGRAL FIELD RAMAN MICRO-SPECTROSCOPY

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Biological analysis requires imaging with specific biochemical contrast of living organisms. Currently, fluorescence microscopy is widely used; however the labeling requires extra sample preparation and may modify the specimen biologically.

Raman scattering provides high molecular specificity without labeling or staining. Unfortunately, the traditional imaging approach based on confocal microscopy [1] is to slow for time critical investigations due to the low Raman scattering cross section and sample head caused by absorption.

Recent developments based on light sheet illumination, avoid unnecessary out of focus illumination and therefore reduce heat. A Fourier-transform imaging spectrometer based approach has been demonstrated to be 5 times faster [2] while providing full hyperspectral information. By choosing a low-noise imaging spectrometer method [3], further speed improvements can be expected.

Here we present a new approach combining light sheet illumination with hyperspectral imaging meeting both optimisation criteria namely: low light load and high signal to noise ratio.

By utilizing integral field spectroscopy which is known from astronomy [4] we are able to recorded 50×50 spectra in parallel. Our setup uses a laser with 785 nm, suitable for biological purposes. It provides spectral information in the range of 500 cm^{-1} to 2000 cm^{-1} with a spectral resolution better than 4 cm^{-1}.

Theoretically this system is expected to be over 50 times faster [5] than a comparable confocal one. We believe that this will enable qualitatively new applications in biomedical research and with clinical background to gain from Raman micro-spectroscopy.

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