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Tomography of biological interfaces using defocusing microscopy
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Transparent objects can render visible in a standard bright-field microscope by slightly defocusing the microscope objective. From contrast fluctuations of images defocused in a controlled way one can measure the fluctuation spectrum of biological membranes and living cells surfaces. We extended our previous defocusing theory, valid for small defocusings, to arbitrarily large defocusings. We discovered that we can measure height fluctuations of transparent interfaces selectively, and obtain elastic properties of layered biological membranes separately. As an example, we measured separately the elastic constants associated with the two opposite surfaces of a red blood cell. The technique is very sensitive and allows us to measure the small increase of surface tension on the surface in contact with the glass-slide, as compared to the one of the free surface. Interface roughness (static and dynamic), down to nanometer amplitudes, can be measured selectively with defocusing microscopy in transparent layered materials.

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