reflection by the barrier at first, but at later times they can clearly see transmission through the barrier. This is due to the particular choice of the asymmetry of the detuning in the experiment (the blue detuning is less than the red detuning, Fig. 1), which leads to optical pumping into the transmitting $F = 1$ ground state.

The one-way wall of light is particularly important as a new method to spatially compress an atomic sample and thus further cool the atoms[2]. Such barriers can, in principle, be designed for a variety of atoms and molecules. In contrast, the commonly used method of laser cooling requires a two-level cycling transition and is thus restricted to a narrow class of atoms, best represented by the alkalis. In the case of laser cooling, heat dissipation occurs through momentum transfer from the photons in the laser beams to the atoms in the vapour, and relies on multiple photon scattering. In the case of the one-way barrier, scattering only a single photon is sufficient to obtain a comparable dissipation[3]. Another method used to obtain ultracold atoms is evaporative cooling, which has been instrumental in reaching the quantum degenerate regime in gases (Bose–Einstein condensates are one manifestation of this). Because this non-optical technique critically depends on the rate of elastic collisions among the atoms, the enhanced density afforded by the one-way barrier could be used to precipitate evaporative cooling.

References

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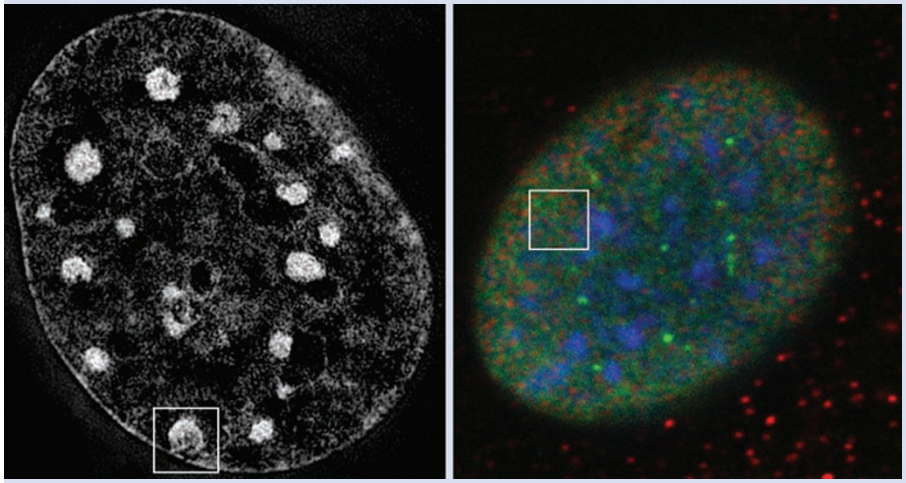
BIOIMAGING

Cellular vision



Fluorescence light microscopy is a key tool for modern cell biology. However, diffraction fundamentally limits the resolution that optical microscopy can offer. Because visible light, which has a wavelength of 400–700 nm, is used, subcellular structures or objects spaced less than about 200–350 nm apart cannot be individually resolved.

Lother Schermelleh and colleagues based in Germany and the USA have now managed to overcome this limit while at the same time retaining the advantages of light microscopy and the specificity of cellular imaging (*Science* **320,** 1332–1336; 2008). They use a technique known as three-dimensional structured-illumination microscopy (3D-SIM) to overcome the resolution limit.

Structured-illumination microscopy manages to beat the diffraction limit by illuminating objects with several beams of interfering light (in the 3D case, three beams are used). As a result, the light that is emitted contains higher-resolution information from the sample, which is encoded by a shift in reciprocal (Fourier or frequency) space into detectable modulations of the image. The extra information contained in the light can be used to reconstruct small features and to obtain resolutions that are twice that of conventional images created without using this technique.

This is not the first time that subdiffraction resolution has been achieved in optical microscopy. However, most of the methods developed so far come with drawbacks: for instance, the enhanced resolution is only attainable in one particular direction, or in the near or evanescent field, or the multicolour features of the images are limited. The advantage of 3D-SIM is that it enables three wavelengths to be detected in the same sample using standard fluorescent dyes, offers 3D optical sectioning and boosts resolution in both the lateral and axial directions.

Schermelleh and co-workers use 3D-SIM to study mammalian tissue cells. In particular they image the positions of nuclear lamina (dense 30- to 100-nm-thick networks of protein filaments), resolve individual nuclear pores, and visualize higher-order features of chromatin (the dense package of DNA and proteins that resides in cell nuclei). Their technique picks up a number of features that are not detectable with conventional microscopy and sheds new light on the substructure at the nuclear periphery. The researchers are able to obtain detailed insights into the exclusion of the chromatin and nuclear lamina from nuclear pores, and can also detect invaginations of the nuclear envelope, which have so far only been detected using transmission electron microscopy. The resolution achieved in both the axial and lateral directions is around 100 nm — a twofold improvement on conventional microscopy — and could open up new avenues in molecular cell biology.

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