4Pi STED Fluorescence Light Microscope with high three-Dimensional Spatial Resolution (P-1010)

Facts

- Technology can be used for 4Pi STED, RESOLFT, and 4Pi GSD
- Precise three-dimensional light intensity distribution
- Steep light intensity gradient

Abstract
In 4Pi STED scanning fluorescence light microscopy, it is known to use devices for forming three-dimensional light intensity distribution comprising a spatially limited area of minimum light intensity that is enclosed by areas of higher light intensity of the fluorescence inhibiting light (Fig. 1a).
The here presented technology provides an apparatus for 4Pi STED which allows to generate a three-dimensional light intensity distribution comprising a very steep light intensity gradient between the areas of minimum and maximum light intensity.

Development Stage
According to numerical calculations in a realistic scenario even DVD diodes as STED lasers will result in highest resolutions in the 20nm range and below in all three dimensions.

The Technology
The apparatus comprises two objectives which are facing each other on a common optical axis, which focus light coming out of opposite directions into a common focal area, and which each have a pupil, and at least one light source. In case of three or more pairs of coherent light beams, the area of minimum light intensity is reduced to a small volume within the focal area (Fig. 1c).

Inventor
The inventor is Dr. Johann Engelhardt, DKFZ Heidelberg, Germany.

Applications and Commercial Opportunity
The presented technology allows generating an even steeper light intensity gradient between the area of minimum light intensity to the enclosing areas of higher light intensity than in isoSTED and can be used for 4Pi STED, RESOLFT or another variant of 4Pi GSD scanning fluorescence light microscopy.

Intellectual Property
Priority patent application filed April 24, 2012 as EP2657747 and international PCT patent application “4Pi STED Fluorescence Light Microscope with high three-Dimensional Spatial Resolution” published as WO2013160336.

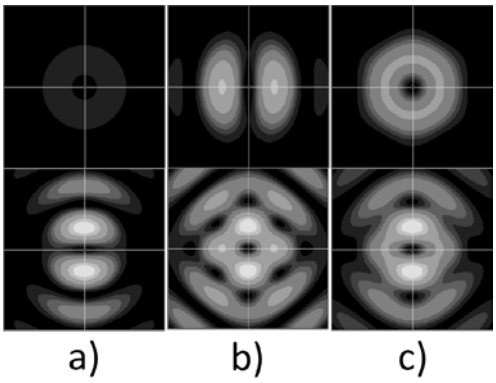

Fig. 1 shows sections through the spatially limited area of minimum light intensity of the overall light intensity distribution. Resulting from a) one pair of coherent light beams (like 4Pi fluorescence light microscopy), b) two pairs of coherent light beams, and c) three pairs of coherent light beams (like the presented technology). Top: common focal plane of the objectives; bottom: orthogonal to the common focal plane of the objectives.

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