New Microscope Gives Scientists 3D Views of Living Organisms

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Physicists at the European Molecular Biology Laboratory (EMBL) have developed a state-of-the-art microscope that gives scientists a much deeper look into living organisms than ever before. The new technology will undoubtedly become a standard fixture in modern biology labs. Its many advantages and applications are described in the latest edition of Science (Aug 13, 2004). Called SPIM (Selective Plane Illumination Microscopy), the technology allows scientists, for the first time, to study live systems from many different angles, under real conditions and with minimal disruption to the specimen.

"Over the years we've seen current microscopes falling short of what the scientists need. We designed SPIM with EMBL biologists to make sure that it was completely suited to their needs," says EMBL scientist Ernst Stelzer, whose group developed SPIM with the input of developmental biologists in the group led by Jochen Wittbrodt. "This new microscope is easy to build, is about one-third the cost of current technologies, and gives scientists improved resolution by a factor of about five."

SPIM allows scientists to view relatively large samples (2-3 mm) in a medium that mimics real conditions, rather than cutting-up and destroying the sample to fix it to a slide (as needed in traditional microscopy). SPIM shines a very thin slice of light through the sample and then systematically moves the specimen through the light sheet to capture images from each layer. No out-of-focus light is created, so SPIM gives a sharper image of the sample without the usual background blur. The whole sample can continue living and growing as it is viewed

under the microscope, something that current microscopes do not allow. SPIM also minimizes the amount of light-induced damage and extends the life of the sample, by using thin slices of light rather than illuminating the entire sample all at once. The entire procedure is extremely fast - detailed images can be acquired in minutes. To further improve the resolution and to correct for distortions that depend on the viewing direction, the sample can be rotated and scanned again. As a result of EMBL physicist Jim Swoger's work on image processing, the combination of the different views yields an unequaled three-dimensional (3D) image.

PhD student Jan Huisken from the Stelzer group, one of the developers of the technology, sees the creation of SPIM as a major breakthrough in both the scientific and microscopy communities. "Not only is this microscope simply more powerful than many existing technologies, but it also comes at the perfect time for biologists who need to study complete systems."

Ernst Stelzer emphasizes this aspect. "It is extremely valuable – especially for studying developmental biology and for viewing 3D cell cultures. With SPIM, scientists can now capture images that would have otherwise been impossible. It enables completely new applications in scientific research."