



Press Release August 27, 2010

**Anja Konschak**  
Public Relations

Phone: +49-(89) 8578-2824  
Fax: +49-(89) 8578-2943  
konschak@biochem.mpg.de  
www.biochem.mpg.de

## **Human protein factories in 3D** **Insights into the interior of human cells at the nano level**

**Due to cell-biological research, it is already known which components of the cell are responsible for the production of proteins. But so far it has not been explored in detail how these protein factories (ribosomes) are organized inside the cell. Recently, scientists at the Max Planck Institute of Biochemistry (MPIB) in Martinsried near Munich, Germany, succeeded in mapping the inner life of an intact human cell three-dimensionally via cryo-electron tomography. In this way they were able to show where the ribosomes are located in the cell and how they are arranged. In the past, this was only possible with bacterial cells. The results have now been published in *Molecular Cell*.**

Human cells are very complex entities with many different components. A very important cellular component are the ribosomes: As the protein factories of the cell, they are responsible for the production of proteins (protein synthesis). The blueprint provides our heritable information, the DNA.

Because of their importance for protein synthesis, the ribosomes have often been subject of structural research. Until now, the scientists could only look at individual, isolated ribosomes. But in the living cell, ribosomes usually appear lined up like pearls on a string, in so-called polyribosomes. An isolated view is not enough to understand completely how the protein production proceeds inside the cell and how it is embedded in the complex cellular structures and processes. Thus it is necessary to map and to investigate the ribosomes in their "natural environment", in the interior of the cell. This permits cryo-electron tomography.

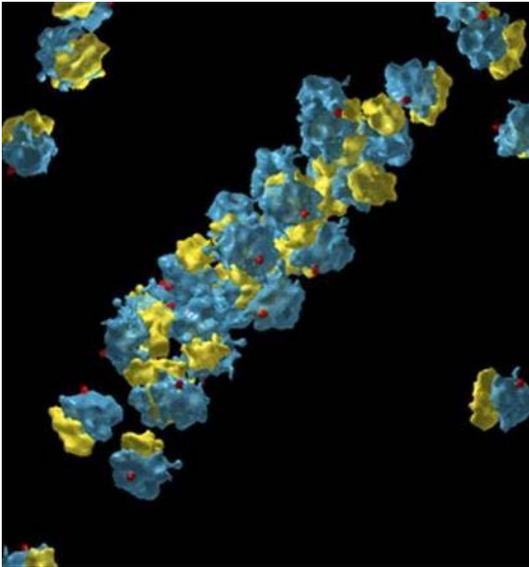
With this method, which was mainly developed in the department of Molecular Structural Biology, headed by Wolfgang Baumeister, three-dimensional cellular structures can be mapped and examined. The cell is sort of quick-frozen, so that its spatial structure remains and its properties are not modified. Then the scientists use the electron microscope to record two-dimensional pictures of the cell from different perspectives. From these pictures they finally reconstruct a three-dimensional image. By using this method, the MPIB scientists were able to create a three-dimensional map of an intact human cell for the first time. This is the continuation of former work, when the team around Wolfgang Baumeister and F.-Ulrich Hartl already managed to analyze the spatial arrangement of polyribosomes in the bacterium *E. coli* (Brandt *et al.*, *Cell* 2009) and of inactivated ribosomes in a whole *E. coli* cell (Ortiz *et al.*, *JCB* 2010).

Now the scientists discovered how the ribosomes are positioned inside the human cell: Their arrangement is clearly non-random but rather makes sure that newly originated, still unfolded proteins keep a big distance between each other. "We could already observe a similar positioning in bacterial cells which suggests that the ribosomes of all human beings are arranged in almost the same manner", explains Florian Brandt, scientist at the MPIB. "This



spatial organization of the ribosomes could probably have the aim to inhibit the aggregation and misfolding of newly originated proteins."

The work of the MPIB scientists is another important step for cell biology, because it helps to better understand the distribution of cellular components and the spatial organization of the whole cell much better. "In the future it could also be interesting", says Brandt, "how the organization of ribosomes changes in aging and sick cells and how these changes affect the total efficiency of protein production and folding." [UD]



**Original Publication:**

Florian Brandt, Lars-Anders Carlson, F.-Ulrich Hartl, Wolfgang Baumeister and Kay Grünewald: The three-dimensional organization of polyribosomes in intact human cells. *Molecular Cell*, August 27, 2010.

**Contact:**

Prof. Dr. Wolfgang Baumeister  
Molecular Structural Biology  
Max Planck Institute of Biochemistry  
Am Klopferspitz 18  
82152 Martinsried, Germany  
E-mail: [baumeist@biochem.mpg.de](mailto:baumeist@biochem.mpg.de)

Dr. Kay Grünewald  
The Division of Structural Biology, University of Oxford  
The Henry Wellcome Building for Genomic Medicine  
Roosevelt Drive  
Oxford, OX3 7BN  
United Kingdom  
E-mail: [kay@strubi.ox.ac.uk](mailto:kay@strubi.ox.ac.uk)

Anja Konschak  
Public Relations  
Max Planck Institute of Biochemistry  
Am Klopferspitz 18  
82152 Martinsried, Germany  
Phone ++49/89-8578-2824  
E-mail: [konschak@biochem.mpg.de](mailto:konschak@biochem.mpg.de)  
[www.biochem.mpg.de](http://www.biochem.mpg.de)