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Programmable gene scissors revolutionize life sciences: Meyenburg Prize 2016 goes to Emmanuelle Charpentier

The Meyenburg Prize 2016 endowed with 50,000 Euros goes to the microbiologist Emmanuelle Charpentier from the Max Planck Institute for Infection Biology in Berlin. She receives the award for her breakthrough work in developing programmable "gene scissors". This new technology that makes genetic manipulation fast and simple. The Meyenburg Prize will be presented during a symposium at the German Cancer Research Center on Tuesday, 20 December 2016.

Emmanuelle Charpentier was the first who understood that the molecular scissors CRISPR-Cas9 from the bacterium Streptococcus pyogenes can be exploited as a tool for genome silencing and engineering. Her research group showed that the combination of two RNAs, which they later combined into along with the protein Cas9 were both necessary and sufficient for the gene editing process. This tool can now be programmed to actually find and cut target sequences of any DNA strand. Together with Jennifer Doudna of the University of California in Berkeley, Charpentier has thus discovered precision tool for making changes to the genome.

“It is the special achievement of Emmanuelle Charpentier to have recognized this potential and to demonstrate its far-reaching applications. The seminal article in Science with Emmanuelle Charpentier as senior author was published only four years ago, but the CRISPR-Cas9 technology has quickly become one of the most sought-after tools in molecular biology research," says Christof von Kalle, member of the board of the Meyenburg Foundation. "Charpentier's discovery is similarly significant to the life sciences as the techniques of sequencing or PCR."

Compared to the methods of sequence-specific cutting of the DNA already known, CRISPR-Cas9 is easy and fast to use, so the method has rapidly been adopted in all life science laboratories. Thus the extremely elaborate process of altering the genome has become a routine procedure.

The application possibilities are enormous: With CRISPR-Cas9 scientists can switch genes on and off, and change or replace them. Basic researchers use the technique to investigate how individual genetic changes affect the emergence of diseases or the development of an organism. Researchers have already devised ways of using CRISPR-Cas9 to eradicate disease-transmitting mosquitoes, or to provide agricultural crops with special properties. In mice, various disease-inducing gene mutations have already been corrected with CRISPR technology. In initial clinical trials currently underway in China and the US, doctors are investigating whether immune cells altered with the help of CRISPR-Cas9 can prove to be effective in cancer therapy.

CRISPR-Cas9 is part of the defense system of bacteria, needed to fight virus infections. To do so, bacteria incorporate short pieces of viral DNA into their genome, virtually as a molecular fingerprint of the enemy. When re-infected with the same virus, the bacterium identifies the intruder by means of the stored fingerprint and cuts the virus gene at exactly this point.

In 2011, Emmanuelle Charpentier already described the two components of the CRISPR-Cas9 system in the Streptococcus pyogenes bacterium, and showed that the system works like a

precision scalpel. The molecular scissors are programmed and directed by an RNA molecule. Charpentier's and her collaborating researchers' achievements also include to making the scissors simpler and more user-friendly.

Emmanuelle Charpentier (48) studied microbiology, genetics and biochemistry in Paris and obtained a doctorate at the Pasteur institute there. After positions in New York and Memphis, Charpentier joined the University of Vienna in 2002 and moved from there in 2009, to the University of Umeå, Sweden, where she is still visiting professor.

Charpentier came to Germany in 2013 as part of a Humboldt professorship. She initially headed a research department at the Helmholtz Center for Infection Research in Braunschweig and was a professor at Hannover Medical School. Since October 2015, she has been director at the Max Planck Institute for Infection Biology in Berlin. Charpentier has been awarded with more than two dozen awards. She received, among other prizes, the Breakthrough Prize in Life Sciences, endowed with three million dollars, and the Leibniz Prize of the German Research Foundation. In 2013, she co-founded the company CRISPR Therapeutics, and in 2014 the company ERS Genomics.

The Meyenburg Foundation under the umbrella of the German Cancer Research Center has been granting the award since 1981. Dr. Marion Meyenburg, daughter of the sponsors Wilhelm and Maria Meyenburg, will personally present this year's prize at the end of the symposium. The award, which is granted every year for outstanding achievements in the field of cancer research, is one of the most highly endowed science awards in Germany. The importance of this award is also reflected by the fact that numerous Meyenburg award winners have also been awarded the Nobel Prize: Andrew Fire, Meyenburg Prize winner 2002, received the Nobel Prize in Medicine in 2006. In 2009, Elizabeth Blackburn, winner of the 2006 Meyenburg Prize, received the Nobel Prize for Medicine. Shinya Yamanaka, Meyenburg Prize winner in 2007, won the Nobel Prize for Medicine in 2012, and Stefan Hell, Meyenburg Prize winner in 2011, received the Nobel Prize for Chemistry 2014.

The Meyenburg Symposium will begin on 20 December 2016 at 3:30pm in the lecture hall at the German Cancer Research Center. Speakers beside Emmanuelle Charpentier, will be the molecular biologists Michael Boutros from the DKFZ and Zoltan Ivics from the Paul Ehrlich Institute in Langen near Frankfurt. A lecture by the prominent bee researcher Jürgen Tautz from the University of Würzburg, who talks about the fascinating world of honeybees, promises a change from molecular biology.

How the gene scissors CRISPR-Cas9 work is also explained in the Helmholtz comic "Klar soweit?".

Contact:

Dr. Stefanie Seltmann
Head of Press and Public Relations
German Cancer Research Center
Im Neuenheimer Feld 280

D-69120 Heidelberg
T: +49 6221 42 2854
F: +49 6221 42 2968
presse@dkfz.de

Dr. Sibylle Kohlstädt
Press and Public Relations
German Cancer Research Center
Im Neuenheimer Feld 280
D-69120 Heidelberg
T: +49 6221 42 2843
F: +49 6221 42 2968
Email: presse@dkfz.de