Tokamak Golem in Prague remotely operated during the lecture "Introduction to Plasma Physics "

An old legend tells that Rabbi Löwe, an important Talmudic scholar, Jewish mystic, and philosopher in the 16th century Prague, created an animate being fashioned from clay: The Golem of Prague. This creature was unnaturally strong and followed blindly the orders of its master, whether they were good or not. And even if the intention of its master was good , it was very difficult to control Golem's powers.

Fusion of hydrogen nuclei into helium is a reaction, which powers our Sun for more than 4.5 billion years. The peaceful use of nuclear fusion for power generation on Earth in a controlled way is possible in magnetized plasmas. This task is highly demanding for scientists as well as engineers due to inherent instability of the plasma, which has to be actively controlled. However, compare to fission reactors, which are burning uranium or plutonium, the fusion plasma reactors are inherently save. Due to the difficulty to control the plasma, still larger and more advanced devices have to be built to achieve an ultimate goal of save and environmental friendly power generation. Well known is currently running construction of the International Thermonuclear Experimental Reactor (ITER), a € 15 billion machine with the main diameter of 12.4 m.

Seeing the parallel to the legend of Golem , the researchers from the Czech Technical University in Prague (CTU) have selected the name Golem for their experimental Tokamak reactor, where the first experience with the generation and sustainment of magnetized plasmas in hydrogen can be made. The Golem Tokamak is with its main diameter of 0.8 m one of the smallest Tokamaks in the world. And also the oldest still functioning one. It was built in former Soviet Union as TM1-MH Tokamak at the beginning of sixties. It moved then to Institute of Plasma Physics in Prague in 1977 (being called CASTOR there) and is now for the last six years operated with name Golem at CTU. It has become an educational device for domestic as well as for foreign students. It is offered to the FUSENET (the 7th FWP European Fusion Education Network) as a remote practica experiment, since its operation can be fully maintained through an internet browser.

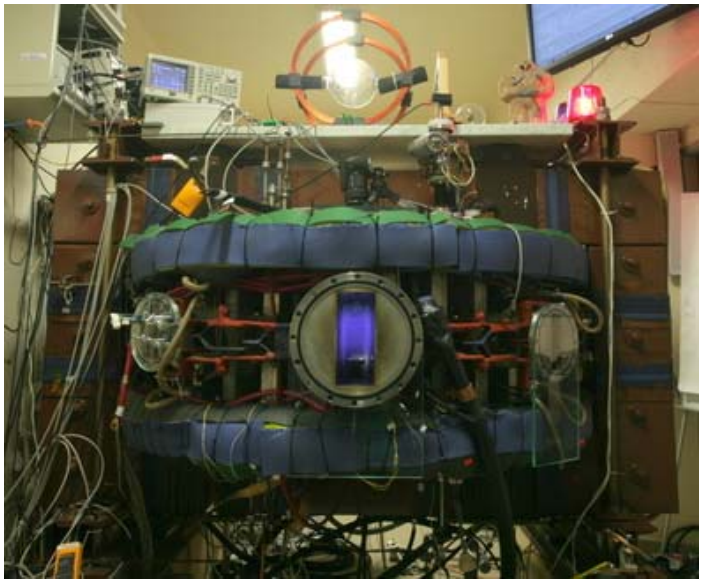

Fig. 1: Golem Tokamak in action. Photo: courtesy The Golem Team

Additionally, the measurements of many experimental parameters are processed and analyzed automatically and are available online several seconds after the plasma operation, allowing very quickly to have a closer look to the plasma performance or even to perform a further analysis.

Ruhr-University Bochum is a well-known plasma center in Germany and in the world, where both low-temperature (technical) and high-temperature (fusion) plasmas are discussed in the bachelor and master study courses and close cooperation exist with the Research Centrum Jülich, with its TEXTOR Tokamak (main diameter 3.5 m).

The participants of the "Introduction to Plasma Physics" in this summer semester (held by Jun.-Prof. Jan Benedikt) had now the possibility to operate the GOLEM Tokamak remotely during the lecture and got familiar with its operation principle. First, the 3D model of the tokamak has been presented, with the possibility to virtually visit the control room with the tokamak, to see all essential parts in detail and even to see the plasma chamber from inside from "plasma-perspective" with highlighted magnetic fields. Afterwards, the effect of different plasma

parameters such as pressure, magnetic field and pre-conditioning of the reactor chamber with glow discharge were tested. Two internet cameras enabled to follow the experiments in real time.

Thanks to the GOLEM team, lead by Dr. Vojtěch Svoboda, the physic students at RUB will have now the opportunity to operate the Golem Tokamak also in the following years. Moreover, the organization of a remote practica, Bachelor theses or even short training visits in Prague is now being prepared.

Fig. 2: Participants of the "Introduction to Plasma Physics" lecture during the introduction to the reactor. 08.07.2013, Photo: courtesy Hendrik Bahre.

Links:

Rabbi Löwe: http://en.wikipedia.org/wiki/Judah_Loew_ben_Bezalel

Golem: http://en.wikipedia.org/wiki/Golem

CTU: http://www.cvut.cz/en

Remote practica experiment: http://golem.fjfi.cvut.cz/

Textor: http://www.fz-juelich.de/iek/iek-4/DE/Forschung/09_TEXTOR/_node.html

Homepage von Jun.-Prof. Jan Benedikt: www.plasmafest.rub.de