



Contribution ID: 4

Type: **Oral**

Oral_3_ITER_DIA: Development of the NPA based diagnostic complex in ITER

Monday, 6 September 2021 12:00 (30 minutes)

Deuterium-tritium fuel isotope composition monitoring is essential for effective plasma burning in a tokamak-reactor. This is the primary task for the Neutral Particle Diagnostic Complex, which is now being developed for the ITER tokamak. The complex comprises several diagnostics led by two Neutral Particle Analyzers (NPA) - HENPA and LENPA. The HENPA, High Energy NPA, provides registration of fast deuterium and tritium atoms with energies from 0.1 to 2.2 MeV, while the LENPA, Low Energy NPA, operates in the thermal energy range from 10 to 200 keV.

Fast deuterium and tritium ions in the MeV energy range can emerge in fusion plasma as a result of close collisions between fuel ions and fusion-born alpha-particles (knock-on effect). The fast ion population belongs to the hot plasma region, and this fact makes possible NPA measurements of the fuel isotope composition in the plasma core. Besides, the shape of neutralized knock-on ion spectra provides information on the alpha-particle confinement properties. Another application of the HENPA is related to studying the fast ion dynamics in the ITER plasma. An example here is the sawtooth oscillations, which lead to redistribution of fast ions not only along the plasma radius but also in the phase space.

The LENPA provides information on the edge isotope composition and ion temperature and can be used in studies of the evolution of near boundary plasma during various phenomena, like for instance, penetration of fuel pellets.

The ITER NPA system is accompanied by three other diagnostic instruments - the Diamond Neutral Particle Spectrometer (DNPS), the Gamma-Ray Spectrometer (GRS), and the Neutron Spectrometer. These tools supplement the NPA measurements, at the same time providing some unique capabilities. The GRS can assess the alpha-particle density profile as well as monitor the runaway electrons, which is of high priority for machine protection. The DNPS will measure charge-exchange atom fluxes with high temporal and energy resolution (but without mass-discrimination) for plasma instabilities studies, and also will provide data for NPA cross-calibration. Besides, it can be effectively used as a DT neutron spectrometer in high-power discharges.

In the present report, the physical basis of the NPA based diagnostic complex and its measurement capabilities for the ITER plasma is considered. The design of the complex and the engineering solutions implemented to meet the requirements of the ITER tokamak-reactor are described.

Primary authors: Dr AFANASYEV, Valery (Ioffe Institute); Dr CHERNYSHEV, Fedor (Ioffe Institute); Dr KOZLOVSKY, Stanislav (Peter the Great St. Petersburg Polytechnic University); Dr MELNIK, Andrey (Ioffe Institute); Mr MARININ, Gennady (RUSSIAN TECHNOLOGIES Ltd.); Dr MIRONOV, Maxim (Ioffe Institute); Mr NAVOLOTSKY, Andrey (Ioffe Institute); Dr NESENEVICH, Vladislav (Ioffe Institute); Dr PETROV, Mikhail (Ioffe Institute); Dr PETROV, Sergei (Ioffe Institute); Mr YATSENKO, Anton (Ioffe Institute / RUSSIAN TECHNOLOGIES Ltd.); Dr SHEVELEV, Alexander (Ioffe Institute); Dr CHUGUNOV, Igor (Ioffe Institute); Ms ILLASOVA, Margarita (Ioffe Institute); Mr KHILKEVITCH, Evgeniy (Ioffe Institute); Dr DOINIKOV, Dmitri (Ioffe Institute); Dr GIN, Dmitry (Ioffe Institute / ITER Organization); Mr ARTEMEV, Kirill (Institution "Project Center ITER"); Dr KRASILNIKOV, Vitaly (ITER Organization); Mr KORMILITSYN, Timofey (ITER Organization); Mr KOVALEV, Andrei (Institution "Project Center ITER")

Presenter: Dr SHEVELEV, Alexander (Ioffe Institute)