High precision neutron-induced cross-section measurements are of major importance for a wide variety of research fields in fundamental and applied nuclear physics. In the field of nuclear structure such measurements allow to study excited levels close to the neutron binding energy and to obtain information on nuclear properties such as level density, nuclear separation energy, etc. In particular, data on neutron induced reactions are also essential in nuclear astrophysics for understanding the production rate of almost all nuclei in the universe heavier than iron, which occurs mainly through slow and rapid neutron capture processes (followed by $\beta^-$decay) during the various phases of stellar evolution. In the field of nuclear technology, a renewed interest in nuclear energy production has triggered new studies aimed at developing future generation systems to find safe, clean and possibly economic energy supplies. Based on these motivations the neutron time-of-flight facility n_TOF has been constructed at CERN.

The n_TOF facility is a pulsed white neutron source based on a spallation reaction. Neutrons are produced by 20 GeV/c protons from the CERN Proton Synchrotron accelerator (PS), impinging onto a lead block, surrounded by a water layer acting as coolant, as well as moderator for the neutrons. The n_TOF facility has been set in operation and commissioned during 2001 with performances matching the expectations. The PS machine of CERN can generate high intensity proton beam, up to $7\cdot10^{12}$ ppp (protons per pulse) in the form of short (7 ns width) pulses with a low repetition time (0.4 Hz). The high neutron flux (about $2.1\cdot10^{15}$ neutrons per pulse), the low repetition rates and the excellent energy resolution opened new possibilities to high precision cross section measurements in the energy range of neutrons from thermal to GeV, for stable and, in particular, for radioactive targets. Since 2014 a second experimental area (EAR2) with vertical path of 20 m from spallation target is available. This new EAR2 with a much higher neutron flux allows to perform challenging measurements with relatively short-lived isotopes offering the unique opportunity to address some open questions in nuclear astrophysics. *n_TOF Collaboration* uses several detector systems, specially designed for the measurement (n,γ), (n,f) and (n,chp) reaction cross-sections. For example, in the test measurement of $^7$Be(n,p) reaction Si telescope (with strip detectors) and electronics, designed and built at the University of Lodz, was successfully used.

We plan to perform several experiments important for nuclear astrophysics issues. We proposed to measure at EAR the $^7$Be(n,p)$^7$Li reaction, which has been previously studied in a limited energy range and poor energy resolution. The $^7$Be(n,p) reaction has the advantage of being characterized by a high cross section, but the disadvantage that the emitted proton has low energy (the Q-value of the reaction is 1.64 MeV), which makes background rejection more difficult. The difficulty is also associated with the availbility of a high-purity $^7$Be sample. The predictions of the Big Bang Nucleosynthesis (BBN) theory reproduce successfully the observations of all primordial abudances expect for the $^7$Li. This nuclide is overstimated by more than factor of 3 – called “Cosmological $^7$Li problem”. In the standard theory of BBN, 95 % of primordial $^7$Li is produced by the electron capture dacay of $^7$Be ($T_{1/2}$ = 53.2 d) relatively late after the BB when electrons and nuclei combined into atoms. Therefere, the abudance of $^7$Li is essentially determined by production and destruction of $^7$Be. In BBN scenario, neutron-induced reactions on $^7$Be also play a role. However, despite of their importance in the BBN context, very few and uncertin experimental data are available on these reactions.

The second example is the $^{70}$Ge(n,γ) reaction. Specially importance of this reaction is due to the fact that $^{70}$Ge is “*s*-only” nuclide, which cannot be produced by the *r*-process since it is shielded from $\beta^-$ decays coming from the neutron rich side by its stable isobar $^{70}$Zn. The “*s*-only” nuclides of $^{70}$Ge produced in the weak *s*-process can be used to extract important *s*-process parameters, such as the mean neutron exposure (time-integrated neutron flux). For $^{70}$Ge(n,γ), datasets extend up to about 200 keV neutron energy, but from 10 keV onwards there is no information on neutron resonances and only the unresolved cross section is given. The level spacing in Ge is larger than the neutron energy resolution of EAR1, therefore, it is possible for the first time to resolve resonances up to few hundred keV.

We also propose to perform the measurements of (n,α) reaction cross-section on light nuclei. The data for the (n,α) reaction cross-section for light isotopes as C, O, Ni, F and B are of great practical importance. These elements are contained in nuclear reactor core in large amounts. This reaction affects the reactivity of the reactor and produces gas, which can significantly alter the mechanical durability of construction materials. This reaction is also a substantial part of the absorbed dose estimations in the biological tissue being irradiated with fast neutrons. The $^{10}$B(n,α) reaction is used as a standard and therefore any clarification of its cross-section can lead to a reassessment of data from large number of works where it was used as a standard. Moreover (n,α) reaction cross-section for mentioned nuclides, especially for neutron energy greater than 5 MeV, was insufficiently studied, resulting in large discrepancy of existing experimental data.