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Searching the Universe in the X-ray band is the most expensive branch of modern astrophysics
Photons at energies from the range between 0.1 to 100 keV are completely absorbed by the atmosphere. Therefore, to see the Universe in X-rays we need to build a telescope satellite and launch it into space. For this reason, X-ray astronomy had developed in the second half of the XX century, when we have learned to launch satellites above the atmosphere. Approximately 15 years period time is needed for full construction of the flight telescope from the mission concept up to the launch.

With the current technology, the best detection we achieve for photons from a narrow energy range from 0.1 to 10 keV - for those photons we can measure with the high accuracy the photon energy, direction and moment of their arrival.
On Nov. 2013, a new generation X-ray telescope ATHENA (the Advanced Telescope for High Energy Astrophysics) was approved by European Space Agency as a large mission with a launch foreseen in 2028. ATHENA telescope will be equipped with the most modern X-ray mirrors inclined in such a way that X-ray photons are grazing over their surface. Polish sciences and research engineers are participating in the design and construction of the telescope.

ATHENA will have two focal plane detectors, which will be used alternatively depending on the observational plan.
X-IFU (X-ray Integral Field Unit) is a very innovative detector, in which a single pixel measures extremely small temperature difference caused by X-ray photon that enters into it. The photon energy will be measured with the very high precision as never before. The second detector, WFI (Wide Field Imager) will be built with conventional silicon pixels, but with modern electronics ensures rapid signal readout.
The above combination of instruments allows us to formulate research tasks which, according to experts of the European Space Agency are the most important from the point of view of modern astrophysics.

The X-ray observations provide us information about the temperature, density and mass of hot gas in the area of ?? the sky. Sometimes it is possible to determine the velocity of emitting gas. These physical parameters combined with the time of observation provide basic information about the morphology and evolution of the observed objects, and thus their connection with colder gas seen in visual light.

ATHENA will provide us an information about the dynamics and the distribution of hot matter in the Universe. Thanks to them we will understand how supermassive black holes grow and how hot gas stabilizes clusters of galaxies.
X-rays with energies 0.1-9 keV interact with matter producing emission or absorption from ionized heavy elements. Observations of those lines allow us precisely examine heavy elements content and their chemical evolution of astrophysical objects. With ATHENA we will investigate
process of matter falling onto supermassive black hole, in particular its relation with outflowing hot winds (galaxy feedback).
Beside more distant objects, ATHENA will be suitable to search for objects from our Galaxy as,
X-ray binary systems and their outflows, coronae of hot stars, and our Galactic Center.

The aim of this project is the science contribution of Polish researchers in the ATHENA mission.
We plan to perform simulations of the X-ray signal detectable by ATHENA's detectors.
We compute models of X-ray emission from ionized wind, illuminated accretion disks, and the hot neutron star atmospheres. All theories formulated by us will be used to interpret future results of the ATHENA mission. Such activities are one of the most important criteria for further sharing of observation time and specification of the objects to be observed.

For many years, Polish engineers are building different satellite components. High expert evaluation of the scientific and technical meant desidet that we were invited by researchers from Max Planck Institute to participate in the design of WFI/ATHENA detector. Within this project we plan to work on developing and testing the filter wheel assembly in the WFI detector. This activity is necessary in the current phase of the mission, called "definition and evaluation" phase. The goal of our project is that engineers from the Space Research Center will define and examine the real satellite component, which in 2028 will help us to observe the Universe in X-rays.