Thermal radiation is electromagnetic radiation emitted from all matter that is at a non-zero temperature. The source of thermal radiation is the energy of thermal vibrations of atoms and molecules in condensed matter, specifically in solids and some liquids. The higher a body's temperature, the brighter it glows and therefore emits more energy. The color of the light also changes. For example, a body with a temperature of about 500°C emits light that is dark red. As the temperature increases, the body color first becomes orange, then light yellow, white-yellow, and finally white. On the other hand, the lower body temperature, the range of wavelengths of thermal radiation emitted by this body extends significantly beyond the visible range. Thermal radiation can reach its maximum intensity at wavelengths corresponding to microwave radiation – an example is the cosmic background radiation. Bodies at a close-to-room temperature emit thermal radiation in the far infrared range. The radiation emitted by the human body reaches peak values at wavelengths between 9 and 10 µm.

Thermal imaging devices, and more specifically focal plane arrays based on detectors operating in the long-wave infrared (LWIR) range (8—14 µm), allow observation of the surroundings in darkness, fog, smoke and even rain and, unlike night vision devices (image intensifier tubes), do not require low-light source. They are also useful for police and military services to detect people, e.g. who want to cross the border illegally. Technological progress has meant that thermographic devices are also used in various areas of everyday life, in construction, industry and medicine, e.g. the temperature distribution in the infrared radiation image of the patient's body allows to see any changes in one body. Here, thermal imaging devices based on inexpensive silicon bolometric arrays are most often used. However, more advanced applications – including military ones – require the use much more sensitive, but also much more technologically advanced arrays based on photon infrared detectors.

The most advanced devices are currently built based on the most technologically "mature" mercury cadmium telluride (HgCdTe). It makes it possible to use the so-called "energy gap engineering" for designing the structure of optoelectronic devices based on heterostructures or detectors operating simultaneously in two spectral ranges (so-called "two-color" detectors). However, the current Restriction of Hazardous Substances (RoHS) Directive limits the use of heavy metals such as Hg, Cd and Te in electronic devices in line with EU legislation. Therefore, there is an urgent need to develop an alternative to HgCdTe materials for infrared detectors. For the LWIR range, the AIIIBV group semiconductors, such as type-II InAs/InAsSb superlattices, combined with wide-gap semiconductors, e.g. AlGaAsSb, can be competitive technologies.

For this reason, the project is aimed at developing of an AIIIBV group semiconductors based active element – a photon detector – based for the LWIR focal plane array. The key to success will be a thorough investigation of the physics of photoelectric phenomena in this type of structures and their comprehensive experimental analysis supported by numerical simulations made with computer programs. The research carried out as part of the project will not only have great cognitive significance, but will allow for the future development of the first Polish focal plane array and imaging devices operating in the LWIR range that meet the requirements of the most advanced applications, including military ones.