Since the production of the first passenger car models (early 20th century), their design has been continuously changing. The automotive industry is still developing thanks to the practical use of scientific achievements. Despite the trend towards the use of low-density construction materials in the automotive industry, such as aluminum alloys, magnesium alloys, and composites, steel remains the primary structural material. This is due to the possibility of ensuring high mechanical properties with much lower production costs than in the case of other construction materials. The contemporary development of highly specialized research techniques and new technological possibilities have contributed to the dynamic growth of the interest of research units and the automotive industry around the world in high-strength steels. Modern steels that are the subject of currently conducted scientific research in leading scientific centers can certainly be included in the group of advanced structural steels representing future-oriented material solutions.

**One of the latest achievements in material engineering are high-strength multiphase steels with retained austenite from the Advanced High Strength Steels (AHSS) group.** Their functional mechanical properties are the result of the interaction of soft and hard structural components, as in the case of composite materials, where one phase is the matrix and the other is the material reinforcement. So far, research on this group of materials has focused on aspects related to the production of car body sheets. In recent years, there has been an increase in interest in steels with a multiphase microstructure with potential application for forgings characterized by a combination of high strength and resistance to cracking under various load conditions. However, the scientific knowledge about this group of steel is still small, because so far no systematic scientific research in this field has been conducted.

Currently, the most promising material to be used for forgings are medium-Mn steels with retained austenite. **The presence of ductile retained austenite located between the martensite, bainite or ferrite laths guarantees a favorable combination of strength, ductility and fracture toughness under static, dynamic and fatigue loads**, which meets the stringent requirements of the recipients of forgings. **The retained austenite of adequate stability and morphological homogeneity prevents the formation of cracks by ensuring local plasticity, while the martensite formed as a result of plastic deformation contributes to blocking the propagation of possible microcracks.**

Due to the advantages of retained austenite contained in the structure, it is important to produce a significant amount of this phase. This is done by means of complex heat treatment. The concept of the project is based on the use of Quenching and Partitioning heat treatment consisting in quenching, after the forging process followed by carbon partitioning (Partitioning). The structure obtained in this way, consisting of low-carbon martensite and carbon-enriched retained austenite, will ensure favorable mechanical properties. The implementation of this process depends on many variables that affect the obtained mechanical and technological properties of steel. This forces to conduct advanced research aimed at its optimization in terms of the amount, stability and morphological homogeneity of the retained austenite. **Taking into account the above aspects, the aim of the project is to develop advanced medium-Mn Quenching and Partitioning (Q&P) steels combining high strength, ductility and fracture resistance under static, dynamic and fatigue loads, which will be produced using an energy-efficient forging process.**

The implementation of the research project requires a wide range of comprehensive studies, using the most advanced research techniques and simulation tools used to assess the structural and mechanical properties of modern metallic materials. As part of the project, tests will be carried out including thermodynamic calculations, dilatometric tests, thermomechanical simulations using Gleeble simulator, comprehensive microstructure tests using research techniques of various resolutions including EBSD / EBSD 3D; APT; XRD and TEM (including in-situ measurements) and fatigue tests with the characteristics of the cracking mechanism of developed steels. Experimental results will be supported by multiscale modeling approach.