Angular and Articulated Pellet Injection Mechanism on the Mexican Tokamak Experimental Facility

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Mexico presents under the Research and Development Project (R+D) approved by the Mexican Education Ministry (SEP, spanish acronyms) one technological development over its articulated pellet injection mechanism for the Mexican Tokamak Experimental Facility. This necessary effort is focused on the great interest for Science and Technology into the magnetic confinement fusion area. At this moment our tokamak has been designed over the Facultad de Ingeniería Mecánica y Eléctrica (FIME) into the Universidad Autónoma de Nuevo León (UANL).

Our main tokamak experimental characteristics are: major radius 41 cm (R), minor radius 18.5 cm (a), aspect ratio 2.2162 (A), safety factor 1.9552 (q), plasma current 277 kA (Ip), beta 0.0532, toroidal field 1.3 T (Bt), ionic temperature 280 eV (Ti), electronic temperature 516 eV (Te), electronic plasma density 2-3 x10^13 cm^-3 (ne).

We have designed a Pellet Injection Mechanism which is capable to drag frozen H2 into the vessel, H2 pellets can be provided by any cryogenic system (HGH85000 is the H2 generator for this experiment). Our injector system can gives to pellet specific speeds from [400-800 m/s] and a selectable direction from a range [-20º, 20º] respect to the machine main axis. Its control system can be interfaced through the fusion serial data bus (designed by our research group) in order to modify the operation status, this data bus is based on an 18f4550 microcontroller and it has a theoretical transferring data speed of 8Mbps.

In addition we have also developed an articulated pipe that can isolate the H2 frozen pellets all the way from the Hydrogen generator to the Pellet Injection Mechanism. This pipe consist of several modules that are assembled together using concentrically knee-like joints, between every module could be a flexibility range of ±15 degrees in all directions. In order to resist the 50 bar pressure generated by the H2 pellet extrusion, every module has a layer of stainless steel and a safety factor of 8. It also has a gross layer of Polytetrafluoroethylene (PTFE) insulator for maintain the 10 Kelvin degrees temperature inside the pipe.

Main objective of this experiment is to understand what kind of effects could have a direction controlled pellet injection upon the plasma density and stability, in order to increase this parameter by using a dynamical and active injection of solid material. In this way a stronger application of different sciences and technologies into our Mexican Energy Fusion Program, and the design and construction of this magnetic confinement device should allow us to develop, innovate and make significantly research in order to make considerably benefits on magnetic confinement fusion area.