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# Preliminary analysis of breakdown and startup conditions for the first plasma of HL-2M

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HL-2M is a new medium-sized copper-conductor tokamak, which is designed and under construction by SWIP, and aims at high-performance plasma physics research and engineering testing for ITER, CFETR and even a fusion reactor. HL-2M has the advantages of flexibility and controllability of the divertor configurations. It can perform a variety of advanced divertor configurations (snowflake, tripod) for physical and engineering testing. It will have the ability to operate with high performance plasma to study the divertor physics and engineering technologies with high power auxiliary heating, as well as the ability to operate experiments with advanced scenarios. However, the most important thing at present is that the initial discharge of HL-2M must be achieved firstly. Since the various systems of the new device are still being optimized, the HL-2M initial plasma discharge will be achieved in a simple and reliable way using a minimum of coils.

In this paper, the circular section limiter configuration necessary for the initial discharge and the divertor configuration with a lower elongation are designed by EFIT. A sufficiently strong electric field (E-field) and good magnetic field-null (B-field) configuration are necessary for the plasma breakdown. Therefore, the design of the magnetic field-null configuration and the analysis of the time and space evolution of the breakdown conditions (E-field & B-field) will be the focus of this paper.

Since the vacuum vessel structure of the HL-2M is designed to be electrically conductive at toroidal, the higher loop voltage will induce the larger eddy currents in the vacuum vessel before the plasma breakdown and during the initial ramp-up of the current after breakdown; The eddy current will generate a vertical field in the plasma region, destroying the B-field configuration, which is not good for the plasma breakdown, plasma current formation and ramp-up. Therefore, this paper will also explore the compensation scheme for the magnetic field generated by the eddy current, and analyze the volt-second consumption of the discharge process. Finally, the stable and self-consistent initial plasma discharge waveform evolution of HL-2M is designed to provide an important guarantee for the initial discharge success.

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Figure 1

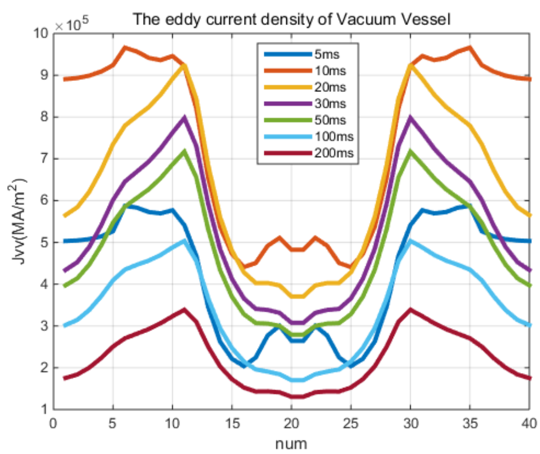


Figure 1, The evolution of the eddy current density in VV of HL-2M