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## The Simulation of MCP and 20 inch MCP-PMT

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Large-area MCP-PMT is an essential device for the neutrino detection experiment. The PMT requirements for this experiment are listed as follows: (1) Large size, high cathode coverage, and single PMT cathode as possible as covering its inner surface in 20 inches. (2) High detection efficiency. (3) Good single photoelectron detection capability and a large dynamic range. (4) Low radioactive background. (5) More than 20 years' lifetime. Taking into account of this, The simulation was done by two part, one is the simulation of the MCP, the other is the simulation of the MCP-PMT.

For the high collection efficiency and high gain of the MCP, the model parameters are determined through the simulation are as follows: the channel length is 410 $\mu$ m, the diameter of the channel is 10 $\mu$ m, the channel inclination angle is 10°, the input and output electrode immersion depth are 5 $\mu$ m. The simulation of two pieces of MCP is done. We adjust the distance and voltage between them, that makes the Gain of them can be  $10^7$ , when the bias voltage is 800V. The collection efficiency can be 73.7% (the maximum value is 80.2%).

Yet for MCP-PMT, the effective work area of the photocathode of PMT should be large enough, the collection efficiency of MCP for the photoelectrons emitted from photocathode need be higher, and the MCP-PMT possesses smaller TTS. A 20 inches MCP-PMT which has ellipsoid structure was designed via computer simulation. The diameter of photocathode is 500mm. It includes transmission-type and reflection-type photocathode, which is able to improve its transformation efficiency. Meanwhile, we designed the best structure of the PMT whose collection efficiency is 98%, and the TTS is 17.7ns. Even considering the influence of the geomagnetic field, the collection efficiency can reach 86%.

**Autore principale:** Prof. LIU, Hulin (Xi'an Institute of Optics and Precision Mechanics (XIOPM), Chinese Academy of Sciences)

**Coautore:** Prof. WEI, Yonglin (Xi'an Institute of Optics and Precision Mechanics (XIOPM), Chinese Academy of Sciences)

**Relatore:** Prof. LIU, Hulin (Xi'an Institute of Optics and Precision Mechanics (XIOPM), Chinese Academy of Sciences)

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