

Status of MRPC TOF technology and development trend

Yi Wang

(Department of Engineering Physics, Tsinghua University, Beijing, 100084, China)

Particle identification is very important in nuclear and particle physics experiments. Time of flight system (TOF) plays an important role in particle identification for example the separation of pion, kaon and proton. Multi-gap Resistive Plate Chamber (MRPC) is new kind of avalanche gas detector and it has excellent time resolution. The intrinsic time resolution of narrow gap MRPC is less than 10 ps. So MRPC technology TOF system is widely used in modern physics experiments for particle identification. With the increase of accelerator energy and luminosity, TOF system is required to identify definite particles precisely under high rate environment. The MRPC technology TOF system can be defined as three generations according the timing and rate requirement. The first generation TOF is based on float glass MRPC and its time resolution is around 80ps, but the rate is relatively low (typically lower than $100\text{Hz}/\text{cm}^2$). The typical systems are TOF of RHIC-STAR, LHC-ALICE and BES III endcap. For the second generation TOF, its time resolution is in the same order with the first generation, but the rate capability is much higher. Its rate capability can reach $30\text{kHz}/\text{cm}^2$. The typical experiment with this high rate TOF is FAIR-CBM. The biggest challenge is on the third generation TOF. For example, the momentum upper limit of K/π separation is around $7\text{GeV}/c$ for JLab-SoLID TOF system under high particle rate as high as $20\text{kHz}/\text{cm}^2$, the time requirement is around 20ps. The readout electronics of first two generations is based on time over threshold method and pulse shape sampling technology will be used in the third generation TOF. In the same time, the machine learning technology LSTM network is also used to analysis the time performance. In this talk, I will describe the evolution of MRPC TOF technology and key technology of each generation TOF including MRPC detector and related electronics. The Freon based working gas is also an important problem in the future. I will show related results of Eco-gas and gas tight MRPC. All of these would be good reference for the design of SPD-TOF system.