About ion-feedback of Micro-Channel Plates (MCP):

Due to the nature of Micro-Channel Plates (MCP) an ordinary MCP having small and straight channels can not produce gains as large as a single (curved) channel electron multiplier ("Channeltron"). One reason for this is the so-called ion-feedback phenomenon: as the electron avalanche gets bigger and bigger on its way though the MCP-channel driven by the MCP bias, atoms from the rest gas or adsorbed atoms on the channel surface can be ionized. These ions then are accelerated by the MCP bias towards the MCP input side. If no care is taken, they can achieve enough energy to release electrons when they hit the channel wall. Then a second avalanche will be initiated. The "false" pulses are not only disturbing the measurement, they could ultimately lead to a permanent glow discharge and destroy the MCP over time.

Measures against this are the use of "short" channels (with an aspect ratio typically between 40 and 80), to tilt the channels slightly against the field direction and to use several MCP stages in so-called "Chevron" (2 MCP) or "Z-stack" (3 MCP) configuration. The MCP must be stacked in such a way that the relative angle between pores is maximized for neighboring MCP. Furthermore the rest vacuum should be $< 10^{-6}$ Torr and the channel inner surfaces should be "clean", i.e. free of adsorbates.

This allows total gains over 10^7 for single particle or photon detection with Chevron or Z-stacks. However, the ion feedback phenomenon might still be present at a certain level and disturb the performance for multi-hit detection: Sometimes a second "signal" may appear (typically at the same position than the earlier one) at times between few ns to few 100 ns after the first signal, although no second particle/photon has hit the detector.

The remaining ion-feedback will strongly depend on the cleanliness of the MCP pore surface and the rest vacuum in the pores. Note, that a good vacuum level in the recipient does not guarantee an equally good vacuum level in the pores. **It may take several days until a freshly installed MCP has clean-enough pores for low ion-feedback**. This is also the case for MCP stacks, which have been operated before but have been in ambient air for a while. A baking of the recipient/the MCP stack will shorten this time.

If the ion-feedback performance is not sufficient for an application although the MCP pores can be considered "clean" and at a good vacuum level, one should first consider if an operation at lower MCP gain is possible and if the ion-feedback is tolerable at this lower gain. Otherwise it is advisable to add one more MCP to the stack. A Z-stack operated at same total gain as a Chevron-stack usually shows much less ion-feedback.

It is to note, however, that using a Z-stack increases the required total voltage across the stack (check high voltage ratings of feedthroughs, cables and power supplies).

As a thumb rule

- Chevron stacks of 40:1 MCP ("L/D", aspect ratio) show HIGH ion-feedback at gain levels for single particle/photon counting.
- Chevron stacks of 60:1 or 80:1 MCP show LOW ion-feedback.
- Z-Stacks of 40:1 (or higher) MCP show VERY LOW (or NO) ion-feedback.