Any travel-time difference for ions of the same mass in a TOF system reduces the mass resolution
Detector Time Jitter

Ion arrival jitter is partially due to the TOF instrument

We are separating out the jitter that is due to the detector

\[ \Delta \tau_{detector}^2 = \Delta \tau_{pulse \, width}^2 + \Delta \tau_{ion \, arrival}^2 \]
Reducing Detector Time Jitter

■ Pulse Width
  - Fast internal transit times
  - Ideally, all of the electrons resulting from the ion impact should reach the anode at the same time.

■ Ion Arrival
  - The electromagnetic environment created by the detector should not disturb the motion of the approaching ions. (no electric or magnetic fields in front of the detector)
  - The detector surface should be planar and parallel to the arriving ion packet.
Global Flatness

- Reporting maximum absolute focal plane deviation
- Values reported as “±” need to be doubled for comparison

25 mm diameter MCPs
Increased Bias Angle

Bias angle change improved resolution ~ 10% at high mass

\[ \Delta \tau = \frac{d}{v \tan \theta} \]
Reduced Pore Size

\[ \Delta \tau = \frac{d}{v \tan \theta} \]

2 µm 12° bias
\[ \Delta l_{2\mu m} = 9.4 \mu m \]

5 µm 12° bias
\[ \Delta l_{5\mu m} = 23.5 \mu m \]

2 µm pore improves resolution ~ 10% at high mass
Ion Arrival: Limit of Resolution Improvement

Showing the expected improvement in resolution if time spread due to the entrance geometry could be eliminated.
Conclusions

- With no changes to the instrument, TOF mass resolution can be improved by:
  - Controlling MCP global flatness
  - Increasing MCP bias angle
  - Reducing MCP pore size
- MountingPad MCP global flatness can be controlled in hardware to under 10 µm for a 25 mm diameter active area.
  - Control of hardware and assembly are critical
- 25 mm diameter 2 µm pore 19° bias angle MCPs reduce the pore penetration depth from 23.5 to 5.4 µm.
- The use of True Flight MCPs can improve resolution by 15% over standard configuration