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A Low Complexity Time-of-Flight Mass Spectrometer With Ion Size Measurement Based On Secondary Particle Yield

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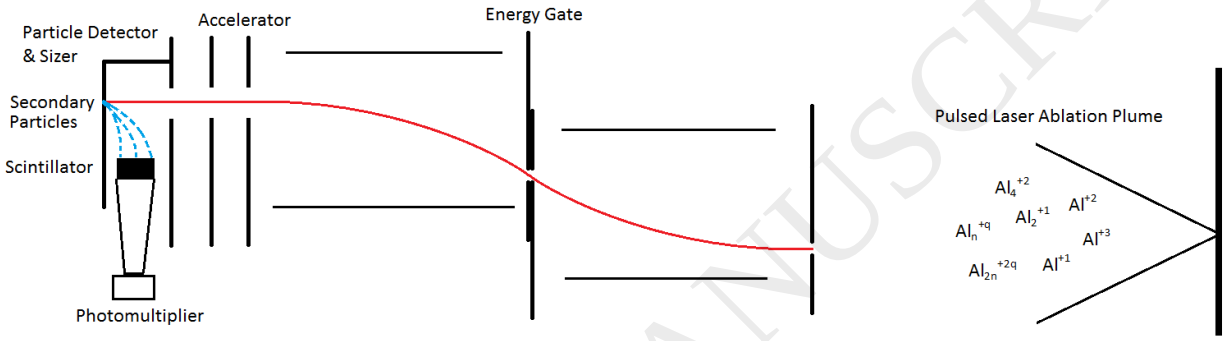
Graphical abstract



Highlights

- A simple spectrometer design for pulsed laser ablation plumes
- Distinguish particles with the same mass-to-charge ratio
- Simple design, with no high voltage pulsing
- Reconfigurable to adjust uncertainty and operating energy range
- Prototype demonstration

Abstract:
A mass spectrometer has been designed to distinguish ions of different mass but identical mass to charge ratio. Separation of mass from charge is based upon secondary particle emission when each ion impacts the detector. The yield of secondary particles is a function of kinetic energy rather than energy-per-charge. Combined with an electrostatic energy gate and time-of-flight, the mass can be determined from kinetic energy, energy-per-charge, and mass-per-charge. The design is of moderate precision but simpler than available alternatives – particles need not be extracted from the vacuum chamber for sizing nor the detector kept at cryogenic temperatures. The prototype is demonstrated on an aluminum ablation plume and an ionic liquid ion source.

Keywords: spectrometer, ablation, secondary emission, time-of-flight, design, detector