

## Performance comparison of two different Laser Ablation Time-of-Flight Mass Spectrometers

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We present extensive intercomparison measurements between two different single particle laser ablation time-of-flight aerosol mass spectrometers utilizing similar working principles with differences in the inlet and particle detection design and in the ablation laser wavelength: the Single Particle Laser Ablation Time-of-flight aerosol mass spectrometer (SPLAT, Kamphus et al., 2008) and the Aircraft-based Laser Ablation Aerosol Mass spectrometer (ALABAMA).

The general setup of both instruments is as follows. Ambient aerosol is focused by an aerodynamic lens system to a narrow beam. Two orthogonal CW laser beams are used to determine the aerodynamic diameter of the aerosol particles and to trigger the ablation laser. The ablation, which vaporizes and ionizes the particles, takes place in the extraction region of a bi-polar time-of-flight mass spectrometer, resulting in detailed information on the chemical composition of the individual particles.

For comparison of the inlet and particle detection systems of the two instruments detection and ablation efficiencies for different types of aerosol particles, namely PSL (Fig. 1) and glass spheres, broken glass, soot and PAH, were determined as a function of particle size, SPLAT was operated with both, a Schreiner type aerodynamic lens (Schreiner, 1999) focusing particles in a size range between 0.2 and 3  $\mu\text{m}$  and with a Liu type lens with a size range from 50 to 800 nm detecting the forward scattered light with an optical lens assembly and a photomultiplier. ALABAMA was operated with the Liu type aerodynamic lens only, using elliptical mirrors to collect the scattered light.

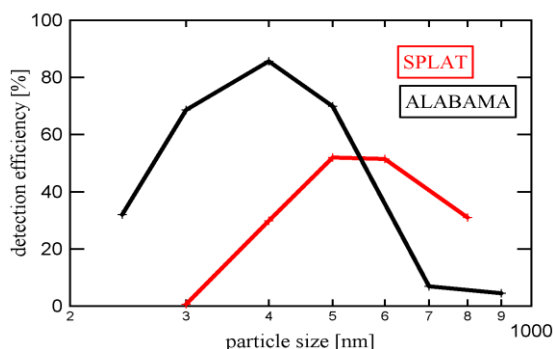


Figure 1: PSL Detection efficiencies of SPLAT and ALABAMA. Both devices equipped with a Liu type lens.

Due to its elliptical mirrors ALABAMA is able to detect smaller particles than SPLAT, which on the other hand detects larger particles more efficiently.

For investigation of the influence of the ablation laser wavelength onto the ion fragmentation a variety of identical aerosol particles has been measured with the two instruments. SPLAT uses an excimer laser for particle ablation, which can be operated at 193 nm and 308 nm, depending on the laser gas; ALABAMA uses a frequency quadrupled Nd:YAG laser, operating at 266 nm. The higher energy of the 193 nm ablation laser is supposed to result in a stronger fragmentation of the vaporized molecules. This was also observed in the mass spectra of Arizona Test Dust particles (Fig. 2).

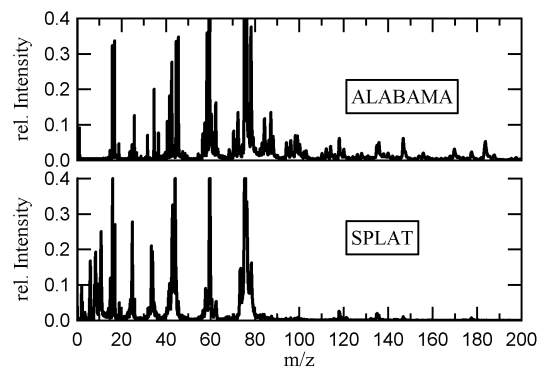


Figure 2: Averaged mass spectra of Arizona Test Dust obtained with SPLAT and ALABAMA.

Further experiments with different mineral dusts and organic substances are conducted to investigate the influence of the ablation wavelength on single-particle mass spectra and to get a better understanding of the underlying laser desorption and ionisation effects.

Kamphus M., et al. (2008), *Aerosol Science and Technology*, 42:11, pp.970-980

Schreiner J., et al. (1999), *Aerosol Science and Technology*, 31, pp. 373-382

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