Application of broadband optical cavity methods to studying the optical properties of aerosols at short wavelengths

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There is currently much interest in light absorption by atmospheric aerosols. Recent research has shown that some types of atmospheric particles start to absorb strongly at blue and ultraviolet wavelengths, but there are few techniques to probe the aerosol optical properties at these wavelengths. Varma et al. (2009) first showed that *incoherent broadband cavity-enhanced absorption spectroscopy* (IBBCEAS) is a promising approach to measure aerosol extinction with high sensitivity. Several groups are now using IBBCEAS for studying aerosol optical properties across a continuous spectral region and at short wavelengths (Washenfelder et al., 2012; Zhao et al., 2013). Our aim in this presentation is to describe our recent work to extend IBBCEAS aerosol measurements to very short wavelengths (Chen et al., 2011; Wilson et al., 2012).

A schematic of the experimental system is shown in Fig. 1. The IBBCEAS system was coupled directly across a 4 m^3 atmospheric simulation chamber in the Centre for Research into Atmospheric Chemistry at University College Cork. The system is unusual in that it is a single channel optical cavity spectrometer with continuous spectral coverage from 320 to 405 nm. The 4 m long optical cavity partially compensated for the reduced mirror reflectivity across this broad range. A xenon short arc lamp was used as a light source across the spectral region.

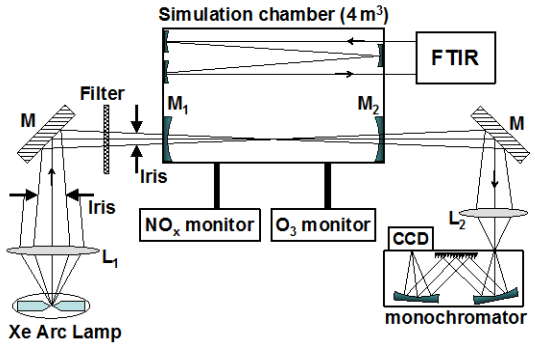

Figure 1. Layout of the atmospheric simulation chamber, IBBCEAS spectrometer, and ancillary equipment.

The stability and sensitivity of the system's extinction measurements were evaluated in a series of SOA experiments. The SOA was formed by photolysing strongly absorbing nitroaromatic compounds, which have been implicated in reducing levels of actinic radiation in large urban centres. The analysis of the total extinction spectrum is discussed, particularly how the contributions of gas phase absorption and particle extinction can be separated. We consider key elements of the experimental system and compare our approach to those of other groups. Finally, the future prospects for using IBBCEAS in field and chamber studies are assessed.

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