Boston College Black Carbon Laboratory Project 4

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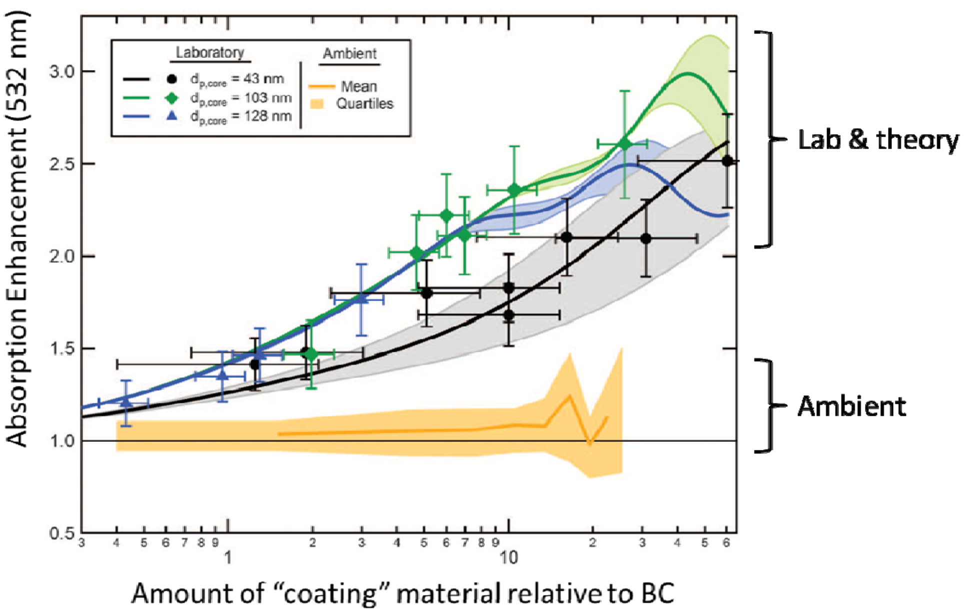
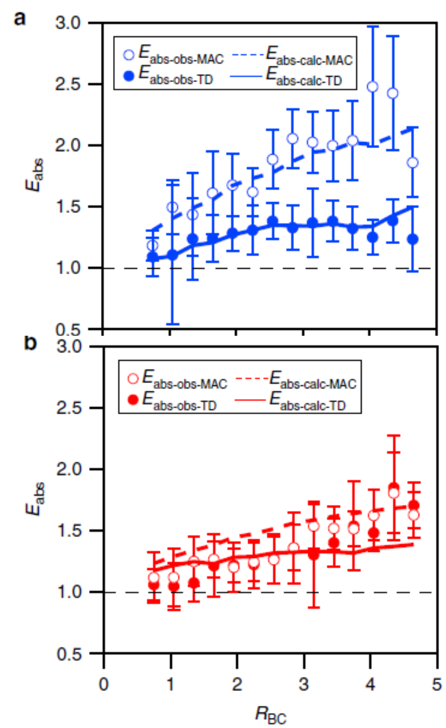
Radiative impact of internal mixing

Cappa et al., 2012



Liu et al., 2015



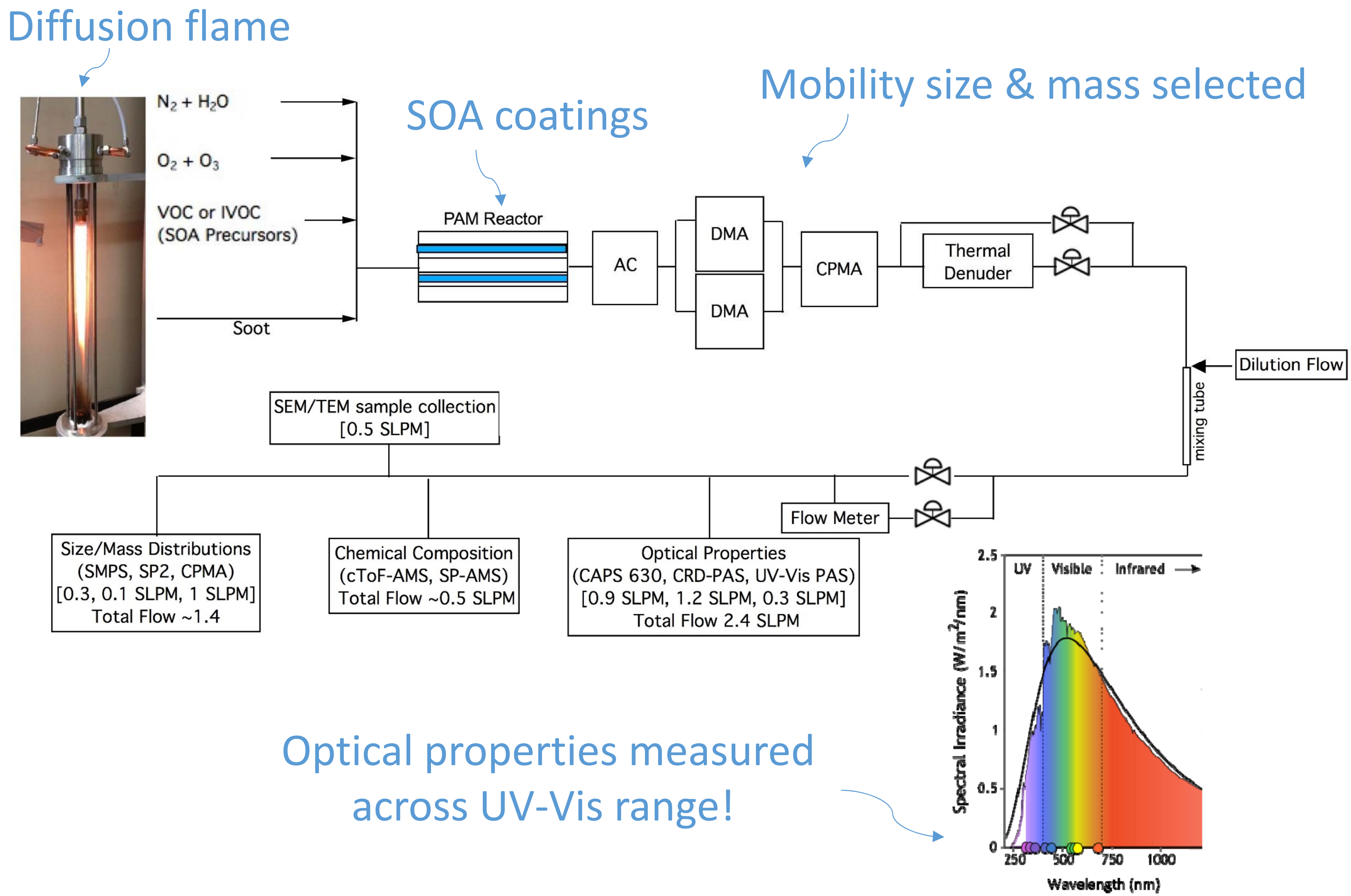
California urban summer

- Mainly urban (traffic, etc.) sources with little/no biofuels
- Measurements lower than shell-core Mie theory

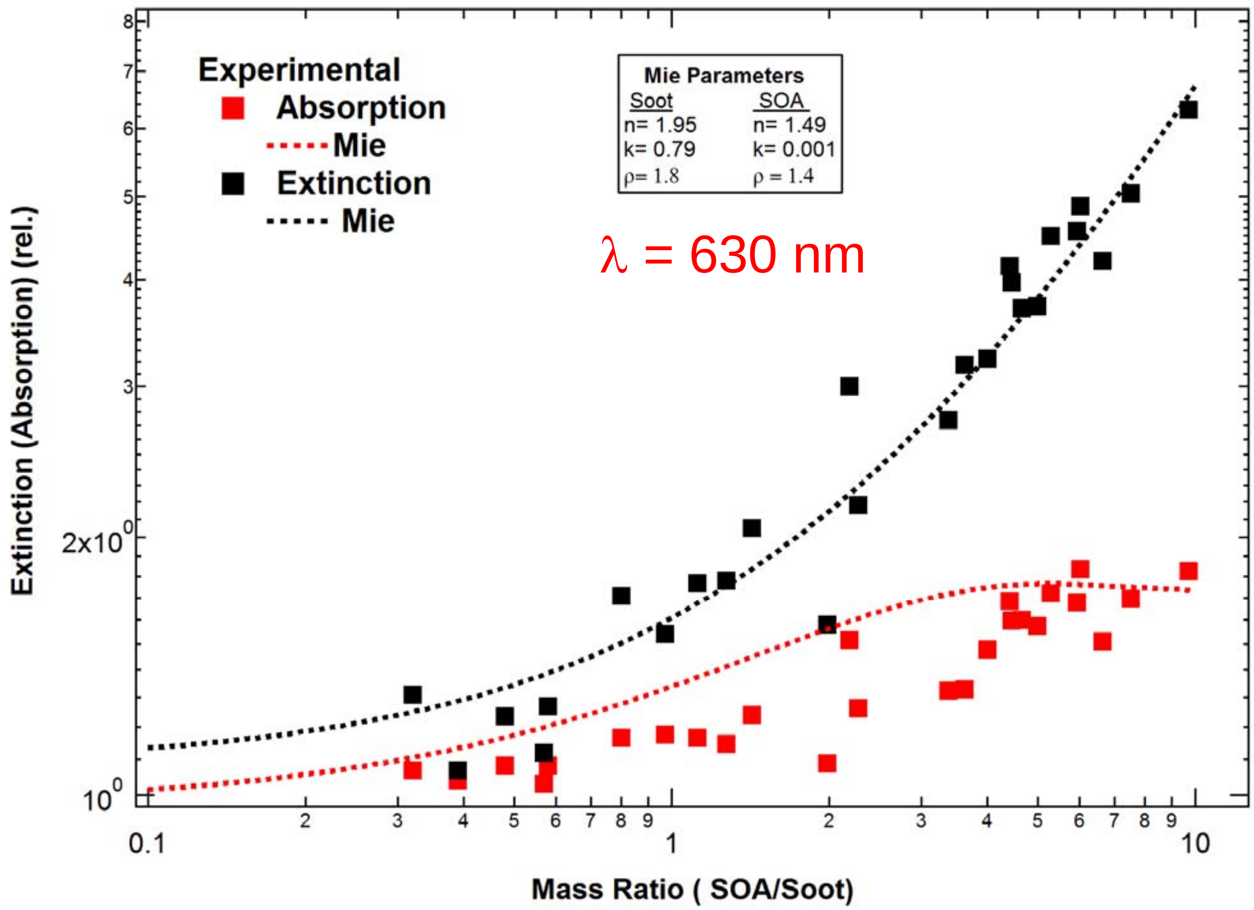
UK suburban winter

- Mixed sources including solid fuel burning
- Measurements match shell-core Mie theory

BC4 experimental details

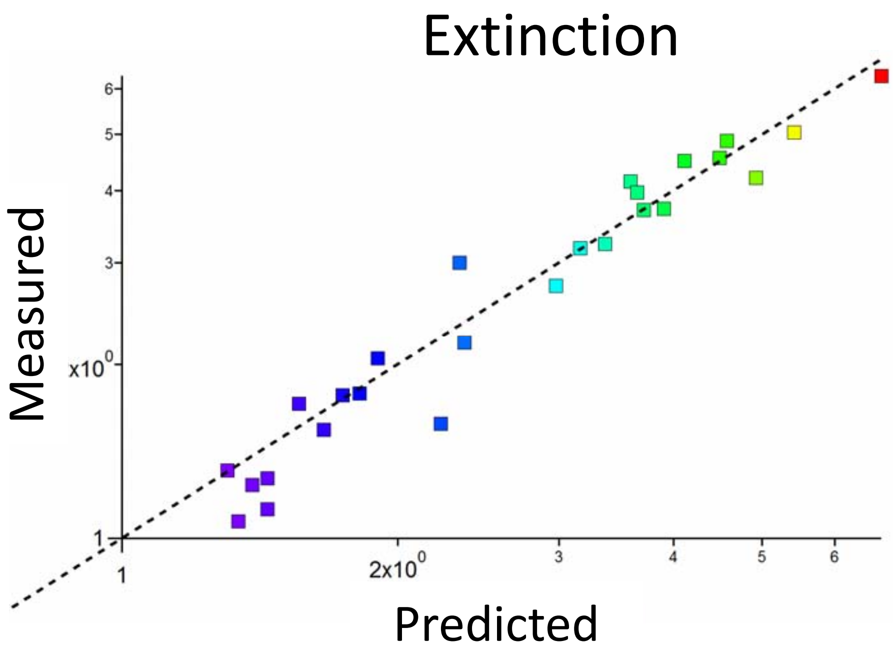


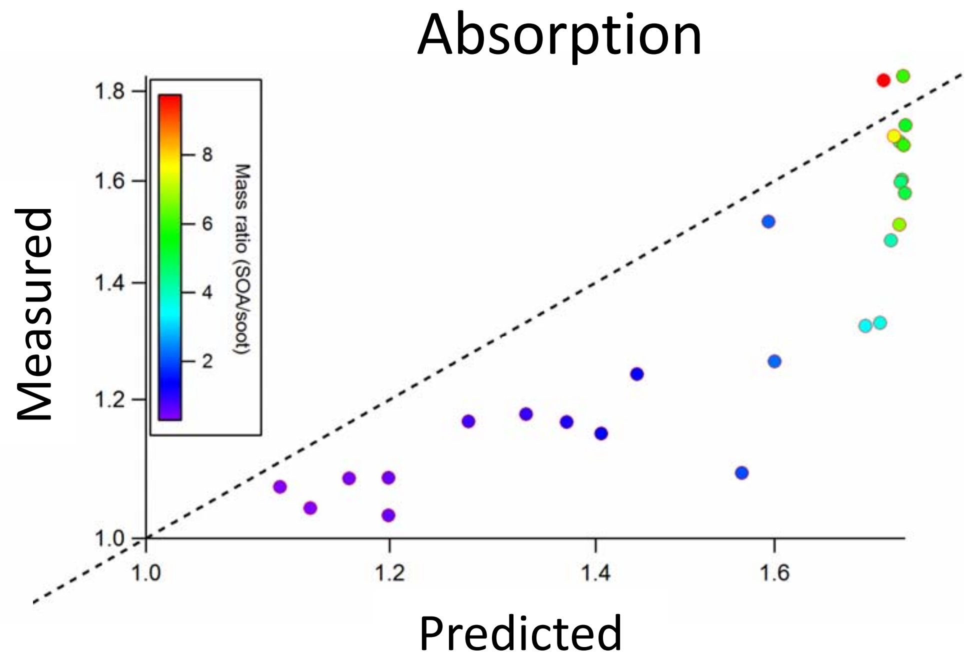
Impacts of coatings on optical properties



- SOA = a-pinene, naphthalene, isoprene (and sulfuric acid)
- ABS increases by ~1.8 and plateaus
- EXT (really SCAT) increases more rapidly than ABS and does not plateau

Predictive core-shell Mie Theory

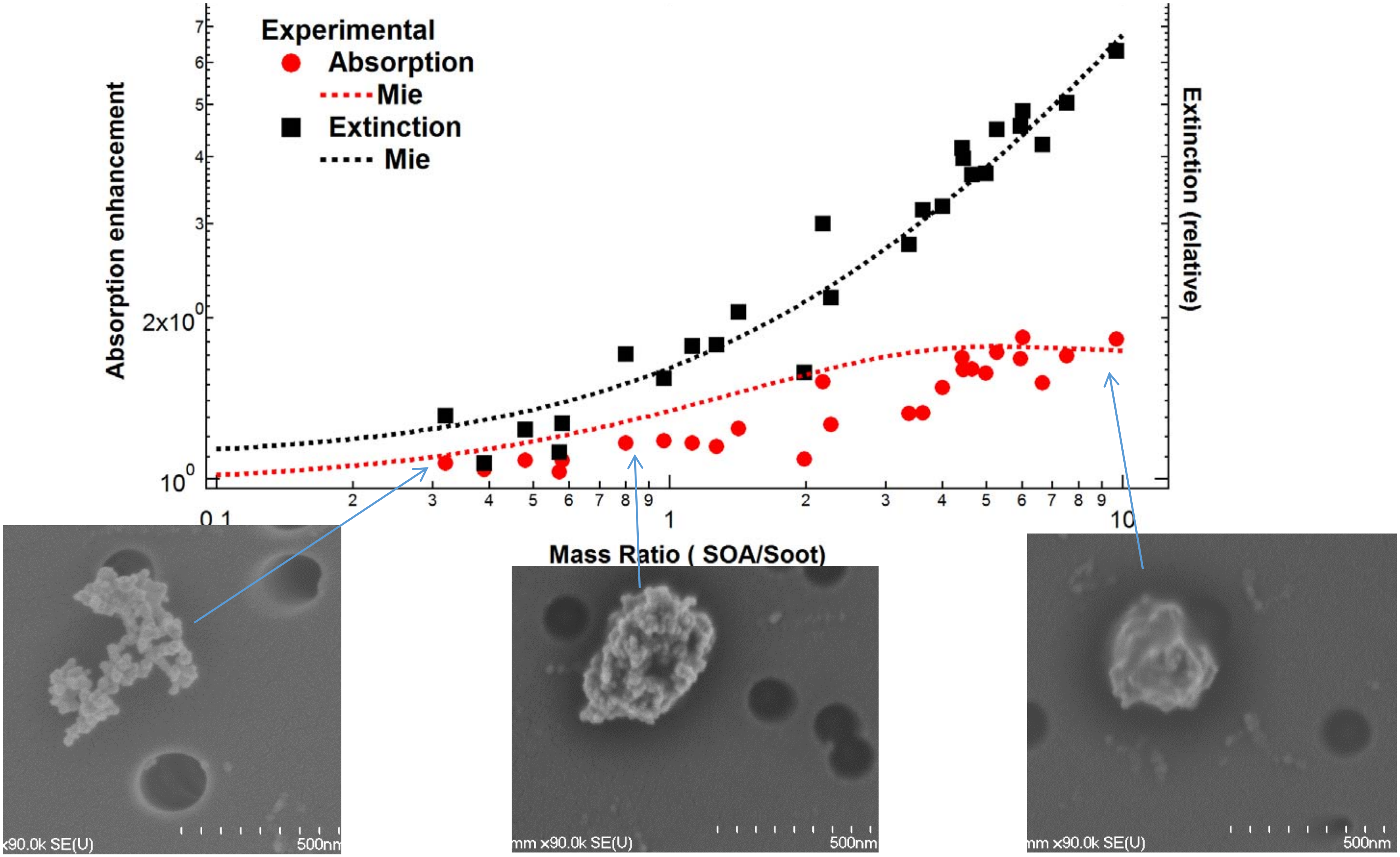




Core-shell Mie theory

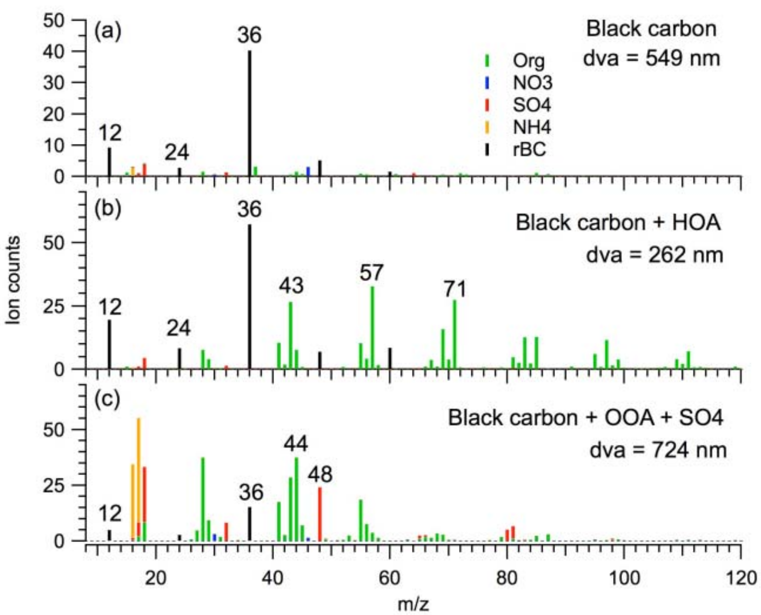
- over predicts EXT at small mass ratios (< 0.7)
- over predicts ABS at small to medium mass ratios (< 5)
- Adequately predicts EXT and ABS high mass ratios (> 5)

Small mass ratios induce morphological changes which affect SCAT and ABS differently

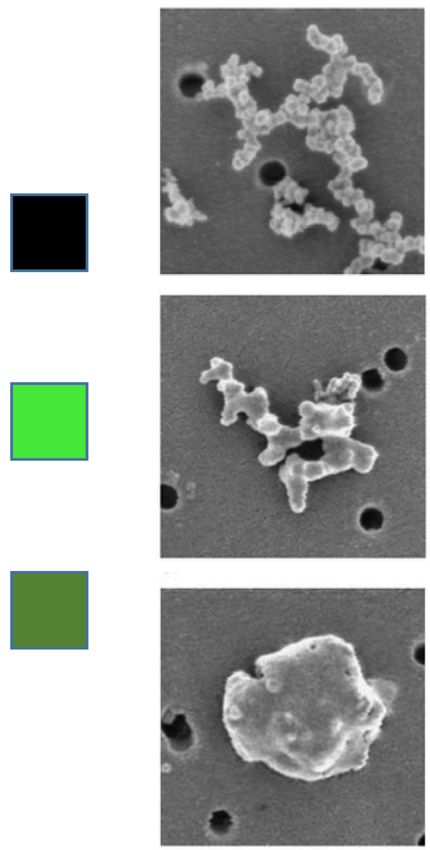


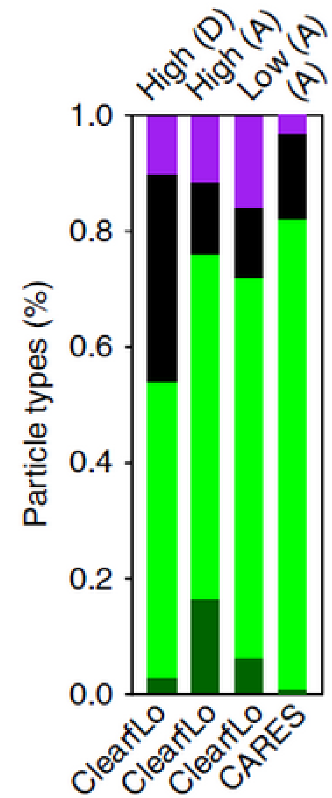
Particle mixing state

- In urban and rural environments, BC is found internally mixed to varying extents with organics (POA and SOA) and inorganics (SO_4 and NO_3).



Alex Lee et al., 2015 - U. Toronto





Liu et al., 2015 - Mich. Tech. Univ.

Conclusions

- Core-shell Mie theory over predicts the scattering and absorption for thinly coated soot particles, but appears to works well for thicker coatings
- Small amounts of SOA and H_2SO_4 mass condensation on fractal-like soot particles
  - Collapse the core soot structures for thin coatings, affecting the scattering more than absorption
  - Fill in interstitial regions initially, minimizing increases in cross-sections, leading to lower initial absorption enhancements