

New Devices for Measuring Indoor and Outdoor Ultra-Fine Particulates – A Case Study at the Fort Lee, NJ, Public Library

Westwood, NJ

August, 2016

Pegasor AQUrban at a Glance

- Ideal tool to measure ambient ultrafine particles (UFP)
- Provides particle mass concentration, particle number concentration and particle active surface area concentration
- Extensive self-diagnosis with alarms in case of reduced data quality
- Easy installation with little installation space
- Can be used as data source for Finnish Metrology Institute Enfuser particulate exposure forecast model
- Various methods for data transfer including direct storage in the cloud
- Stable with few replacement parts
- Easy maintenance, half to one year maintenance period



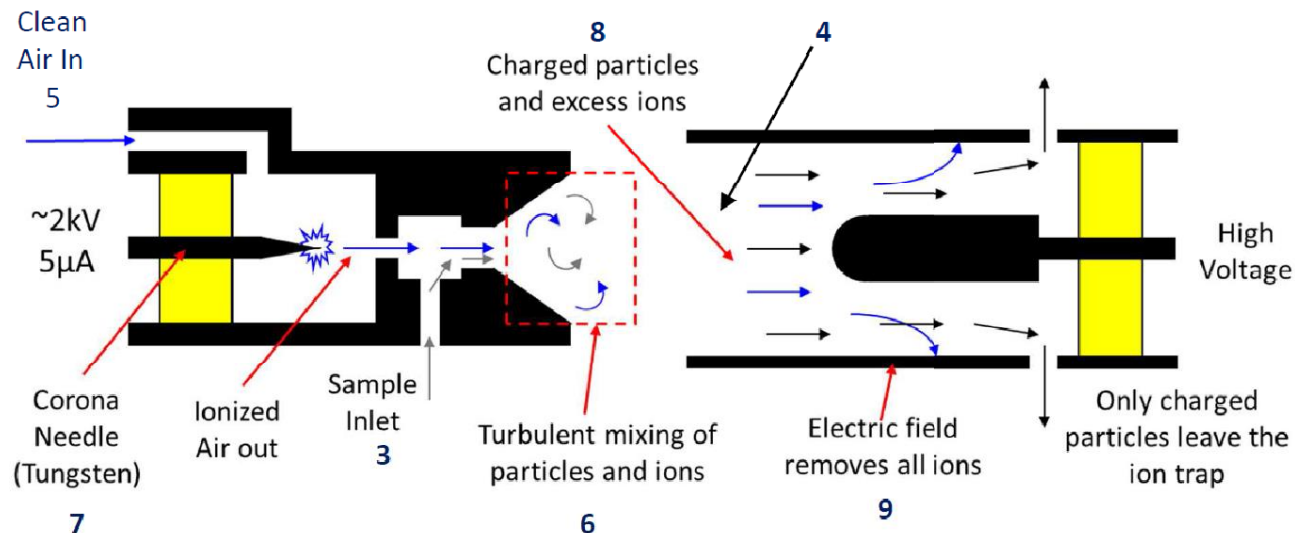
Pegasor AQIndoor at a Glance

- Ideal device for measuring ultrafine particles indoors
- Detects temperature, relative humidity and CO₂ concentration
- Self diagnostic procedure guarantees accurate and continuous measurement
- Fits easily to any indoor environment
- Measured data can be read from the touch screen in graphical and numerical form
- Measured data can be stored on hard disk or USB and transferred to data storage, cloud service, or printed out as separate document
- Easy maintenance and long maintenance interval
- Reasonable pricing and very low cost of ownership



Pegasor Detection Method

- Passive charging of nanoparticles - escaping-current technology
- Accurate detection range 10 nm – 800 nm (overall range 10 nm to 10 μm)
- Report Lung Deposited Surface Area (LDSA), Concentration
- Concentration range 1-20,000 μm²/cm³ which corresponds to a number concentration of about 500-10⁷ particles/cc
- Can be equipped with TEM collection grid for further analysis of the collected nanoparticles with electronic microscopy





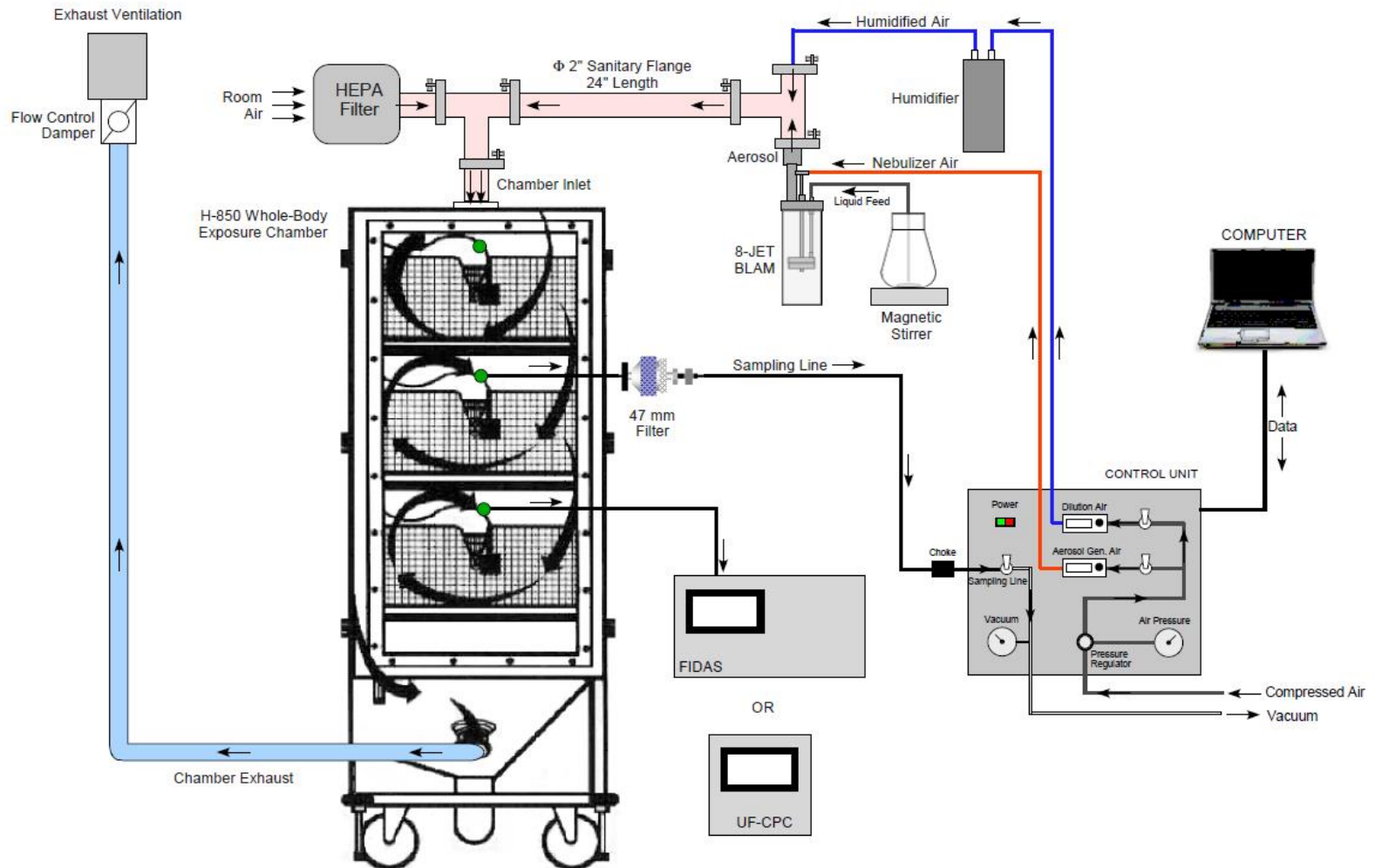
Why Use Pegasor Systems

- Evidence is mounting that Ultrafine Particulates may be a major contributor within the range of environmental particulates that adversely affect human health and more strongly associated with such health impacts
- Ambient ultrafine concentration is a good measure of overall exposure but large human sub-populations, especially those in urban and suburban areas, generally spend most of the time indoors
- Even well spaces with well managed incoming air filtration can constitute UFP exposure hot spots due to internal sources
- The I/O ratio of a facility (indoor vs. outdoor particulate concentration) can be calculated by monitoring simultaneously with a Pegasor AQIndoor inside and Pegasor AQUrban outside the facility

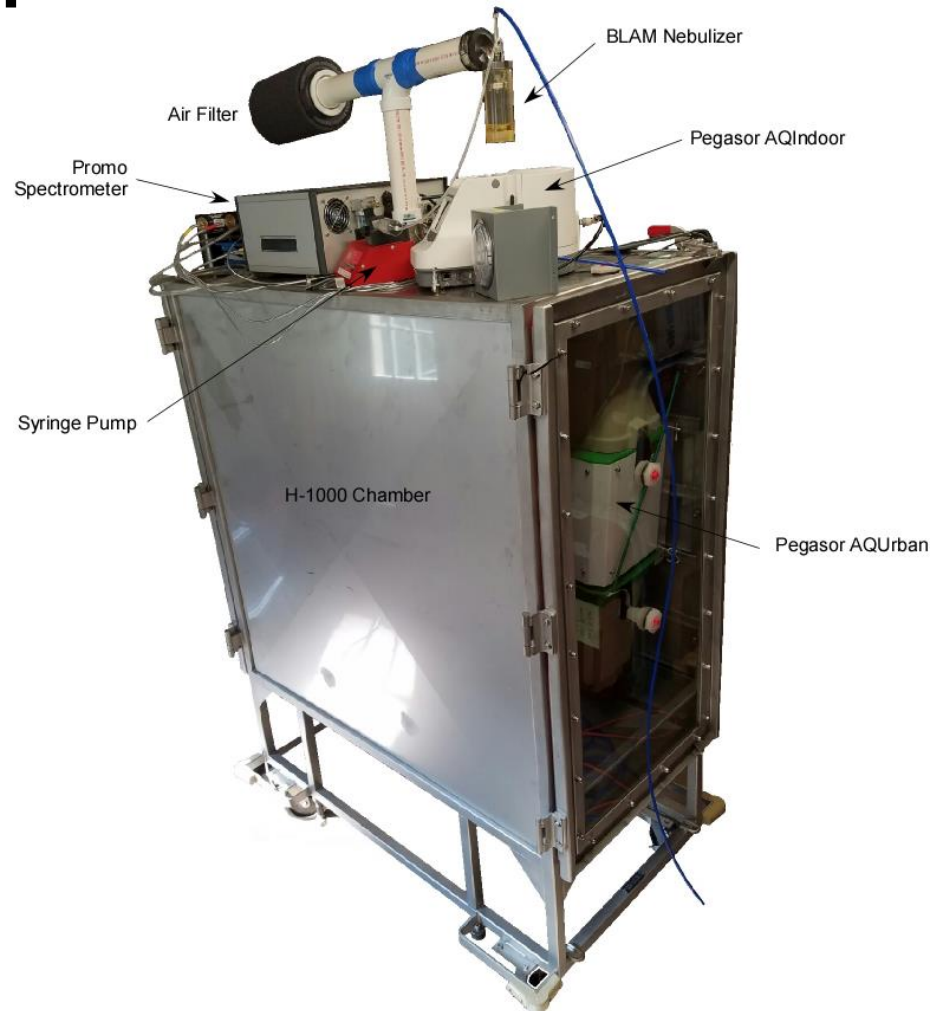
First Step: Device Calibration

- In order for the Pegasor AQIndoor and Pegasor AQUrban units to provide meaningful data as an integrated system their sensors need to deliver equivalent concentration values
- CH Technologies has developed a calibration system based on the H-1000, a 1 m³ dynamic exposure chamber
- The system uses a BLAM nebulizer to generate a known aerosol under controlled conditions.
- Both devices are placed inside the chamber and their measurements are be fine tuned and synced with each-other by adjusting their operation parameters
- The results are compared against reference devices such as aerosol spectrometer and SMPS

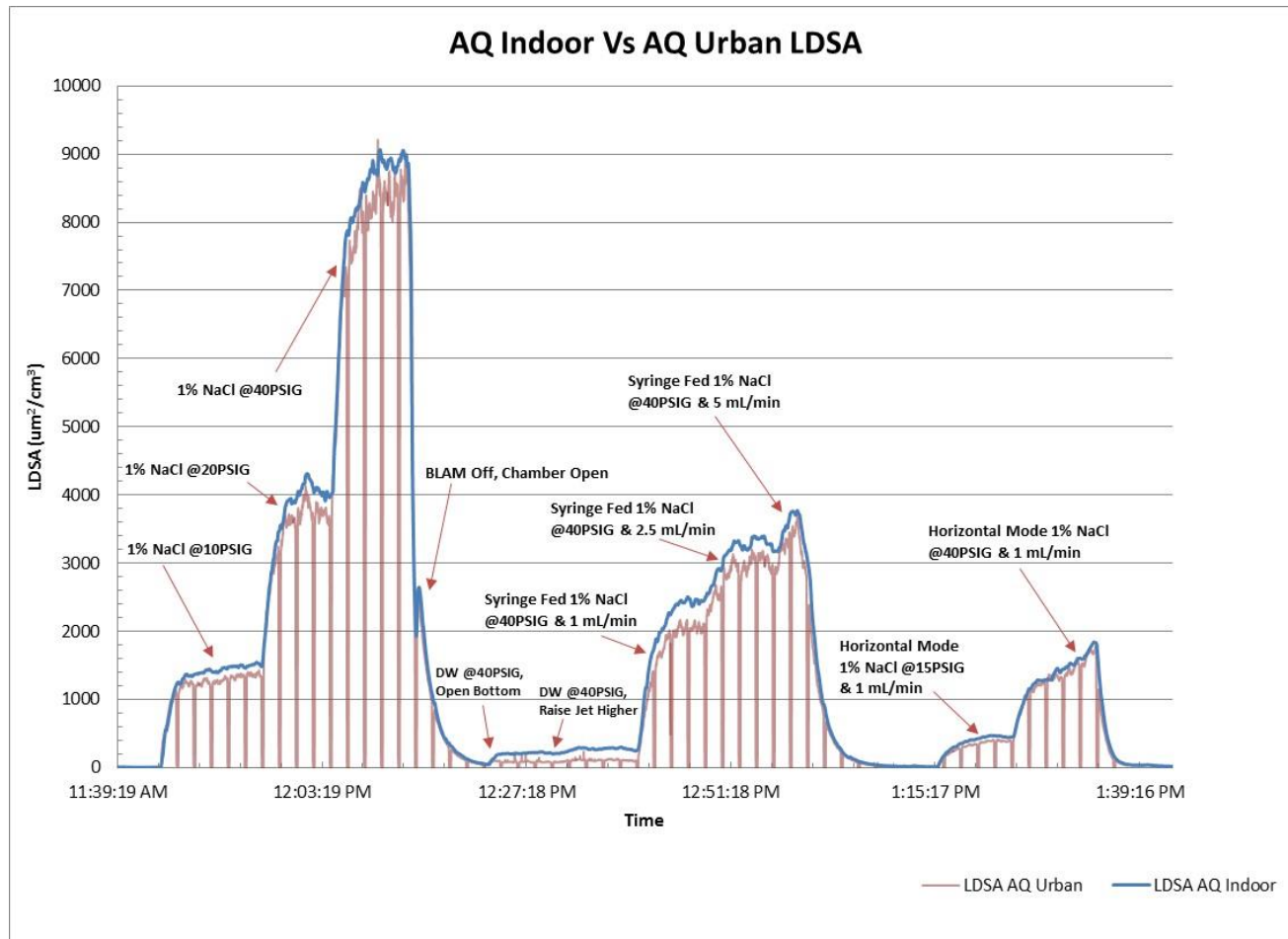
Schematic of the Calibration System



View of a Calibration System Prototype



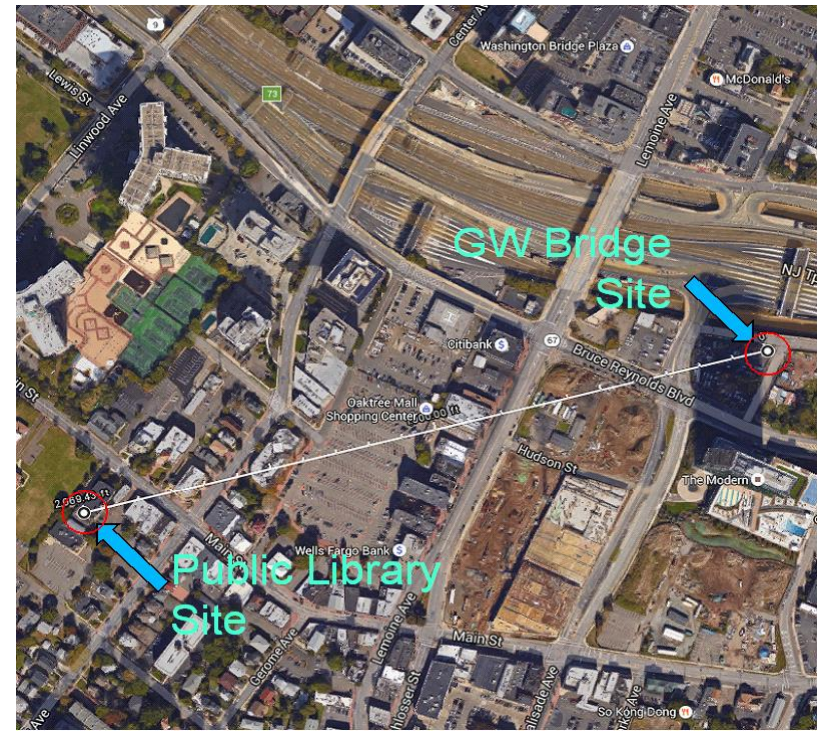
Example of Sensor Calibration Results – with 1% NaCl Solution



Overview of the Case Study

- Pegasor AQUrban monitor deployed on the roof of the Fort Lee, NJ, Public Library during March 18 – June 30, 2016
- Pegasor AQUrban co-located with a gravimetric FRM PM2.5 monitor operated by the NJ Department of Environmental Protection that provides a daily measurement every third day
- Pegasor AQIndoor monitor placed in the children's reading room of the Library during March 28 – May 9, 2016
- Another Pegasor AQUrban was placed near the upper level east-bound toll plaza of the George Washington Bridge, less than a mile away, as part of a larger study in the area

Ultrafines Monitoring at Fort Lee Public Library



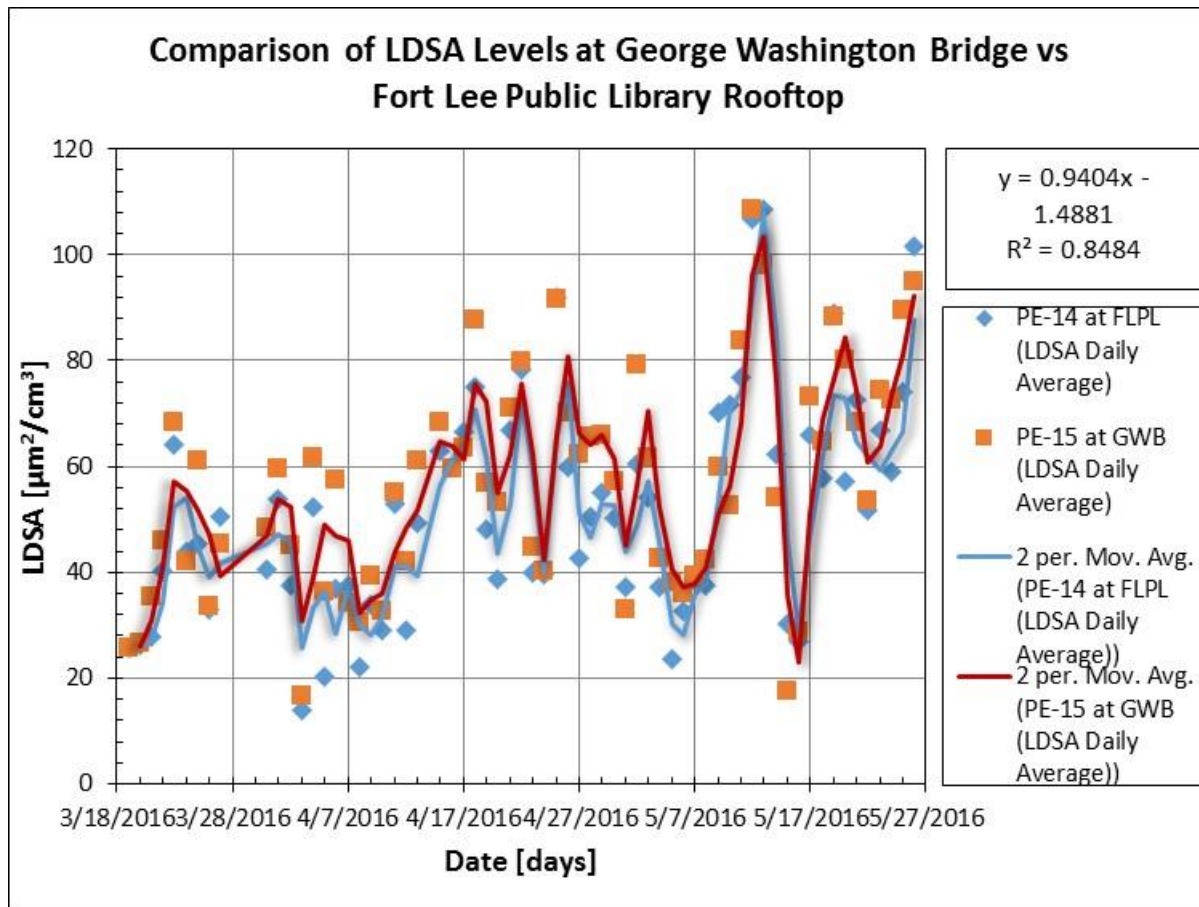
View of Fort Lee Public Library Building



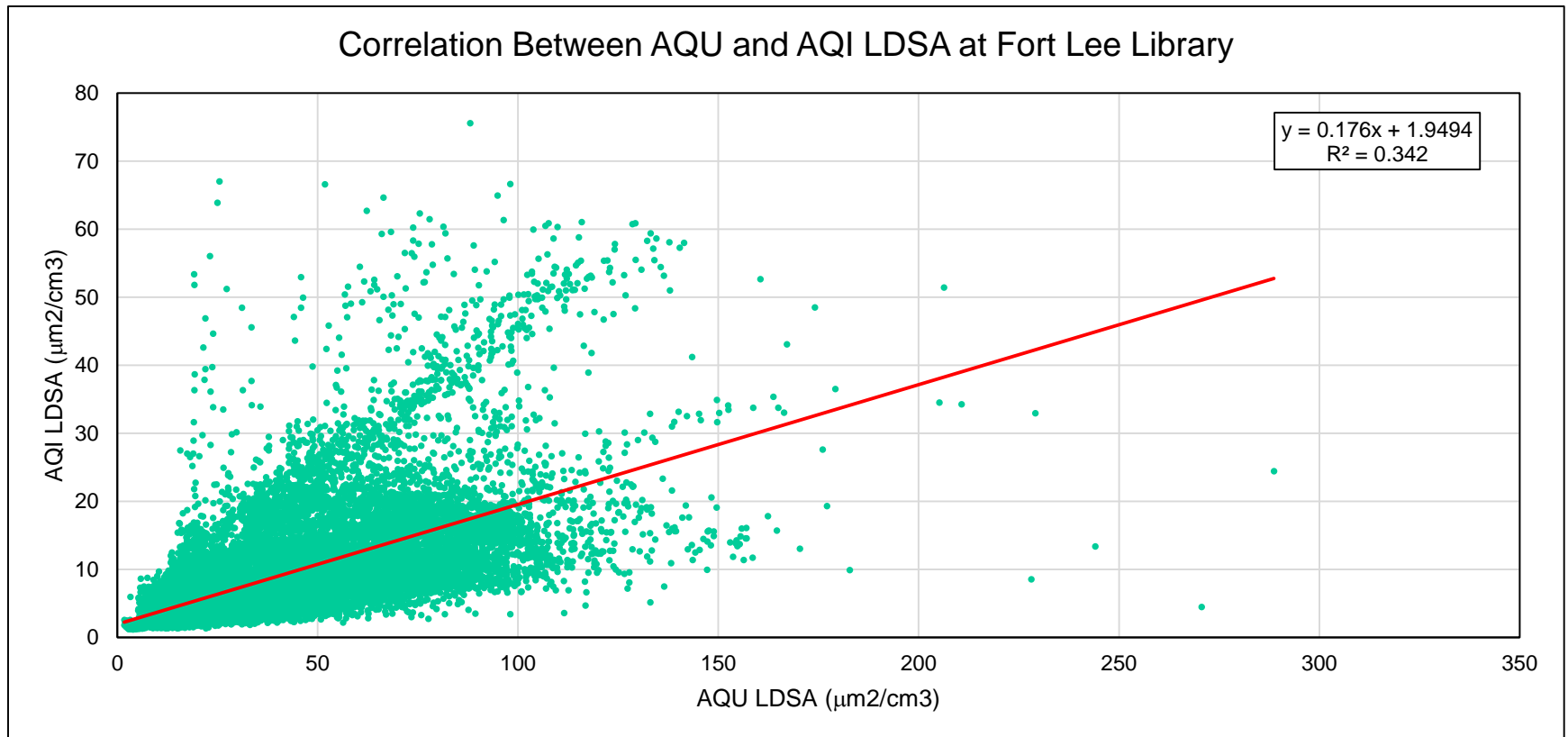
Outdoor Ultrafines Monitoring at GW Bridge Toll Plaza



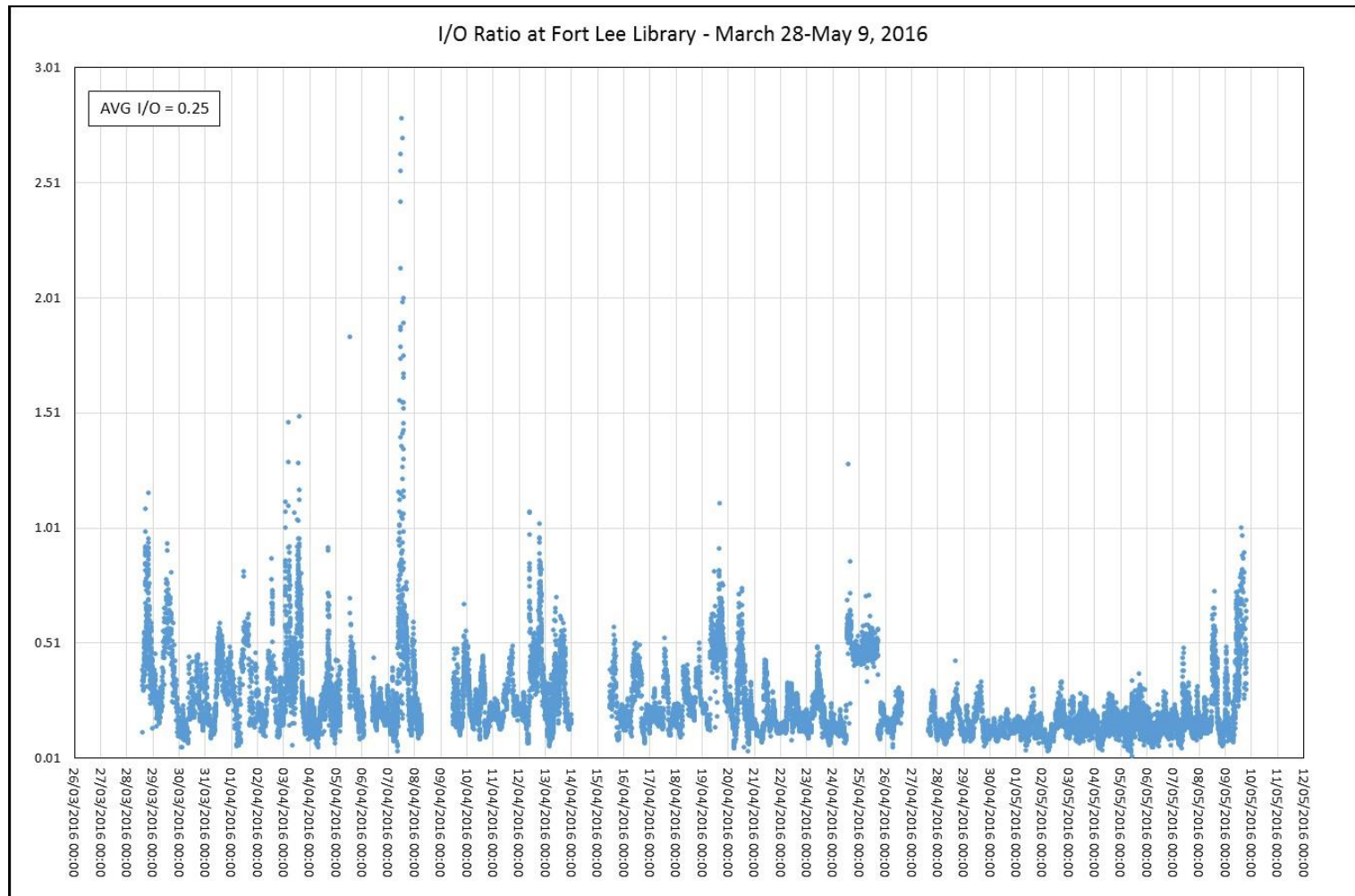
Results of Co-Location at GWB – Comparison with LDSA at FLPL



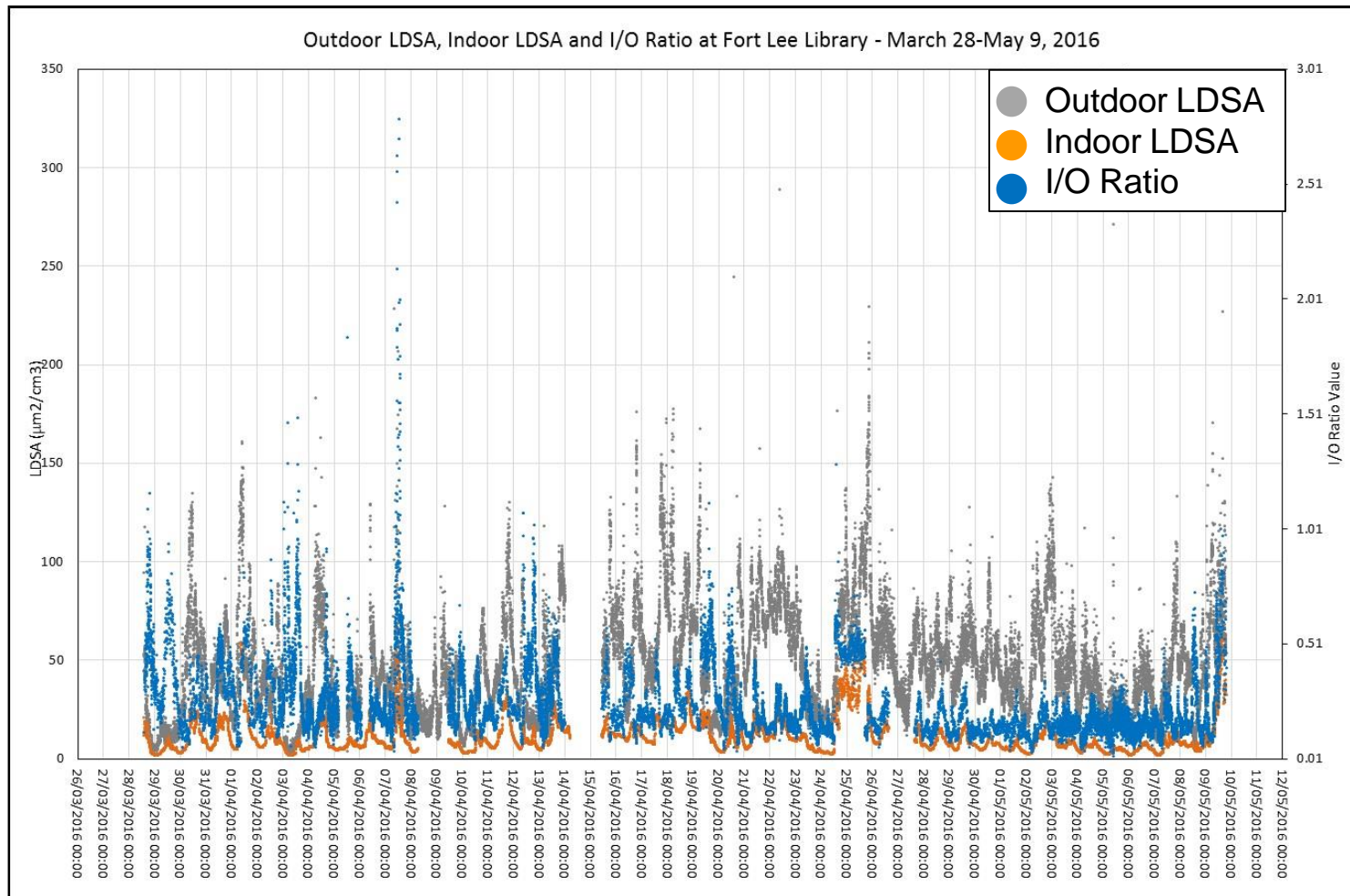
Indoor vs. Outdoor Ultrafine Concentrations



I/O Ratio at Fort Lee Library



Overview of Measurement Results at Fort Lee Library



Main Conclusions of the Case Study

- The combination Pegasor AQUrban and AQIndoor is the ideal package for monitoring air quality of large indoor spaces
- The CH Technologies proprietary calibration system ensures excellent intra-monitor measurement consistency between AQUrban and AQIndoor monitors
- The average I/O value of 0.25 calculated for the children's reading room of the Fort Lee Public Library indicates that the ventilation system removes UFP from outside air
- There are episodes occurring almost daily in the early afternoon hours where the calculated I/O ratio values clearly indicate elevated levels of indoor generated UFP
- A follow up study in the library is needed to identify the origin of the internal UFP source(s) and investigate their periodic occurrence

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