

# Retrofitting Smartphones to be Used as Particulate Matter Dosimeters

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## Portable particulate matter sensing

• Application scenarios: *personal exposure monitoring, alert systems, Participatory Sensing*

## Handheld measurements:

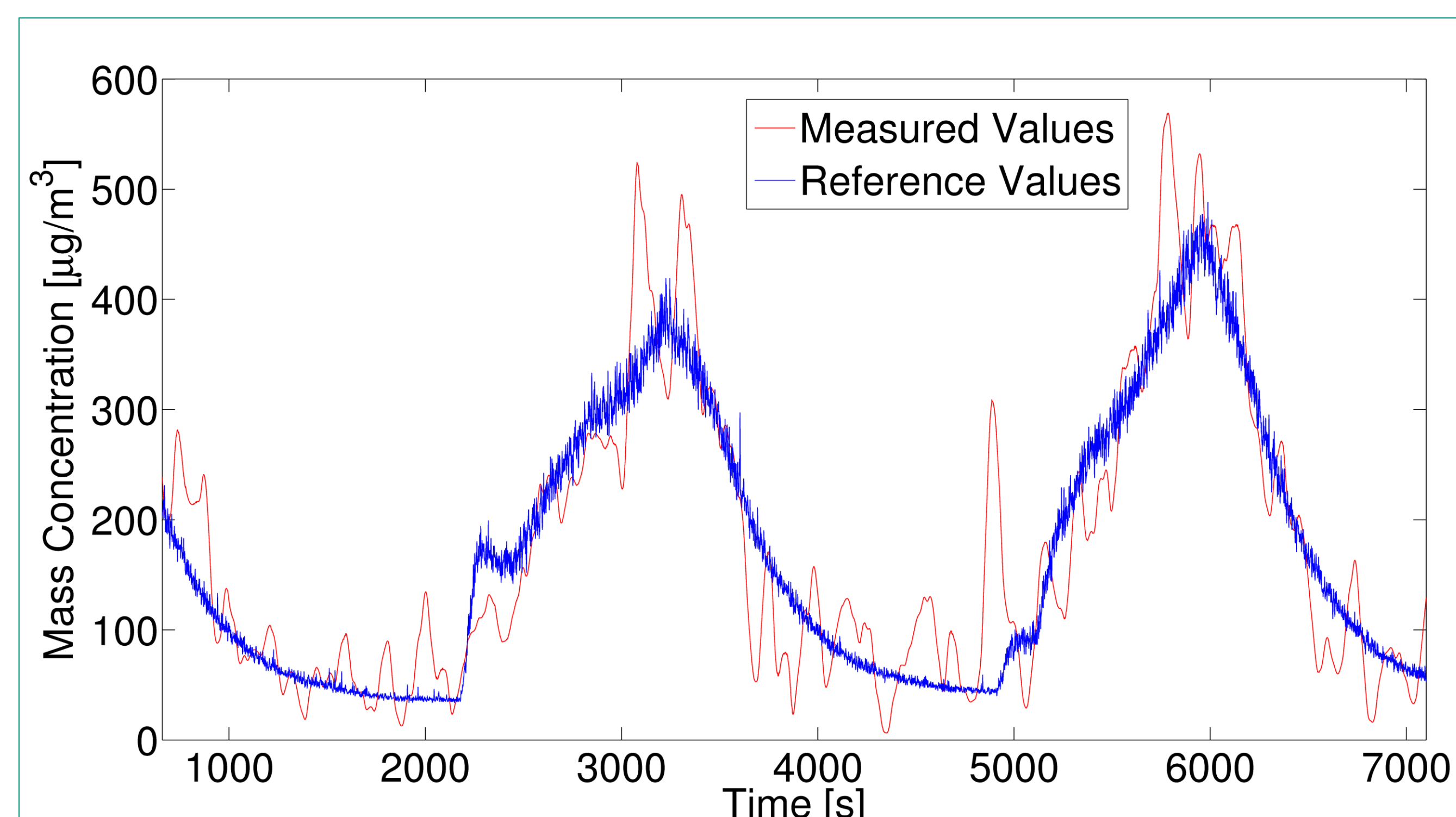
- Mobile particulate matter sensing today requires relatively pricy special devices.
- Cheap commodity sensor readings correlate, yet they are not embeddable into smartphones.
- Alternative: Retrofit smartphones with an exchangeable dust sensor embedded into the back shell (see Figure 1).

## Experiments and Conclusions

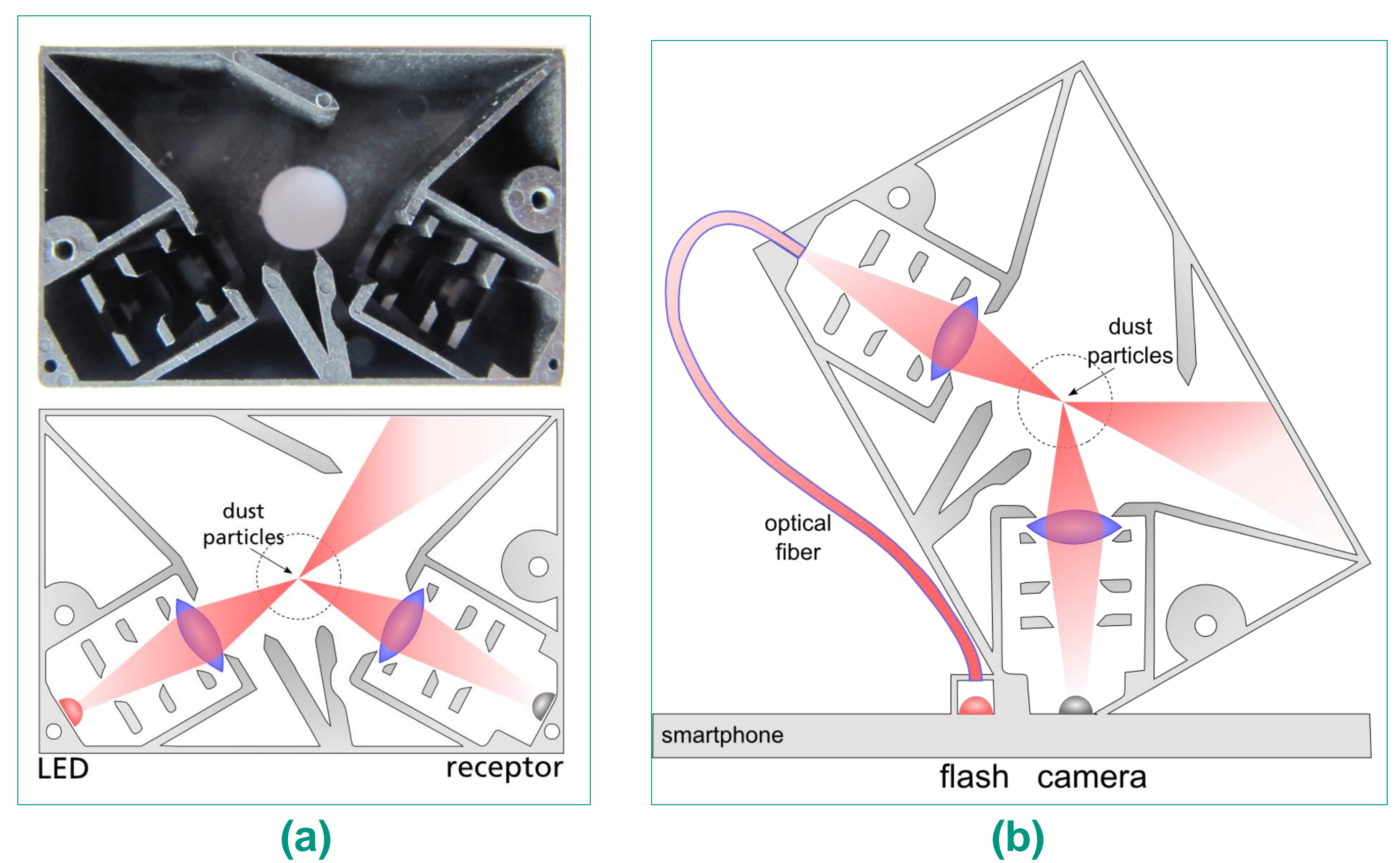
- Prototype uses light trap of Sharp GP2Y1010 sensor and is installed on standard Android smartphone: the phone itself remains completely unaltered.
- 2 prototypes: active (using external LED) and passive (re-routed light from phone's LED flash).
- Comparison of prototypes and gauged TSI Dusttrak DRX 8533 aerosol monitor.
- Readings correspond very well (Fig. 2 and 3).

## Future Work

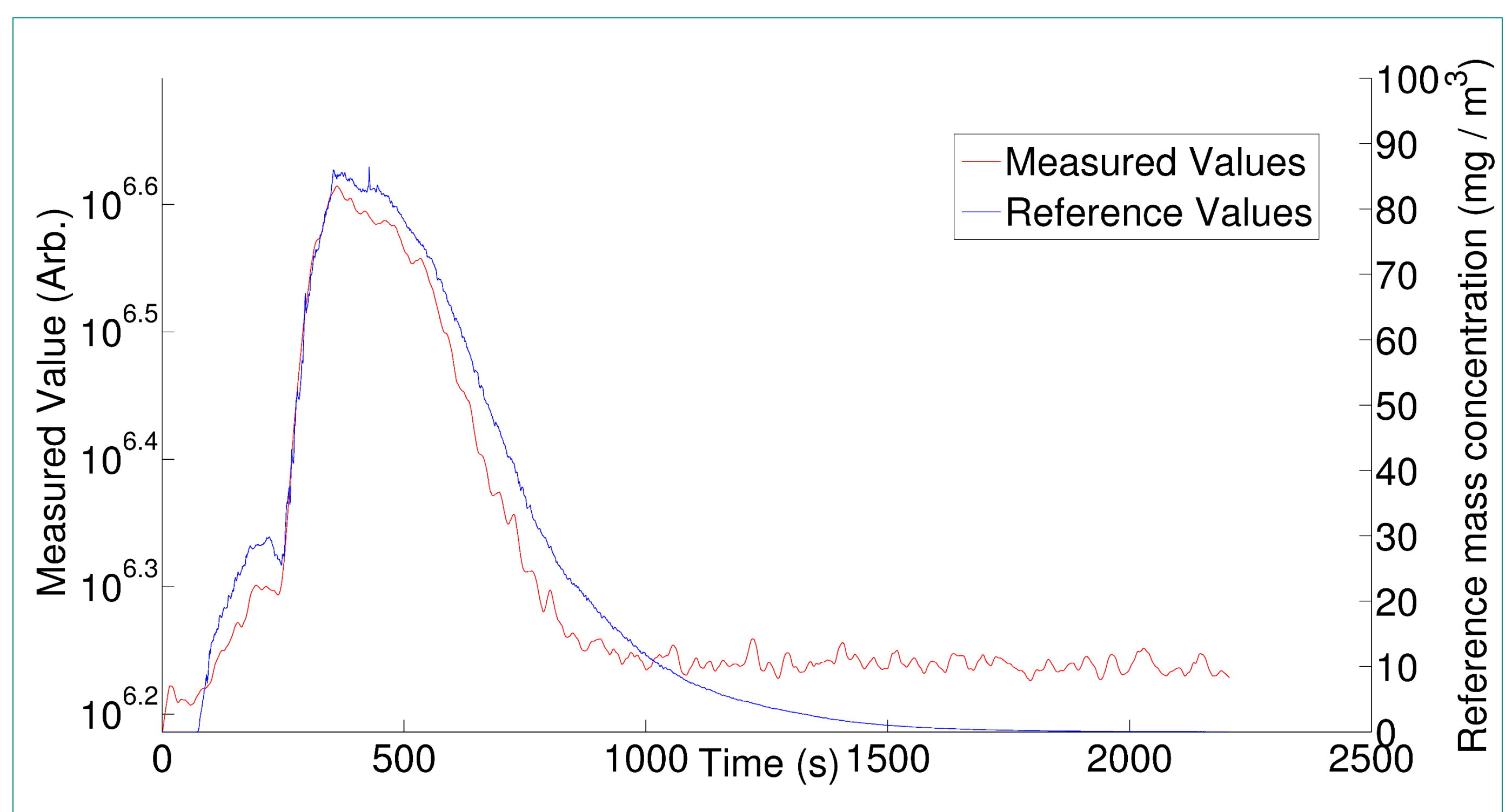
- Improve coupling of LED flash and optical fiber.
- Improve form factor: own light trap design.
- Characterize sensor (e.g. possible drift, etc.).
- Develop online calibration procedure for Participatory Sensing scenarios.



**Fig. 2:** Example particulate matter concentration levels measured by reference device TSI DustTrak DRX 8533 and our active prototype. This first prototype reaches a very good accuracy down to the range of  $\mu\text{g}/\text{m}^3$ , proving the general feasibility of the approach.



**Fig. 1:** The Sharp GP2Y1010 dust sensor (a), sketch of our fully passive modification (b) and implementation on a smartphone (c).



**Fig. 3:** Example particulate matter concentration levels measured by reference device and our completely passive prototype (see Fig. 1). It reaches an accuracy down to  $\sim 10 \text{ mg}/\text{m}^3$ . We currently work on boosting this by improving the coupling between the LED flash and optical fiber.