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Particle mass distribution dependent inaccuracy of low cost sensors:

Bjhike HK-A5

Bernd Laquai, 29.10.2017

HK-A5 Laser PM2.5/10 Sensor

Main characteristics

- ◆ The data is accurate
- ◆ The quick response
- ◆ The standard serial digital output
- ◆ The two-stage multipoint calibration curve
- ◆ The smallest particle size of 0.3 microns



Overview

HK-A5 is a universal digital particle density sensor, can be used to obtain in unit volume of air in 0.3 ~ 10 microns suspended particulate matter number, i.e., particle concentration and output in the form of digital interface and output of each of the particles in the quality of data. The sensor can be embedded in a variety of airborne particulate matter concentration related instruments or air purifier equipment, to provide timely and accurate concentration of data.

Source: Datasheet HK-A5 Laser PM2.5/10 Sensor

www.bjhike.com



Fig. 1: Air intake



Fig. 2: Fan (air outlet) and connector

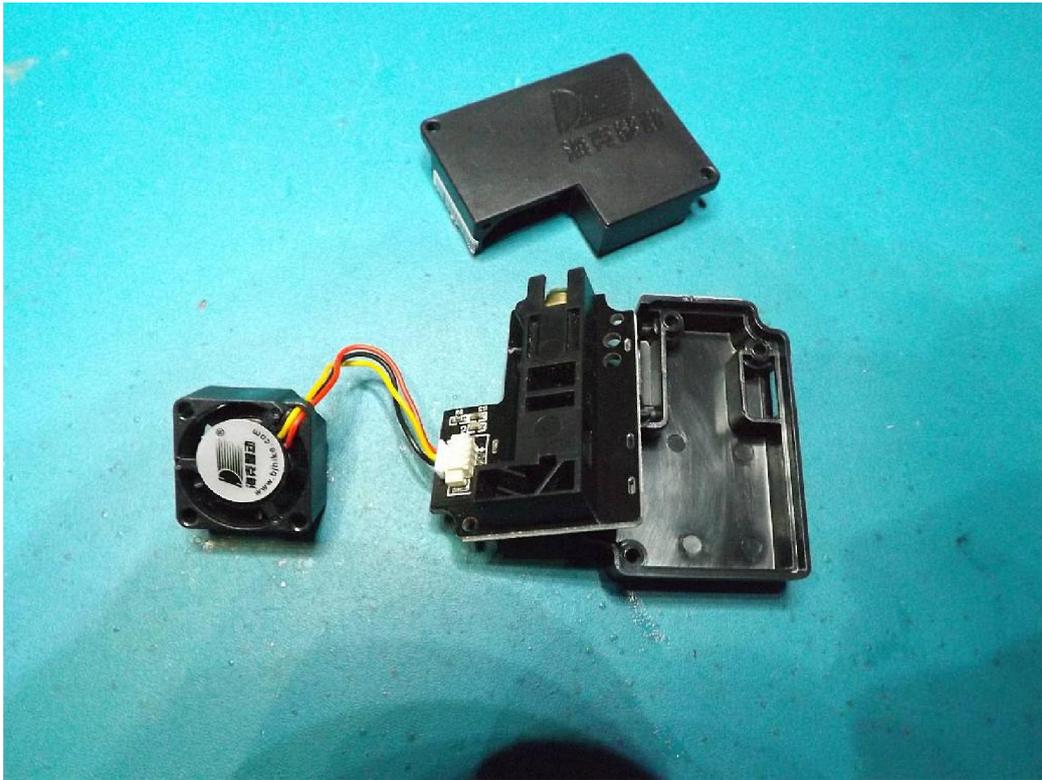


Fig. 3: Disassembled sensor

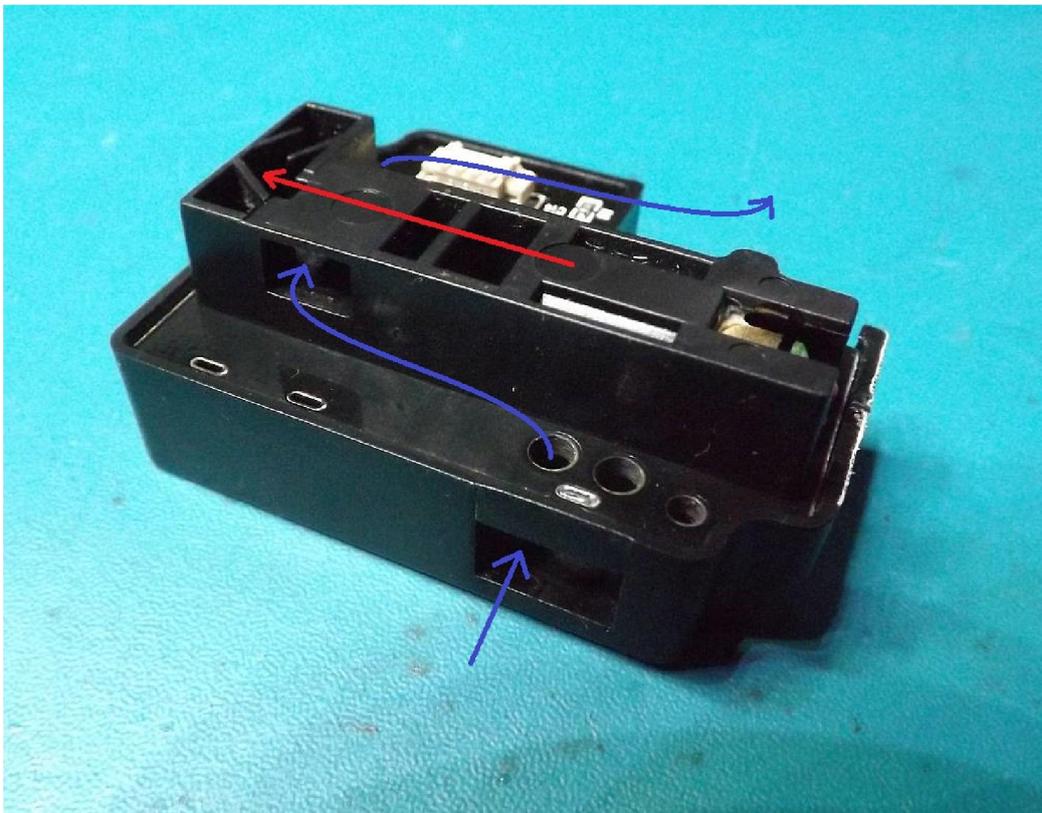


Fig. 4: Air flow (blue) and laser beam (red)

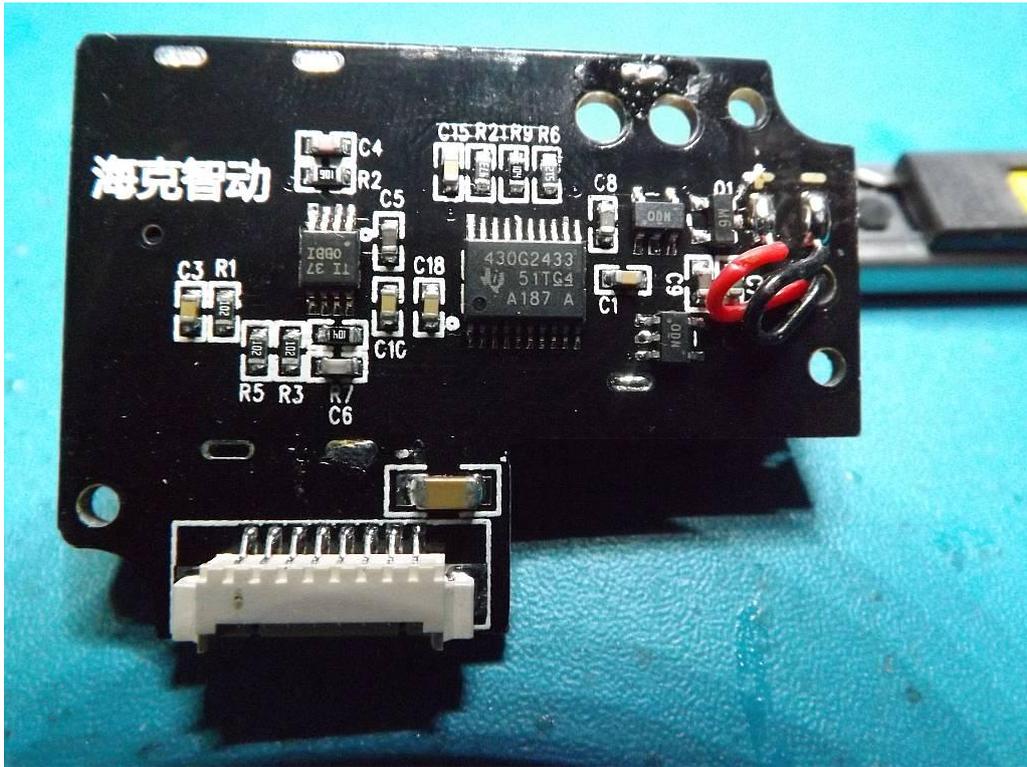


Fig. 5: PCB with TIA and 16-bit MSP430G2 microcontroller from Texas Instrument

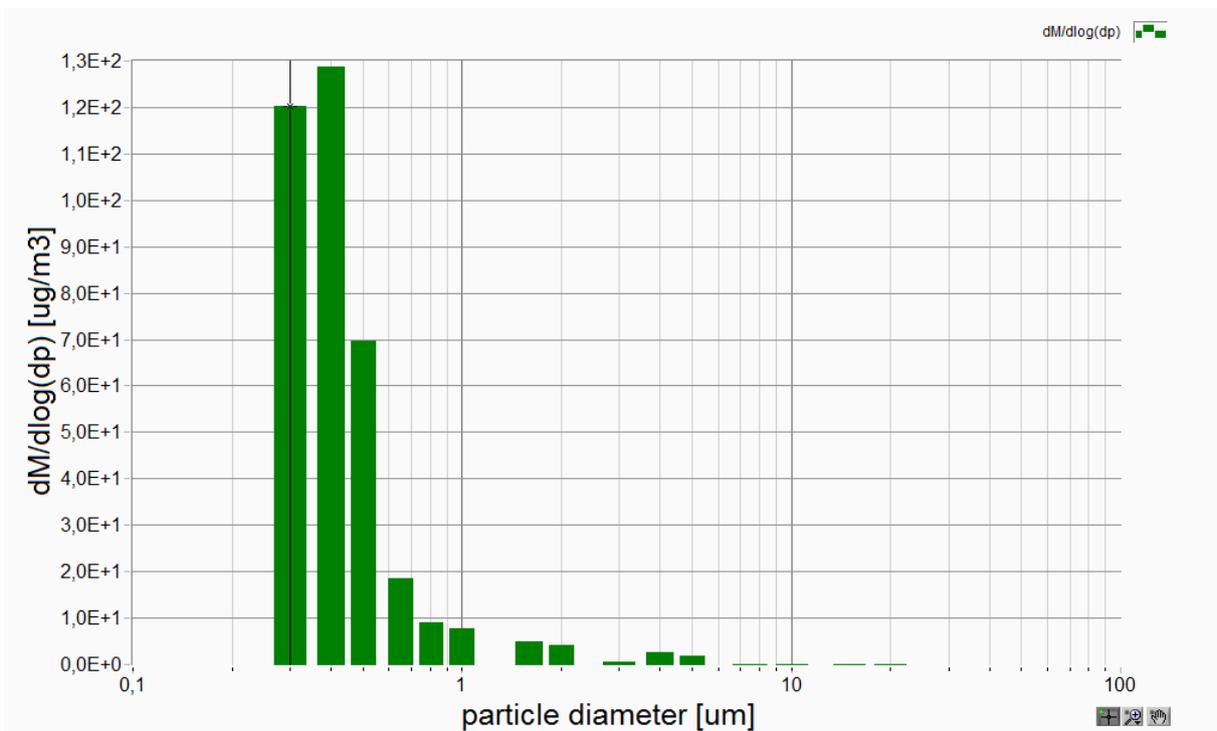


Fig. 6: Particle mass distribution used during phase 1 (PM10 = PM2.5) as seen by the Grimm, mass contribution only from particles $d < 2\mu\text{m}$

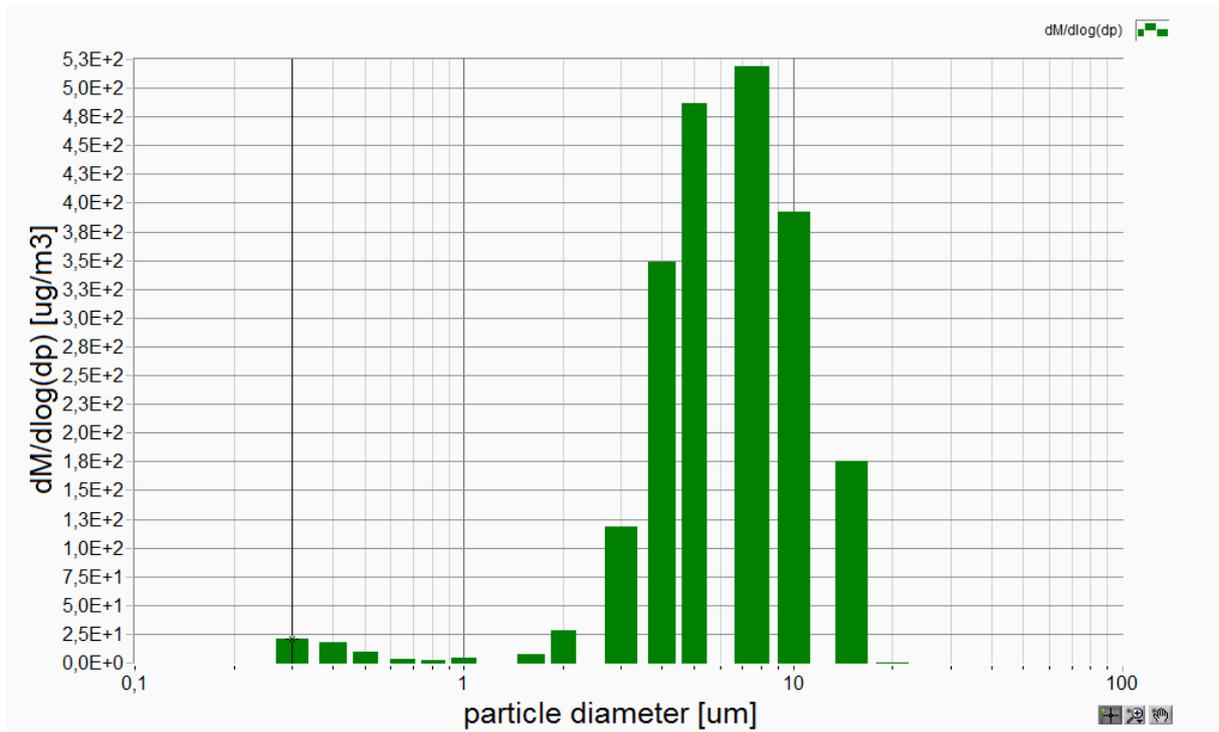


Fig. 7: Particle mass distribution used during phase 2 (PM10 >> PM2.5) as seen by the Grimm, mass contribution only from particles $d > 2\mu\text{m}$

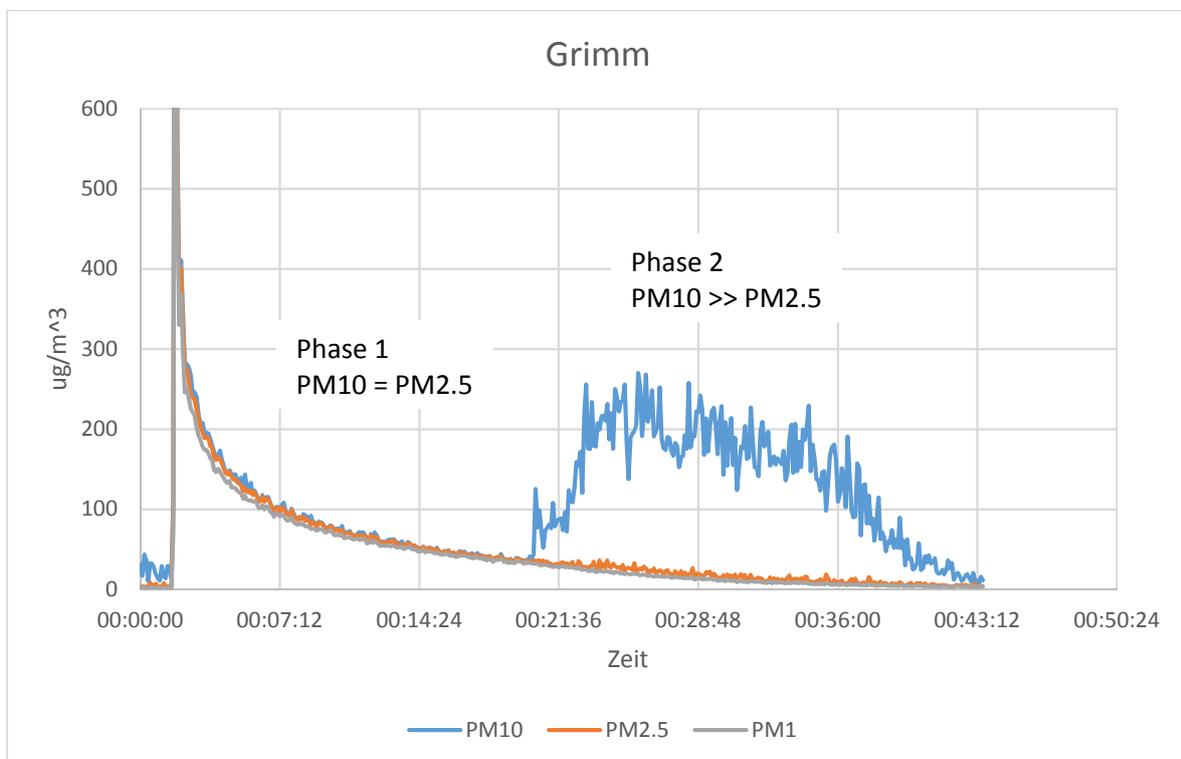


Fig. 8: Phase 1 (first 21 min) and phase 2(21-43min) as seen by the Grimm reference instrument

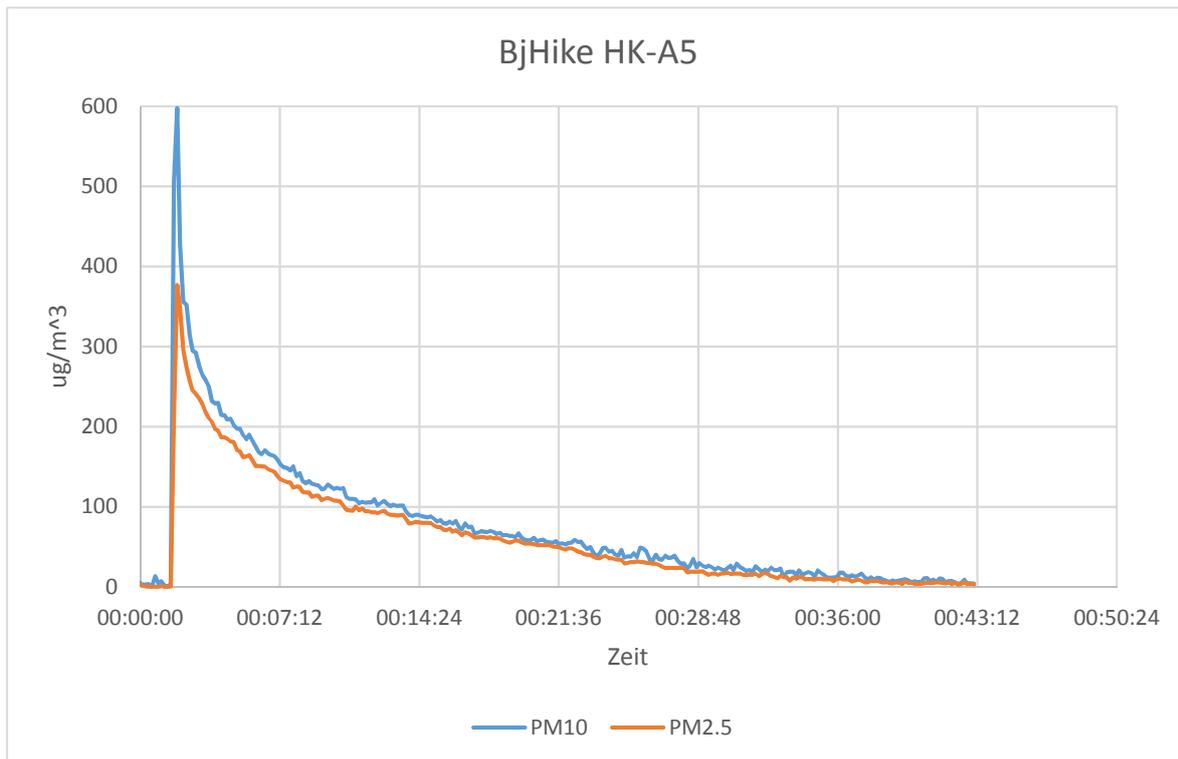


Fig. 9: Phase 1 (first 21 min) and phase 2(21-43min) as seen by the HK-A5 low-cost sensor

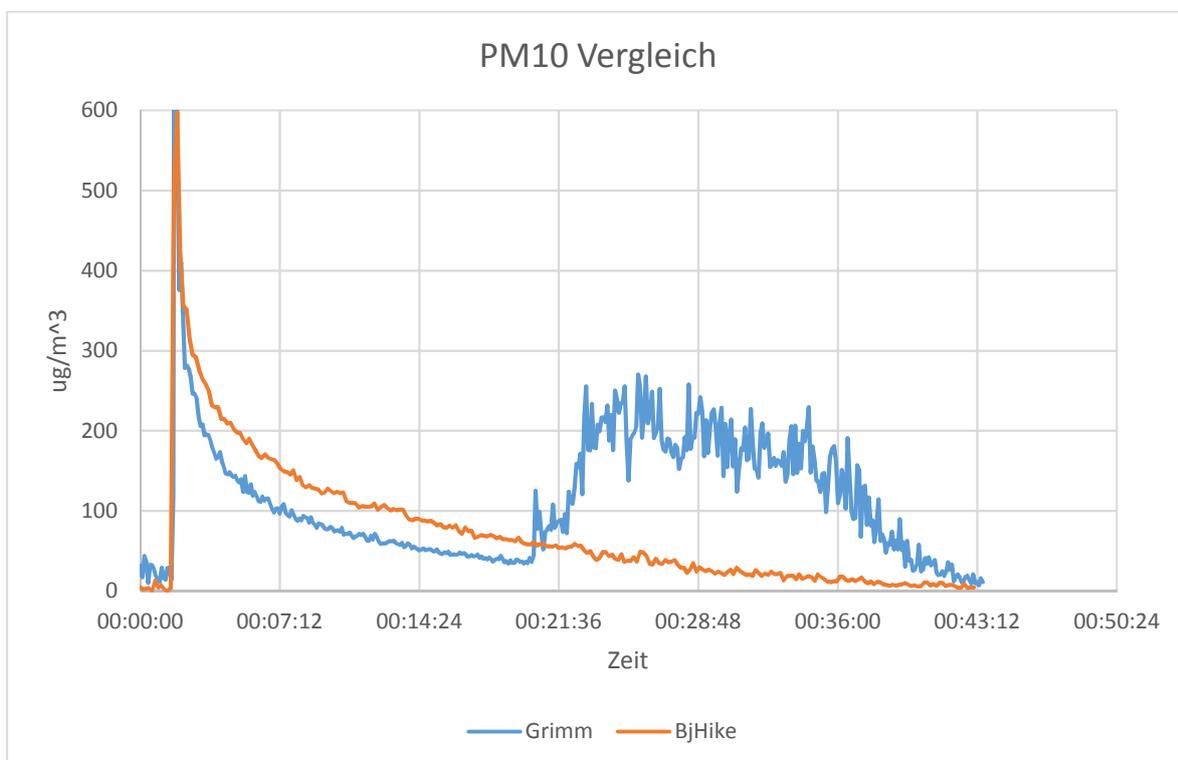


Fig. 10: Comparison for PM10, Grimm vs. HK-A5: the low-cost sensor doesn't react on the large particles at all

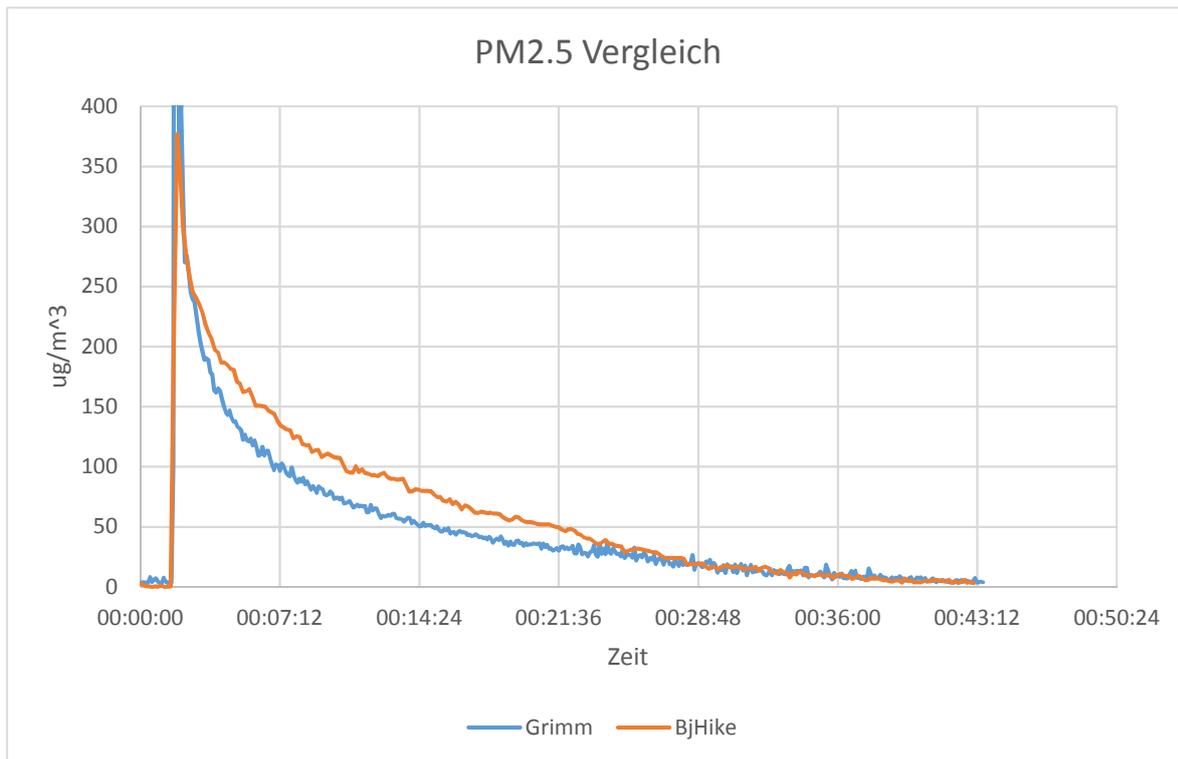


Fig. 11: Comparison for PM2.5, Grimm vs. HK-A5: the low-cost sensor reports PM2.5 comparable to the Grimm reference instrument just with about 50% higher values in the first phase

Conclusion:

As other miniaturized low-cost PM2.5 sensors the HK-A5 is able to measure PM2.5 but it does not measure particles larger than 2 μm . The reported PM10 values are just estimates based on the measurement of particles smaller than 2.5 μm .