Development of a low cost black carbon sensor for air quality monitoring in Ghana

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Problem Statement

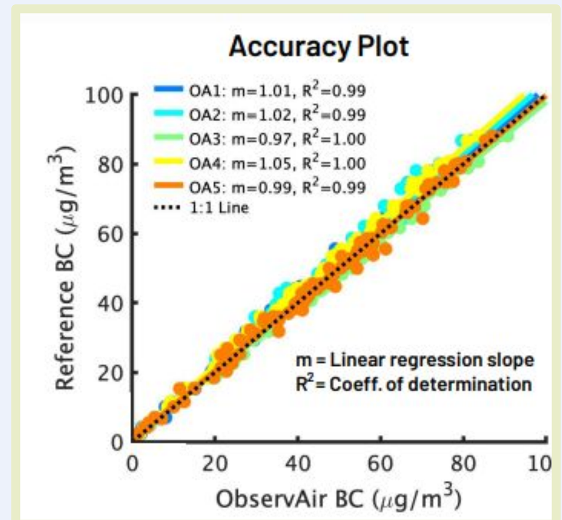
[1]Approximately **970 million** Africans use biomass for cooking, emissions from which expose them to pollutants like particulate matter (PM) and black carbon (BC). A considerable challenge is accessing affordable standard BC sensors; most **cost>US$20,000** and are thus too expensive to deploy in large numbers to provide high spatial resolution. We address this by designing the first BC sensor in Ghana, that costs less than **US$200** that incorporates a rechargeable battery & Wifi communication to enable long-term, remote operation .

@n_milanzi

Methodology: State of the Art, Materials and Design

Commercial price **$3000**

Adsorption Black Carbon Detector (**ABCD**)



[2] **Existing works**

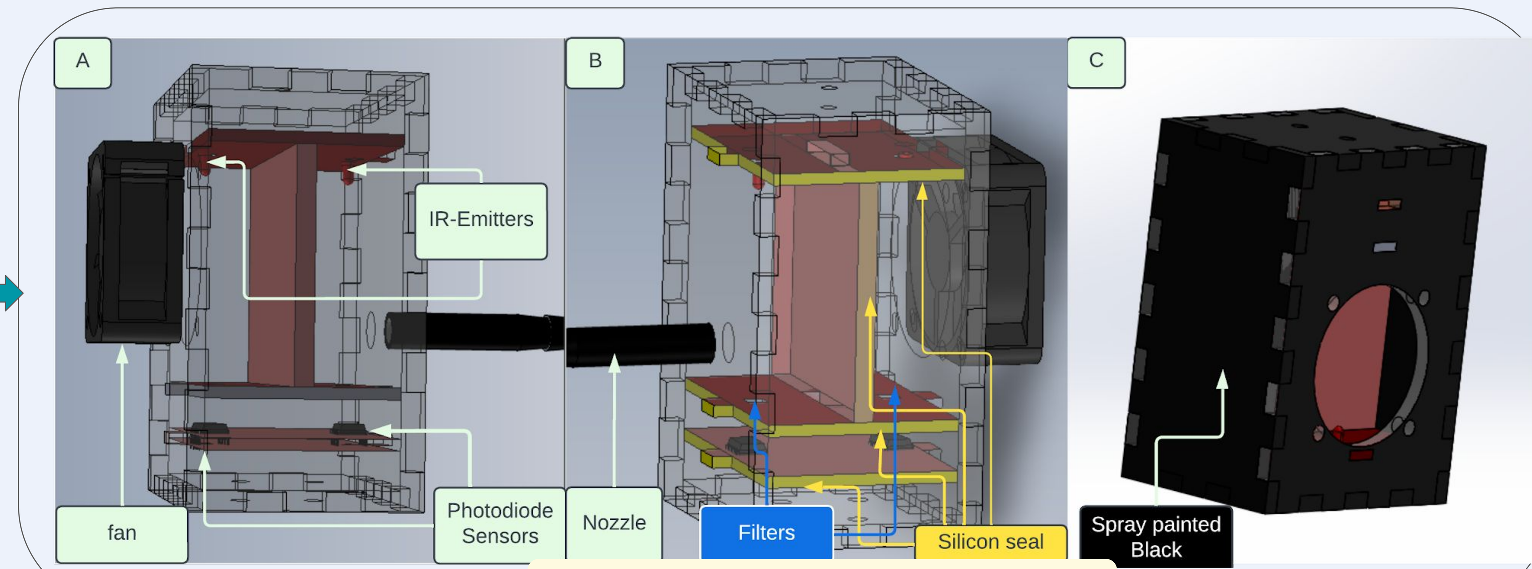
✖ Vacuum Pump (**$150**)

✔ 12V DC fan (**$2**)

✖ Glass fibre Filter

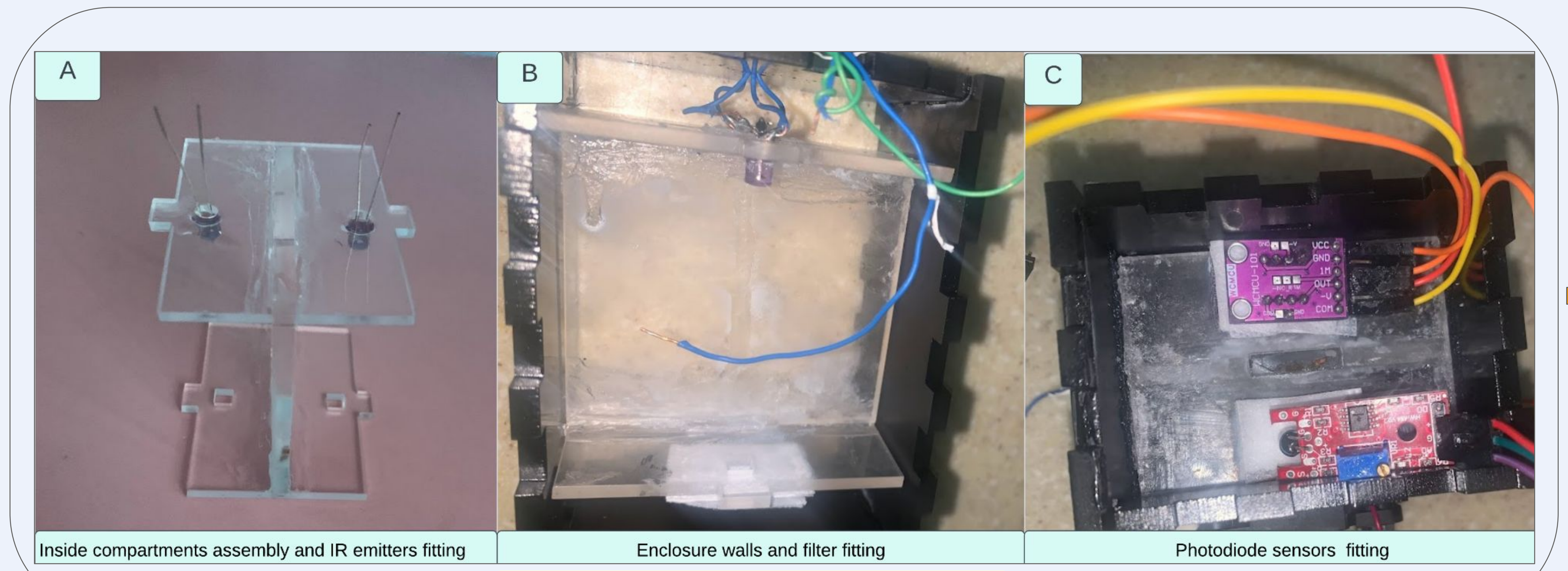
✔ KN95 Masks

Material Selection



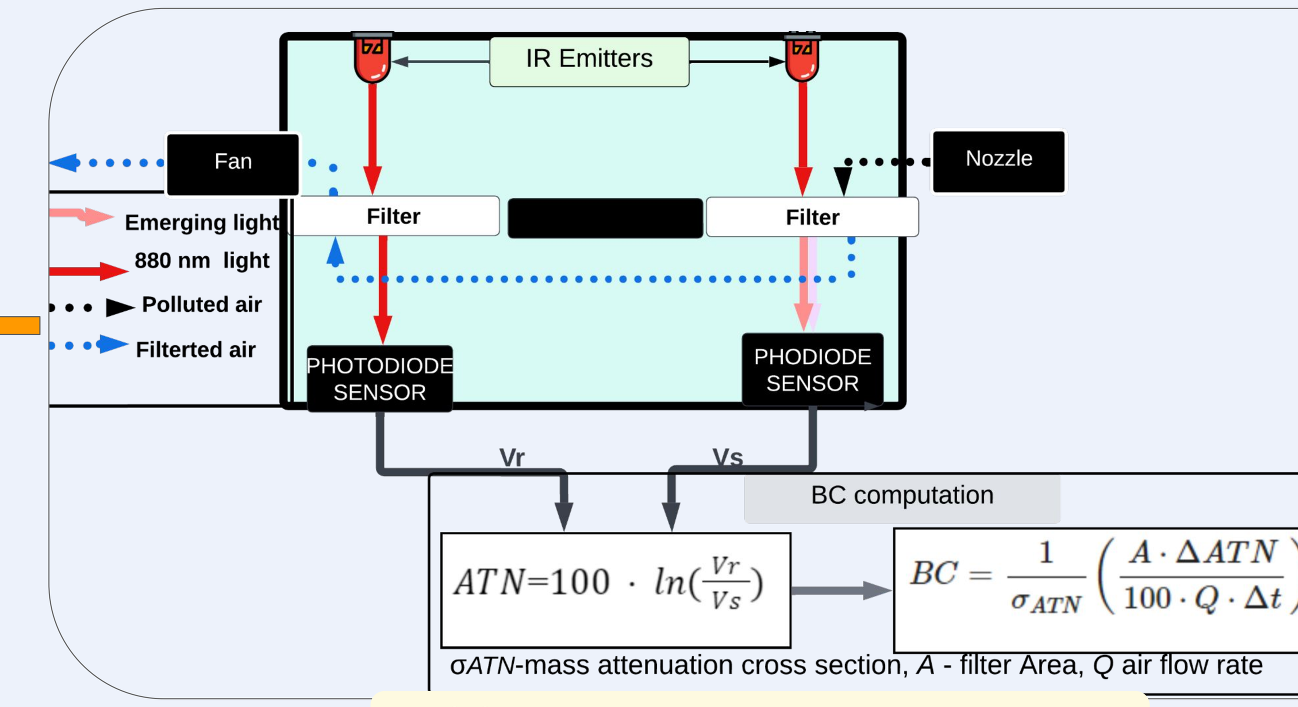
CAD Design

Methodology: Assembly and Principle of operation



Assembling

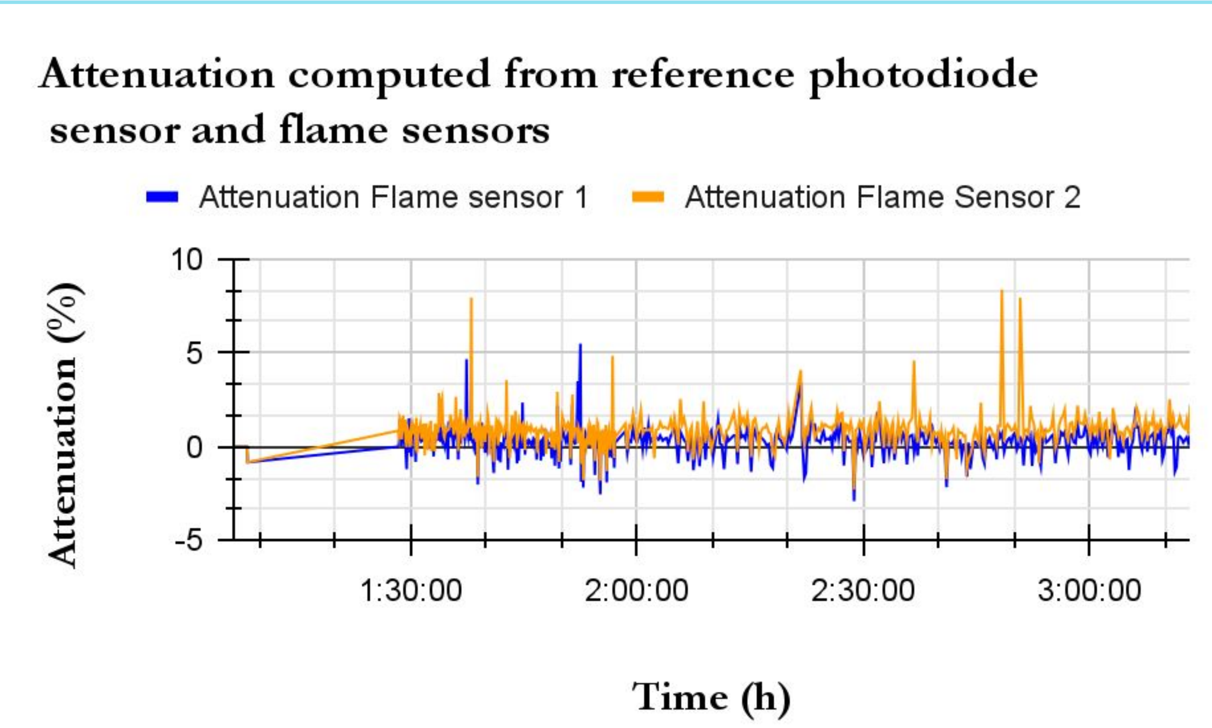
BC Sensor



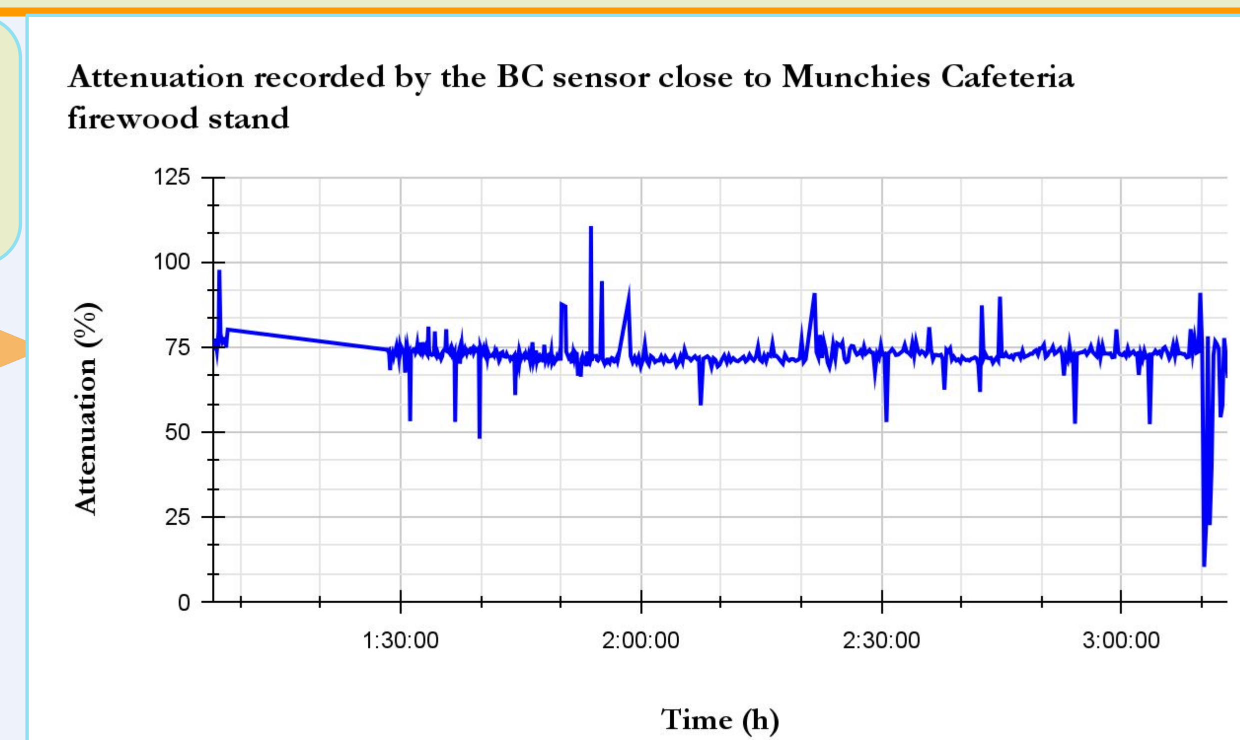
[2,3] **Principle of Operation**

Preliminary Results: Calibration, BC and NO_2

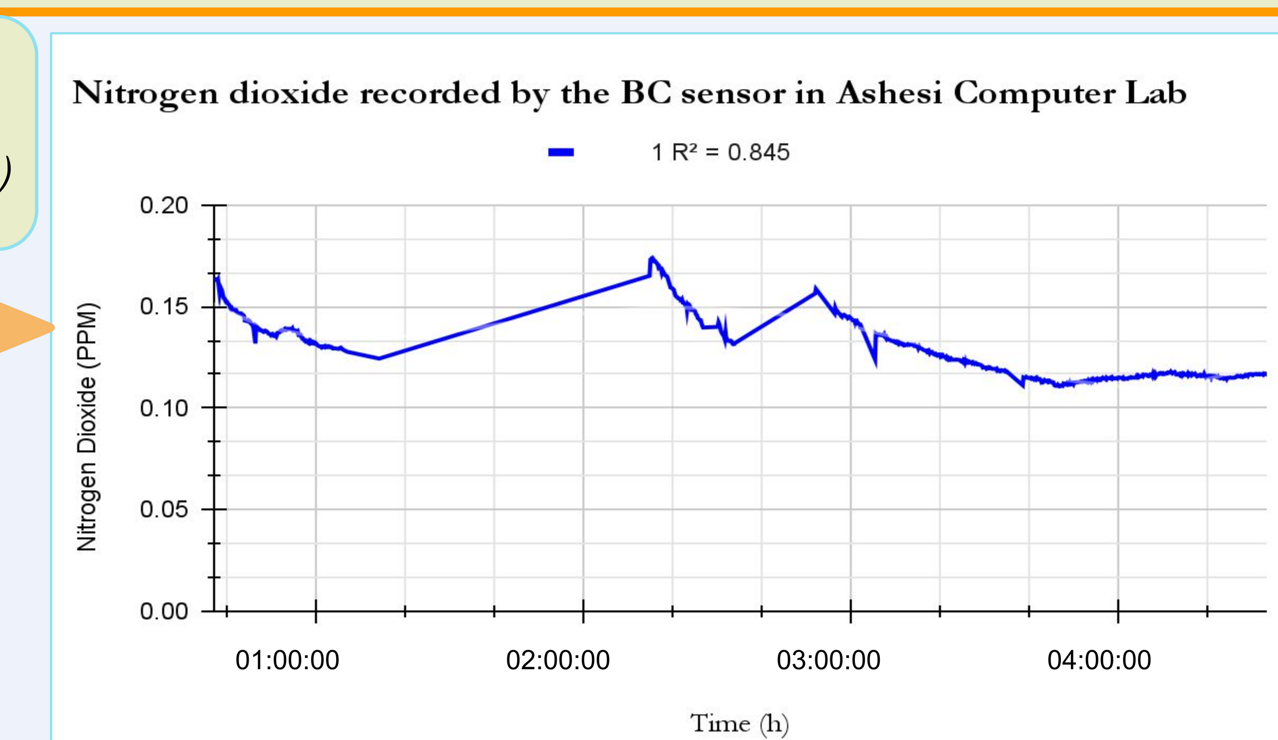
Photodiode Calibration



BC sensor near *BC* **source**



Nitrogen Dioxide *(NO_2)*



Online presentation

Conclusions

1. **It is possible to build a low-cost black carbon sensor** for use in the recent air quality monitoring networks
2. **The low-cost black carbon sensor should be adequately calibrated using a standard monitor** such as the **ABCD** to provide high quality data.
3. **More measurements from the black carbon sensor can further our understanding of low cost air sensors and thus provide useful tools to monitor** BC, CO and NO2 emissions can aid policymakers to devise data-driven solutions to BC-associated human health impacts Africa.

References

(1) IEA (2022), Africa Energy Outlook 2022, IEA, Paris https://www.iea.org/reports/africa-energy-outlook-2022, License: CC BY 4.

(2) J.J. Caubel, T. E. Cados, and T. W. Kirchstetter, "A New lack Carbon Sensor for Dense Air Quality Monitoring Networks," *Sensors*, vol. 18, no. 3, Art. nBo. 3, Mar. 2018, doi: 10.3390/s18030738.

(3) J. Lee, "Performance Test of MicroAeth® AE51 at Concentrations Lower than 2 µg/m3 in Indoor Laboratory," *Applied Sciences*, vol. 9, no. 13, Art. no. 13, Jan. 2019, doi: 10.3390/app9132766.

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How to support: I am looking for grants/funds to purchase a standard sensor (**$3000**) to calibrate our low cost sensor