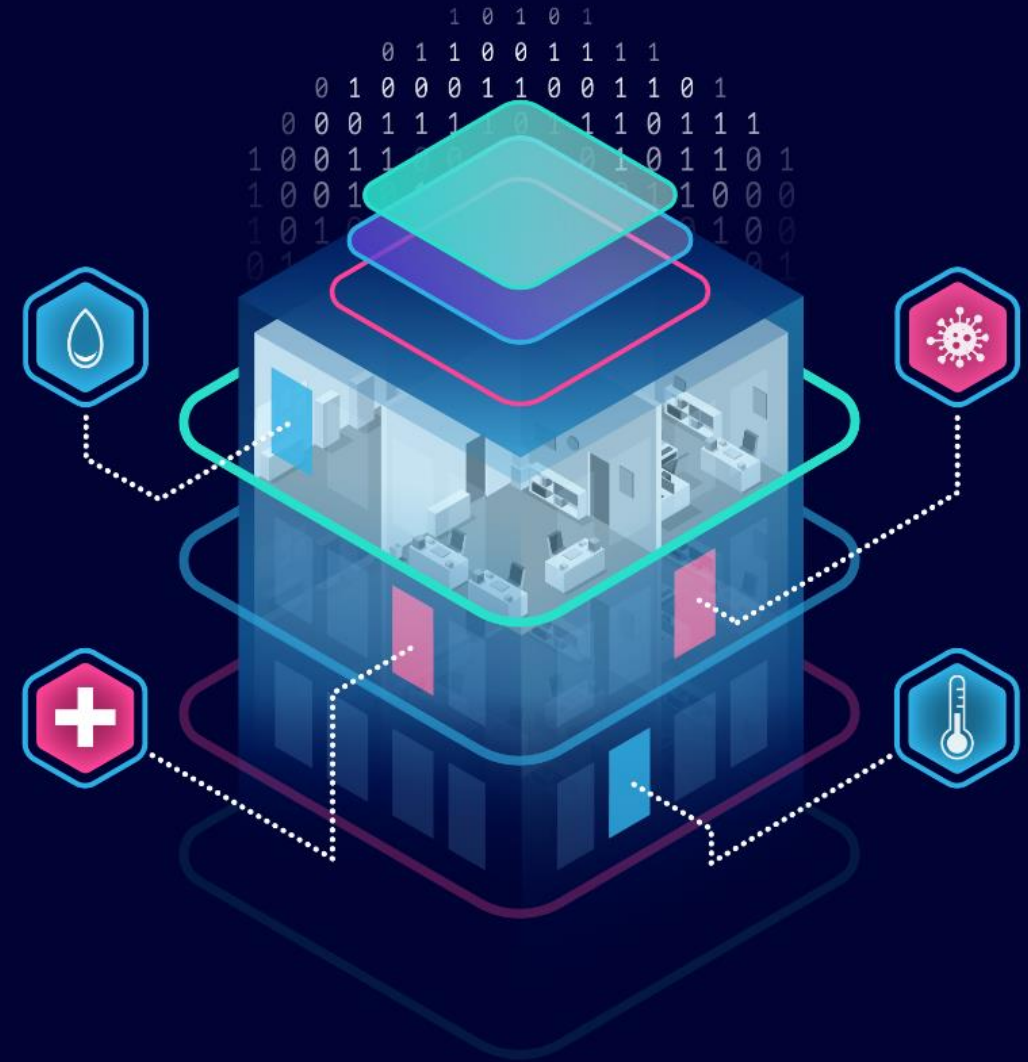


BREATHE

Building Resilient Environments for Air and Total Health

Matchmaking Webinar 1



Housekeeping Items

- Please remain on mute. If you are a panelist with an approved lightning talk, you will be invited to unmute later in the presentation.
- Please enter any technical questions in the chat.
- Please check your Audio Settings if you are having difficulties hearing us.

Agenda

- Introduction to ARPA-H and BREATHE
- Lightning Talks
- Conclusion and Next Steps



ARPA-H Mission

Accelerate better health outcomes for everyone.



Program Launch!

Building Resilient Environments for Air and Total HEalth (BREATHE)

Vision: A future with healthy indoor air for everyone.

Technology focus areas:

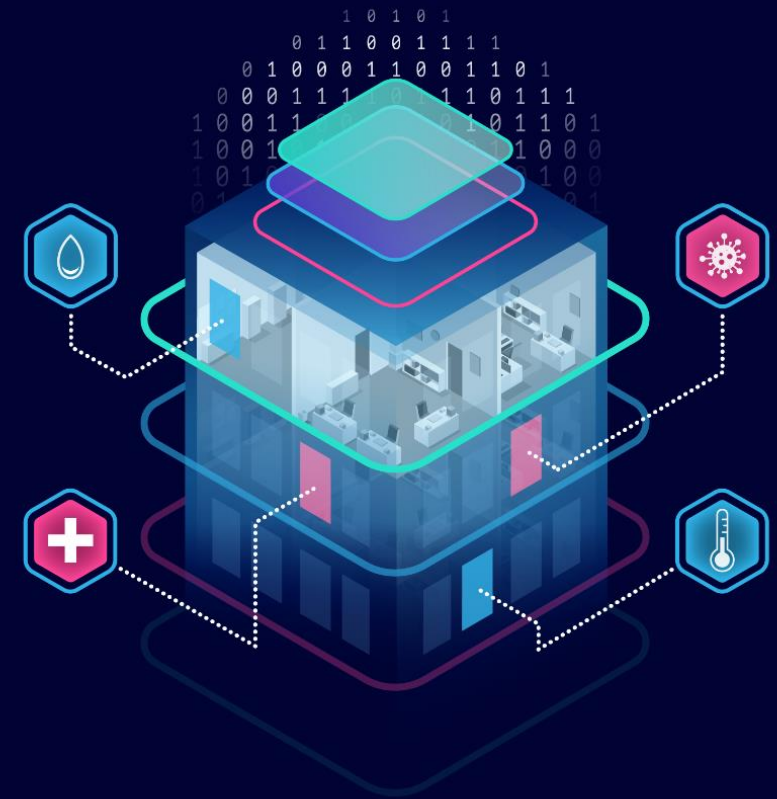
- Indoor Air Biosensors (TA1)
- Respiratory Risk Assessment Software (TA2)
- Healthy Building Controls and System Integration (TA3)
- Real-world efficacy trial (TA1 + TA2 + TA3)

How to apply

- Submit solution summary (encouraged)
- Submit full proposal
- **Visit arpa-h.gov** for more information about BREATHE and applying to the PS or email: BREATHE@arpa-h.gov

Key Dates (note: dates have been updated)

- **Matchmaking Webinars on May 22nd and May 29th, 2024**
- **Solution summary due on June 21st, 2024**
- **Full proposals due on August 26th, 2024**





Lightning Talks

Tips for Presenters

- The BREATHE team will share your slide on the screen during your presentation.
- You have three (3) minutes to give your talk and a member of the BREATHE team will say “One minute left!” when you have one (1) minute left and “Out of time!” when your time is over.
- We ask that you keep your talk to a maximum of three (3) minutes to ensure a timely webinar.

Spectrologics: Air mobile monitoring Systems



Summary

Spectrologics founded in 2022 developed Patented real time biological threats monitoring platform, and developed a first paid by customer proof of concept. We recruited a strong team with proven experience, particularly in Aerodynamics, Raman Spectrometry, Semiconductor sensors and lasers, Biology AI, HW and SW. we have a strong IP position based on HW design patent filed in 2023 And Supported by a scientific advisory board of leading experts in Israel & abroad

Core technology

Air/ Aerosol is collected continuously through an active special designed flow pumping the patented filtering system divides organisms by group sizes, these are then being continuously analyzed by micro Raman devices/ Raman spectrometry, data is based generates molecular signatures.

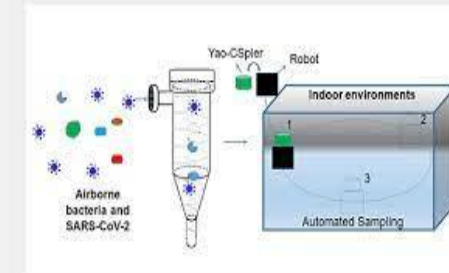
and analyzed against library developed for organisms by groups of size separation.
Data analyzed against baseline and library of all known viruses, Bacteria, fungi and other known pathogens.
Alarm generation based on multi location and pre-defined deviation from baseline.

Core scientific rational

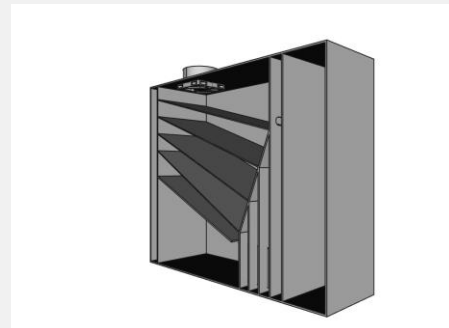
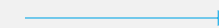
Specific signatures based on data sets identified on any organism family developed by Spectrologics
Specific focus on high-risk air carried Bacteria and viruses.
Higher loads generate larger data sets.
Brownian circulation of droplets based on occupancy.

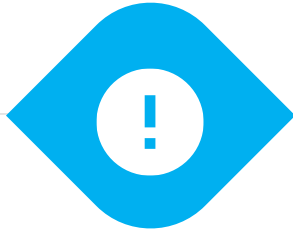
Possible use cases

Early detection of pathogenic threat in public and highly populated buildings/Identify pandemics in Entry points/on Airplanes other transpiration Vessels/ Identify Diseases in Animals/Homeland security/Biological warfare.



The spectrologics maze

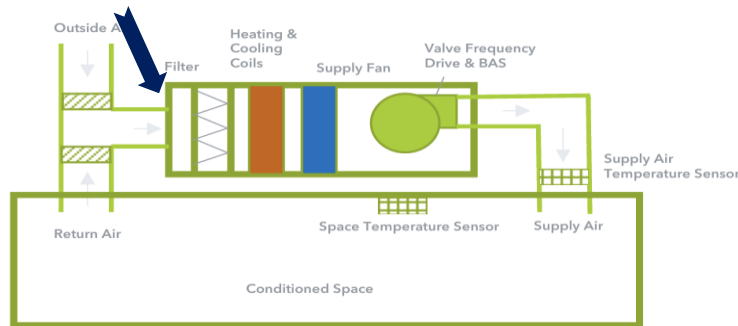




Problem: High resistance of current HEPA filter

Residential and commercial buildings HVAC systems are using low performance filters because they are not capable of supporting HEPA filters

The most common used: MERV 8 – 13 filter (<50% filtration efficiency)



Solution: Matrogenix Antimicrobial Nanofiber HEPA Filter System

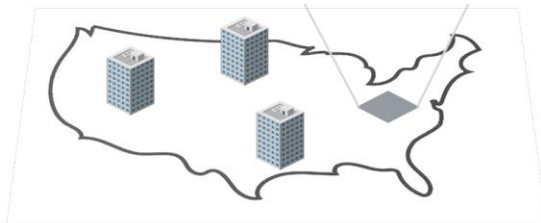


Apply antimicrobial HEPA in HVAC system Improve indoor air quality, and reduce cost

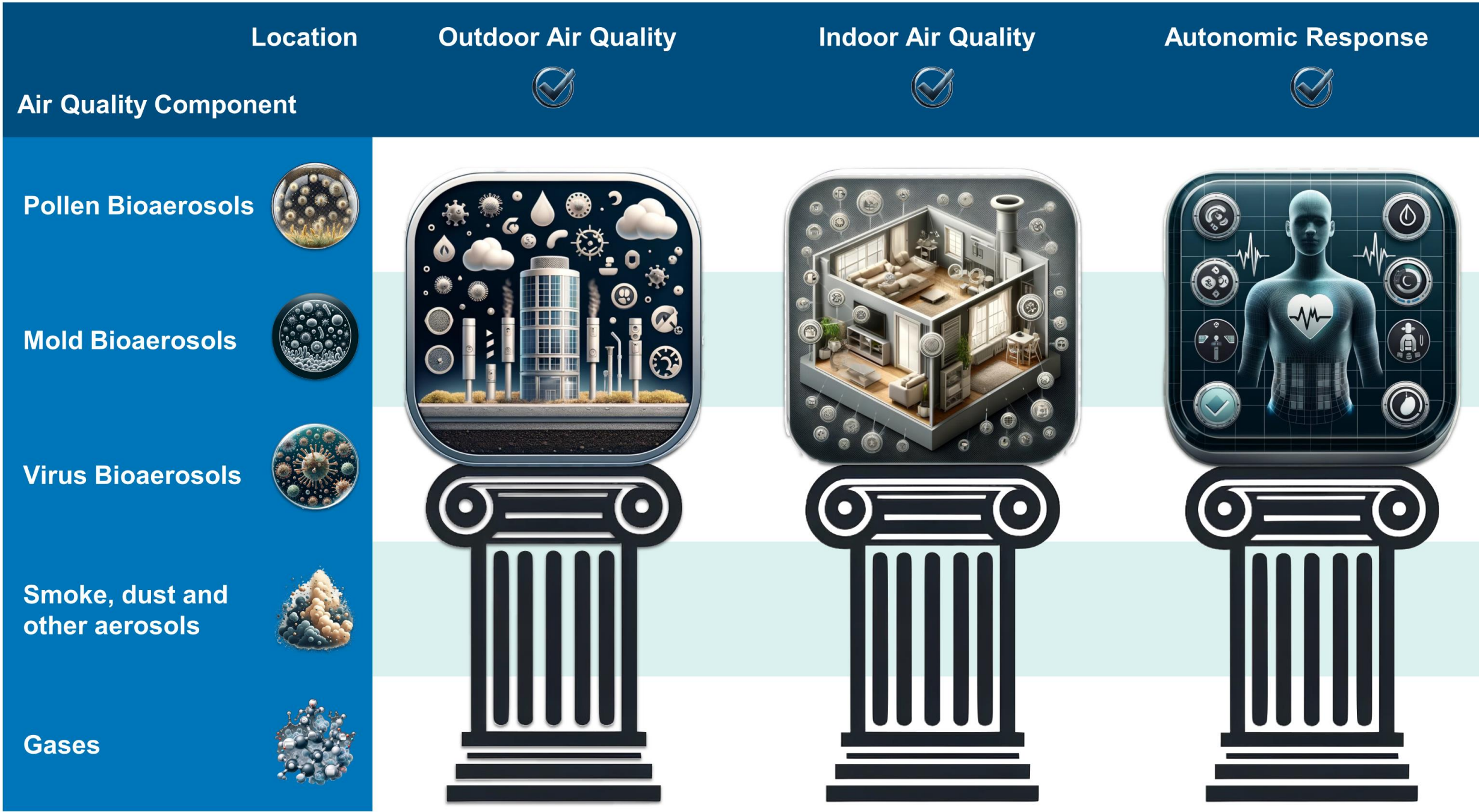
Sample	Air Flow, cfm	Filtration Efficiency, %	Pressure Drop, inch w.c.	Fan, FHP
MGX	200	99.98	0.24	0.012
Lydall	200	99.98	1.12	0.044



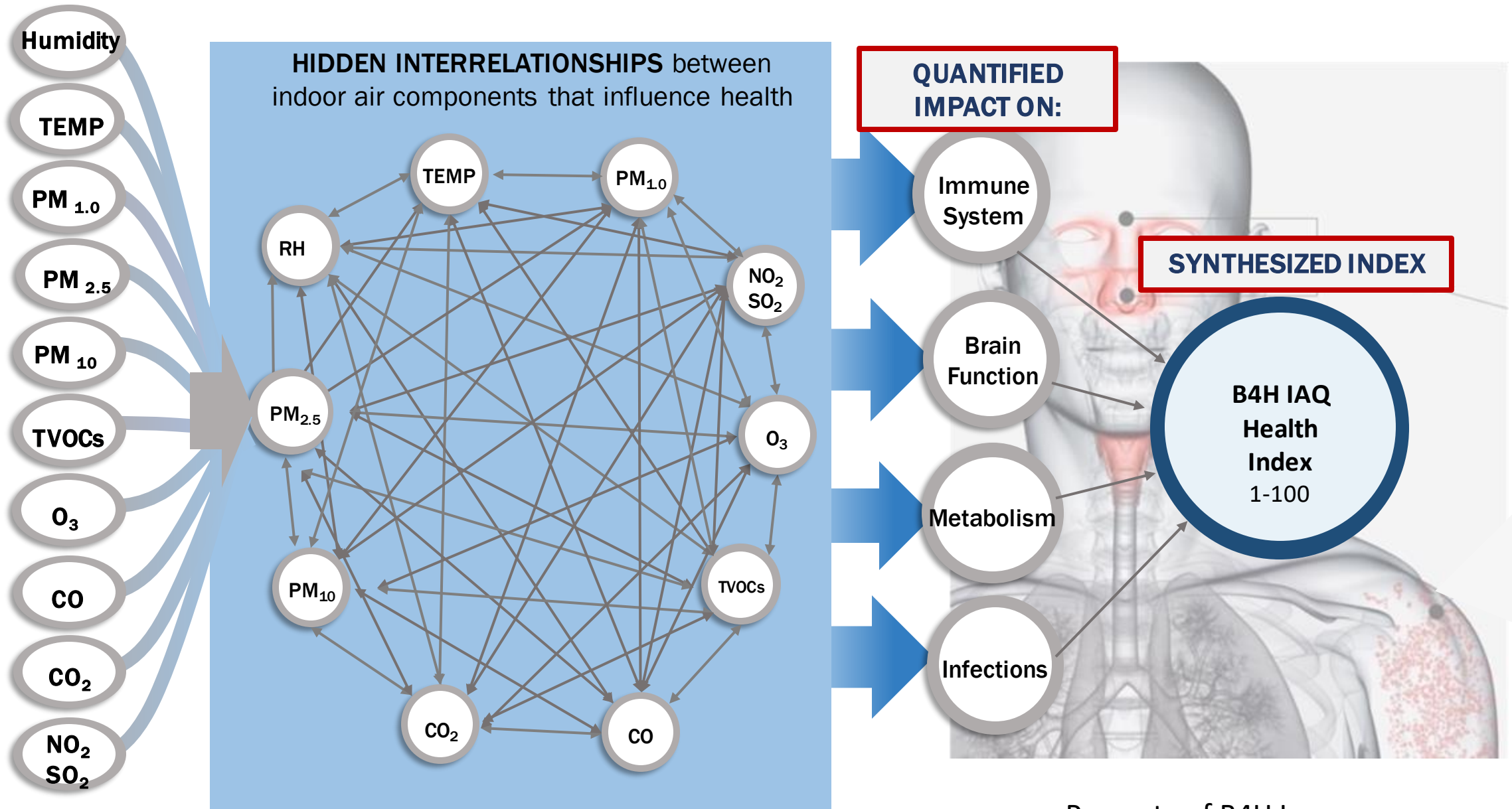
Metrics



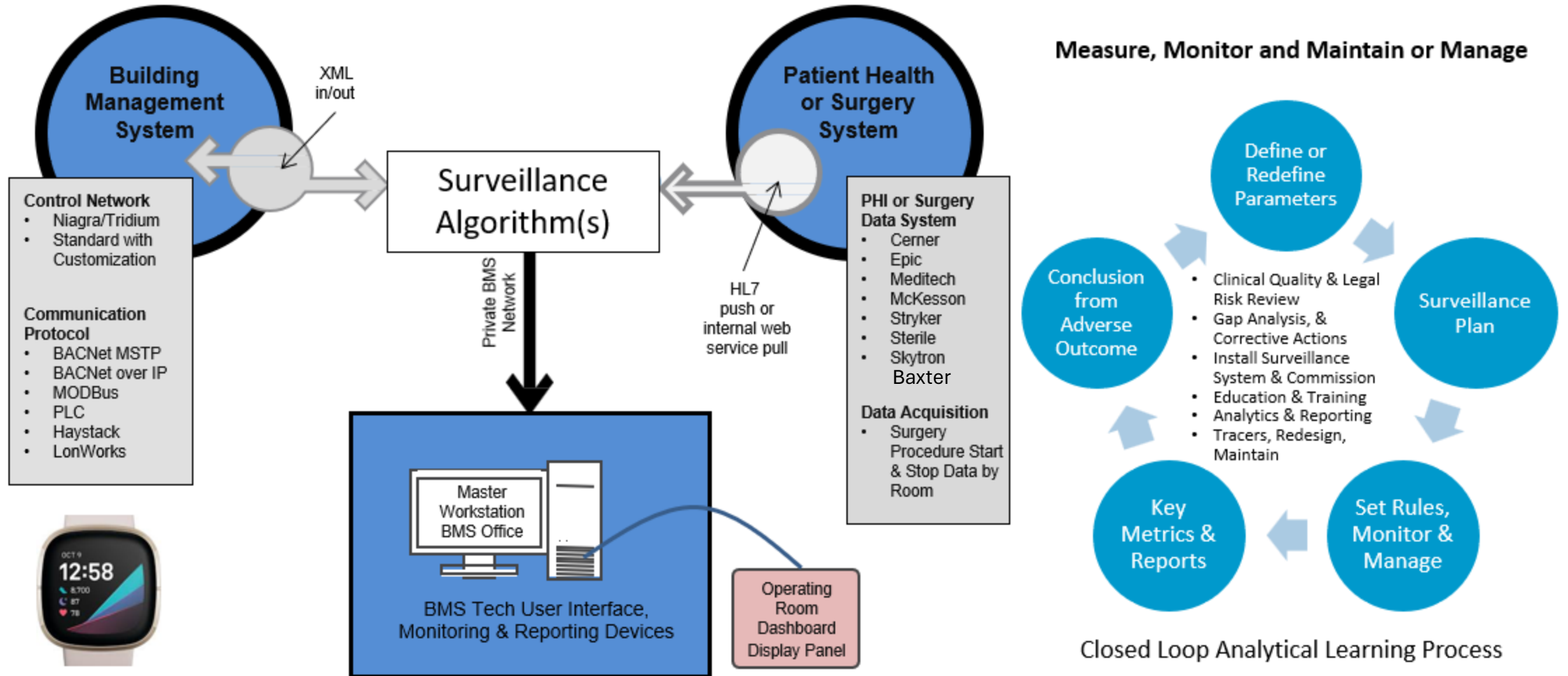
- Matrogenix be implemented the MGX HEPA filters in a network of facilities through our HVAC contractors network including UCI Health.
- Matrogenix will have access to occupant health and wellbeing data.



Holistic analysis of IAQ on human physiology



Applied in critical and non-critical environments

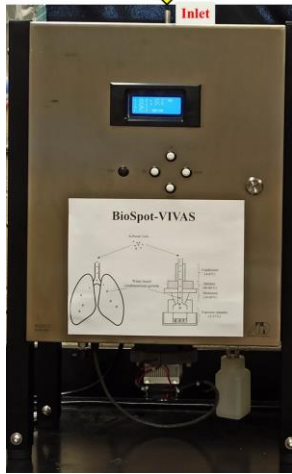


High-Fidelity Bioaerosol Detection Network

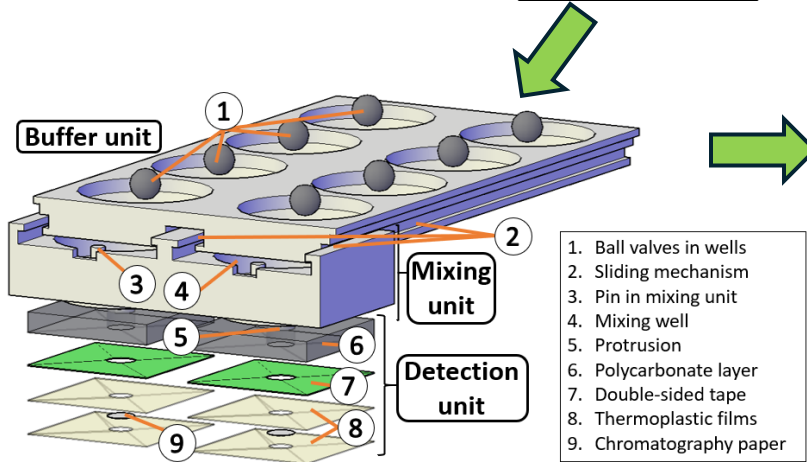
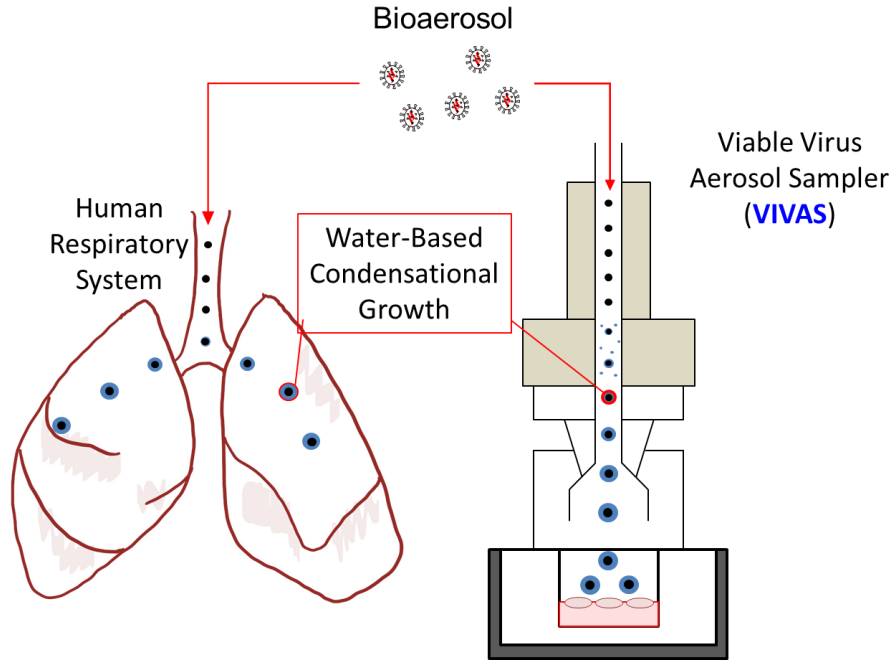
An integrated & automated unit for sampling and detection in one system

Multiangle, Multiwavelength (MAMW) Bioaerosol Detection System

8 Lpm → 30 Lpm



Portable 1.5 Lpm

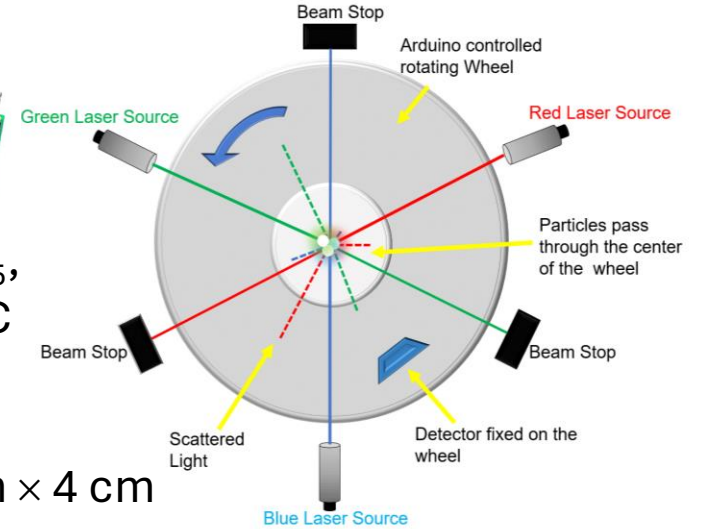


1. Ball valves in wells
2. Sliding mechanism
3. Pin in mixing unit
4. Mixing well
5. Protrusion
6. Polycarbonate layer
7. Double-sided tape
8. Thermoplastic films
9. Chromatography paper

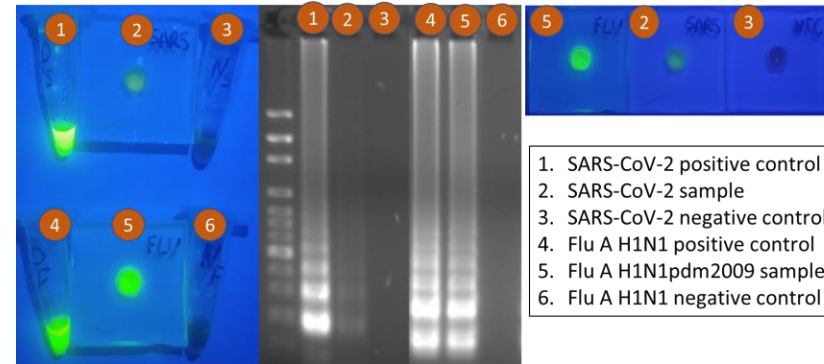


CO₂, PM_{2.5},
 T, RH, VOC

7 cm × 7 cm × 4 cm



Machine Learning algorithms can assist in unraveling the species of bioaerosols



1. SARS-CoV-2 positive control
2. SARS-CoV-2 sample
3. SARS-CoV-2 negative control
4. Flu A H1N1 positive control
5. Flu A H1N1pdm2009 sample
6. Flu A H1N1 negative control

LOD for H1N1: **0.06 TCID₅₀**
 LOD for SARS-COV-2: **2 GE**

PeakV-AIR: An autonomous real-time PCR Panel Analyzer for 25-target panel, Auto switching between screening and identification, Lab quality Airborne Pathogen Detection every 45-minutes

Specifications (Those marked in red color are achieved. Those marked in black was designed):

- ❑ **Technology:** Autonomous PCR monitoring of 25 pathogens with a cartridge replacement system every 45 minutes, and capable of auto switching between screening and identification for low-cost operation
- ❑ **Workflow (automated):** 1. Automatic installation of consumables (recovery media, and PeakV cartridge), 2. air sampling, 3. recovery of pathogens, 4. nucleic acid extraction from recovered pathogens, 5. preparation of PCR master mix, 6. real-time PCR panel test of 25 targets, 7. automatic removal of consumables and resume Step 1 for the next test.
- ❑ **Detection time interval:** 45 minutes from air sampling to PCR result.
- ❑ **Pathogen Targets per test:** Detects in parallel 25 targets of bacteria, viruses, and fungi; Expandable to 104 targets.
- ❑ **Auto switching between screening and identification:** Given the capability of testing 25 targets every 45 minutes, a user can reduce cost of operation by using a “Screening Cartridge” containing a panel of 1-3 “indicator pathogens” for routine screening monitoring of air every 45 minutes, and switch automatically to an “Identification Cartridge” for PCR analysis of 25-100 pathogens once an “indicator pathogen” is found during screening.
- ❑ **Limit of Detection (LoD):** < 800 copies/mL; nested PCR available for enhanced LoD.
- ❑ **Sensitivity & Specificity:** 95% sensitivity and 100% specificity in clinical samples for FDA EUA.
- ❑ **Automatic Cartridge Replacement:** Stores and replaces cartridges for autonomous testing
- ❑ **Turnaround Time:** < 45 minutes
 - Air sampling: 25 minutes
 - Nucleic Acid purification and PCR preparation: 12 minutes
 - Real-time RT-qPCR of a 25 multiplexing panel: 8 minutes
- ❑ **Control tests:** Includes external positive and negative controls and internal controls.
- ❑ **Cartridge Design and storage condition:**
 - Reagent-packed and sealed disposable cartridge, preventing contamination
 - Dried master mix; cartridges can be shipped and stored at room temperature
 - High reliability in manufacturing and operation
- ❑ **Remote Servicing:**
 - Monitor cartridge usage
 - Diagnose issues
 - Schedule regular maintenance

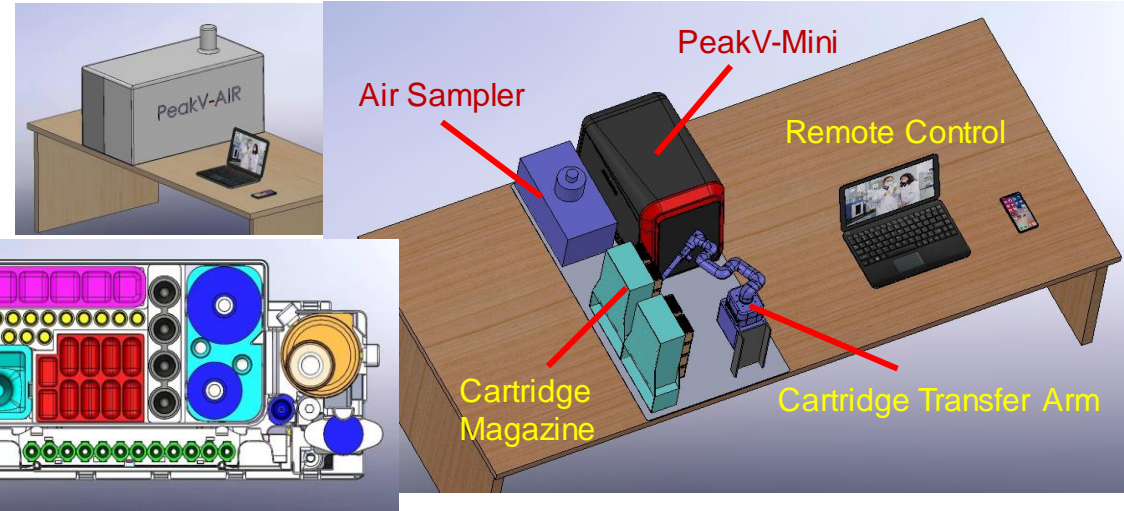
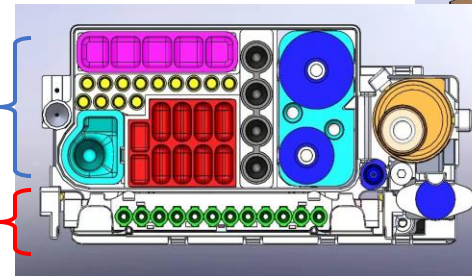
- 1) FDA EUA (for COVID-19 RT-PCR test kit);
- 2) FDA EUA (for SalivaDirect™ COVID-19 test kit);
- 3) FDA EUA (for Monkeypox test kit);
- 4) ISO13485 production facility,
- 5) IEC 61010 product safety certification from TUV;
- 6) IEC 61326-2-6:2020 electromagnetic safety certification from TUV.
- 7) 16 patents granted in US, EU, China, Japan, etc

- ❑ **Cost :**
 - Instrument: \$9,900
 - ❖ PeakV-Mini \$3,900
 - ❖ Cartridge Manager \$2,000
 - ❖ Air Sampler \$2,000
 - ❖ Casing \$1,000
 - ❖ System Controller \$1,000
- Screening Cartridge (with reagent): \$5
- Identification Cartridge (with reagent): \$25

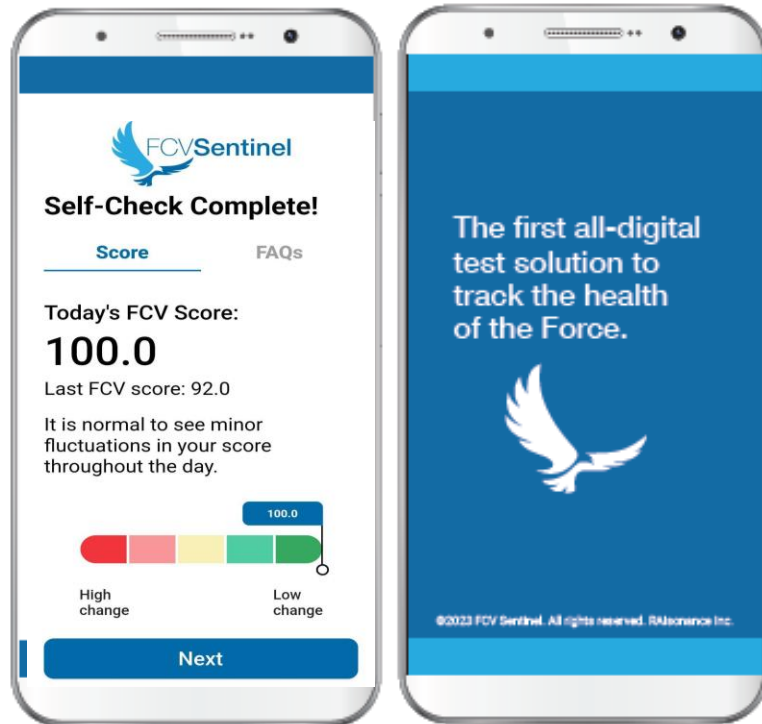
Disposable Cartridge



Nucleic acid extraction
PCR panel



Human Biosensor (TA1) for Building Occupants



[*FCV Sentinel*](#)

- **Early Detection:** provides early warning of a pre-symptomatic human spreader with a respiratory illness before they enter the building and become a source of pathogenic bioaerosols.
- **Sensitive/Threat Agnostic:** reacts to subtle changes from viruses, pathogens, chemical agents, environmental toxins, particulate matter, etc.
- **Non-invasive:** uses a few coughs to conduct the analysis.
- **Fast:** In-App results available in 2 minutes.
- **Intelligent:** Individual and workforce results pushed to web-based, customized Dashboards in near real time.
- **Human datasets:** Respiratory and health metrics, demographics/geolocation for the occupants provide human datasets for TA2 risk assessment, to correlate with IAQ indices, and to assess health impacts of remediation actions.
- **Zero Installation:** Interface is a mobile app - no sensors or hardware.

Testing at Scale: Ginkgo Biosecurity has collected over 14.12 million samples to date

	Waste-water Samples	Nasal Samples (Swabs)	Program Total
K12 4,250+ schools in 38 states	—	11.56 M	11.56 M
CDC TGS 9 domestic airports	750+	1.03 M	1.03 M
Other Including, but not limited to... <ul style="list-style-type: none"> • 14 countries w/ active pilots/ programs/MOUs • Municipal wastewater 	8,500+	1.55 M	1.56 M
Modality Total	9,250+	14.11 M	14.12 M

Risk Analytics: Contextual data, threat assessment, and epidemiological modeling

Analysis of Program Testing Data



Contextual Data from Digital Biointelligence



Epidemiological Modeling & Forecasting

Disease Spread **Mobility Networks**

Mitigation



Estimated Future Mortality from Pathogens of Epidemic and Pandemic Potential

■ Nita K. Madhav, Ben Oppenheim, Nicole Stephenson, Rinette Badger, Dean T. Jamison, Cathine Lam, and Amanda Meadows

Historical trends demonstrate a pattern of increasingly frequent and severe spillover events of high-consequence zoonotic viruses

Amanda Jean Meadows ●, Nicole Stephenson, Nita K. Madhav ●, Ben Oppenheim ●



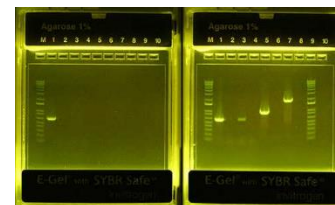
Monitoring & Analysis

- Efficacy evaluation of procedures to remove microorganisms.
- Air monitoring of toxic substances, biological and chemical
- Application areas include cleanrooms, medical devices, raw materials, environmental assessments, fuels & oils, room purifiers, etc.
- Execution of standard or uniquely designed procedures using techniques such as ATP, MF, MPN, PCR, and plate counts

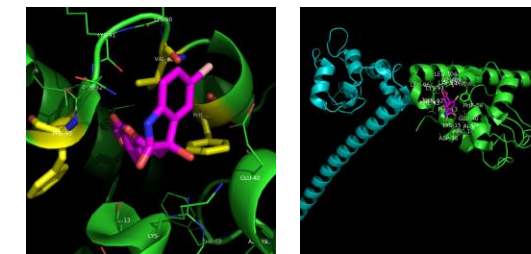


Microbial Forensics

- Addressing Biosecurity Technologies
- Detection studies
- Decontamination studies
- Bacteria, Toxin, Viral, Fungal (BSL-2+/CDC permissible levels)
- Various culture formats
- Bioaerosol testing



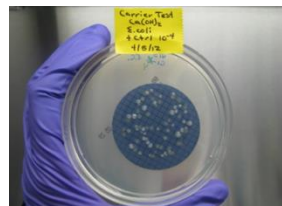
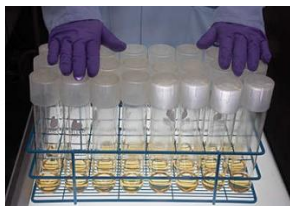
Computer Sciences



- Simulated docking of small molecules for in silico screening of biologically active compounds

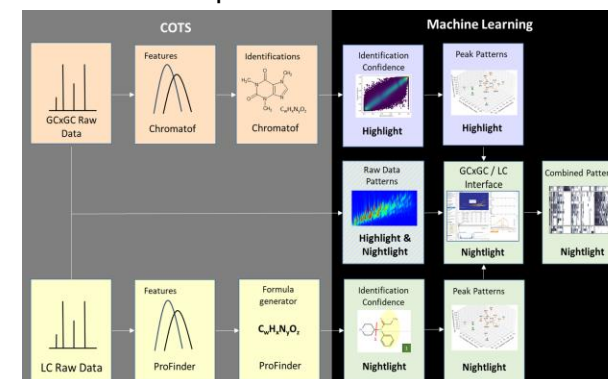
EPA Good Laboratory (GLP) Studies

- High integrity of non-clinical studies
- Follows EPA or FDA's guidance and standard methodology for acceptance criteria
- Focused on bactericidal & fungicidal base claims
- Multiple product formats: sprays, towelettes, powders, pastes
- Formulation improvements, delivery applications, and microencapsulation avenues



Facilities

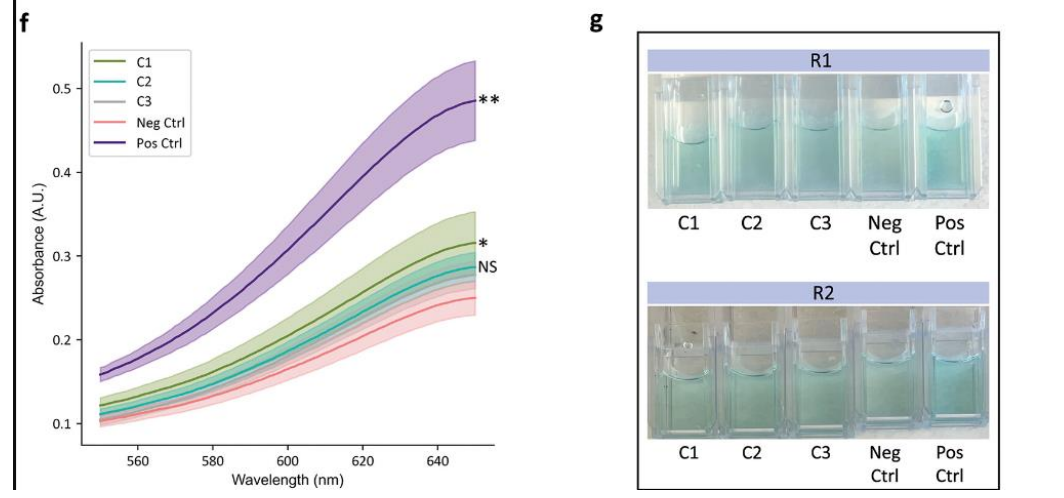
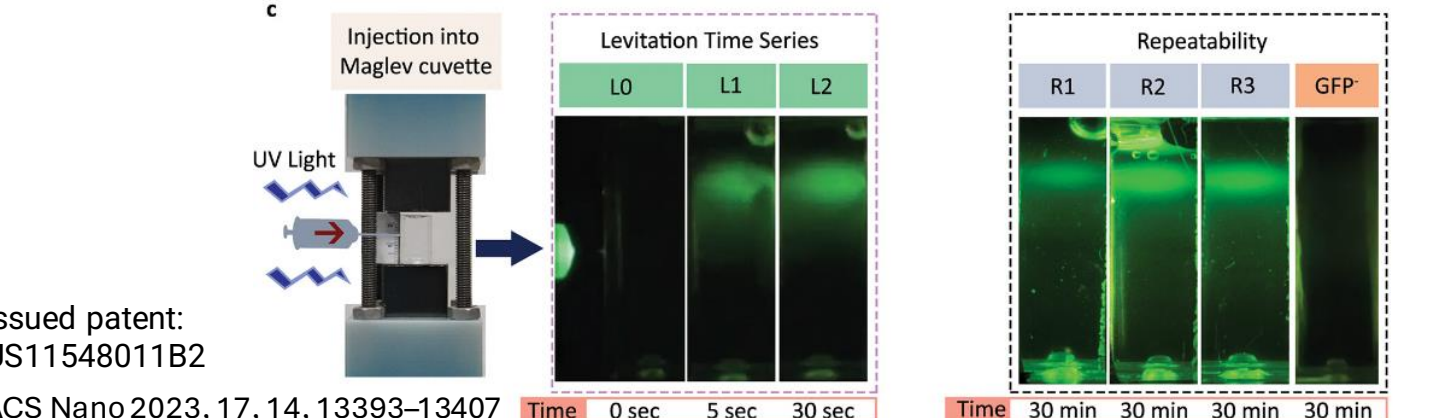
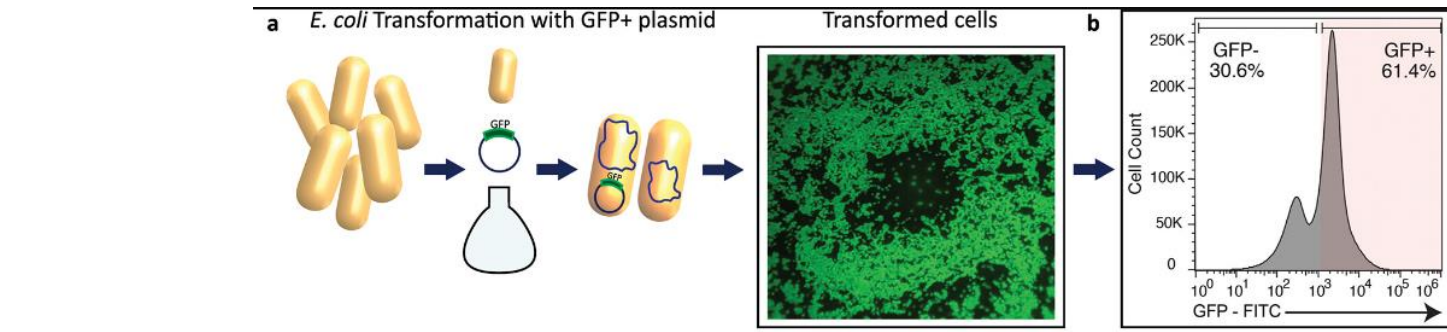
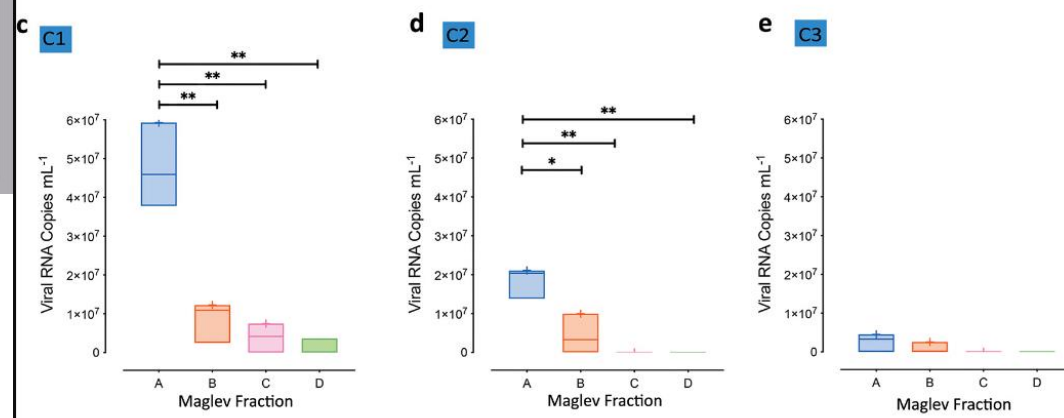
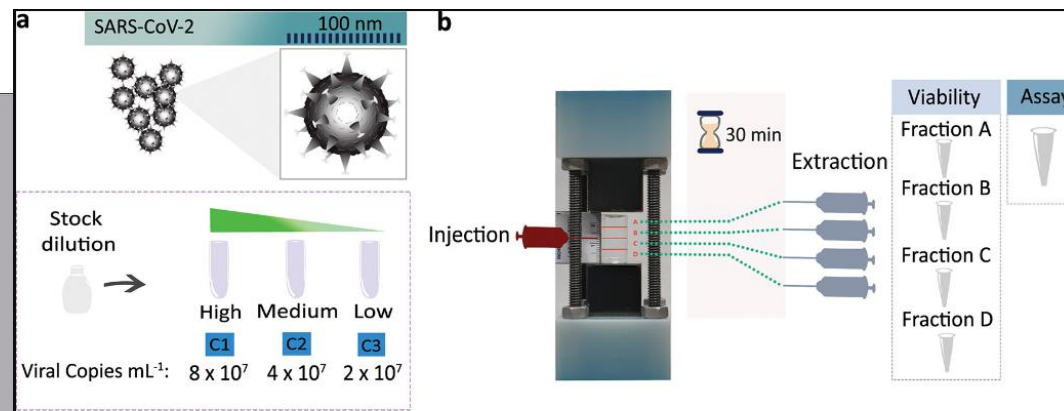
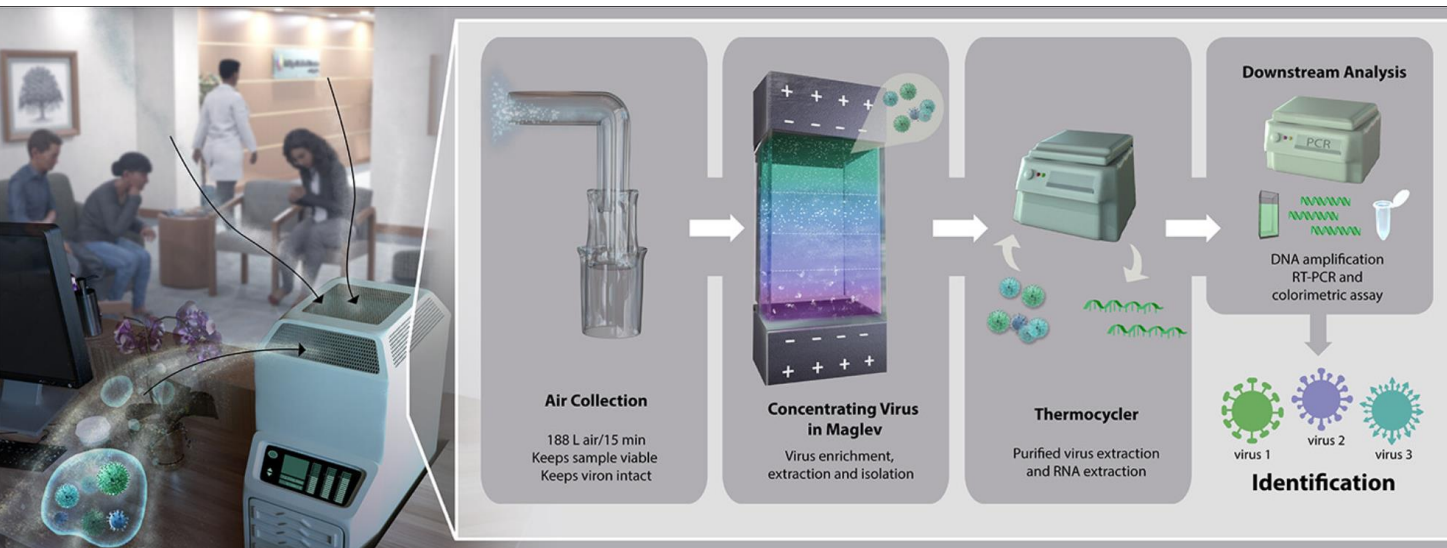
- Lab to small pilot scale growth
- BSL-2 laboratories (prokaryotes, eukaryotes, virus propagation)
- Bacterial or yeast growth up to 10 liters (shaker flasks)
- 150L ss jacketed growth vessel
- Standard and tray lyophilization
- Controlled release formulations
- 60+ years of encapsulation and particle formulation experience
- Broad technology platform (>20 encapsulation techniques)
- Lab and pilot-scale capabilities (mg to kg)



- Advanced machine learning of complex and multiplexed data for rapid decision support and unknown analysis of untargeted chemical screening
- Probabilistic risk assessment for safety-critical applications
- Industrial control systems automation, integration, and cybersecurity

Magnetic Levitation for Isolation and Purification of Airborne Viruses

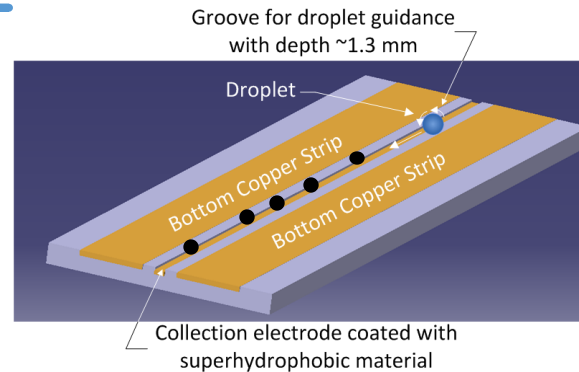
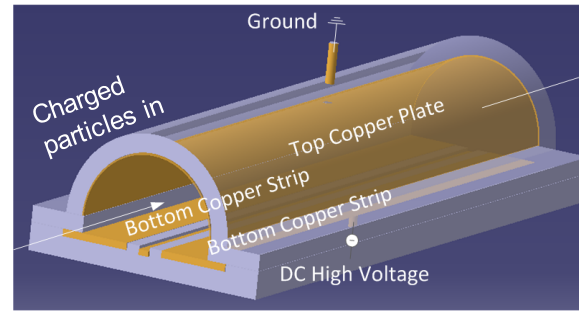
Morteza Mahmoudi; MSU; mahmou22@msu.edu



Issued patent:
US11548011B2

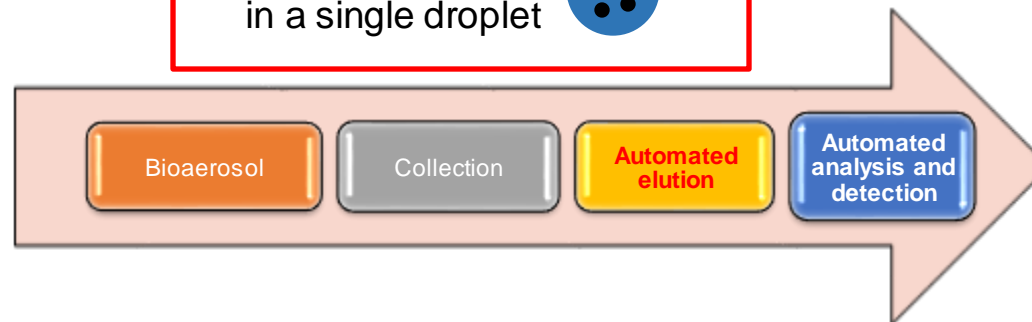
TA1: Electrostatics-based Bioaerosol Collector with High Concentration Rate

Combination of Lotus effect and electrostatics



- Entire sample captured in a **tiny 5-20 μL rolling droplet.**
- High sample concentration rate: up to 10^6 min^{-1}
- Enables **fast detection** of low pathogen concentrations
- **Low power consumption**
- Battery operated
- **Easy integration** with microfluidics

Entire air sample in a single droplet



Patented sampling technology uses biomimetics to ensure high collection efficiency and sample concentration in a single droplet (US Patent No. 8,186,235)

ARPA-H: BREATHE related capabilities:

- Testing: chamber, room and whole building levels
- Mitigation strategies and technologies
- Modeling the transport, transformation and transmissions
- AI/ML-based model predictive controls and system integration

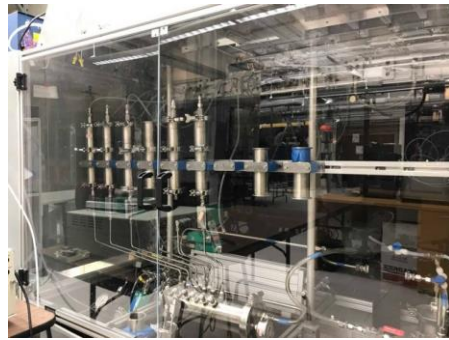
Contacts:

- Dr. Bing Dong, bdong@syr.edu
- Dr. Jensen Zhang, jzhang@syr.edu

Thrust 1: Lab Testing and Studies

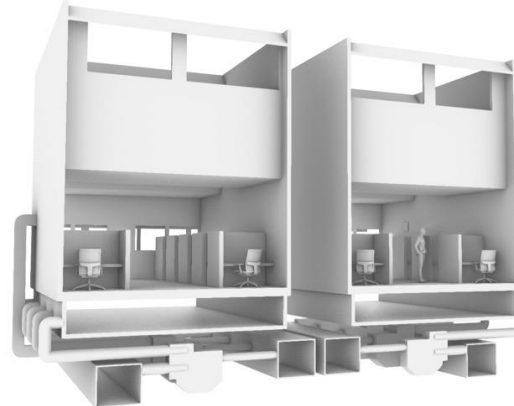


Filtering & Ventilation New IAQ Sensing



Thrust 2: Room Level Field Testing

a. Controlled Lab Testing at TIEQ Lab



- Position and # of IAQ Sensors
- Filtering
- Edge Computing enabled AI
- Human-in-the-loop Control Interface



b. Room Level Testing at BEST Lab

a. Deployment of Smart Controls



Field Data
Collection

Room
Conditions

c. Deploy Improved System:
Campus as a LAB



b. Whole Building Testing at SyracuseCOE

Next Steps

**Find information about Teaming,
FAQs, Key Dates, and More!**

BREATHE Program Page:



Mark your calendar with these Key Dates!

- **May 29, 2024: Matchmaking Webinar 2**
- **June 21, 2024: Solution Summaries Due**
- **August 26, 2024: Full Proposals Due**

ARPA-H Technical Area 3/Cost-Effective Interventions

Novel Broad-Spectrum Antibacterial/Antiviral/Antifungal

99% Effective Against 50+ Pathogens in Independent Tests

Including SARS-CoV-2, Ebola, Influenza A/B/C, MRSA, and Aspergillus Niger

Nontoxic to Humans or Pets

Accelerated Aging in Laboratories 10 Years with No Loss of Efficacy

Scalable Production Ready

First-ever air treatment technology both safe and effective enough to use in all indoor spaces to eliminate airborne pathogens



1. SIMPLE

- Proprietary liquid formula aerosolized in company-certified device.
- Device emits non-visible vapor that desiccates the microbe in the air.
- Company had first and only EPA emergency exemption for use against SARS-CoV-2.
- Tested effective in multiple venues: Broadway theatres, houses of worship, Amtrak trains, transit buses, commercial and industrial spaces.
- Currently in pursuit of EPA registration for use in all indoor occupied spaces.



INDEPENDENT TESTING:

Grignard Pure® effectiveness against multiple pathogens

Bacteria	
• Pseudomonas	99.958%
• Klebsiella	99.911%
• MRSA	99.998%
• Salmonella	99.996%
• Listeria	99.983%
• Tuberculosis	99.943%
Virus Surrogates	
• MS2 Bacteriophage	99.928%
• PH16 Bacteriophage	99.917%
Mold	
• Aspergillus	99.950%

GLP (Good Lab Practice) testing conducted by ARE Labs, Mar-May 2022

EFFECTIVE

2.

- GLP (good lab practice) testing at multiple labs confirms efficacy against multiple pathogens.
- EPA's Office of Research and Development testing confirms Grignard Pure efficacy surpasses all commercial solutions.
- Efficacy peer-reviewed in *Environmental Science & Technology*.

3. SAFE

- **Active ingredient:** triethylene glycol (TEG).
- **EPA knows TEG:** established tolerance threshold of 1,000mg/m³.
- **All around us:** for 80 years, including last 25 in theatrical fog and haze in live events, with hundreds of millions of exposures with no reported adverse effects.
- **Concentration levels:** Optimally effective at levels of between 0.5mg/m³ – 2.0mg/m³.
- **3rd party safety assessment:** white papers from leading labs including Nelson Labs, Intrinsik, TSG speak to safe application.
- **Final testing:** Company in process of final, full occupancy testing.

A Solution for 21st Century Disease Mitigation

The Lancet's 2022 Commission on lessons for the future from the Covid-19 pandemic outlined 5 pillars; Grignard Pure addresses and solves for each:

- **Prevention:** Stop an outbreak before it occurs.
- **Containment:** Elimination of the transmission of disease.
- **Health services:** Protection of healthcare workers from disease.
- **Equity:** Ensure that economic and social burdens are shared.
- **Global innovation:** Diffusion of new therapeutics and vaccines.

COMPELLING

4.

Agentis Air

Air Filtration Technology

Technical Area III

Energy Efficient Air Filtration Technology developed at U Washington
Now in commercial deployment

Deployable as Free Standing Room Units – ASHRAE 241 Certified

High Capacity, Low Noise, Energy Star

Can be centrally controlled, turned off and on, adjusted on demand

Deployable as HVAC filter

Tunable (from MERV 8 to MERV 15) in real time

Can be controlled by a Building Control System

Increase/Decrease filtration and energy use in response to:

- Building Occupancy
- IAQ threat

Potential to decrease energy use 70% over mechanical filters

Improved filtration of smaller UFP particles

TA 1: Indoor Air Biosensors

- Indoor (bio)chemistry testing facilities (bioaerosol tests)
- Multi-scale environmental chambers & test house
- Connections w/ sensor dev. & bio-eng. groups at NIST

Seeking collaborations in developing indoor air biosensors



TA 3: Healthy Building Controls & System Integration

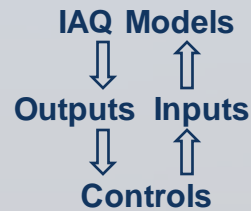
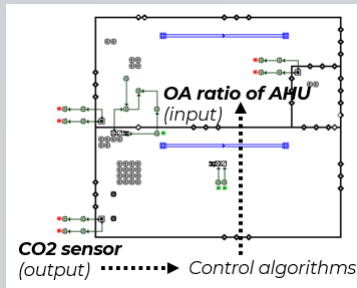
- CONTAM APIs for advanced building control strategies
- Demand-controlled ventilation (DCV) applications

Seeking collaborations in healthy building controls

contamxpy 0.0.9

`pip install contamxpy`

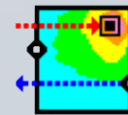
ContamX API on Python



TA 2: Respiratory Risk Assessment Software

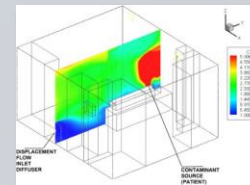
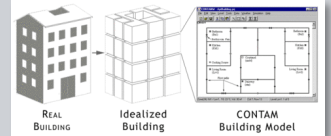
- Many recognized IAQ & health analysis tools (CONTAM)
- CFD modeling tool (CFD0)
- Infection risk estimation tool
- Exposure & health impact assessment
- Chemical-Biological-Radiological-Nuclear (CBRN) analysis
- APIs for co-simulation / advanced algorithms

Leading respiratory risk assessment software development



CONTAM

Whole-bldg. airflow & contaminant transport analysis tool developed by NIST (since 1980s)



CFD modeling w/ CFD0



Exposure & Risk models

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