Forensic Evidence for Drug-Impaired Driving

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Acknowledgements

Hill Lab Staff

Prologue to Current Work

- WSP Data Sharing with WSU for Racial Profiling Monitoring, Decade+
  -- traffic stops, citations, searches & use of force

  I. Experience with DUI/DWI Data Records in this racial profiling work

  II. Learned of DRE Program; assessment of drug-impaired driving trends

  III. Digitized DRE 5 years of Archival Records (Paper records to dataset)

- Engagement with Hill Lab prior to I-520 in 2010; objective then was top 20 drugs detection in the field in service to DRE officers

- Interest of *Chemring Corp.* in commercialization of field assessment tools; exploratory meeting in Nov. of 2011; provision of grant funds and instrument for lab studies; request for second proposal for additional funds to promote lab work and preliminary field testing

- **Emphasis shifts to THC after passage of I-502**

Need for Marijuana Breathalyzer

- Washington Association of Sheriffs and Police Chiefs – Traffic Safety Committee (Nov. 2014)
  - 2030 goal of no traffic fatalities.

    ~440 last year and dropping at a rate of ~3/year.

    Need to drop at a rate of ~30/year to meet goal. Pledged support of field testing of prototype

GOAL ATTAINMENT MUCH MORE DIFFICULT: Privatized Alcohol Sales (2011) & Legalized Recreational Marijuana (2012)

Need for a Marijuana Breathalyzer

- Increase in impaired driving due to drugs other than alcohol; NHTSA/USDOT and IACP initiative; Holder Memo of 2013 condition on cannabis-impaired driving (*8 conditions memo*)
- Marijuana was legalized in Colorado and Washington state, DC, Oregon & Alaska; 23 states medical marijuana

Need for a Marijuana Breathalyzer

- DRE (Drug Recognition Experts) trained in recognizing drug-impaired driving.
- Cannabis impairment is difficult to document even for DRE officers (Type I & II errors documented in archival data)

Not enough DREs to combat the increase in drugged driving, especially with the legalization of marijuana. ARIDE training back-up (Advanced Roadside Impaired Driving Enforcement)

State of the Art

- **Beck[1]: drugs can be captured on absorbents in the field**
  - Runs all analysis in laboratories after pre-treatment of samples
  - Analysis done on non-portable instruments (LC-MS, GC-MS)
- **Reviews and publications have been written about saliva, sweat, urine, hair and blood analysis for drugs[2,3]**
  - Saliva and sweat can be performed in the field by immunoassay
  - Large contamination problems with each approach & DNA issues
- **No scientific literature published on breath collection methods that have been publicized in the media.**
  - Cannabix and Lifeloc efforts (note on contacts made)

Currently there is no field method that can reliably identify drugs in the field by law enforcement to combat drugged driving.

1)Beck, O.; Sandqvist, S.; Dubbelboer, I.; Franck, J., Detection of Δ9 Tetrahydrocannabinol in Exhaled Breath Collected from Cannabis Users. *Journal of Analytical Toxicology* **2011,** *35*, 541-544.
2) Kidwell, D. A.; Holland, J. C.; Athanaselis, S., Testing for Drugs of Abuse in Saliva and Sweat. *Journal of Chromatography B* **1998,** *713*, 111-135.
3) Desrosiers, N. A.; Lee, D.; Schwope, D. M.; Milman, G.; Barnes, A. J.; Gorelick, D. A.; Huestis, M. A., On-Site Test for Cannabinoids in Oral Fluid. *Clinical Chemistry* **2012,** *58* (10), 1418-1425.

Objective:

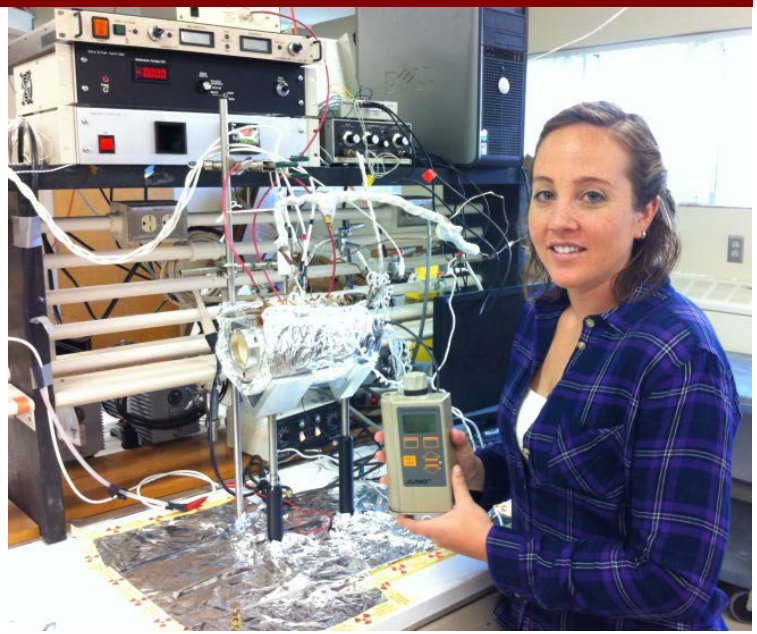
Help DRE & ARIDE-trained officers reduce false positive rate of detection

WSU ADA Pilot Study Funding for Hill and Lovrich *(Alcohol and Drug Abuse)*

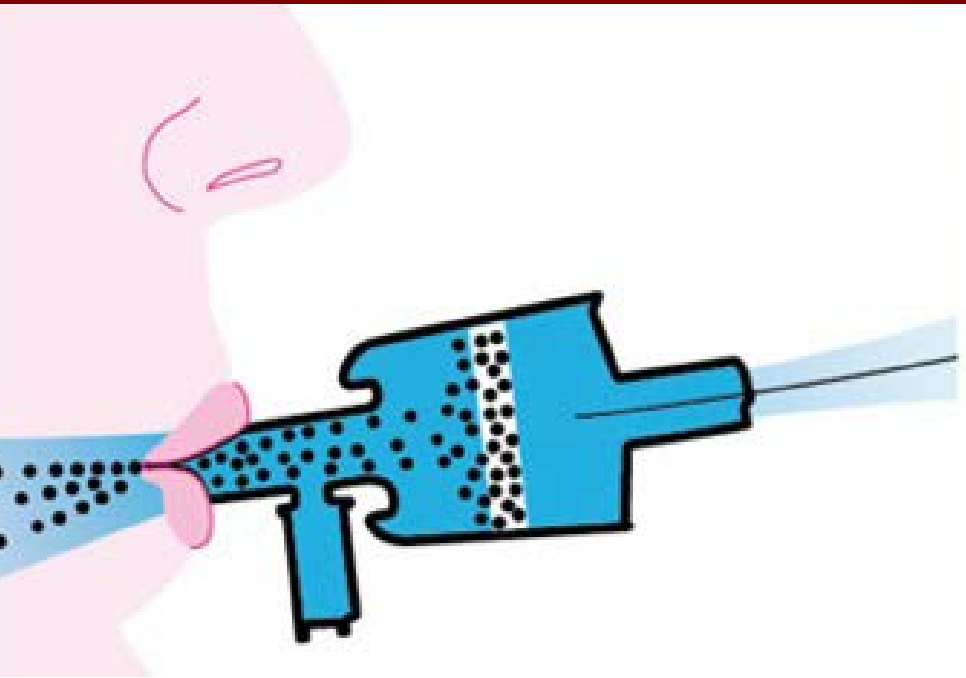
Correlation of Drug Recognition Expert (DRE) Evaluation with Chemical Field Analysis: The Timely Enhancement of Enforcement Capacity to Deal with Drugged Driving (Volunteer human subject testing)

Doctoral student on task:

Jessica Tufariello



Current Breathalyzer Solid Phase Adsorption Technologies With a C_{18} Filter



Detection of THC in Breath

Detection of Δ^9-Tetrahydrocannabinol in Exhaled Breath Collected from Cannabis Users

Journal Analytical Toxicology, 35, Oct 2011

Use of C_{18} Filter disk

Liquid extraction with hexane/ethyl acetate

LC-MS-MS

1-12 hr after cannabis smoking

Thermal Desorption of Drugs

- Detection of Volatile Organic Compounds in Breath Using Thermal Desorption …

Analytical Chemistry (82) 2010

Prof. C. L. P. Thomas
Department of Chemistry
Loughborough University
Loughborough, UK

Detection of Drugs by IMS

Heroin and Cocaine with

Mass-Identified Mobility Spectra

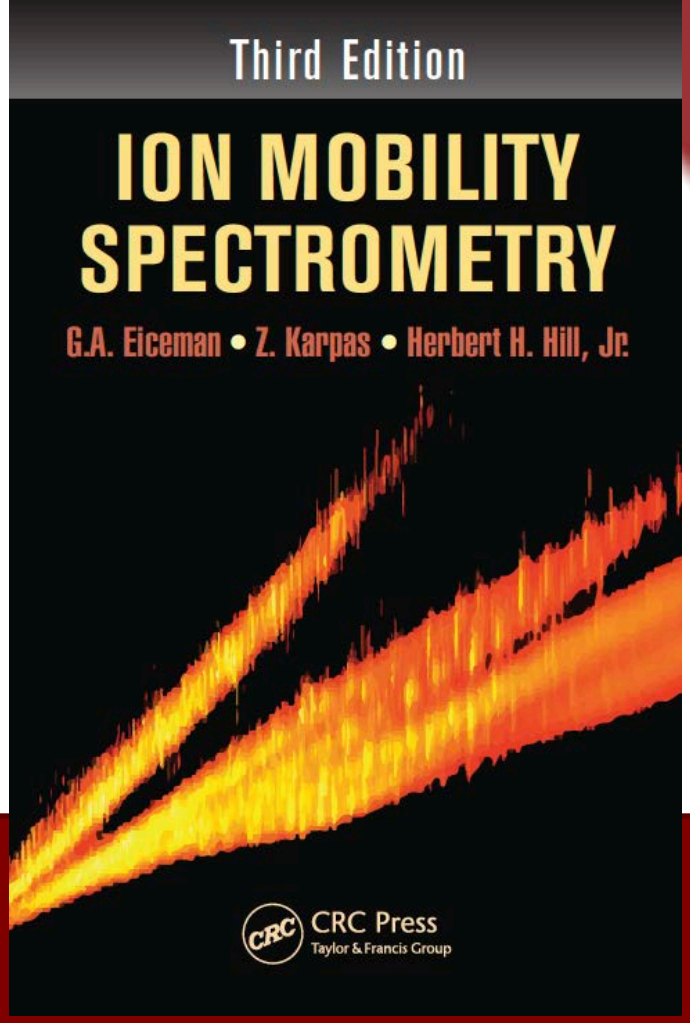
Journal of Chromatography 117, 1976

Herbert Hill

Department of Chemistry

Washington State University

Pullman, WA



http://www.springer.com/chemistry/analytical+chemistry/journal/12127

Applications in Explosives & Drugs Detection

Airports

Border Crossings

Courts

Public Venues

- Correction Facilities
- Embassies
- Federal Buildings
- Forensic Labs
- Military Sites
- Postal Facilities
- Schools

Hand Held IMS Systems

On site analysis of samples

History of hand held IMS:

- 1970's: 14cm long drift tube IMS
- 1980's: Ceramic drift tube design
- 1990's: miniaturized 15mm by 70mm
- Chemical agent monitor (CAM)
- Lightweight Chemical Detector (LCD)

Ionization sources:

- Radioactive
- Corona discharge

Used for:

- Chemical warfare agents (CWAs)
- Explosives
- Drugs

Hand-Held Ion Mobility Spectrometers:

Products in Development or off-the-Shelf

Lightweight Chemical Detector

DT IMS

Smiths Detection
Watford, UK

ChemPro-100

Open-Loop IMS

Environics, Oy
Mikkeli, Finland

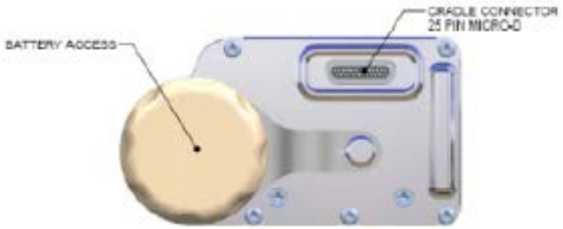
JUNO

RF-DC IMS

General Dynamics
Charlotte, NC, USA

µ-IMS ODOR

DT IMS
G.A.S.
Gesellschaft fur Analytische Sensorsysteme
Dortmund, Germany

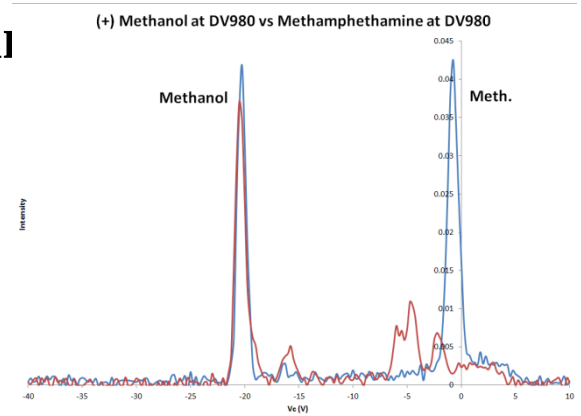


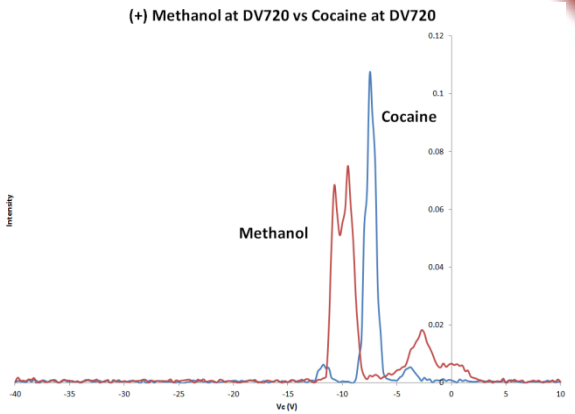
Hand held DMS system:

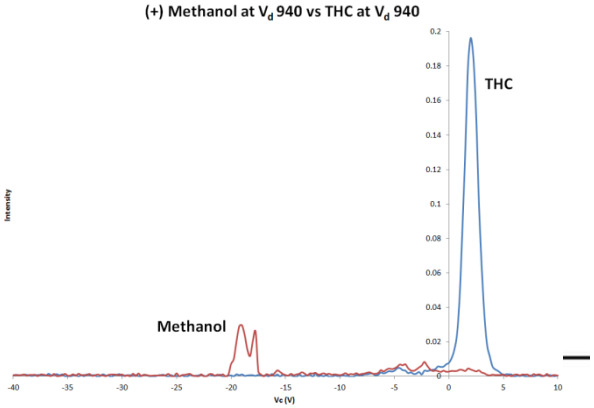
- ^{63}Ni ionization source
- Membrane inlet
- DMS Chip
- Self cleaning
- Visual and Audio Alerts
- Detect and identify CWA's and Toxic Industrial Chemicals

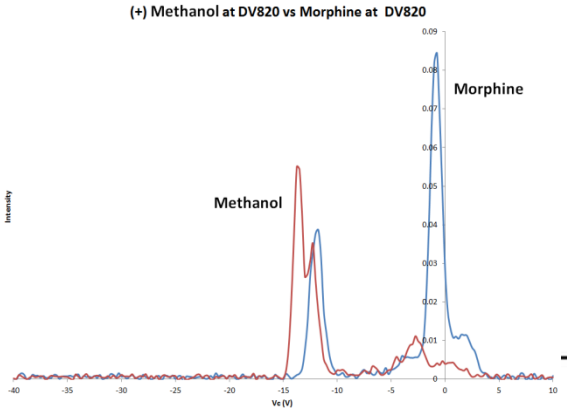
Drug response in DMS

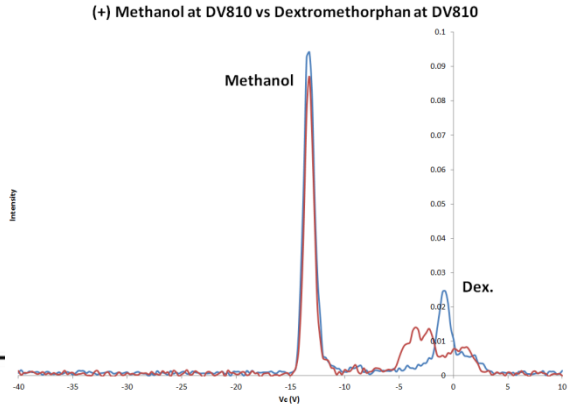
- Difference responses for five different drugs:
  - Methamphetamines
  - Cocaine
  - **Tetrahydrocannabi**
  - Morphine
  - Dextromethorphan



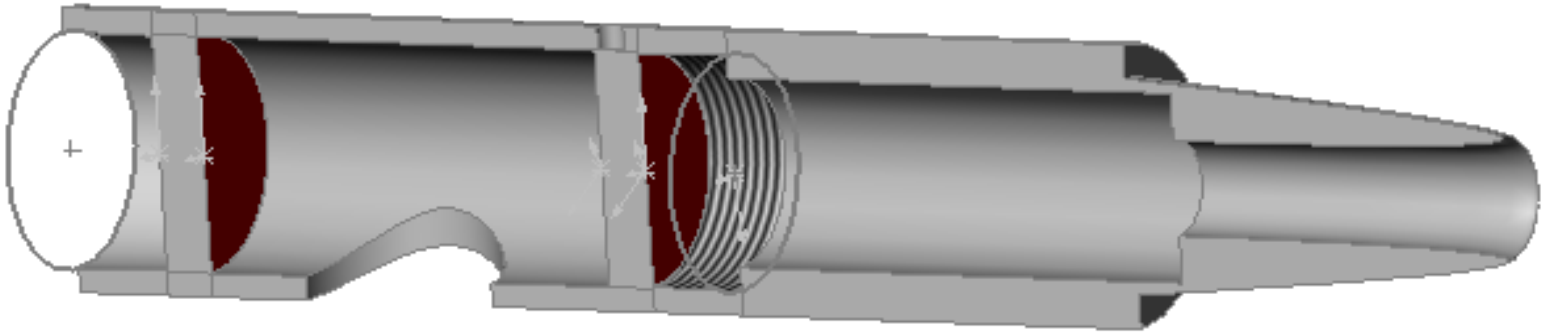


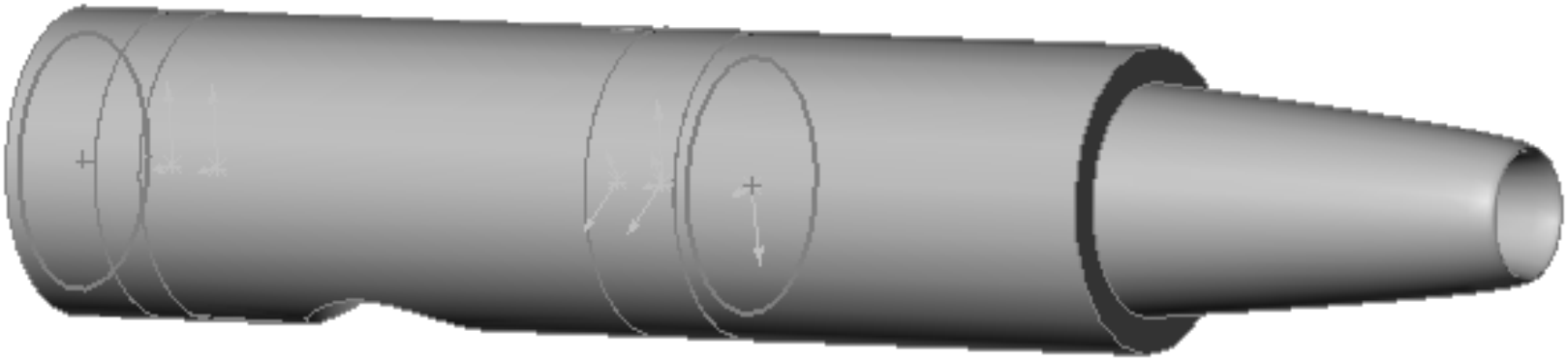






Model of breathalyzer



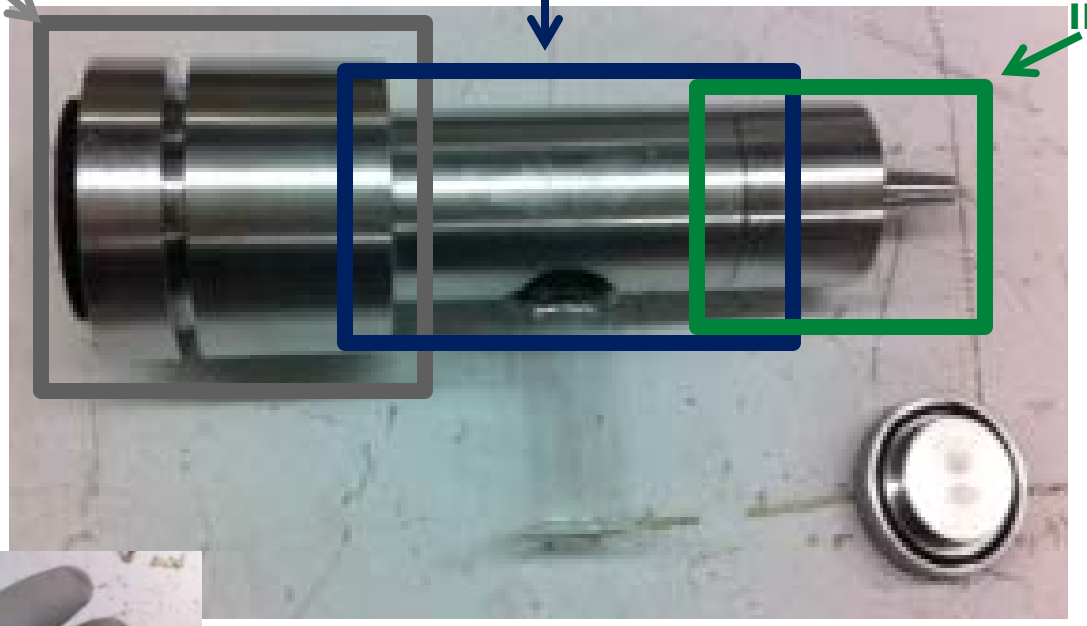


Thermal desorber (design 1)

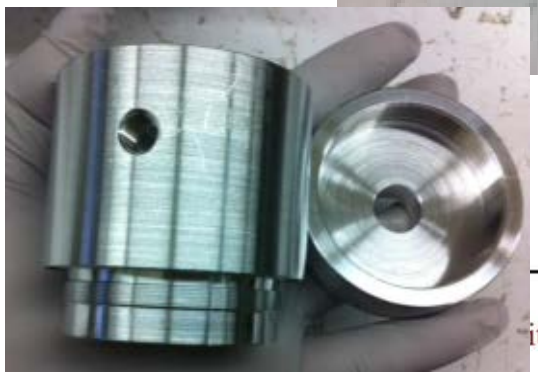
Filter holder to JUNO

Drug vapor introduction

Breath introduction



Filter holder to JUNO



Drug vapor introduction

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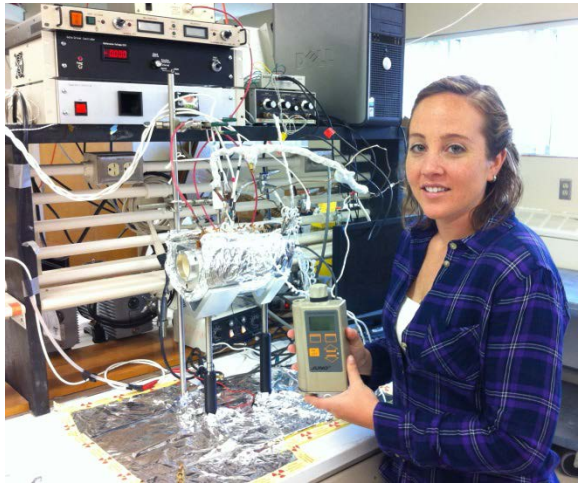
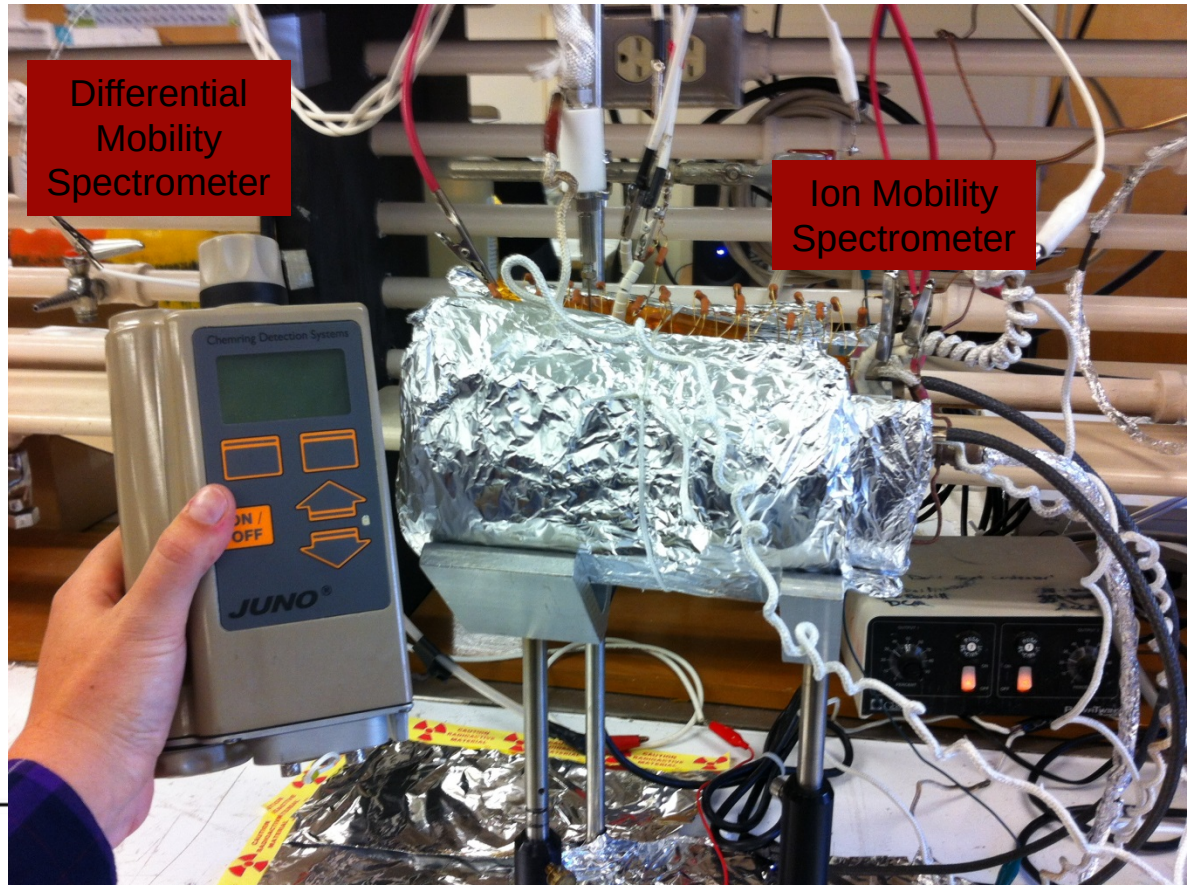
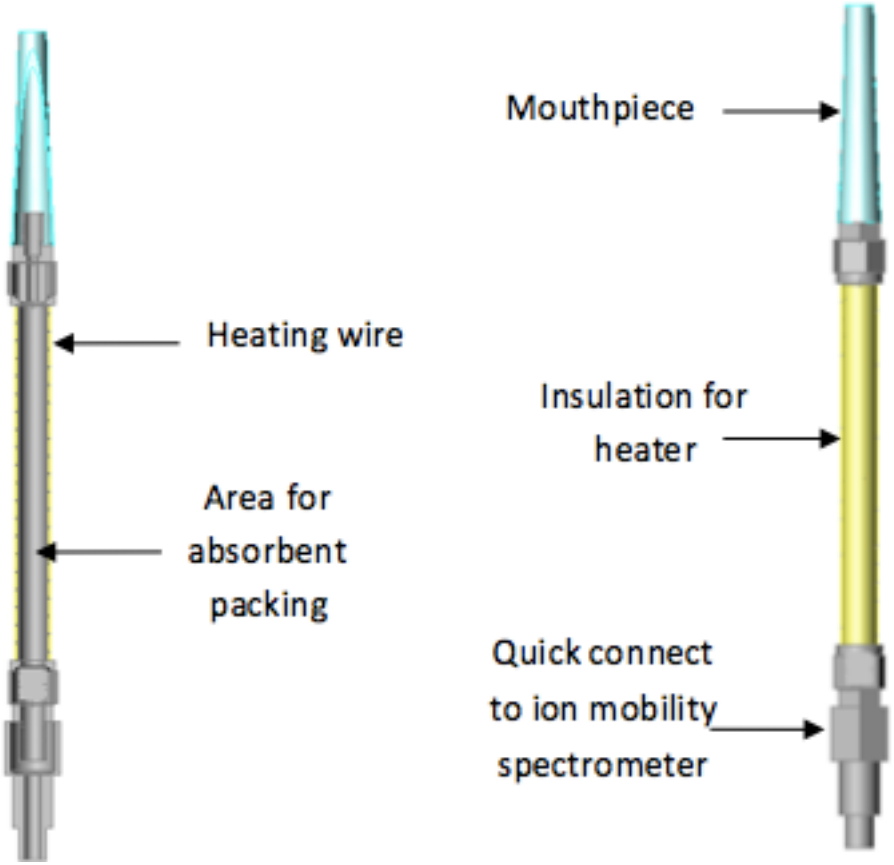
WSU: Hill Laboratory



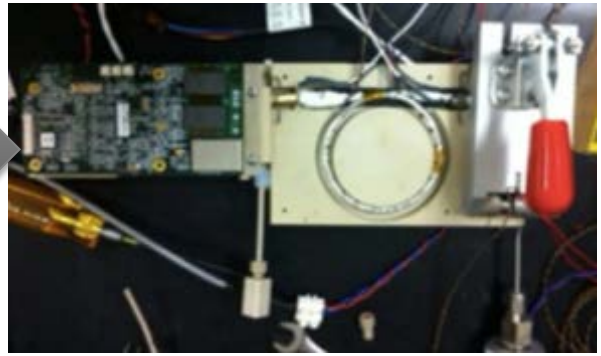
Two different IMS systems in the Hill lab





DTIMS

GC-DMS



DMS

Conclusions

- Drugs can be detected in Breath using Solid Phase Adsorption (SPA) technologies.
- Drugs can be transferred from adsorbents to IMS by thermal desorption (TD)
- Ion Mobility is a proven screening technique for Explosives, Drugs, and CWAs

By combining SPA-TD-IMS we can develop a light portable hand-held screening device for drugs.

LAB STUDIES MOVING TO FIELD TESTING: Breath-to-Blood correlation and in-field detection (staff & police)

Questions?