SOUTHERN ILLINOIS UNIVERSITY
EDWARDSVILLE

Portable Electrothermal Atomizer

- **Portable electrothermal elemental analyzer for clinical applications**
- *Southern Illinois University Edwardsville*

- Brad Noble

  Associate Professor
  School of Engineering

- Edward Navarre

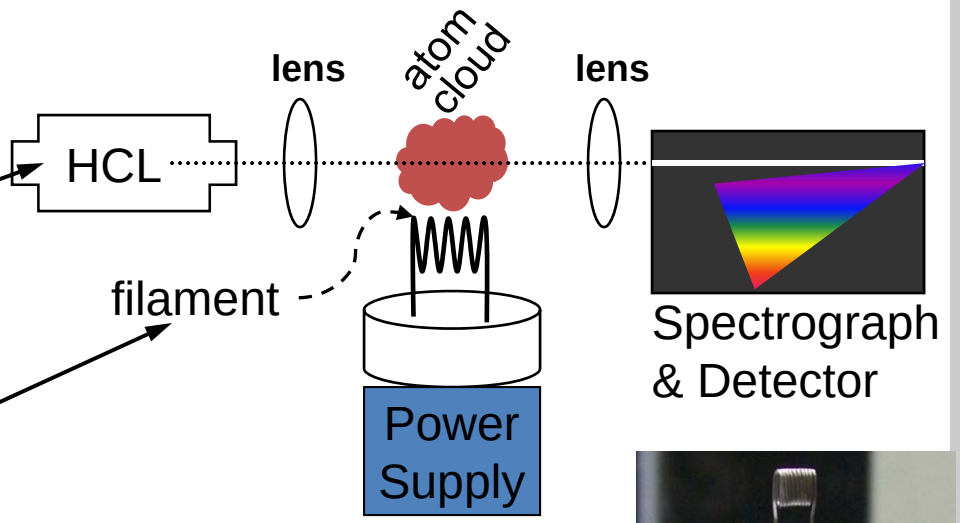
  Assistant Professor
  College of Arts and Sciences

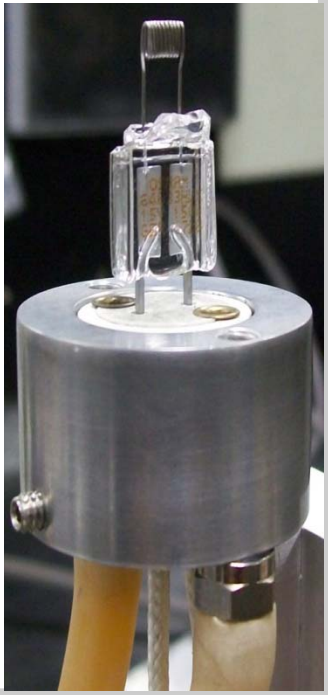
Technology Summary

- **Measures elemental content**: atomizes liquid sample, automatically compensates for sample/instrumental changes
- Developed by:
  - Dr. Brad Noble, Associate Professor, Electrical and Computer Engineering, SIUE School of Engineering
  - Dr. Edward Navarre, Assistant Professor, Chemistry, SIUE College of Arts and Sciences
- Portable instrument designed for field work
  - Public health screening – toxic metals screening (Pb, Cd, Cr, Ba)
  - Inexpensive instrument for non-routine analysis
- Seeking technology licensing opportunities

Technology Details

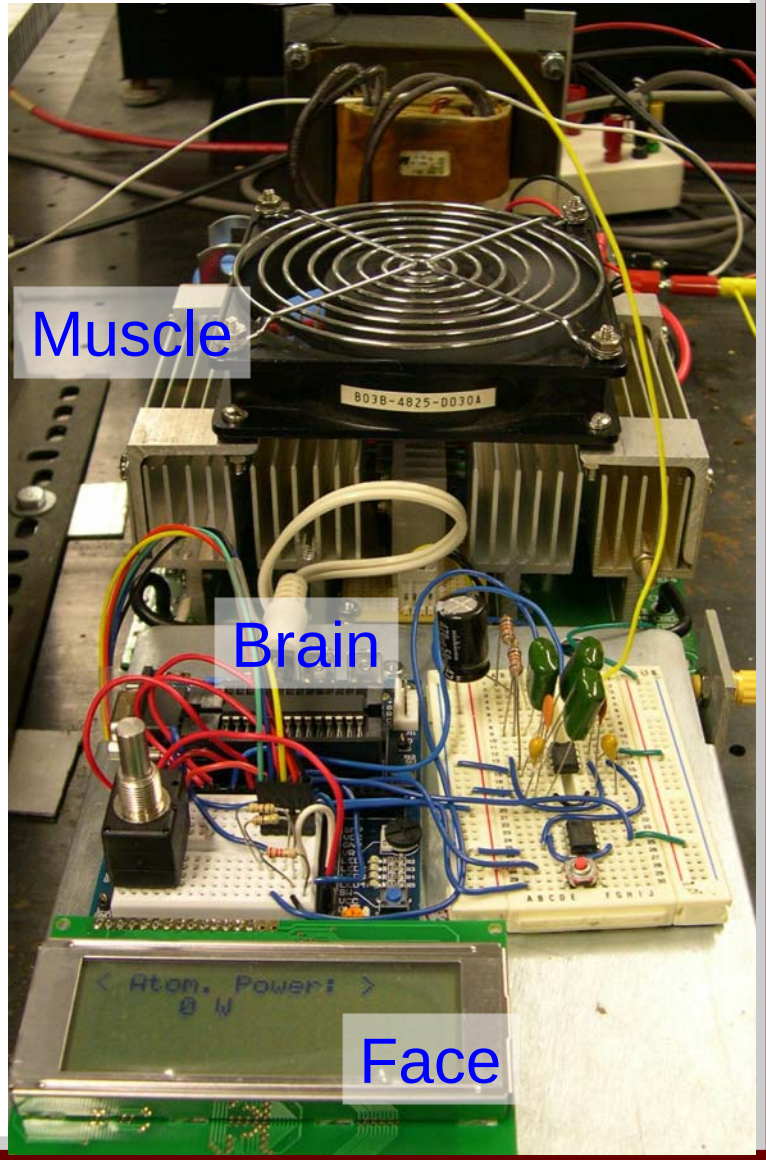
- Atomic Absorption Spectrometer
- Hollow cathode lamp emits element-specific wavelengths
- Tungsten filament atomizes microsample
- Mini-spectrograph detection
- Power-mode control of filament
- Microcontroller for heating and feedback
  - All features and control on the power supply
  - No computer required for basic functions





Technology Details

- Temperature $\propto$ Power
- Neither *v* nor *i* are $\propto$ temperature
- Filament resistance is *dynamic* and changes with new filament
- Old *versus* new filament:
  - 3% higher voltage & 3% lower current
  - **1% difference in power**
- Beyond feedback – intelligent power supplies
  - ***v*** & ***i*** marks end of drying
  - Sample mass / volume estimation
- "One-shot" analysis for selected sample types (e.g., blood, urine)



Brief History

- **1972** 1st tungsten filament AAS experiment
- **1975** 1st and *only* power-mode filament system (PDP 8)
- **1988** filament mounted on FAAS instrument (inexpensive add-on)
- **1990** filament as sample introduction device
- **1995** first prototype instrument (never commercialized)
- **1996** prototype of battery powered instrument (never commercialized)

How do we succeed? What's our advantage?

Exploit advances in:

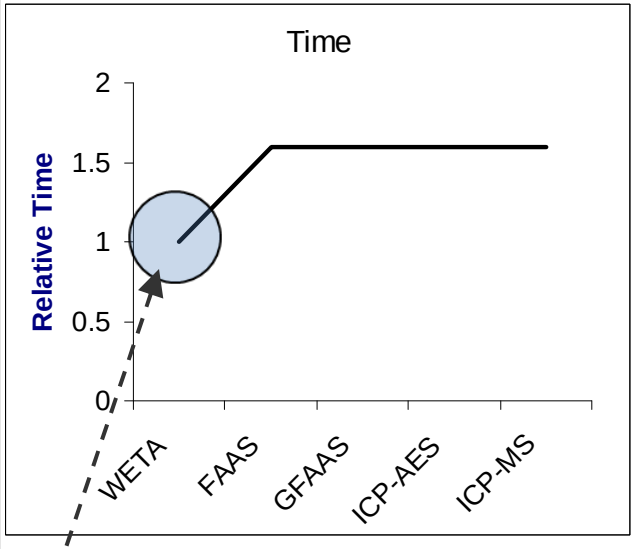
- Microcontrollers
- Detectors
- Power conversion

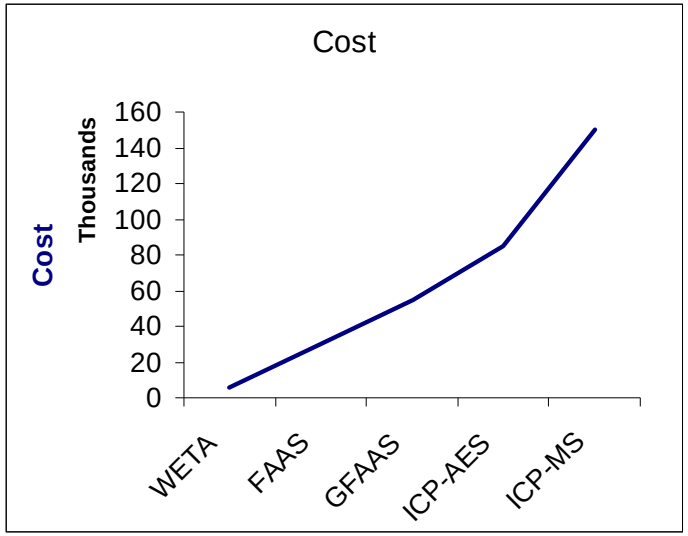
The Competition

- No similar technology available. Only prototypes.
- Traditional instruments
  - are resource intensive
  - are not portable

- One competitor
  LeadCare II from *Magellan Biosciences*
  Only a blood lead analyzer. Requires major R&D to analyze other elements. Uses mercury.

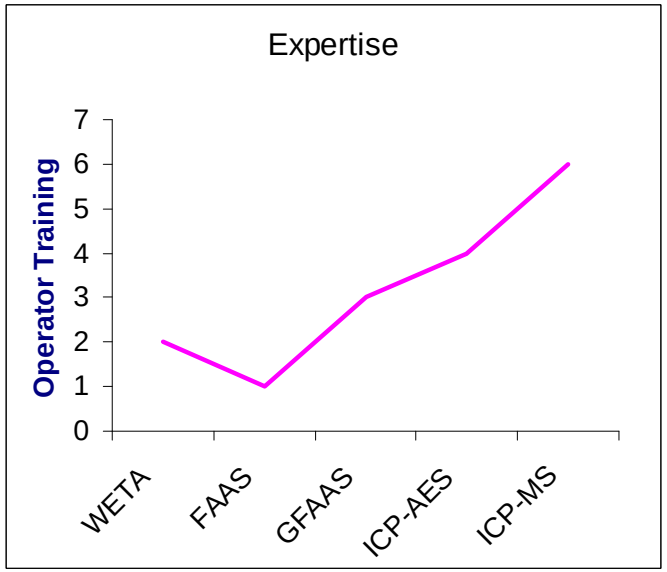
Cost and Performance

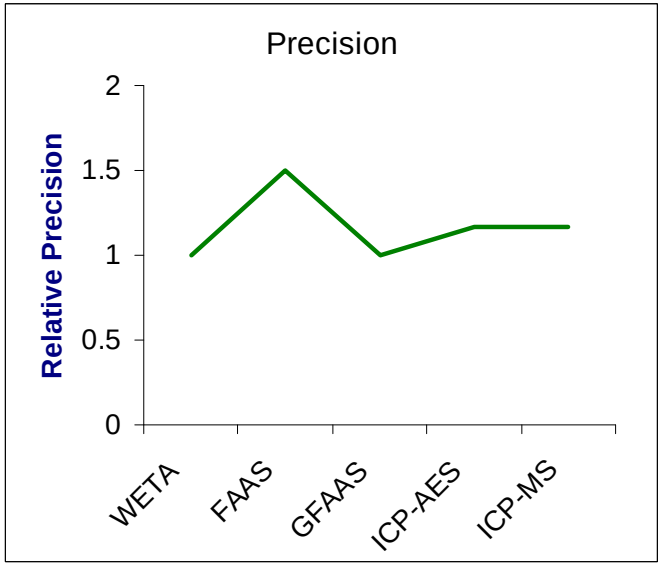




Target cost < $10k

Measure on-site !





Current Developmental Status

- Progress to date
  - Power-mode control completed (v.1)
  - Currently used in lab for AAS studies
  - Data collection for drying and “one-shot”
- Developmental hurdles
  - Verification of absolute measurement
  - $75,000 to build version 2 with a hybrid PS
    - Smaller, more efficient
    - Implement sample sensing and automation
    - Analytical methods – field methods

Technology Market

- Market
  - Clinics, hospitals, field work, small industry
  - Outside the U.S. – can't afford >$30k for an instrument (e.g., areas of South America, Africa, and Asia)
  - Teaching laboratories (low-cost)
- Public health impact
  - (U.S.) 250,000 children with elevated blood lead levels *
  - Active lead paint production in 12 countries
  - 29 product recalls in 2009 for excess lead #
  - 12 million drinking glasses with excess cadmium (2010)

* 2007 CDC data
# 2009 CPSC data

Technology Opportunities

- Instrument target:

  public health monitoring of toxic metals

  - Blood and urine (Pb, Cd, Cr, Ba)
    - Hospitals
    - Foundries, factories
    - Public works departments (drinking/waste water)
  - Residential and commercial paint
    - Public works (I-64 bridge repair in St. Louis)
    - Lead abatement programs
    - Customs inspection

Technology Opportunities Cont'd

- Additional markets
  - Field work – environmental analysis of water
  - Small industry – low investment
  - Police and art preservation
  - Worldwide governmental labs
- Stand-alone or add-on for Flame AAS
  - U.S. small college
  - Worldwide educational institutions

Intellectual Property Protection

- Technology is available for licensing

  Innovations
  - Process automation
  - “One-shot” analysis
  - Portability

- Hardware will be commodity parts (low-cost)

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- For more information:
  - Call or email
    - Edward Navarre: enavarr@siue.edu
    - Brad Noble: bnoble@siue.edu
    - Christa Johnson: cjohnaa@siue.edu
- Questions?