

# A Mass Spectrometer for Elemental Analysis Based on Fieldable Technologies

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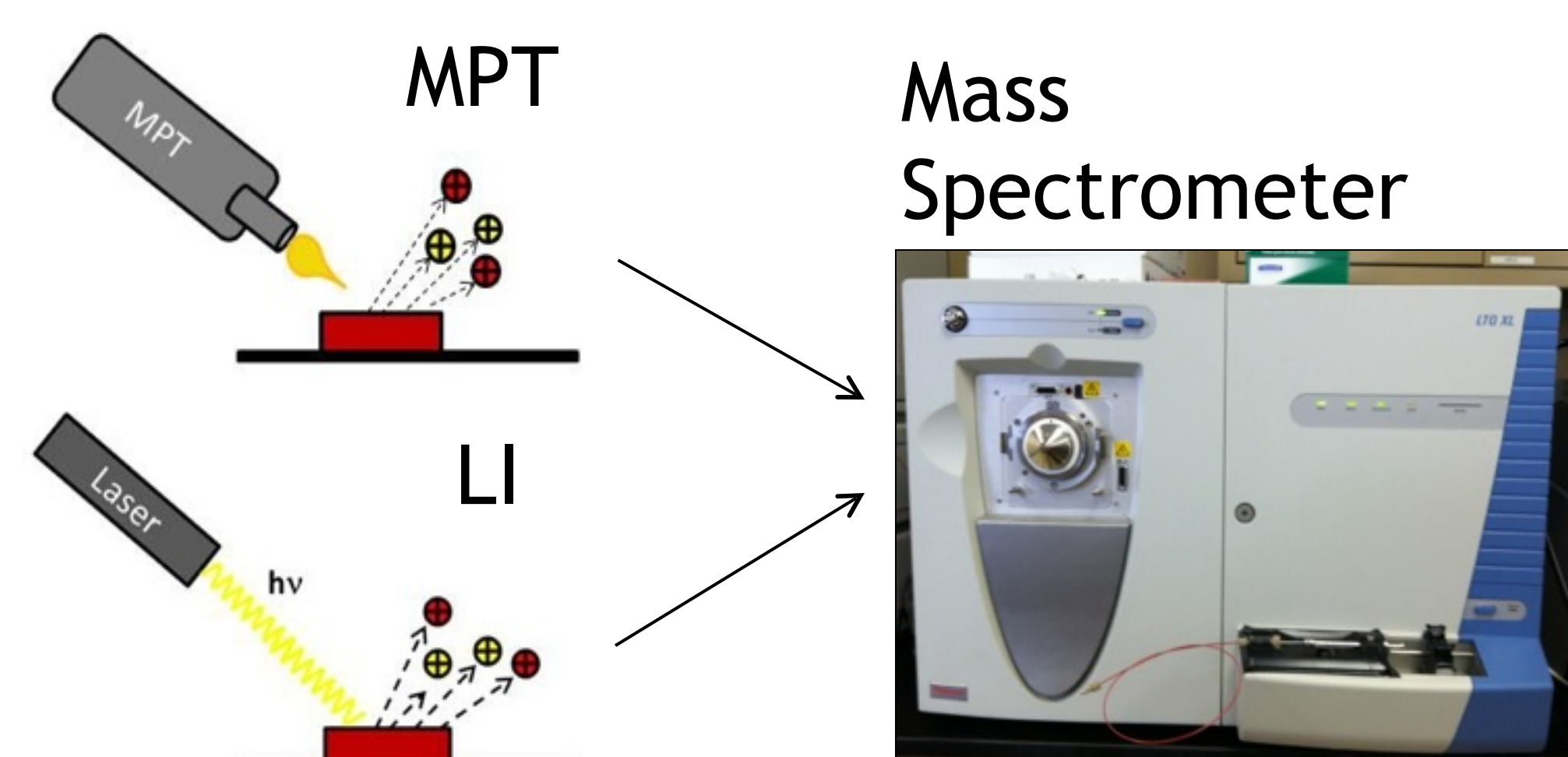
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## Introduction

- Laser ablation (LA) can facilitate direct analysis of solid samples for mass spectrometry (MS), and is often coupled with an inductively coupled plasma torch (ICP).
- LA-ICP-MS is now widely used for accurate elemental and isotopic analysis; however, the technique is not fieldable, primarily due to the gas and power requirements of the ICP torch. A similar plasma torch, the microwave plasma torch (MPT) is fieldable.
- MPTs, laser ablation and ion trap mass spectrometers can be incorporated into portable instruments
- Complementary ambient ionization sources, microwave plasma torch (MPT) and laser ionization (LI), were coupled to a mass spectrometer

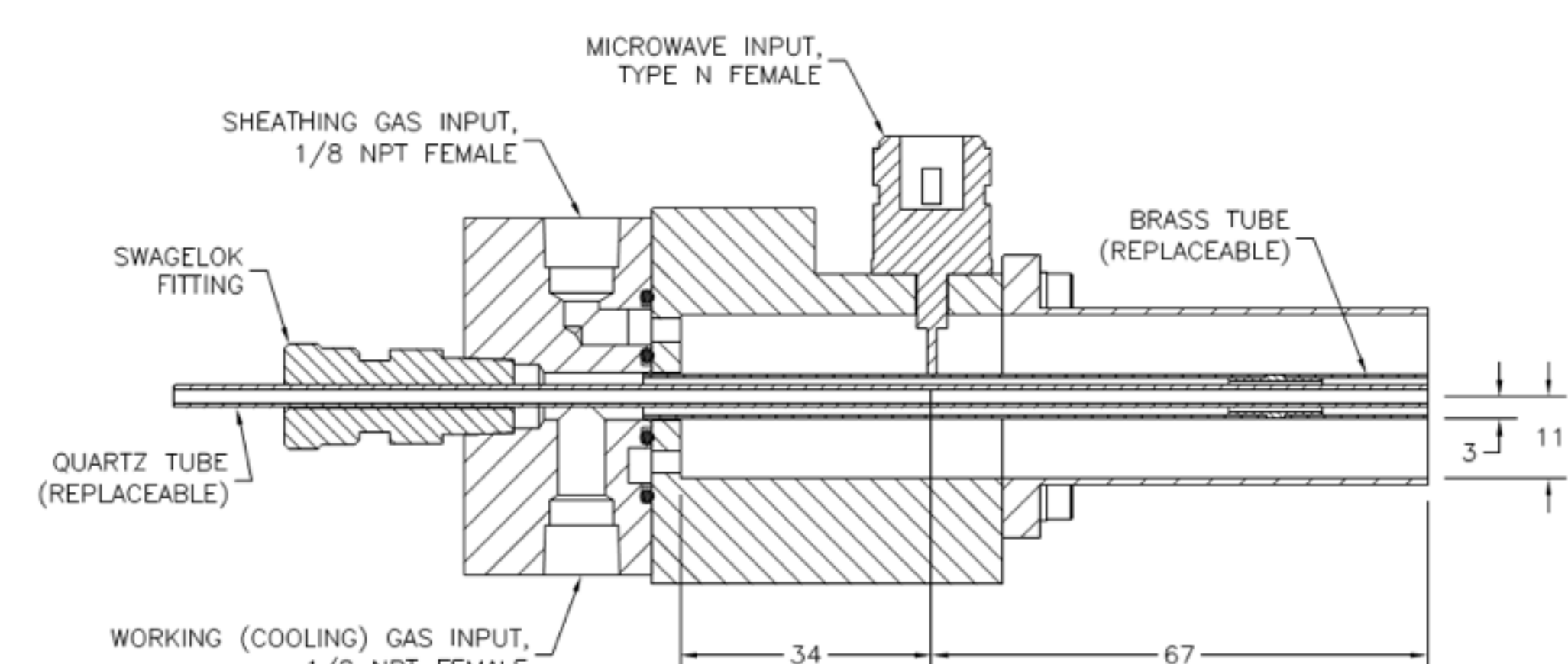
## Ambient Ionization Techniques



- Microwave Plasma Torch (MPT) uses a high temperature plasma to ionize solid samples
- Laser ionization (LI) uses a high-energy laser to ablate and ionize solid samples

## Instrumentation

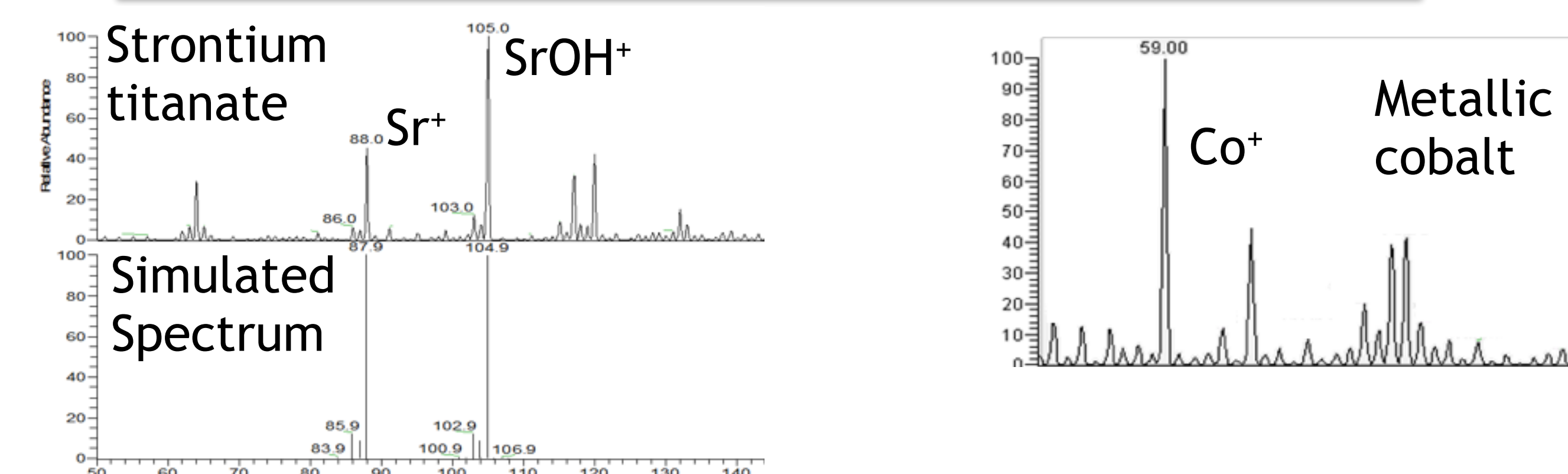
- Thermo LTQ XL Linear Ion Trap Mass Spectrometer
- GAM EX100H KrF Excimer Laser, 248 nm, 100 mJ output, 100 Hz
- Custom Microwave Plasma Torch (MPT)



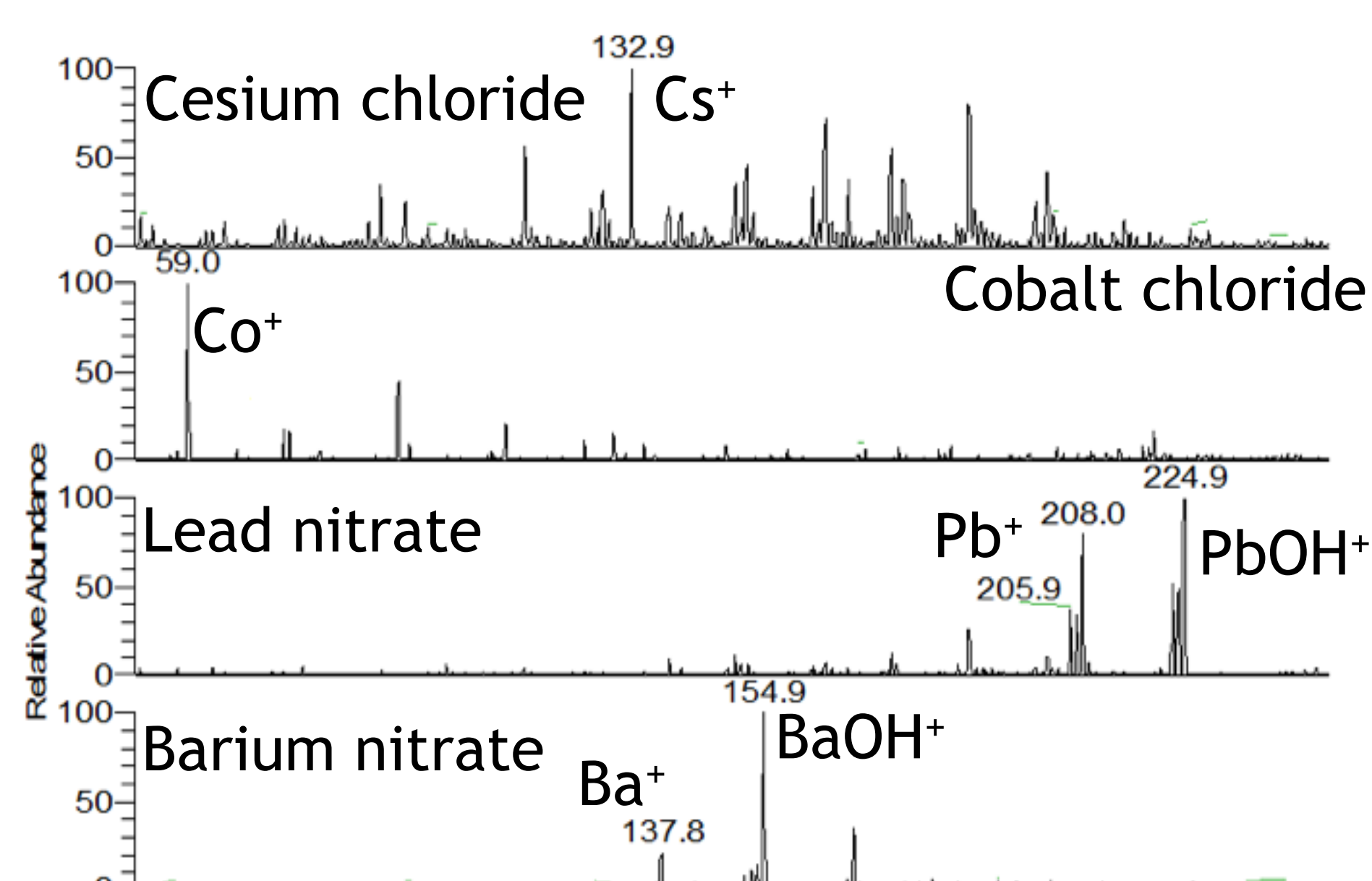
MICROWAVE PLASMA TORCH

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## Laser Ionization of Refractory Materials

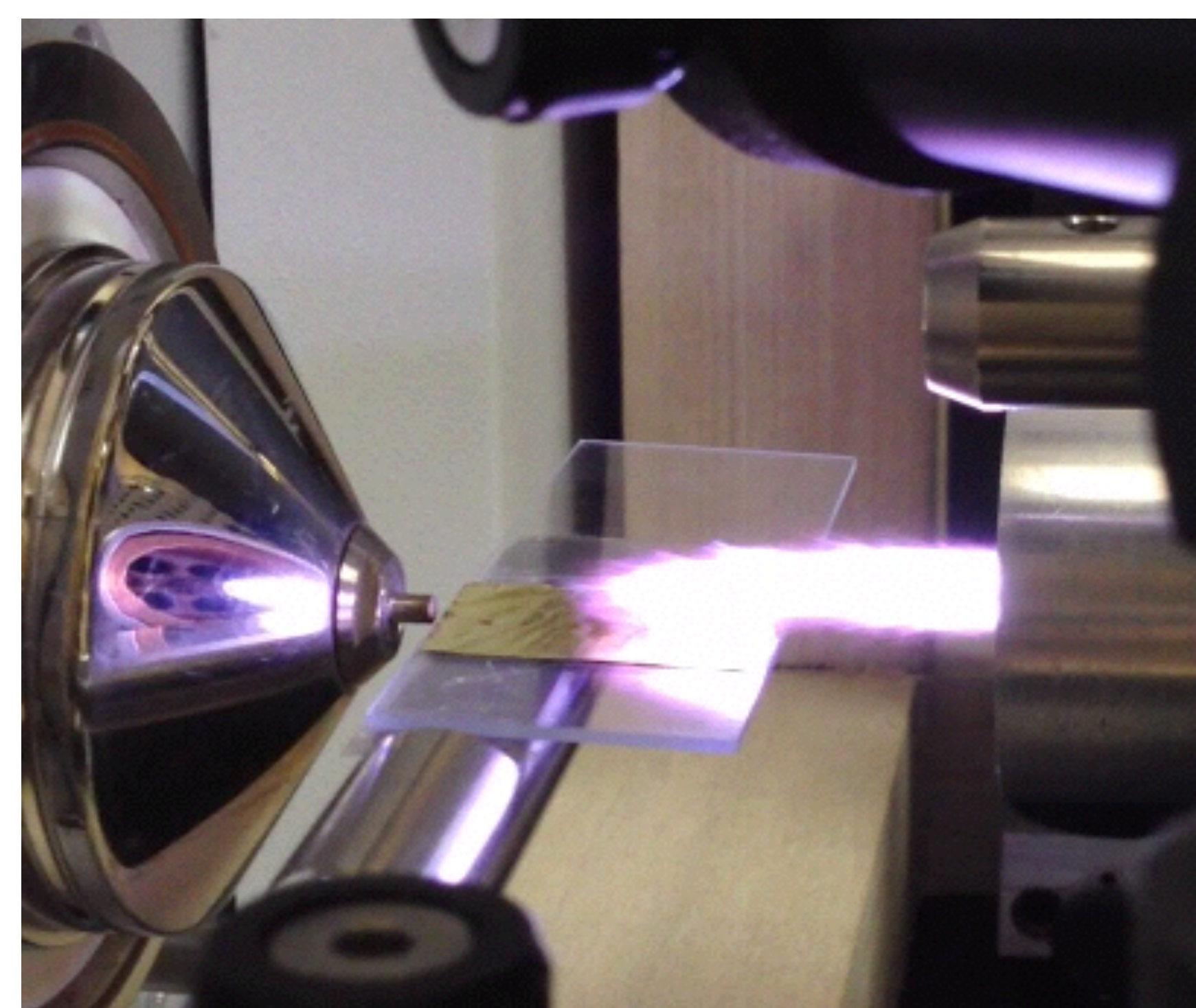
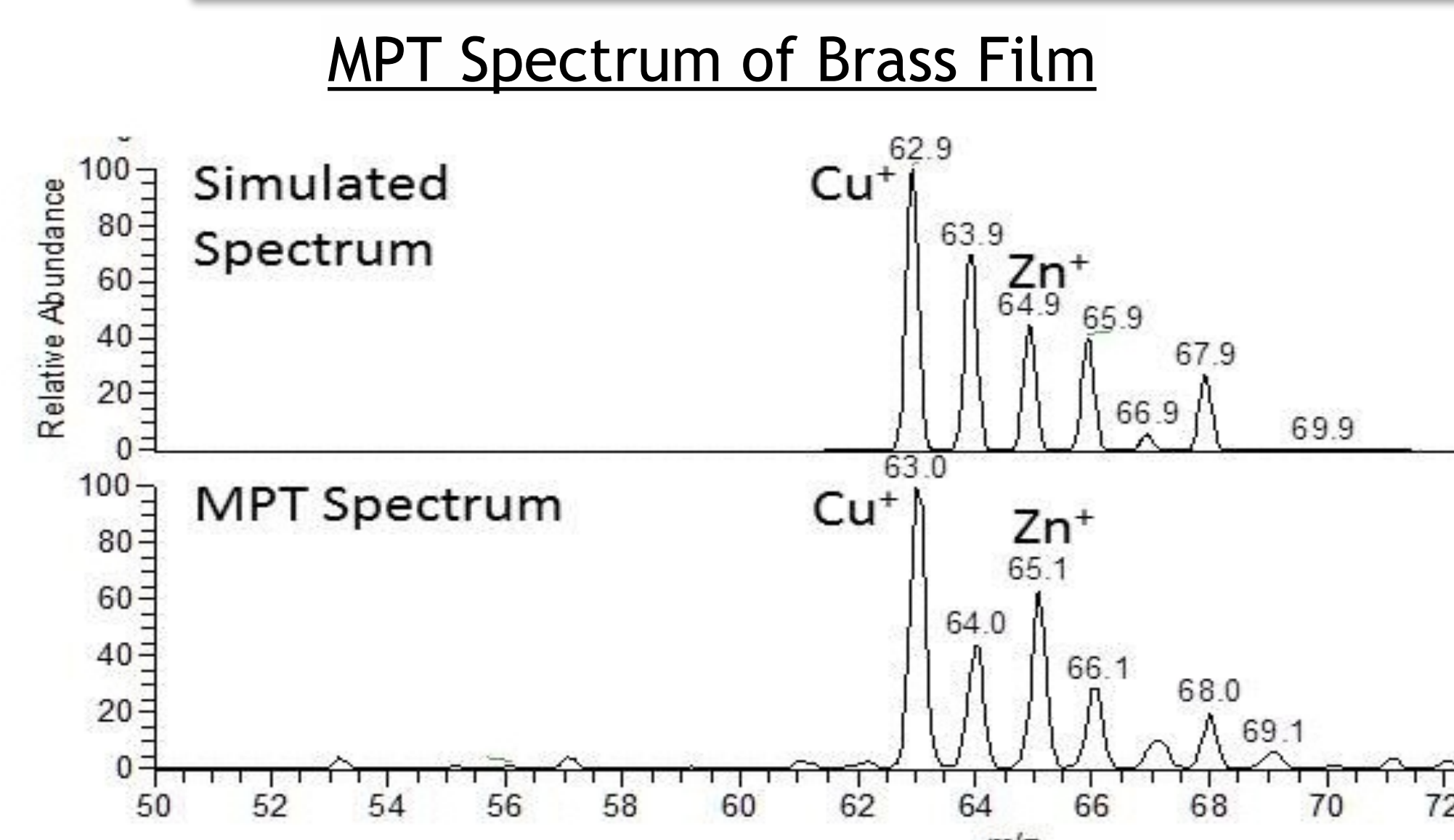


- Refractory/Solid materials (spectra above) as well as solid salts (spectra below) were detected using LI-MS



- Helium sheath gas was used to reduce noise
- Without sheath gas, laser-ionized atmospheric gases yielded significant noise

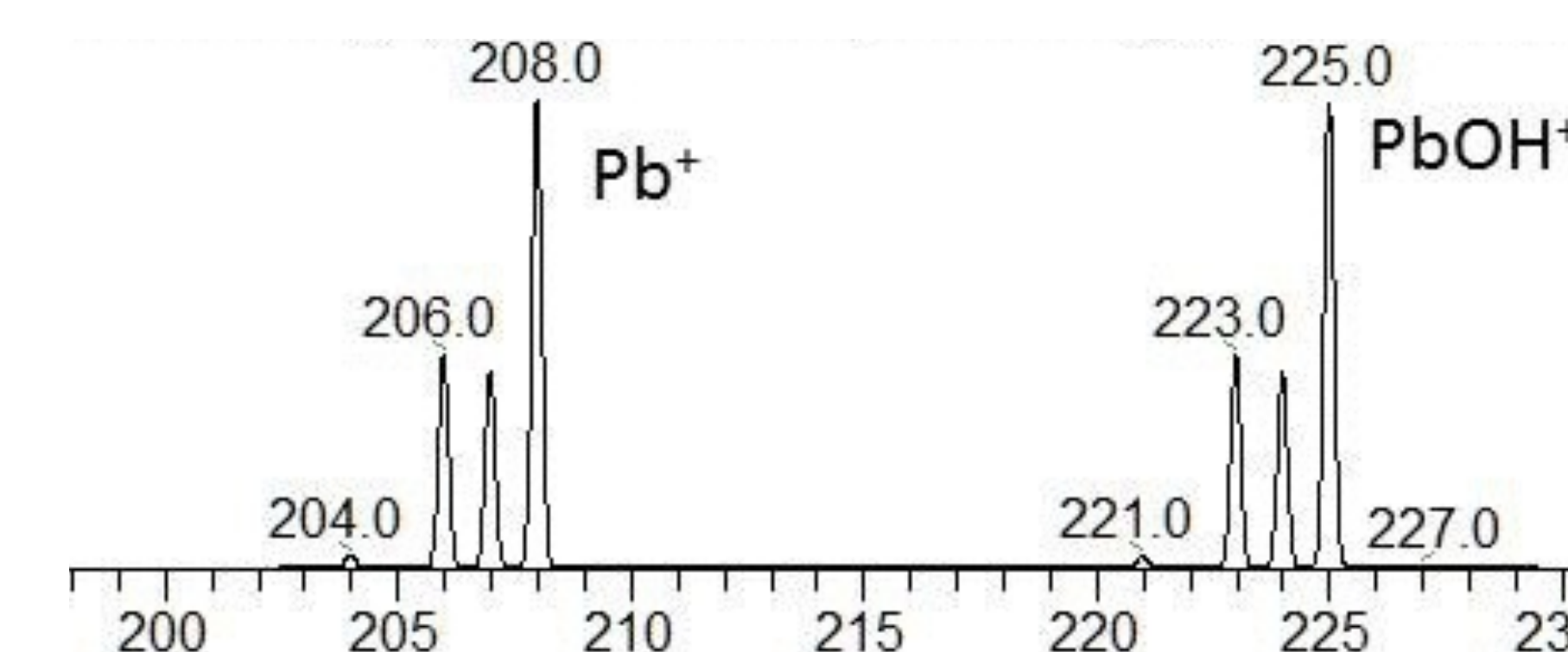
## Microwave Plasma Torch (MPT) Ionization



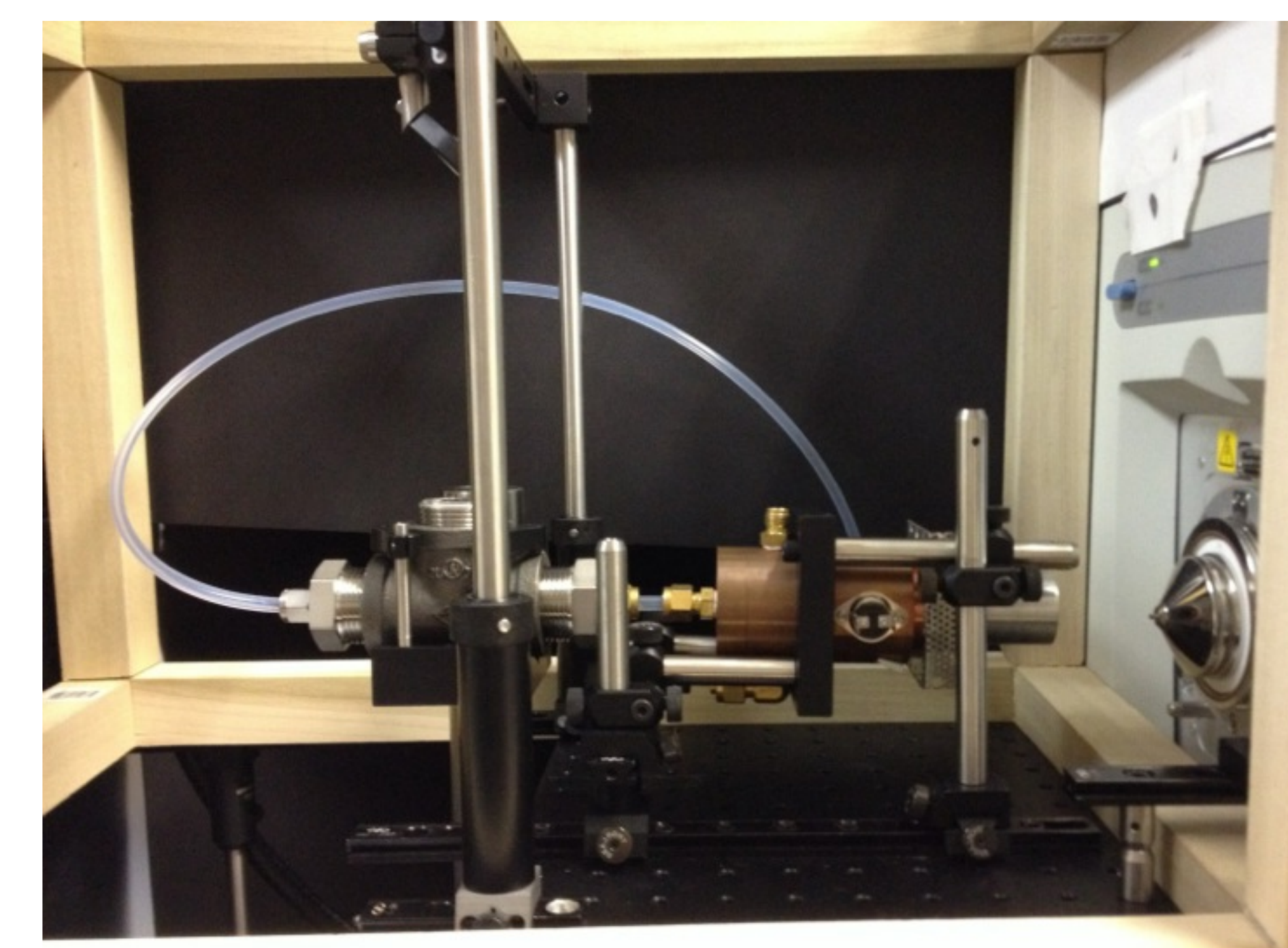
- MPT used as an ambient elemental ionization source
- Brass film and Lead sinker were held in front of the MPT

## MPT Ionization Cont'd

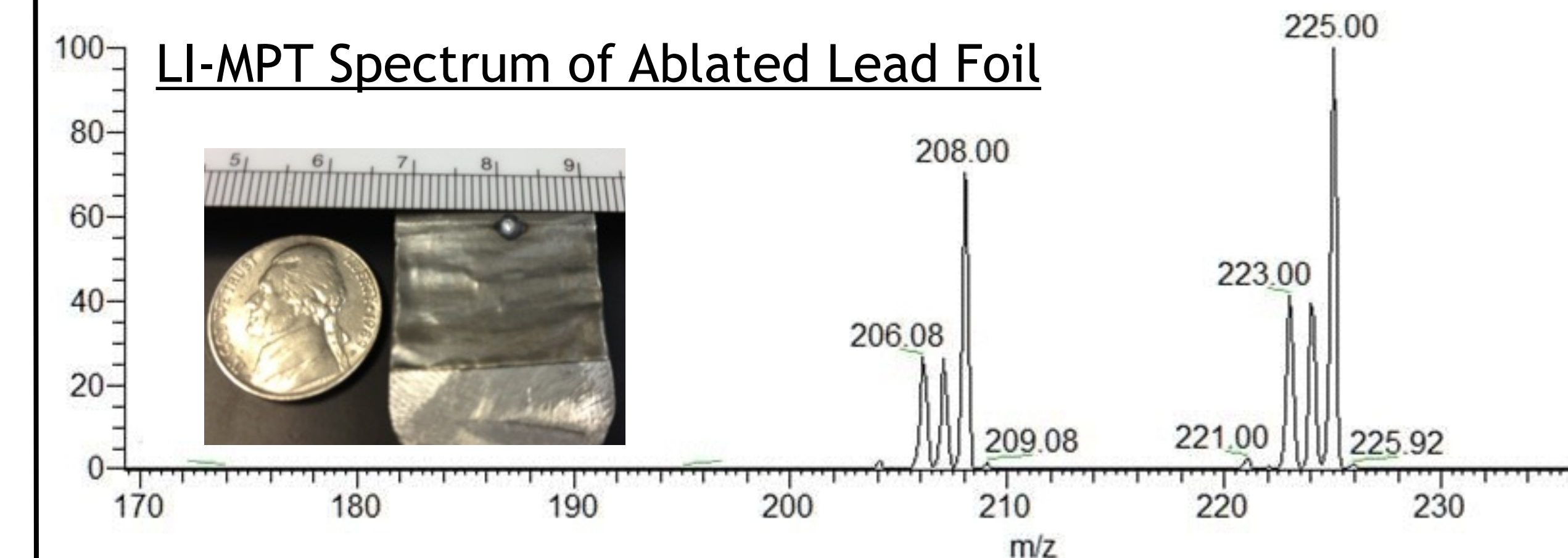
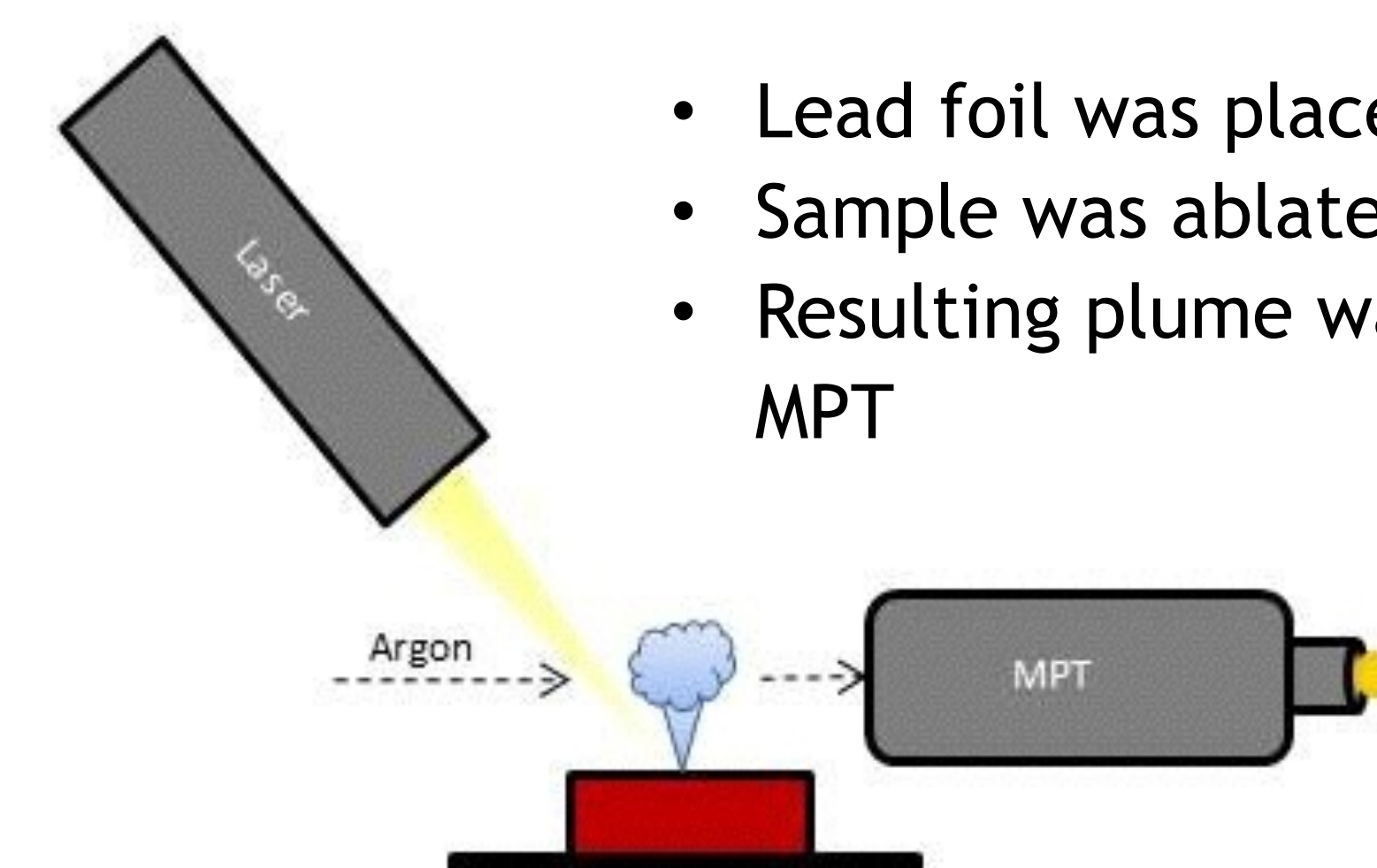
MPT Spectrum of Lead Fishing Sinker



## Laser Ionization Coupled with Microwave Plasma Torch (MPT) Ionization



- Lead foil was placed inside sample cell
- Sample was ablated by the laser
- Resulting plume was pushed into the MPT

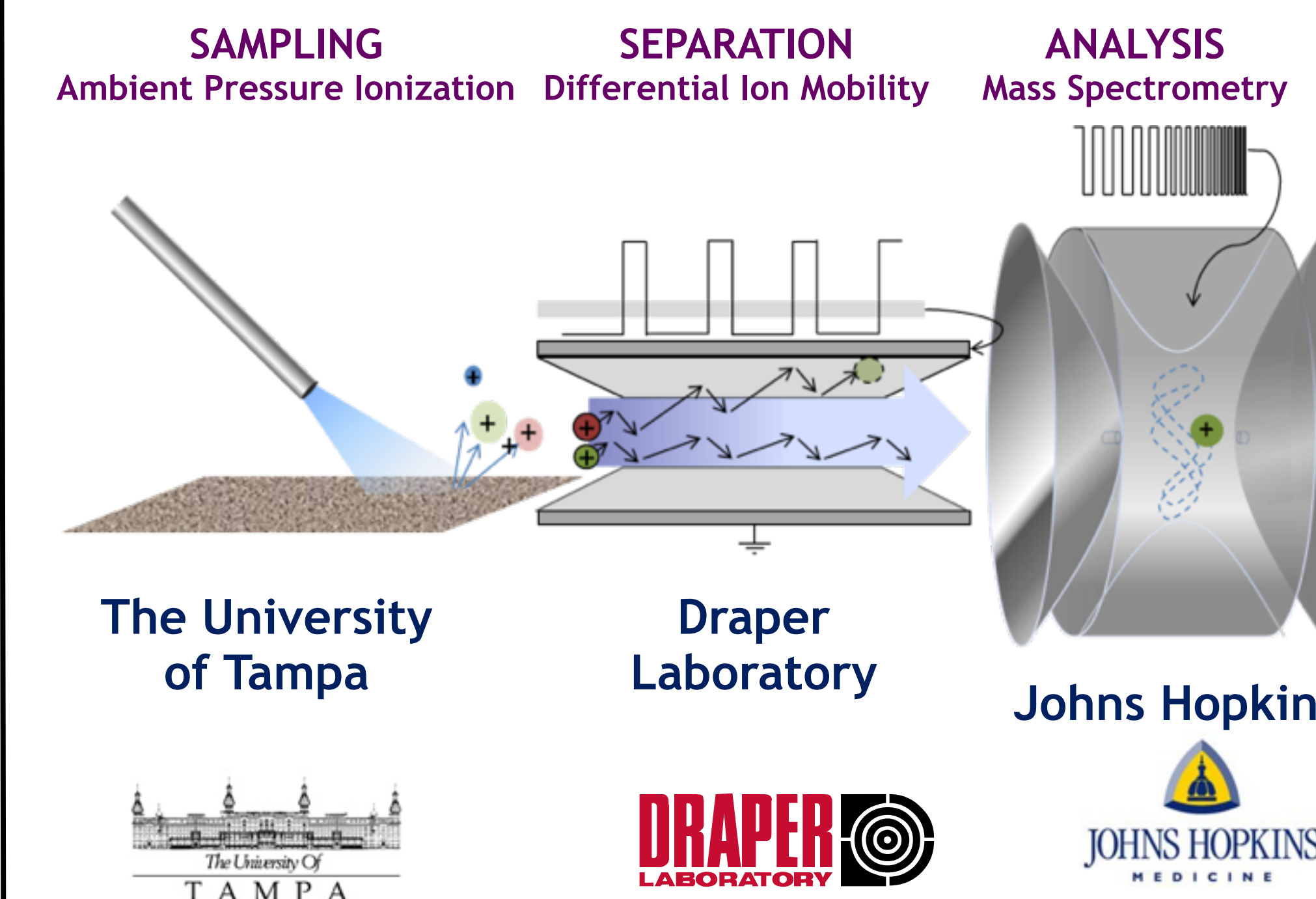


## Conclusions

- Laser ionization is a viable technique used to detect insoluble materials and refractory compounds.
- MPT ionization can be used as an ambient ionization source for producing elemental and isotopic information
- LI-MPT-MS provided increased signal and enhanced sensitivity compared to LI and MPT separately
- LI-MPT-MS is a viable alternative to LA-ICP-MS direct for elemental and isotopic analysis of solid materials with portable instruments

## Future Work

- Develop a multi-mode source coupling LI-MPT with DART and/or DESI
- Simultaneous or near-simultaneous molecular and elemental mass spectrometry with fieldable technologies
- Development of a field-portable high resolution ion trap mass spectrometer coupled to a differential mobility filter and a multimode ambient ionization source



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