

MONITORING CLANDESTINE ACTIVITIES BY THE MINI 12

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WHY IS PORTABLE INSTRUMENTATION IMPORTANT IN FORENSICS ?

Immediate results

- Expedited criminal investigations
- Providing timely information to law enforcement and forensic practitioners

Results obtained directly

- Decrease chair
- Reduce sample
- Alleviate the ne

TABLE 6

Requests for services backlogged in publicly funded forensic crime labs, by type of request, year end 2009 and 2014

Type of request	2009		2014	
	Number	Percent	Number	Percent
All requests	895,500	100%	570,100	100%
Controlled substances	139,200	16	213,700	37
Digital evidence	1,600	--	7,800	1
Firearms/toolmarks	48,300	5	51,100	9
Forensic biology casework	103,500	12	107,800	19
Forensic biology from convicted offender/arrestee samples	502,500	56	64,800	11
Impressions	6,100	1	2,400	--
Latent prints	49,500	6	69,400	12
Questioned documents	2,600	--	800	--
Toxicology	27,600	3	40,000	7
Trace evidence	14,700	2	12,200	2

Note: A request is classified as backlogged if it was not examined and reported to the submitting agency within 30 days of submission. Totals exclude requests outsourced to other labs. Numbers are rounded to the nearest hundred. Detail does not sum to total due to rounding. See appendix table 6 for standard errors.

--Less than 0.5%.

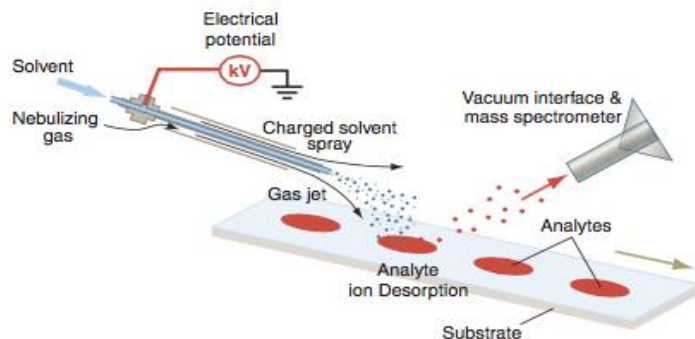
Source: Bureau of Justice Statistics, Census of Publicly Funded Forensic Crime Laboratories, 2009 and 2014.

te laboratories

AMBIENT IONIZATION DEVELOPMENTS

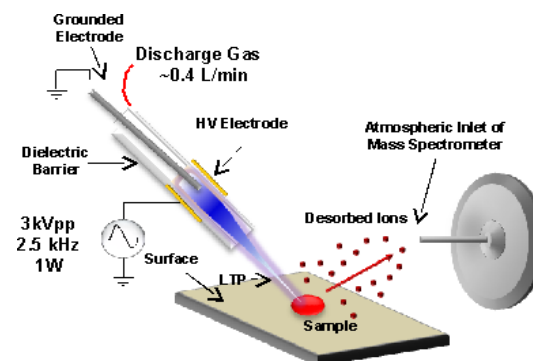
Desorption ElectroSpray Ionization (DESI)

R. G. Cooks, Science, 2004



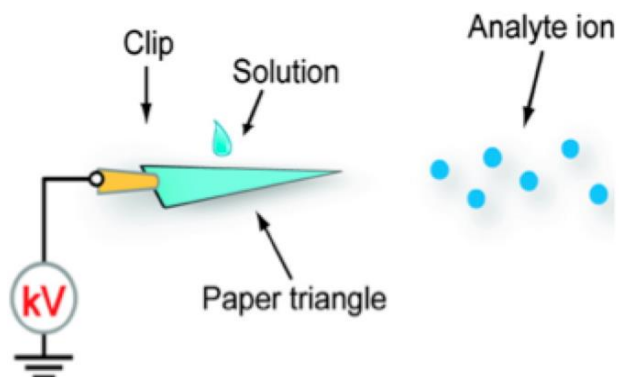
Low Temperature Plasma (LTP)

R. G. Cooks, Analytical Chemistry, 2008



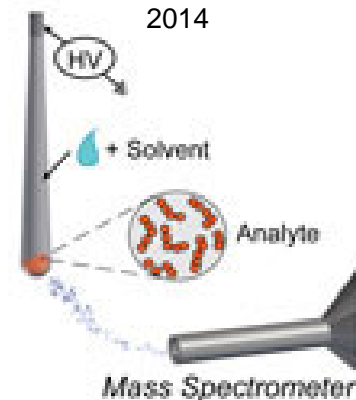
Paper Spray Ionization (PS)

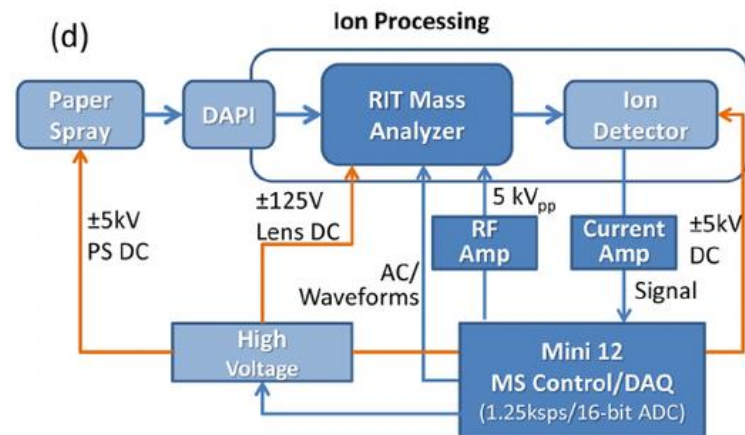
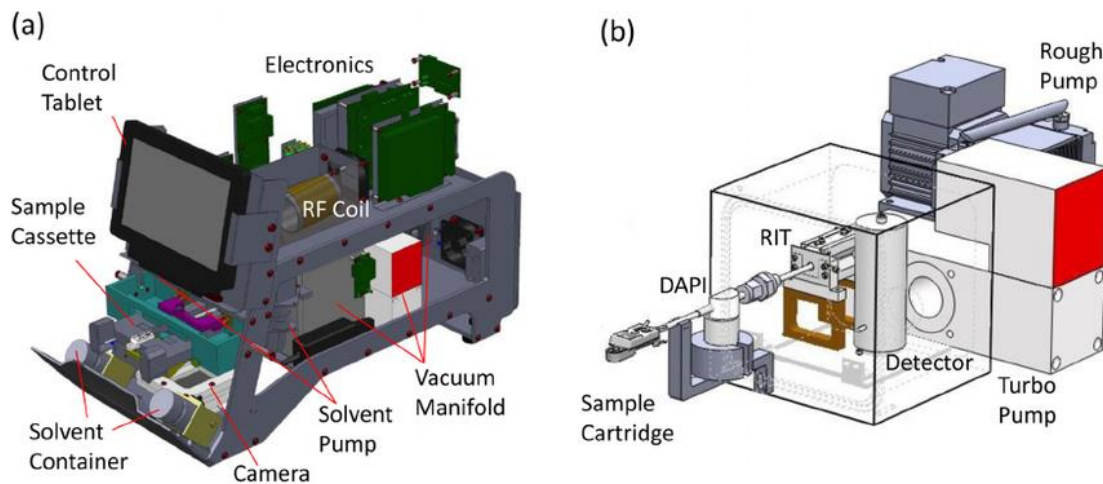
R. G. Cooks, Analytical Chemistry, 2010



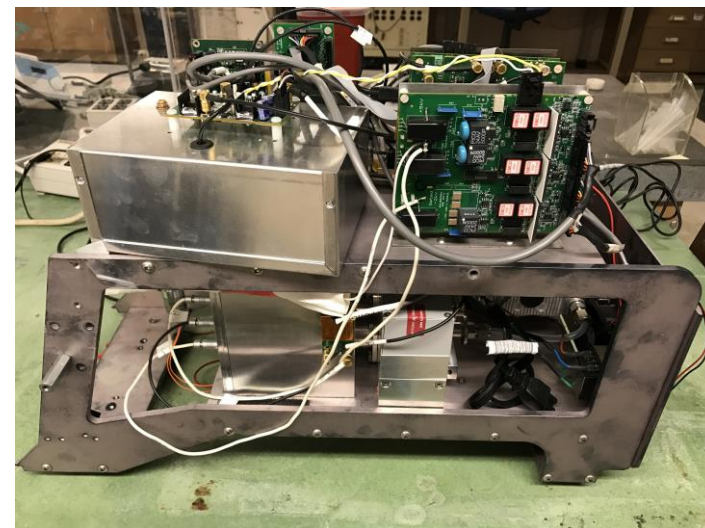
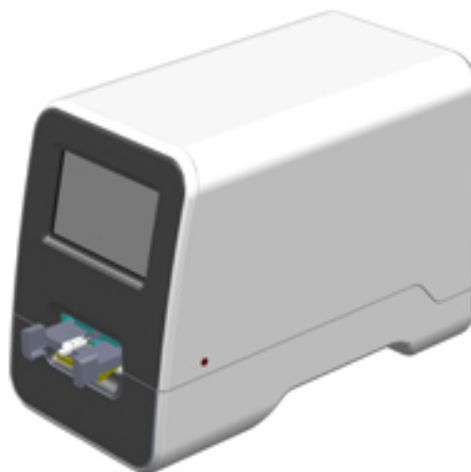
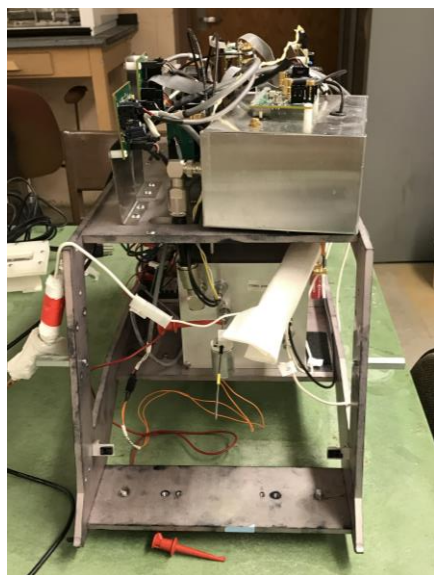
Swab Touch Spray (TS)

R. G. Cooks, Analyst, 2014





Anal. Chem., (2014) **86**, 2909–2916. DOI: 10.1021/ac403766c



THREE VIGNETTES

Mini 12 Mass
Spectrometer

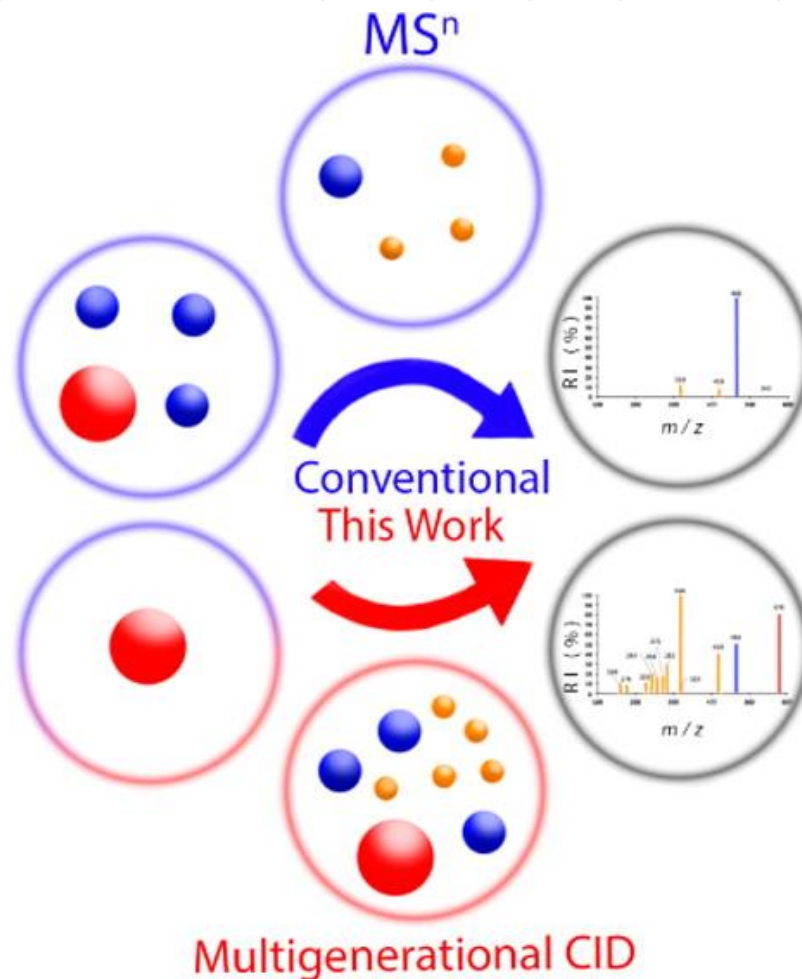
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graph TD; A[Mini 12 Mass Spectrometer] --> B[Multigenerational CID]; A --> C[Organic Gunshot Residue Analysis]; A --> D[Paper SERS Raman Spectroscopy followed by MS];
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Multigenerational
CID

Organic Gunshot
Residue Analysis

Paper SERS
Raman
Spectroscopy
followed by MS

MULTIGENERATIONAL COLLISION-INDUCED DISSOCIATION FOR CHARACTERIZATION OF ORGANIC COMPOUNDS



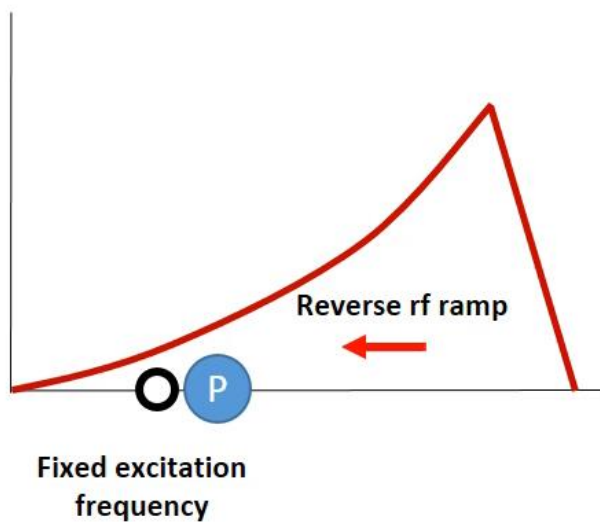
SOFTWARE - FULL CONTROL

0	1	2	SWIFT	COOL	CID2	2.5	3	4	smooth	pkdetect
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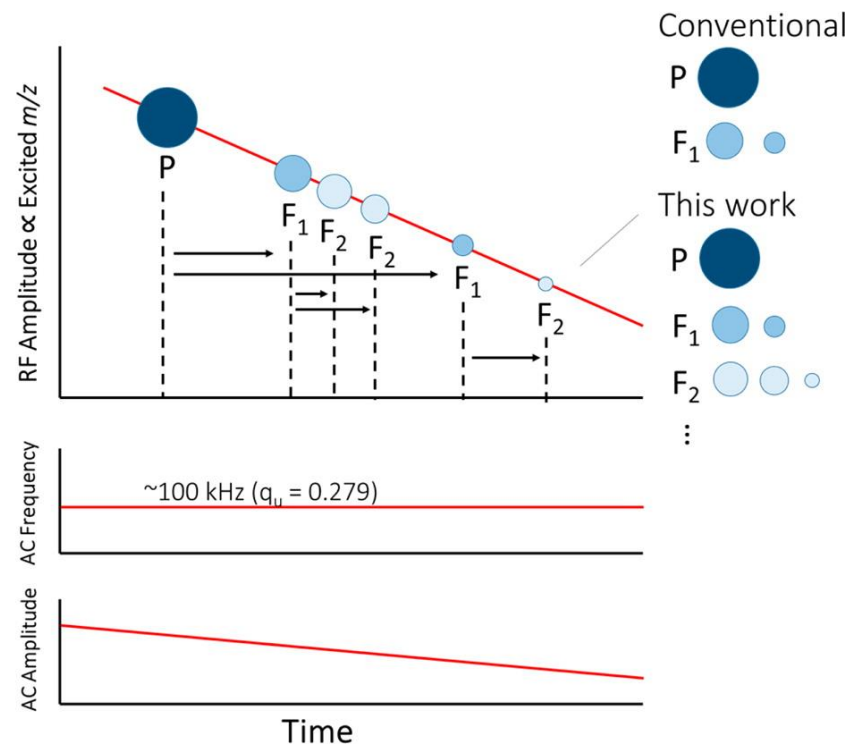
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<input type="text" value="5000"/>	RF Peak Amplitude	<input checked="" type="radio"/>	Swift 1	<input type="text" value="100"/>	Swift Amplitude
<input type="text" value="0"/>	AC Start Voltage	<input type="radio"/>	Swift 2	<input type="text" value="0"/>	% of Full Scale
<input type="text" value="0"/>	AC End Voltage	<input type="radio"/>	Swift 3		Number of times
<input type="text" value="0"/>	AC Peak Amplitude	<input type="radio"/>	Swift 4		to repeat Swift...
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<input type="text" value="35000"/>	RIT Z Voltage				
<input type="text" value="35000"/>	Gate Voltage				

MULTIGENERATIONAL CID

a

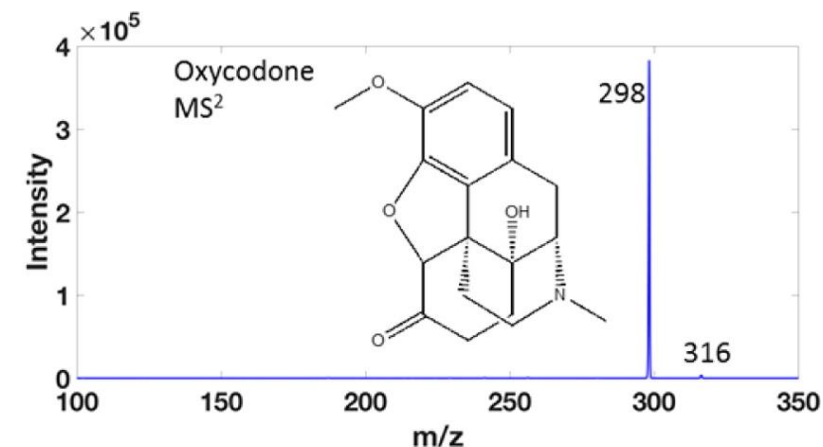


q

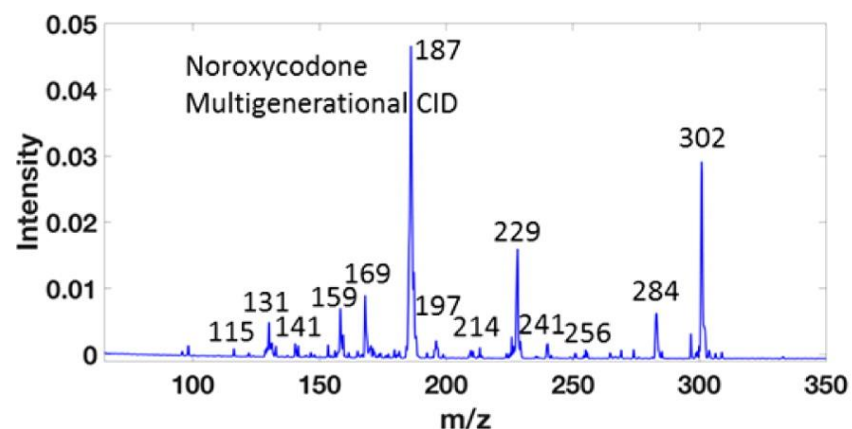
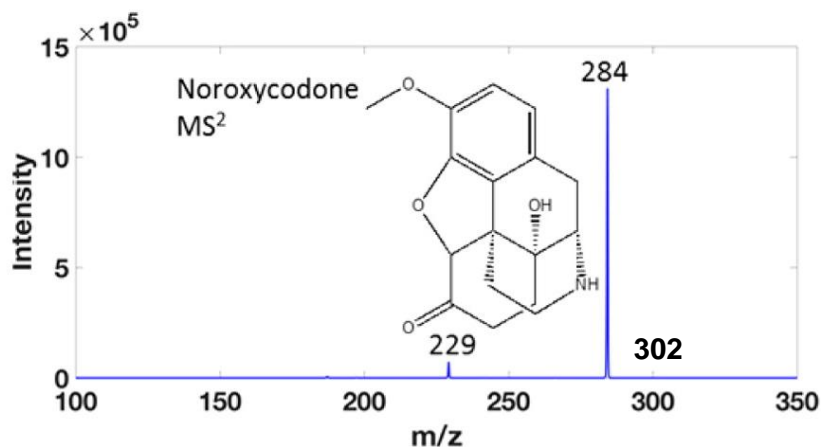
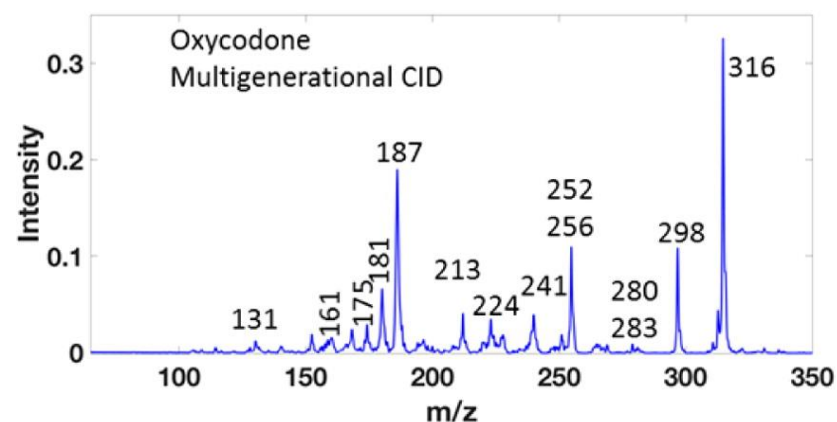


COMPOUNDS THAT LOSE H₂O IN MS²

Conventional CID on the LTQ

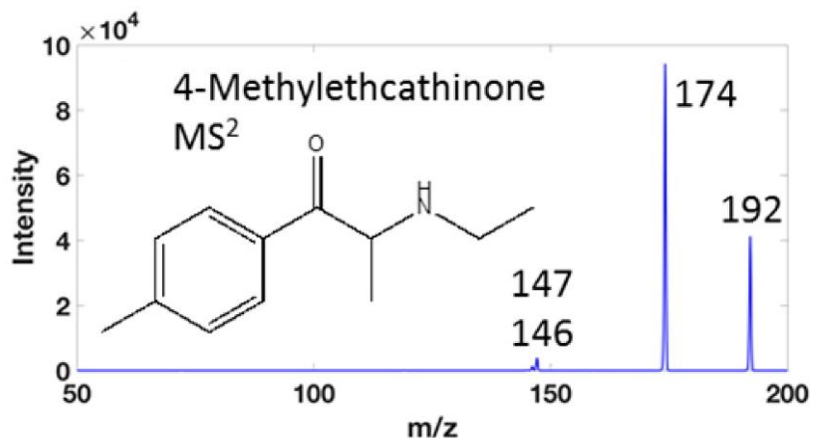


Multigenerational CID on the Mini 12

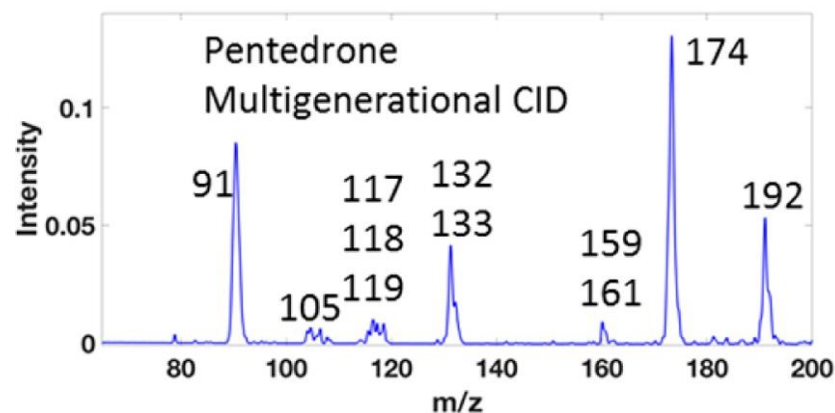
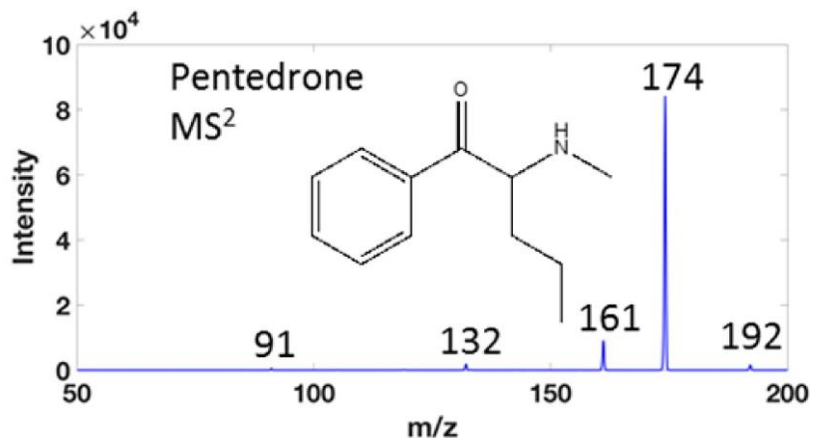
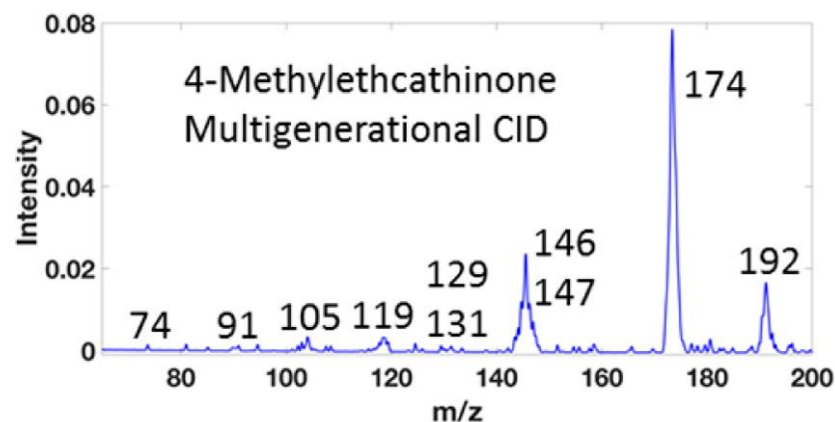


ISOMERIC CATHINONES

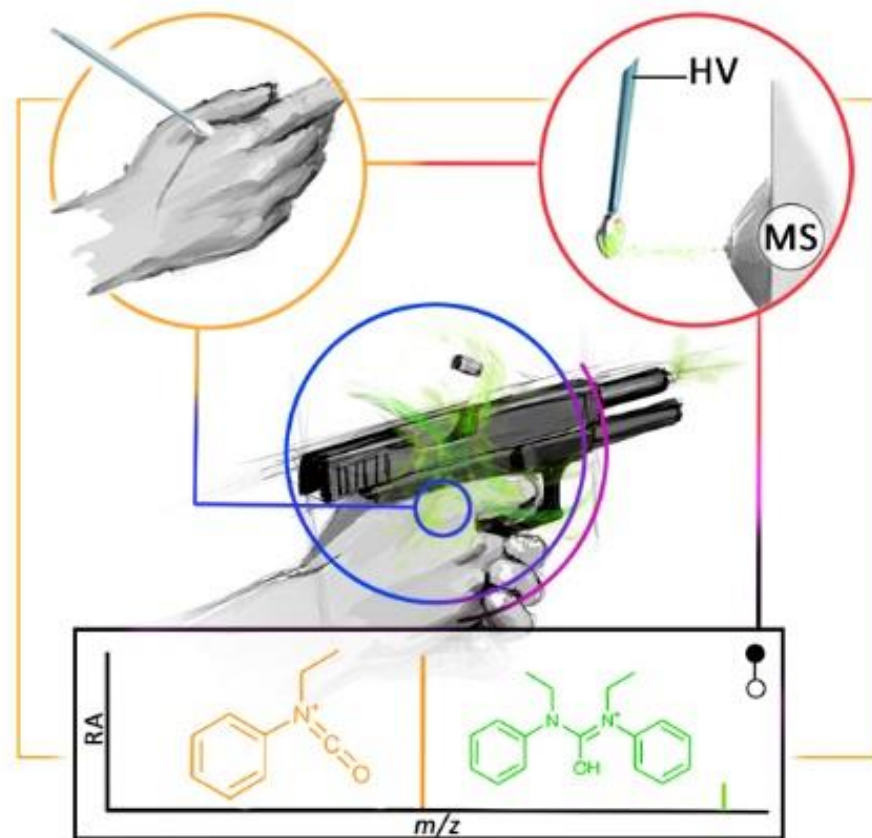
Conventional CID on the LTQ



Multigenerational CID on the Mini 12



SWAB TOUCH SPRAY MASS SPECTROMETRY FOR RAPID ANALYSIS OF ORGANIC GUNSHOT RESIDUE FROM HUMAN HAND AND VARIOUS SURFACES USING COMMERCIAL AND FIELDABLE MASS SPECTROMETRY SYSTEMS.



GUNSHOT RESIDUE (ELEMENTAL)

Colorimetric Tests



Atomic Absorption Tests



SEM Tests

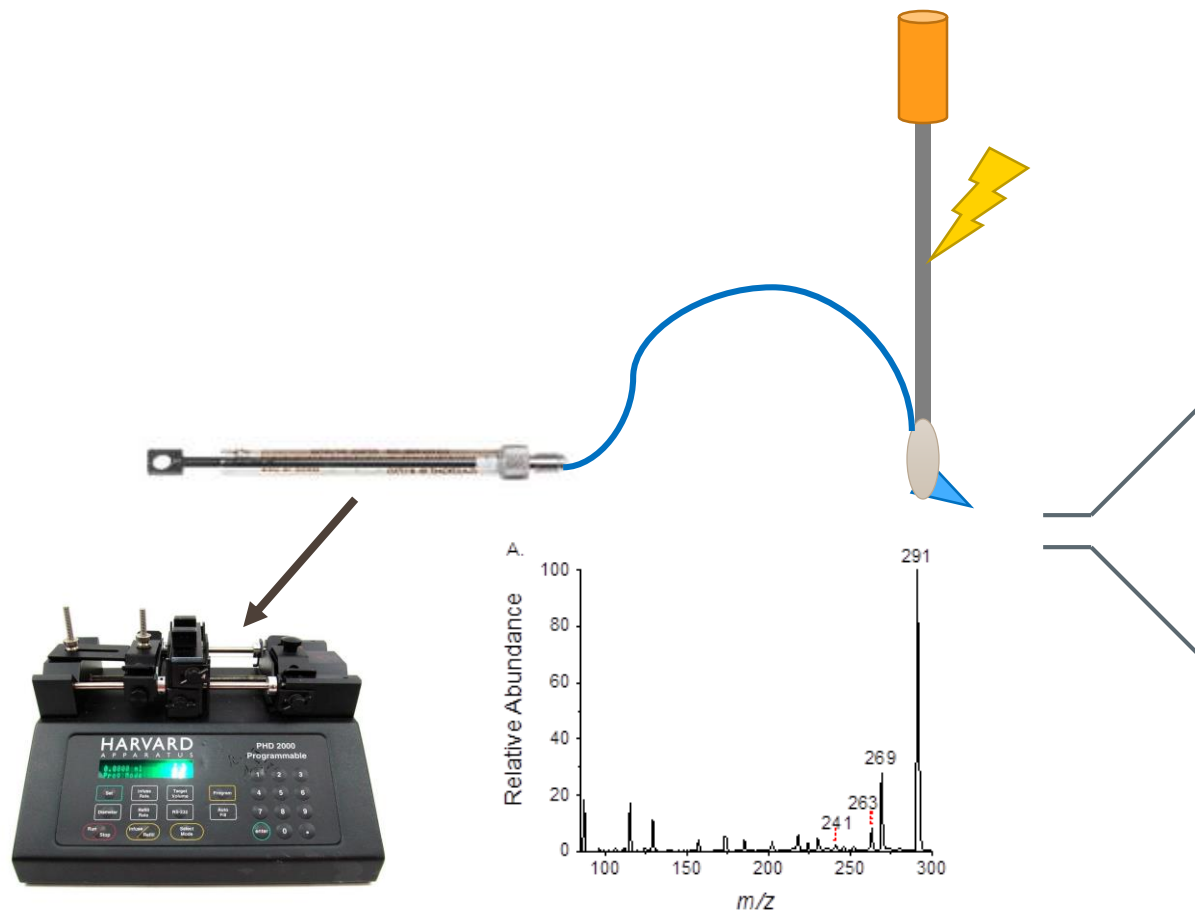


ORGANIC GUNSHOT RESIDUE (MOLECULAR) >136 COMPOUNDS

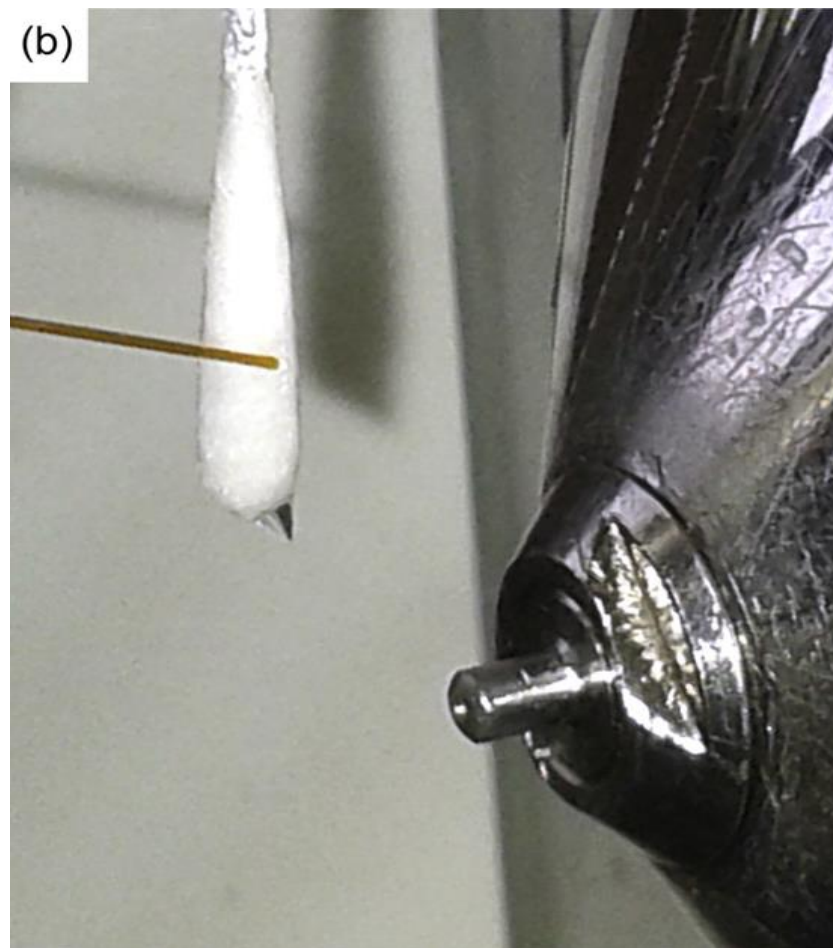
Classification system for OGSR compounds.

Category	Description	Compounds	Function
1	Compounds that are very strongly associated with GSRs with very restricted applications unrelated to GSR	Ethyl centralite	Stabiliser
		Methyl centralite	Stabiliser
		Nitroglycerin	Explosive
		Nitroguanidine	Explosive
2	Compounds that are strongly associated with GSRs, but which have less restricted applications unrelated to GSR	2,4-Dinitrotoluene	Flash suppressor
		Akardite II	Stabiliser
		2-Nitrodiphenylamine	Stabiliser
		4-Nitrodiphenylamine	Stabiliser
		Diphenylamine + nitrated-derivatives	Stabiliser
3	Compounds that are associated with GSR, but which are detected less frequently and have less restricted applications unrelated to GSR	Nitrocellulose	Explosive
		Other nitrotoluenes (2-NT, 3-NT, 4-NT, 2,3-DNT, 2,5-DNT, 2,6-DNT, 3,4-DNT, TNT)	Flash suppressor
			Sensitiser

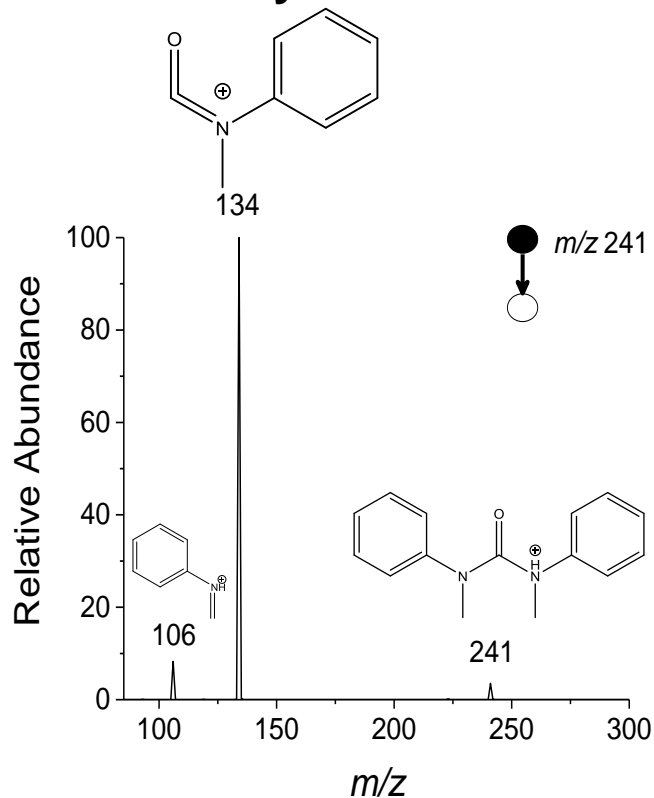
EXPERIMENTAL SETUP



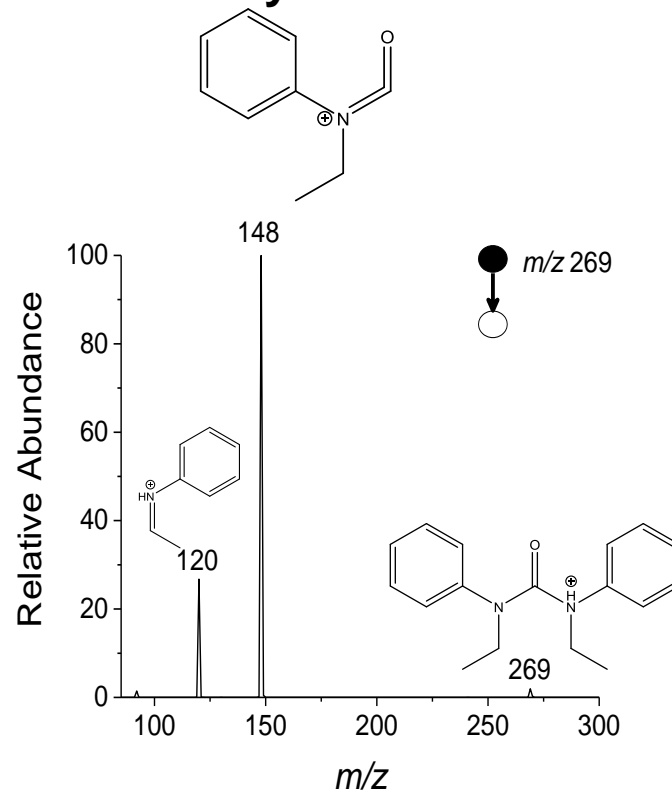
CLOSE UP OF SWABS SETUP



Methyl Centralite



Ethyl Centralite

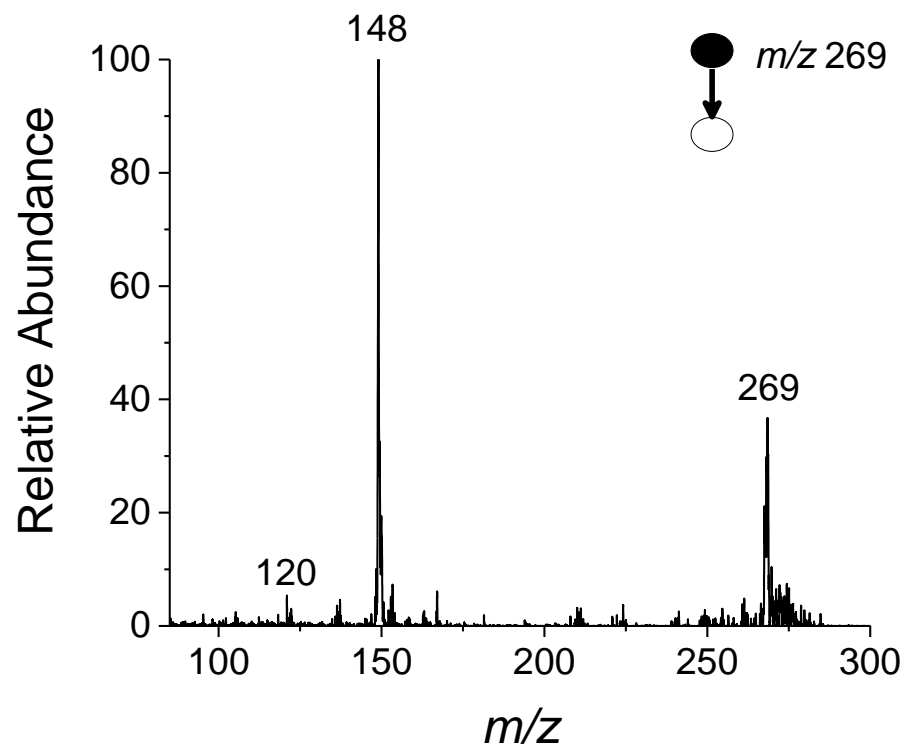
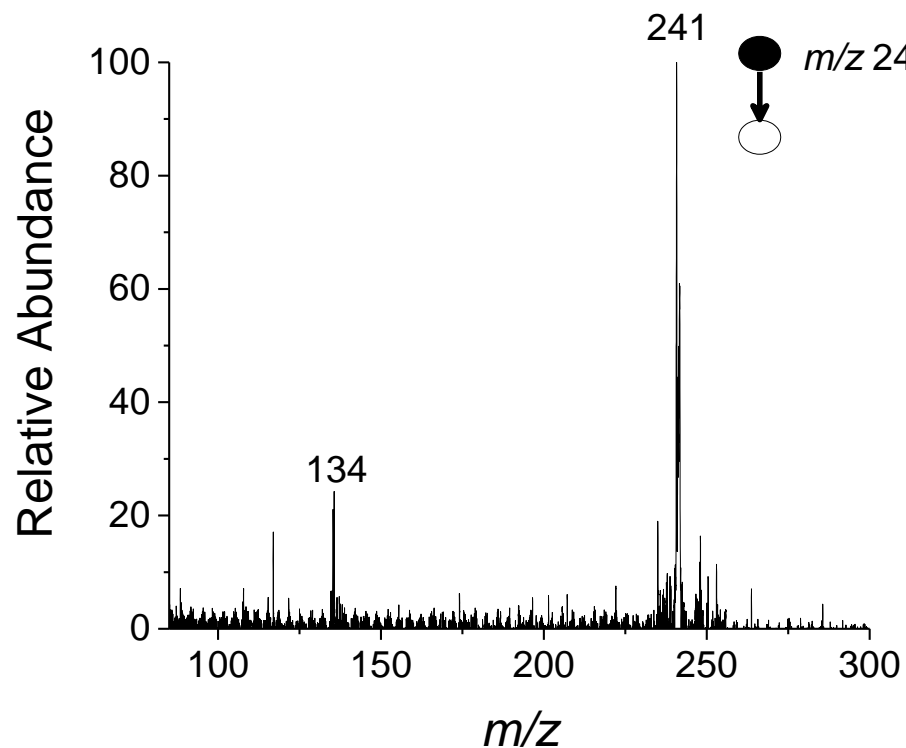


4 DIFFERENT 9MM HANDGUNS

Ammunition	Compound	Exposed Hand	Vinyl Glove	Nitrile Glove	Latex Glove
Federal Ammunition 9mm Luger 115 Grain Full Metal Jacket	Methyl Centralite	✓	✓	✓	✓
	Ethyl Centralite	✓	✓	✓	✓
Independence 9mm Luger 124 Grain Full Metal Jacket	Methyl Centralite	✓	✓	✓	✓
	Ethyl Centralite	✓	✓	✓	✓
Winchester 9mm Luger 147 Grain Full Metal Jacket	Methyl Centralite	✓	✓	✓	✓
	Ethyl Centralite	✓	✓	✓	✓
Federal Ammunition American Eagle 147 Grain Full Metal Jacket Flat Point	Methyl Centralite	Not Detected	Not Detected	Not Detected	Not Detected
	Ethyl Centralite	Not Detected	Not Detected	Not Detected	Not Detected

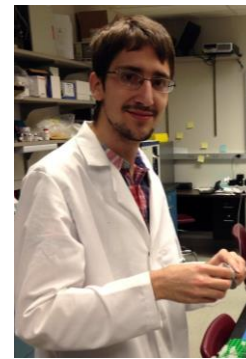
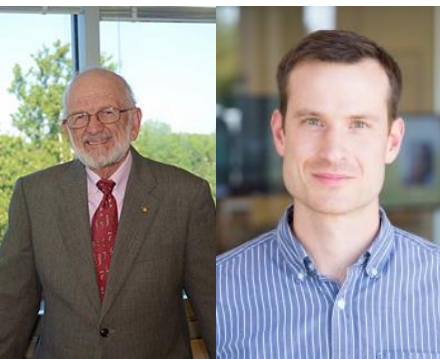
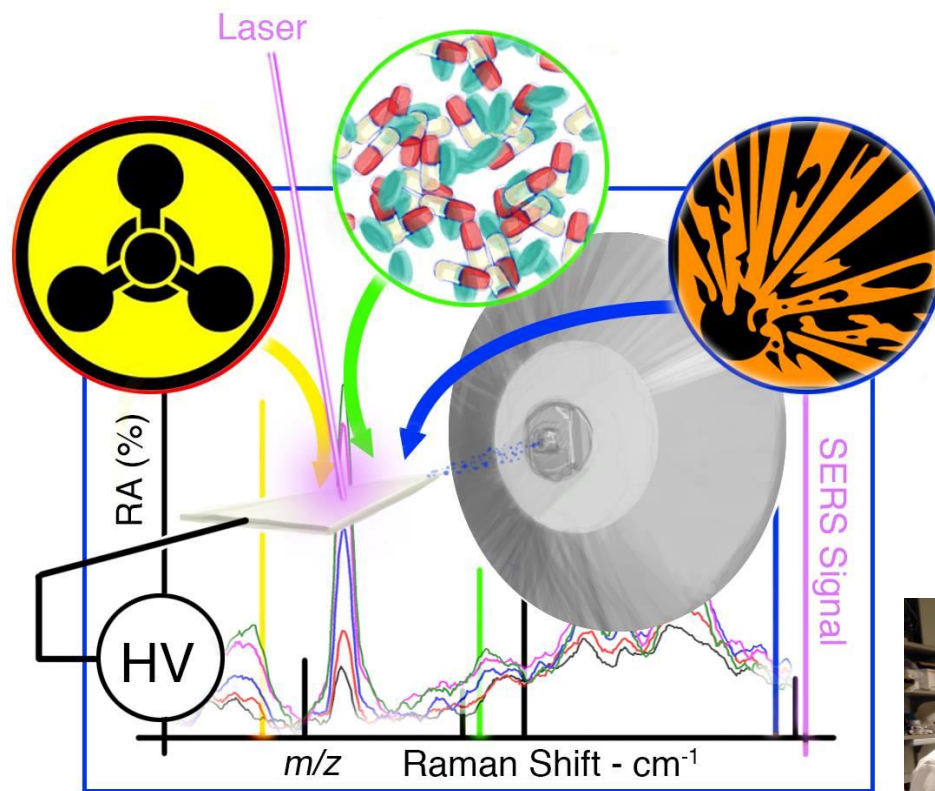
THE LOWER LIMIT OF DETECTION FOR BOTH MC AND EC WERE LOWER THAN 50ng ON THE LTQ XL.

MINI 12 SPECTRA



DETECTED AFTER 1 ROUND WAS DISCHARGED

FORENSIC SAMPLING AND ANALYSIS FROM A SINGLE SUBSTRATE FOR SURFACE-ENHANCED RAMAN SPECTROSCOPY FOLLOWED BY PAPER SPRAY MASS SPECTROMETRY

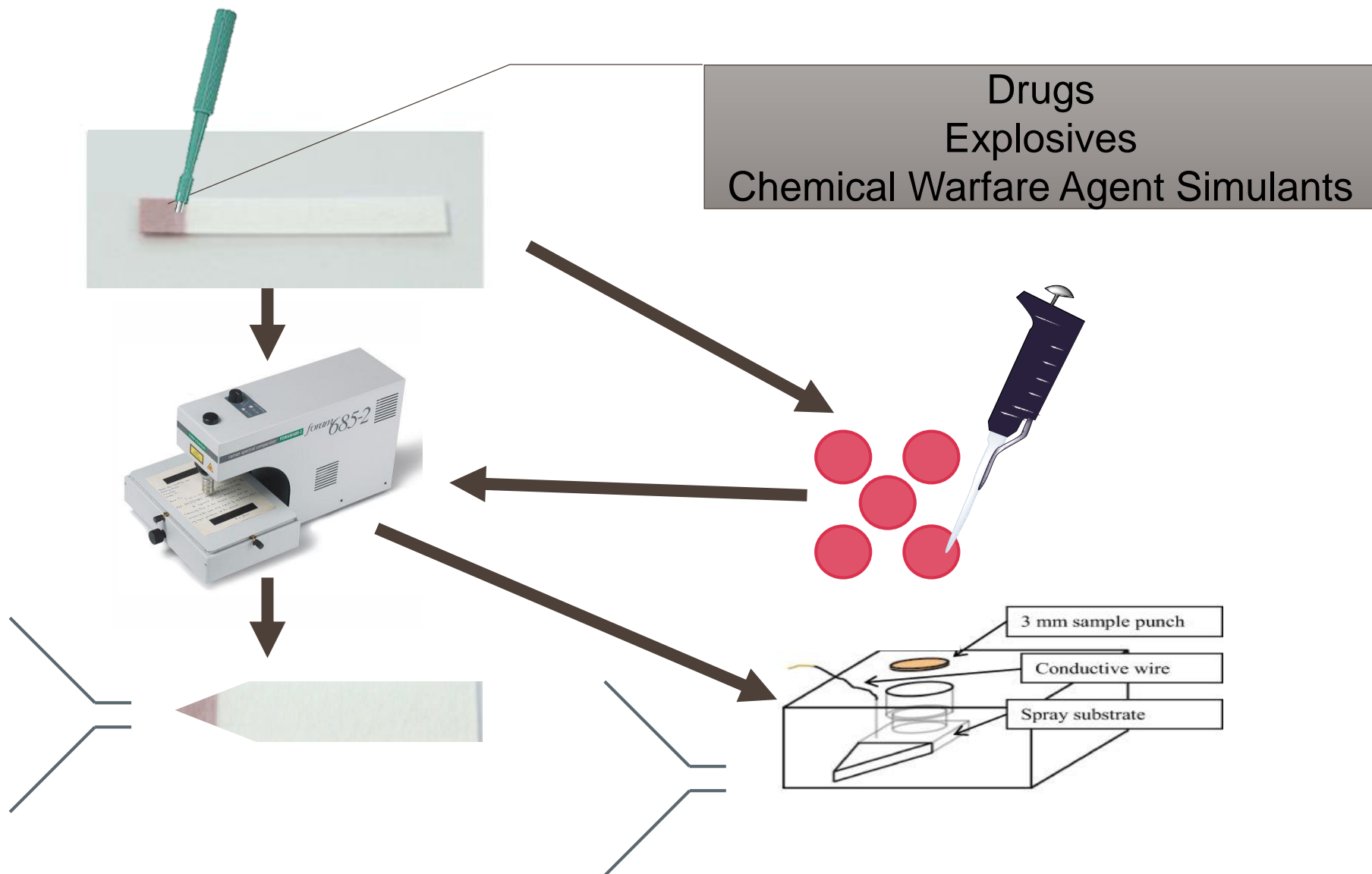


SCIENTIFIC WORKING GROUP FOR THE ANALYSIS OF SEIZED DRUGS (SWGDRUG) RECOMMENDATIONS

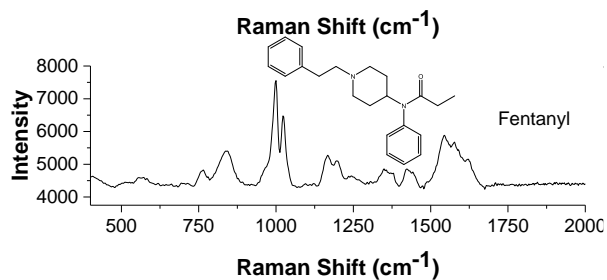
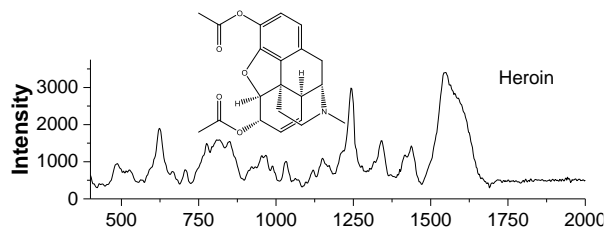
- Techniques for the analysis of drug samples are classified into three categories (see Table 1) based on their maximum potential discriminating power.
- IIIB.3.1 When a validated Category A technique is incorporated into an analytical scheme, at least one other technique (from either Category A, B or C) shall be used.

Category A	Category B	Category C
Infrared Spectroscopy	Capillary Electrophoresis	Color Tests
Mass Spectrometry	Gas Chromatography	Fluorescence Spectroscopy
Nuclear Magnetic Resonance Spectroscopy	Ion Mobility Spectrometry	Immunoassay
Raman Spectroscopy	Liquid Chromatography	Melting Point
X-ray Diffractometry	Microcrystalline Tests	Ultraviolet Spectroscopy
	Pharmaceutical Identifiers	
	Thin Layer Chromatography	
	Cannabis only: Macroscopic Examination Microscopic Examination	

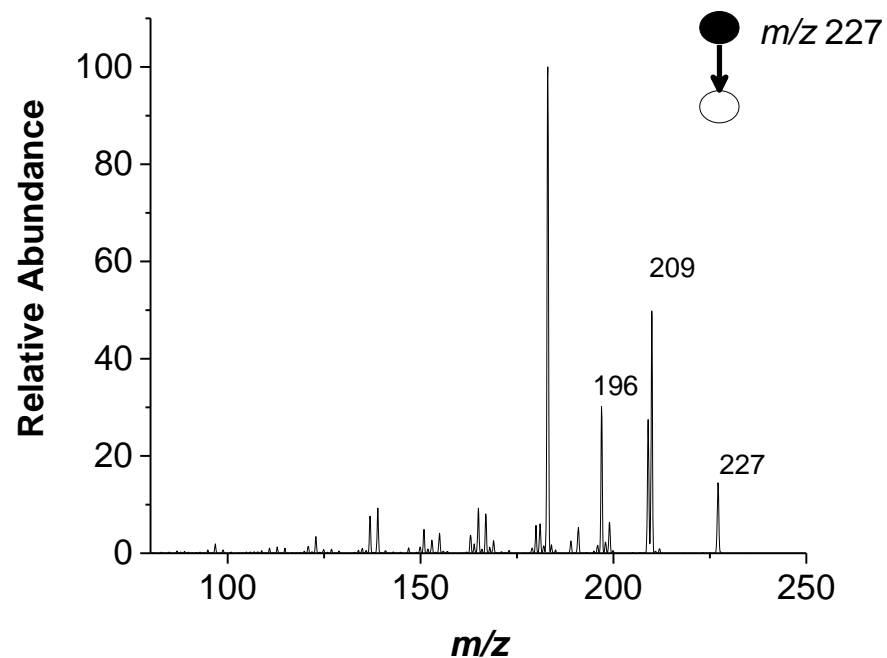
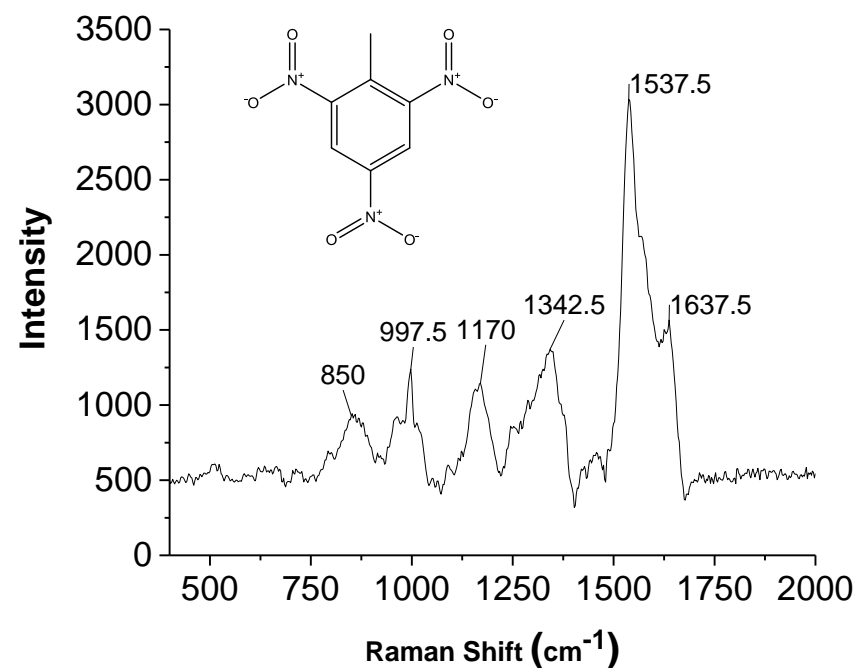
EXPERIMENTAL SETUP



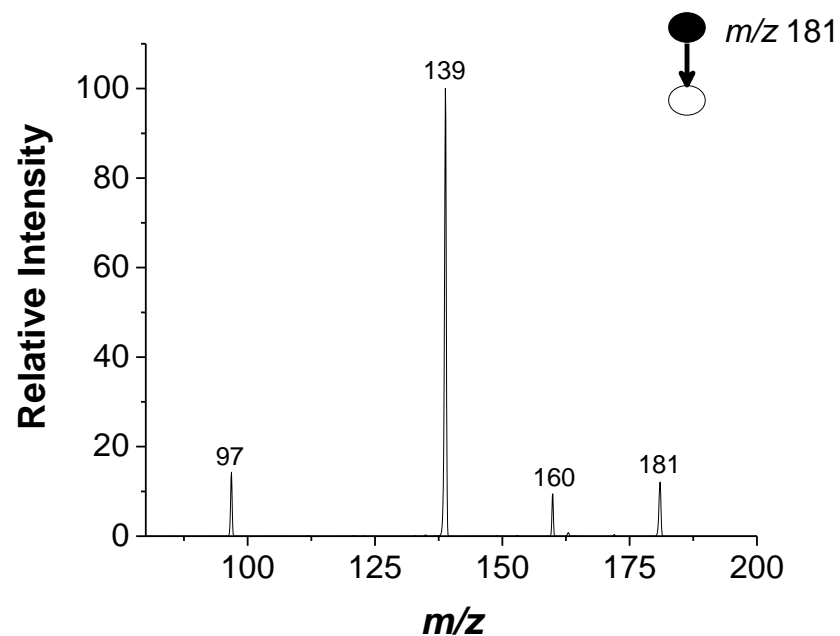
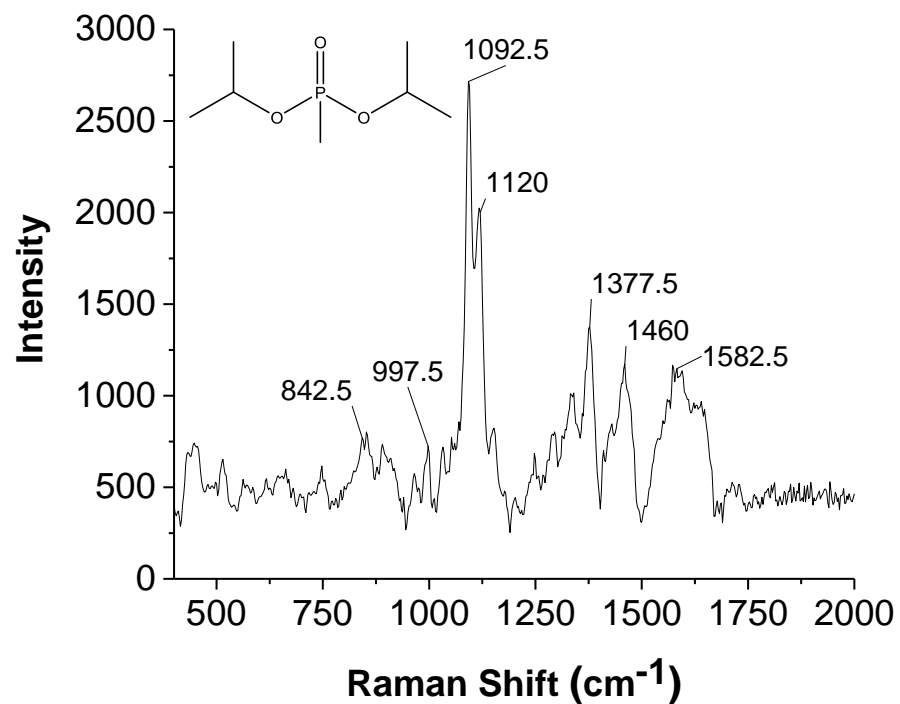
DRUG MIXTURE – HEROIN AND FENTANYL



EXPLOSIVES - TRINITROTOLUENE



CWAS – DIISOPROPYL METHYLPHOSPHONATE



CONCLUSION

The full control of the Mini 12 allows for new ways of scanning ions, which provides additional information.

Portable mass spectrometers allow *in-situ*, rapid analysis of forensically relevant compounds.

New sampling techniques coupled with the Mini 12 could help cut down on backlogged samples.

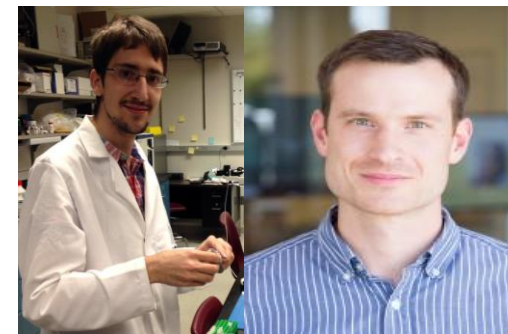
THANK YOU!

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