

# microFAST Isotope

Syringe Loading  
& Injection



# microFAST Isotope

The microFAST Isotope combines the capabilities of the SC- $\mu$ DX autosampler with single or dual loop FAST capabilities and syringe based sample loading/injection. The system accurately loads a loop and then smoothly injects the solution into a  $\mu$ Flow concentric nebulizer at defined rates from 5-1000  $\mu$ L/min. The valve on the flow injection system selects from two discrete, parallel flow paths for standards and samples. This allows rapid switching between sample and standard solutions with minimal dead volume between the valve and the nebulizer.

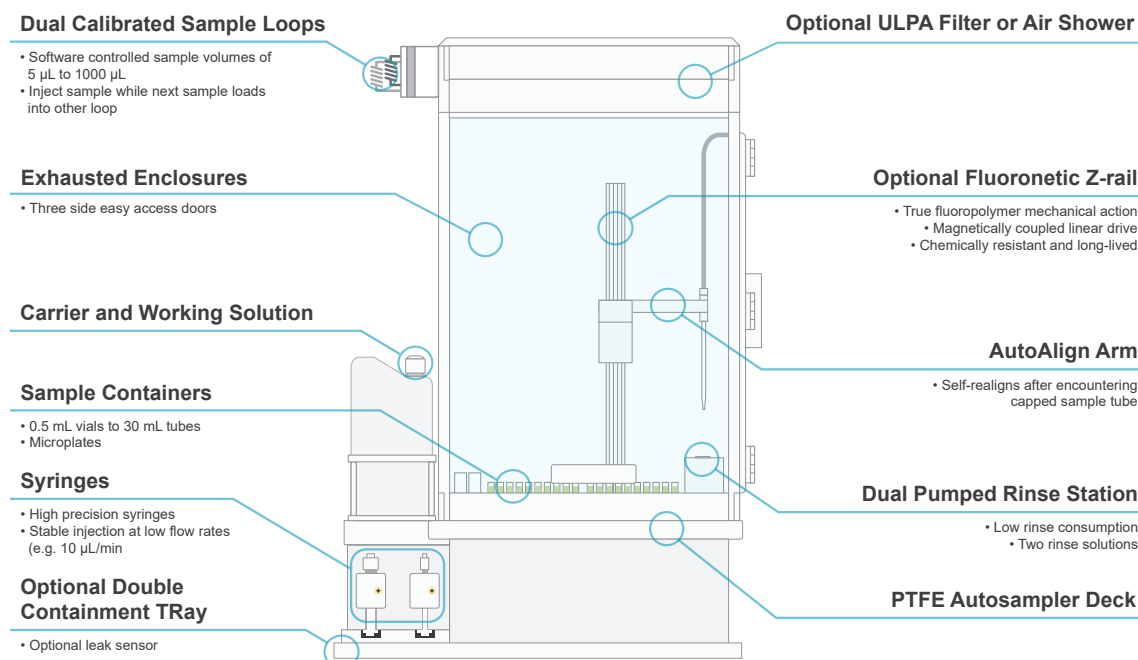
## Features

- Total sample consumption
- Syringe load micro volumes (5-1000  $\mu$ L)
- Syringe inject at desired flow rate (5-1000  $\mu$ L/min)
- Dual loop system

## Benefits

- Reliably run small volume samples at 5-1000  $\mu$ L/min
- Dual loop for high throughput and reduced carryover
- Stable injection profiles for precise isotope ratios
- Combine with Apex Omega for enhanced instrument sensitivity and low blanks

The single loop setup allows for accurate syringe loading and injection of samples into the plasma. With a single loop setup, the microFAST Isotope operates in a similar fashion as the standard FAST systems. The vacuum and peripump are simply replaced with syringes. In the dual loop configuration one loop is cleaned and loaded with sample, while the other loop is injected and analyzed. Rapid switching between loops drastically reduces long uptake and wash times associated with low sample flow rate.

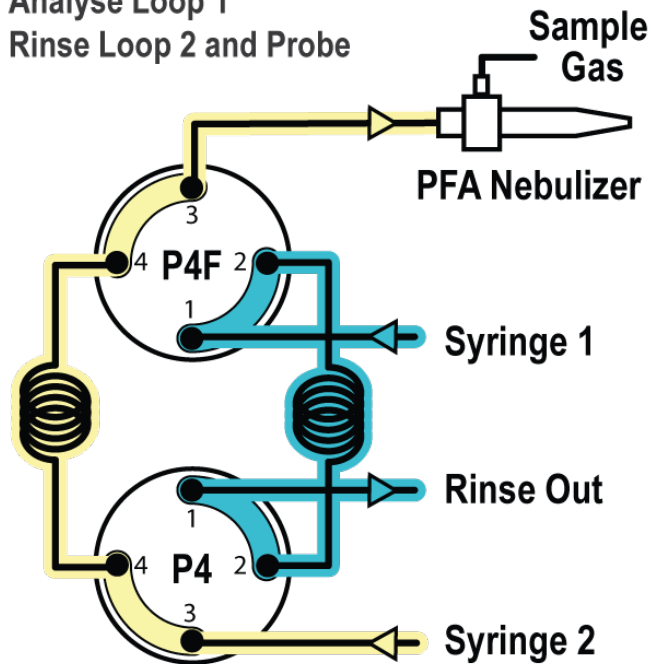


# Dual Loop System

## Rinse and Load One Loop While Injecting the Other

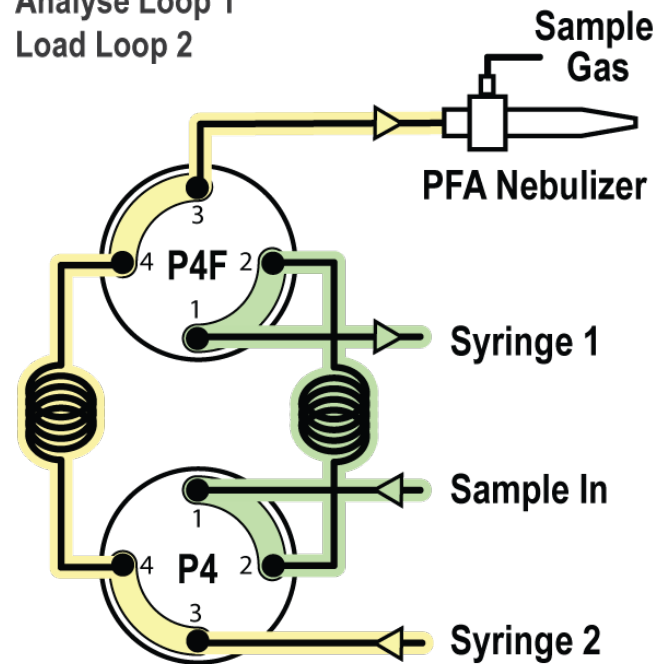
### Step 1

Analyse Loop 1  
Rinse Loop 2 and Probe



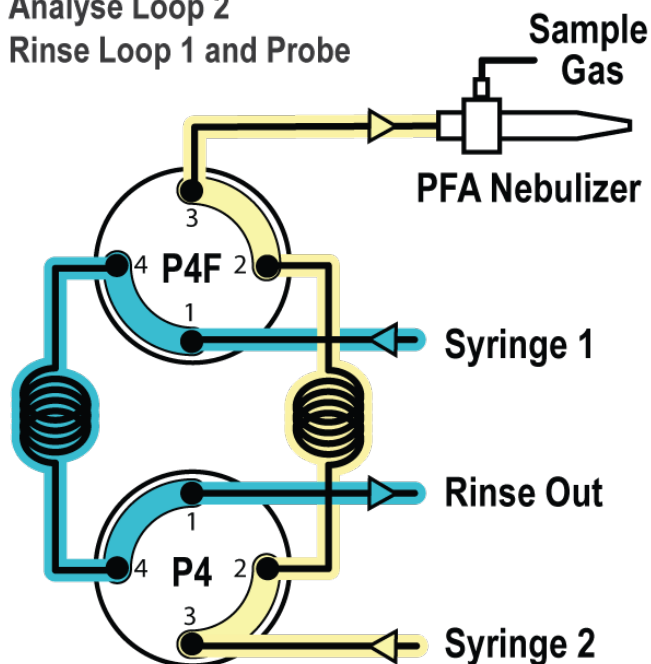
### Step 2

Analyse Loop 1  
Load Loop 2



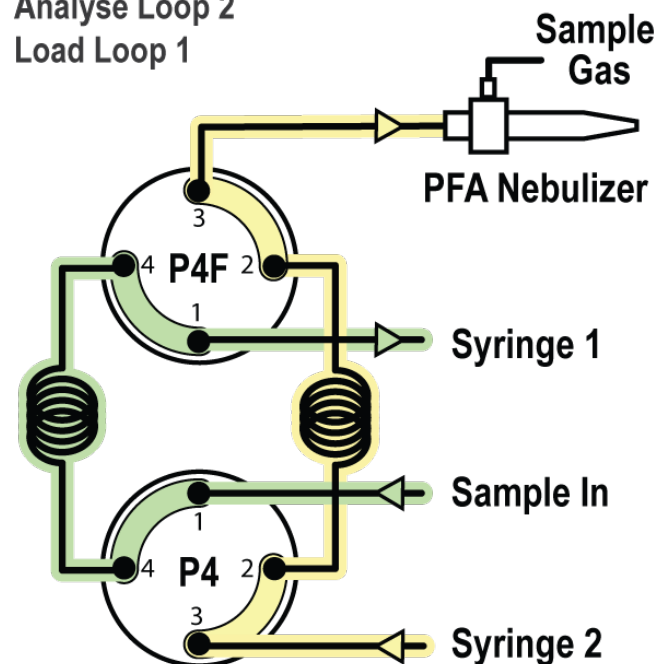
### Step 3

Analyse Loop 2  
Rinse Loop 1 and Probe



### Step 4

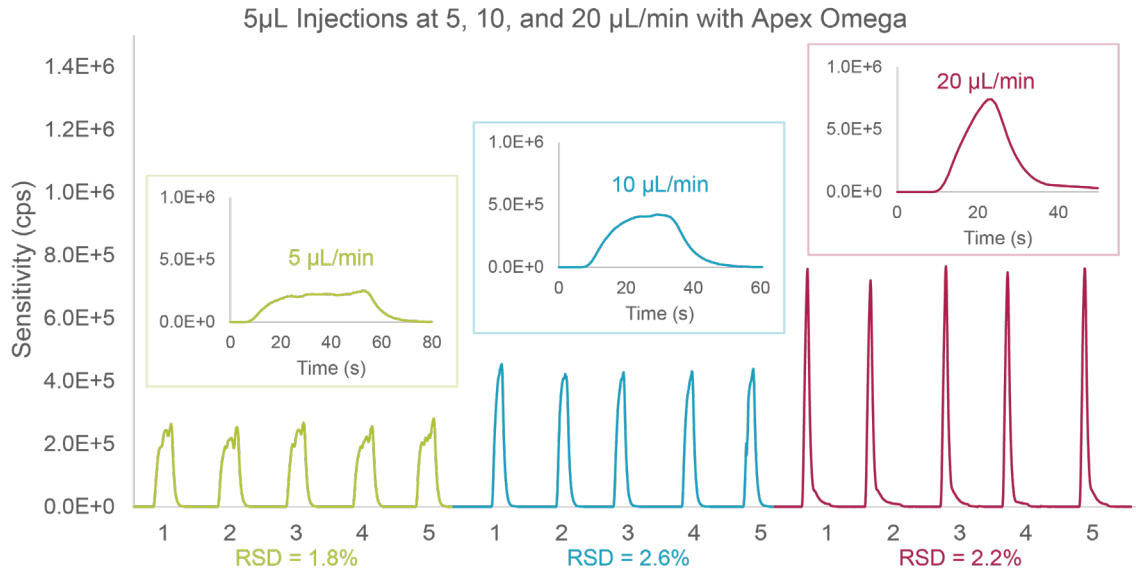
Analyse Loop 2  
Load Loop 1



# Micro Volume & Micro Flow Rate

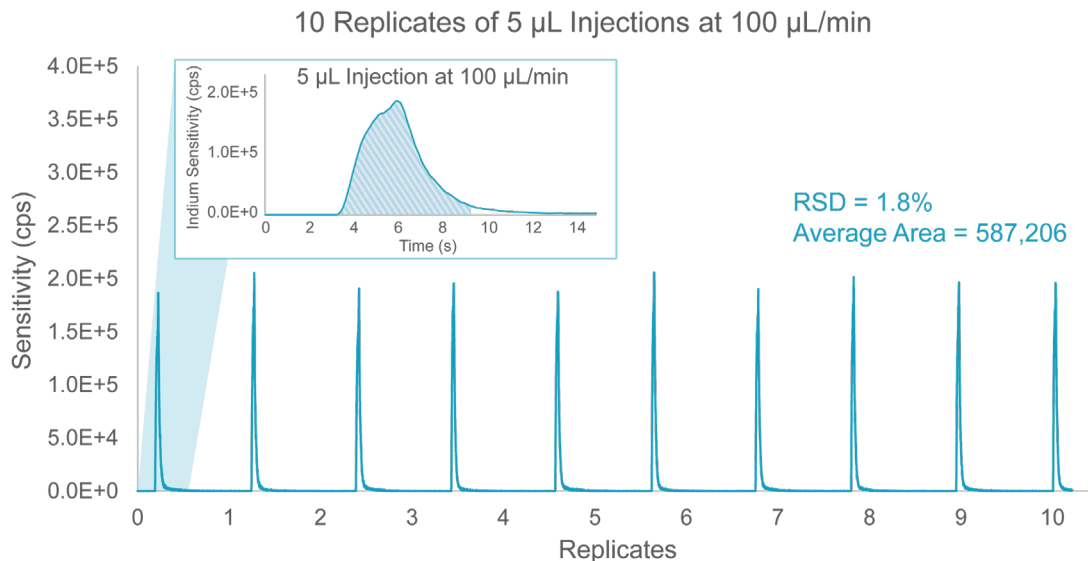
## 5 $\mu\text{L}$ Injections

The microFAST Isotope precisely syringe injects micro-volume samples (5  $\mu\text{L}$ ) into the Apex Omega at 5  $\mu\text{L}/\text{min}$ , 10  $\mu\text{L}/\text{min}$  and 20  $\mu\text{L}/\text{min}$ . The figures below plot signal profiles of approximately 60 sec, 30 sec and 15 sec for a 5  $\mu\text{L}$  sample. Increased sensitivity with flow rate is a result of high sample transport efficiency using the Apex Omega. Smooth injection profiles for 5  $\mu\text{L}$  samples at all flow rates, results in excellent reproducibility (<2% RSD, n=5)



## 10 Replicates of 5 $\mu\text{L}$ Injections at 100 $\mu\text{L}/\text{min}$

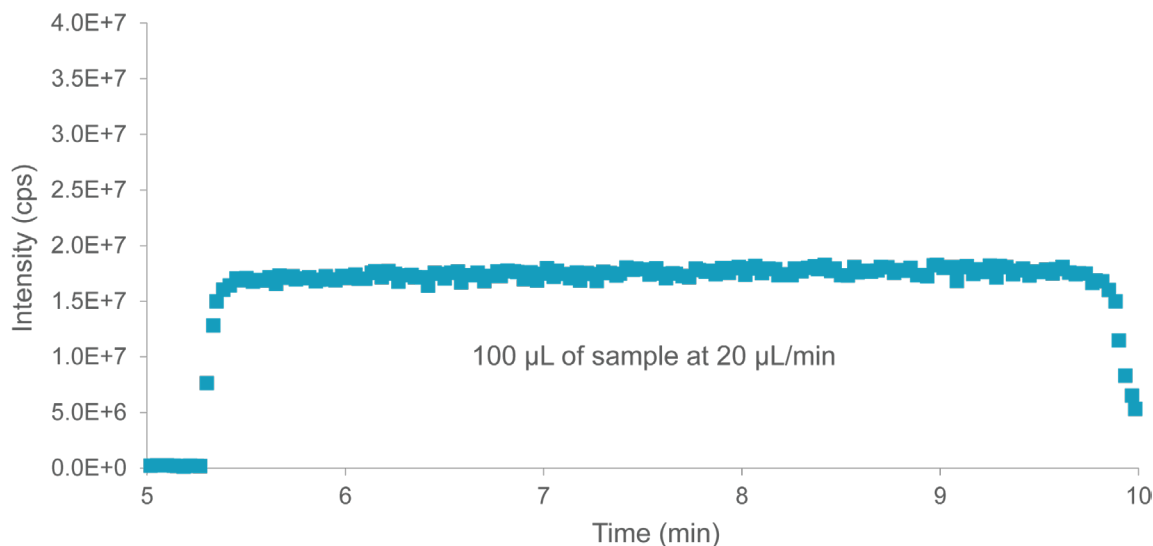
The microFAST Isotope utilizes syringes to precisely load micro-volumes samples (as low as 5  $\mu\text{L}$ ) and inject them at any user defined flow rates. The figures below illustrate the capability to produce smooth injection profiles for 5  $\mu\text{L}$  samples at 100  $\mu\text{L}/\text{min}$  with excellent reproducibility (<2% RSD, n=10)



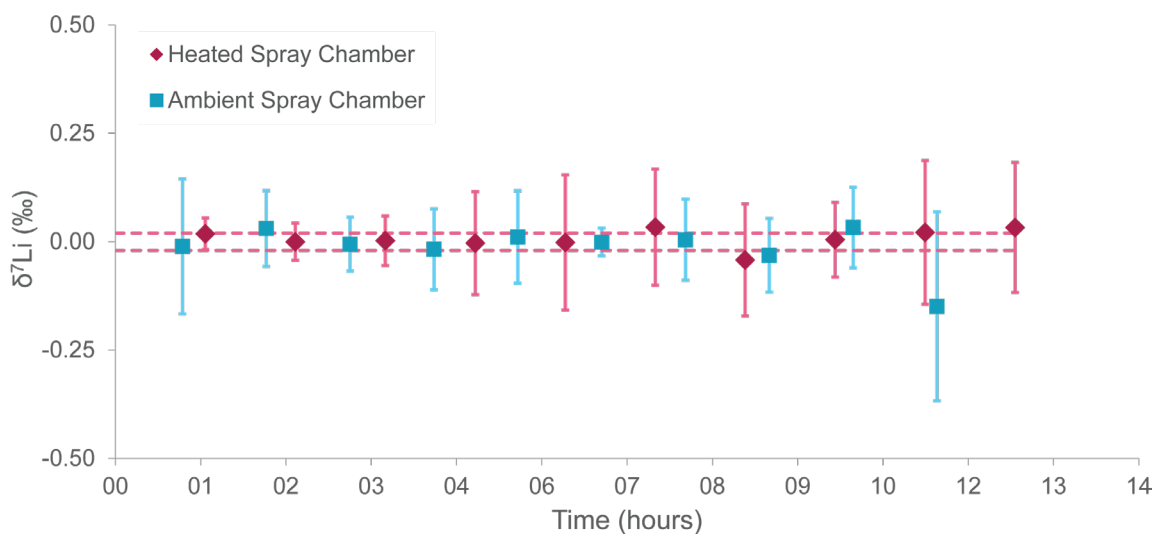
# Li Isotopes

Li isotope ratios are measured using the microFAST Isotope system. Syringe injecting 100  $\mu\text{L}$  of sample at 20  $\mu\text{L}/\text{min}$  provides nearly 5 minutes of steady state signal for isotope ratio analysis. External reproducibility is improved for the smallest absolute sample amounts (6 ng) using low volume solution aliquots.

## Syringe Loading & Injection



## $\delta^7\text{Li}$ (6.3 ng Li per quintuplicate)

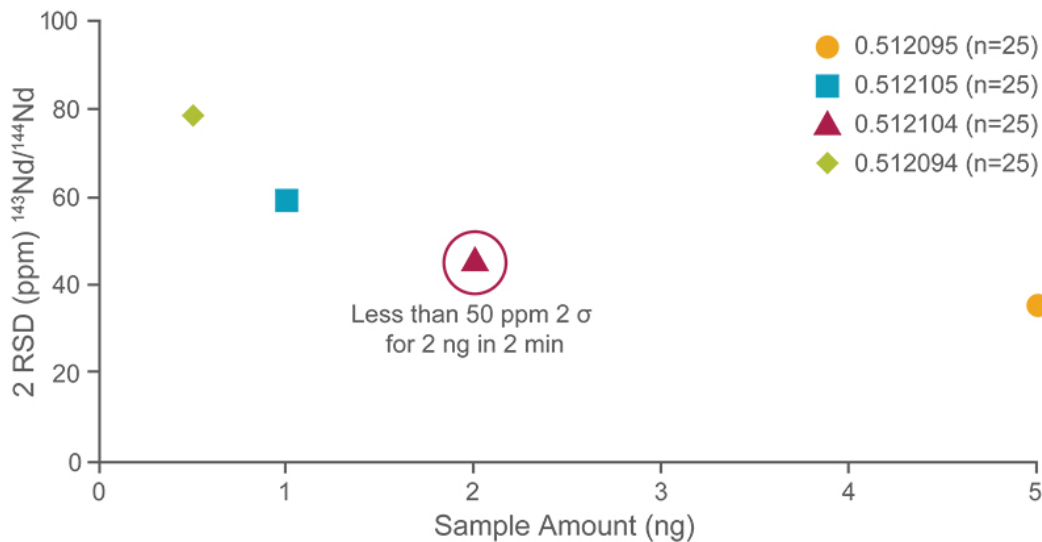


Presented at Goldschmidt Prague 2015; M. Paul Field, Sambuddha Misra, Aleksey Yu. Sadekov, and Nicholas S. Lloyd

# Nd Isotopes

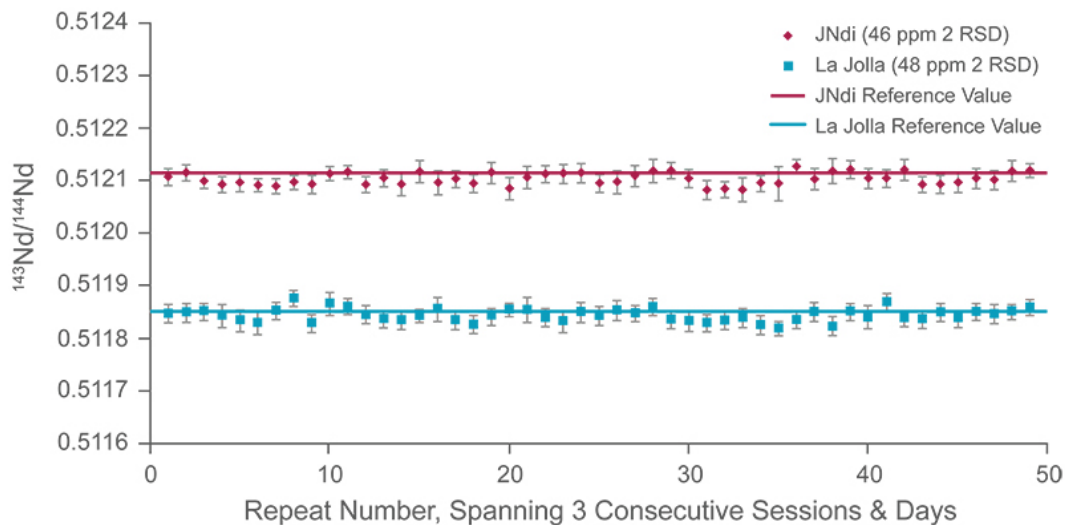
Minimizing the amount of Nd required to obtain desired precision (< 50 ppm) and throughput for precious oceanographic samples is illustrated in two figures. First, internal precision is plotted for variable amounts of Nd injected at 100  $\mu\text{L}/\text{min}$  for two minutes. Less than 50 ppm (2 RSD) internal precision is obtained for 2 ng samples of Nd. Repeat analysis of reference materials JNdi and La Jolla indicate that the external precision for 2 ng of Nd is similar to the 50 ppm internal precision and appropriate for oceanographic applications.

## Sample Amount



Presented at Goldschmidt Yokohama 2016; Nicholas S. Lloyd, Paul Watson, and M. Paul Field

## Reproducibility for 2 ng

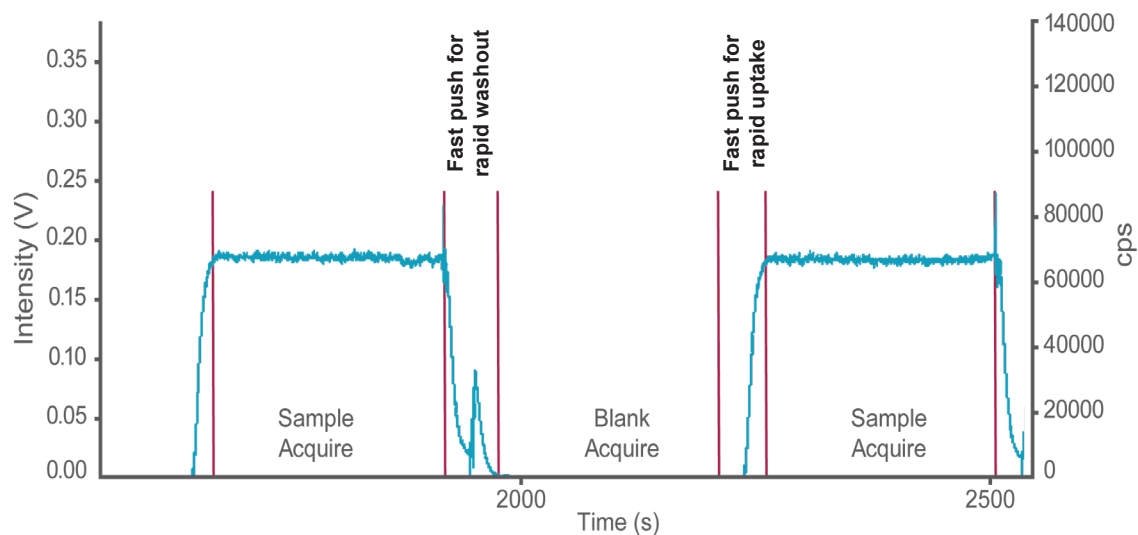


Presented at Goldschmidt Yokohama 2016; Nicholas S. Lloyd, Paul Watson, and M. Paul Field

# Nuclear Forensics

Plutonium particles in environmental samples taken from nuclear facilities pose massive risks to human health. Given the small sample size accurately measuring isotope ratios by mass spectrometry to identify and minimize these risks remains a challenge. The microFAST Isotope is used to load small volume samples, provide stable injection profiles and rapid washout for precise Pu isotope ratios.

## Multiple Injection Profiles



## Plutonium Isotopes

### Pu CRMs (500 femtograms of sample)

	Ratio	Certified	SD (2 sig)	Determined	SD (2 sig)
<b>CRM 126</b>	$^{240}\text{Pu} / ^{239}\text{Pu}$	0.02096	-	0.02073	0.00014
<b>CRM 082</b>	$^{240}\text{Pu} / ^{239}\text{Pu}$	0.047096	5.20E-05	0.04687	0.00041

In collaboration with Dr. Cole Hexel and Dr. Brian Ticknor at Oak Ridge National Laboratory



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