Comparison of $PM_{2.5}$ Speciation Results by Inductively Coupled Plasma Mass Spectroscopy with X-Ray Fluorescence

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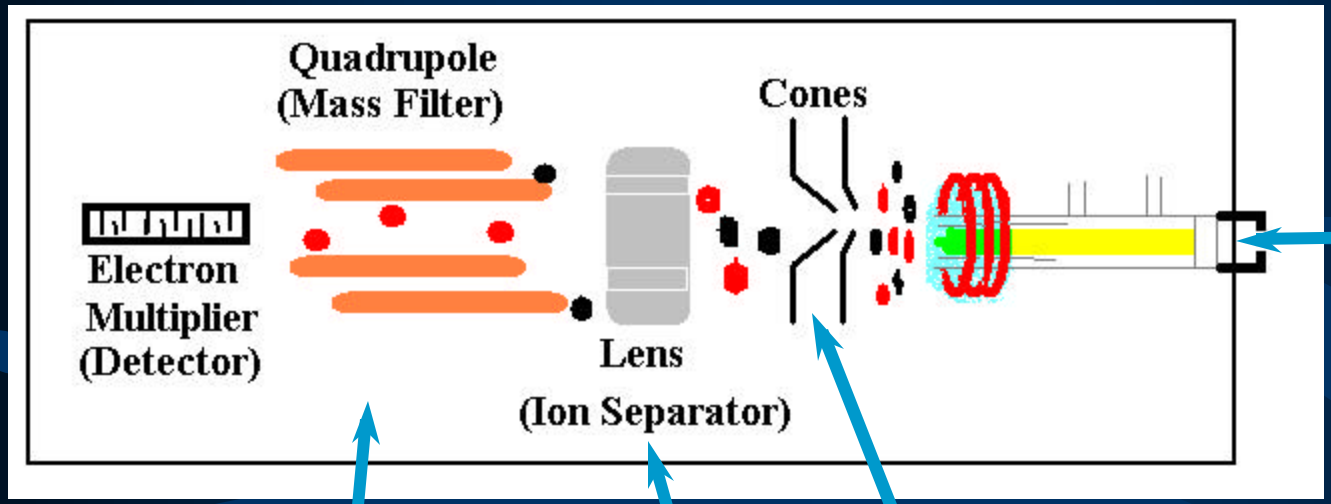
The Purpose of this Presentation is to:

- Illustrate ICP-MS as a viable technique for $PM_{2.5}$ Speciation
- Highlight the benefits of ICP-MS over XRF for $PM_{2.5}$ Speciation

ICP-MS: Principle of Operation



Sample Input From Nebulizer

Plasma-Spec. Interface

Vacuum

Applied Voltage

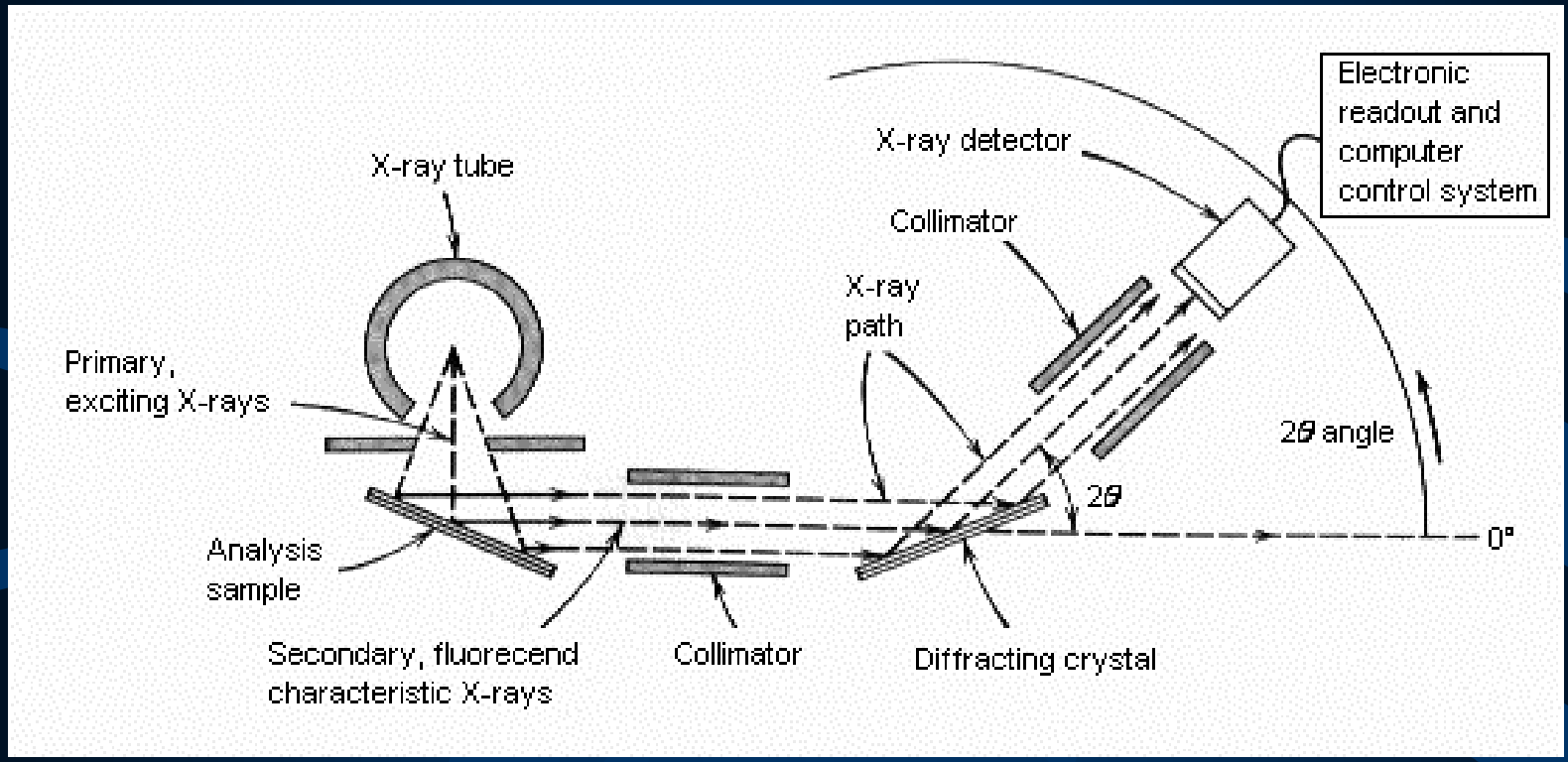
Ultrasonic Nebulizer and Desolvator

Removes Solvent Interferences

Sample Input: ICP

Detection: Mass Spectrometer

XRF: Principle of Operation



Sample Preparation:

- Particulate Extraction:
  - Filters wetted with anhydrous Ethanol (Spectrophotometric Grade).
  - Solubilized in dilute HNO_3 by sonication with heating.
  - Analyzed directly or after dilution.

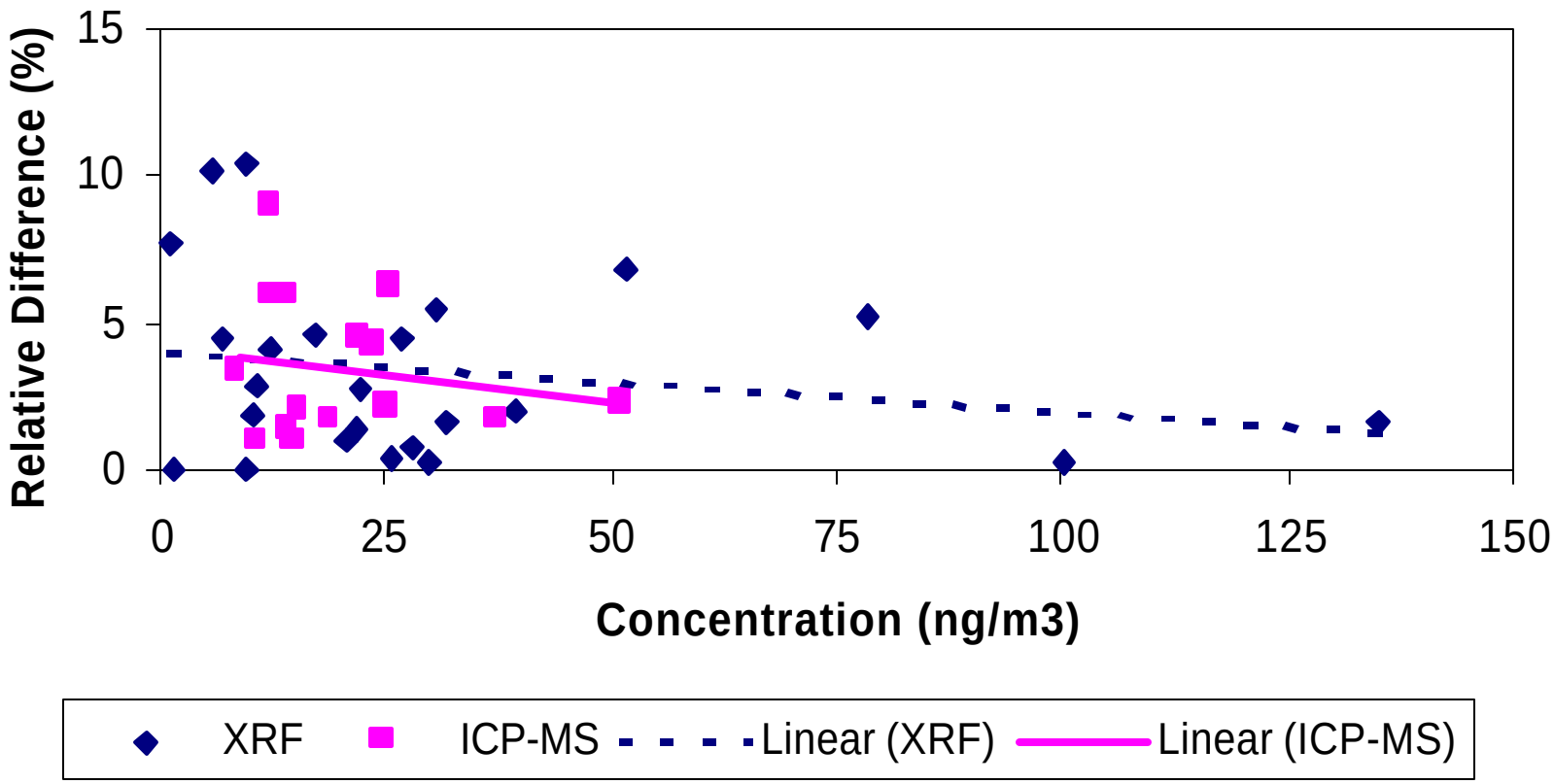
Detection Limits Comparison:

- ICP-MS
  - ^{75}As 1 ng/m^3
  - ^{9}Be 1 ng/m^3
  - ^{51}V 1 ng/m^3
  - ^{39}K 5 ng/m^3
  - ^{98}Mo 1 ng/m^3
  - ^{28}Si 5 ng/m^3
  - ^{44}Ca 25 ng/m^3
  - ^{63}Cu 1 ng/m^3
- XRF
  - As 2 ng/m^3
  - Be ---
  - V 4 ng/m^3
  - K 3 ng/m^3
  - Mo 2 ng/m^3
  - Si 3 ng/m^3
  - Ca 2 ng/m^3
  - Cu 1 ng/m^3

Ratio of XRF/ICP-MS (Preliminary Results):

Analyte	Average Ratio
– *Ideal*	*1.0*
– As	1.4
– Be	Undetermined
– V	1.1
– K	1.1
– Mo	< LOD (for both)
– Si	3.7
– Ca	1.0
– Cu	0.8

Precision Comparison for Cu:



Benefits of using ICP-MS for $PM_{2.5}$ Speciation:

- Source identification from isotopic ratios
  - Fingerprinting of contaminates not possible with XRF.
  - Speciation of Cr (VI) using *EPA Method 6800*.
- Allows monitoring as Analyte levels decrease.
  - Lower overall detection limits than XRF.

Wrap up:

- ICP-MS
  - Isotopic Fingerprinting
  - Low Detection Limits
  - Results Comparable with XRF Analyses
- Recommendation
  - ICP-MS be included as a primary analytical tool for $PM_{2.5}$ Speciation.

Questions, Comments:

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