

# Accelerated in Elemental Impurity Analysis by ICP-MS

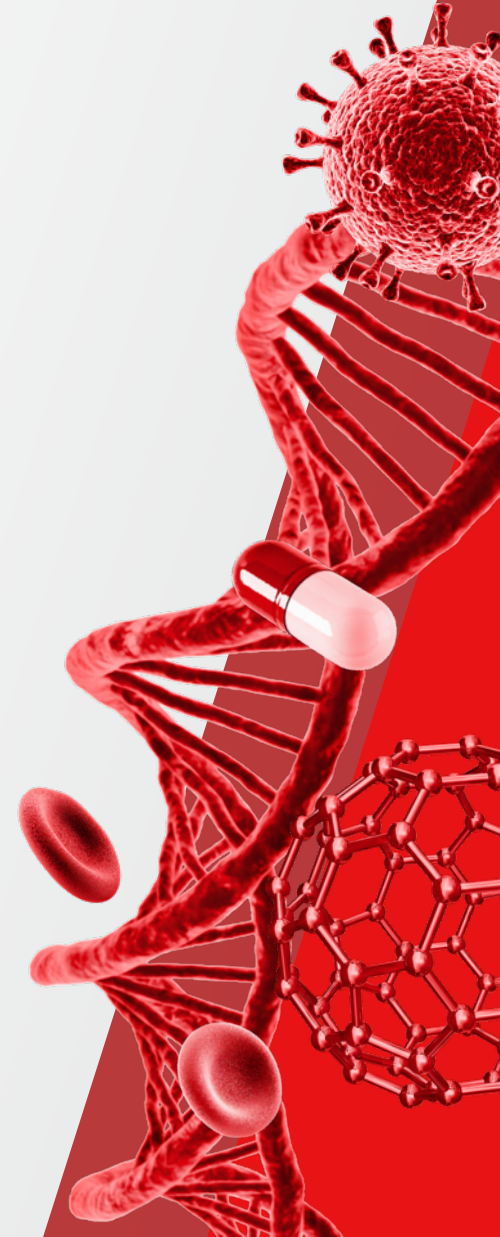
Presented by:

**Dr. Maja Budanovic**

TEA Regional Application Expert (SEA)

19 August 2021

 The world leader in serving science



# Agenda

1 Introduction - A review of Why

2 iCAP RQ ICP-MS Technology

**P1. Reliability, Productivity & Performance**

3 iCAP RQ ICP-MS Hardware & Software Demo

**P2. All the power and non of complexity**

4 Summary – Q & A



# Time is ticking for trace metals in pharmaceuticals...

## Analytical Technique Popularity Worldwide

**Q1. What is the most widely used technique for trace elemental analysis of pharma products in your area?**

- Atomic Absorption Spectroscopy (AAS)
- Inductively coupled plasma - optical emission spectroscopy (ICP-OES)
- Inductively coupled plasma - mass spectrometry (ICP-MS)

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**Adrian Holley** -Former Global Marketing Director at Thermo Fisher Scientific

“Large companies are talking about 40 to 50 installations globally, China is already gearing up, and in India it’s predicted that there will be **50 to 60 ICP-MS.**”

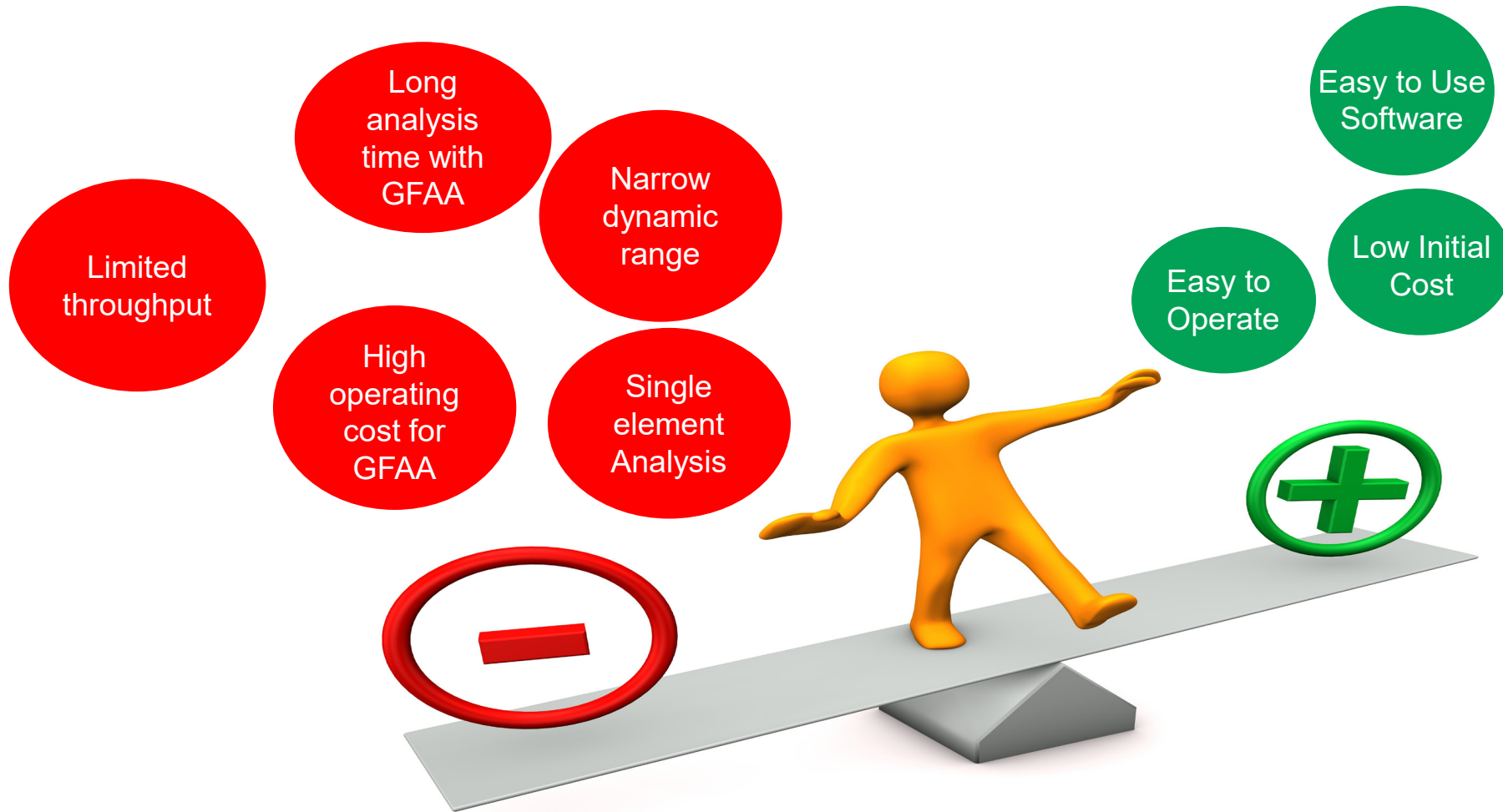
Europe → ICP-OES & ICP-MS

SEA ?



**US** → **Richard Cochran**- Application Scientist at Thermo Fisher Sci.

“An **even mix of both ICP-OES** (mainly used for screening materials used in manufacturing) **and ICP-MS** (used for screening final products). We are also seeing an **increase in the use of the iCAP RQ ICP-MS** for screening both manufacturing materials and final products.”



**For Pharma Laboratories requiring multi-element determinations and higher throughput, ICP is a better choice**



## 2. iCAP RQ ICP-MS Technology

### Reliability, Productivity & Performance

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# Thermo Scientific iCAP RQ ICP-MS

The iCAP RQ ICP-MS delivers the reliability, analytical performance and ease of use needed to meet the demands of the highest throughput routine laboratory

1.

## Reliability

- New interface cone design giving less memory effects and less drift
- Lower service costs and new **longer life detector** supplied as standard

2.

## Productivity

- Single measurement mode, integrated sampling valves
- **Unique QCell flatapole** technology with **automatic** low mass cut-off + He KED mode

3.

## Performance

- **Best Signal /Noise** of any Quadrupole ICP-MS on the Market
- Best interference removal with unique **patented QCell** technology

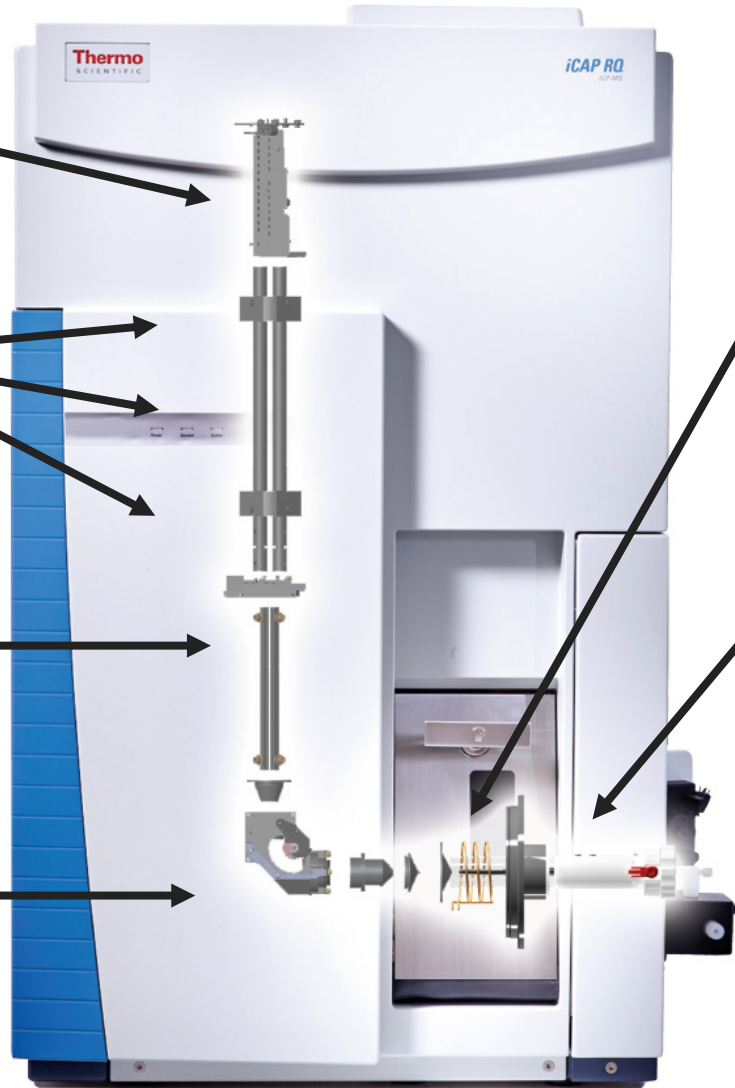
# iCAP RQ/TQ ICP- MS Interface Design

Long Life Detector

Stable electronics –  
minimal downtime and  
**maximized stability**

Collision/reaction cell;  
high transmission and  
**low mass cut off**

Increased capacity  
interface pumping for  
**higher sensitivity**



Robust interface for **reliable long-term analysis** of dirty samples → minimal intervention

Robust RF generator → **maximum uptime**

Quick connect sample intro and torch design for easy handling

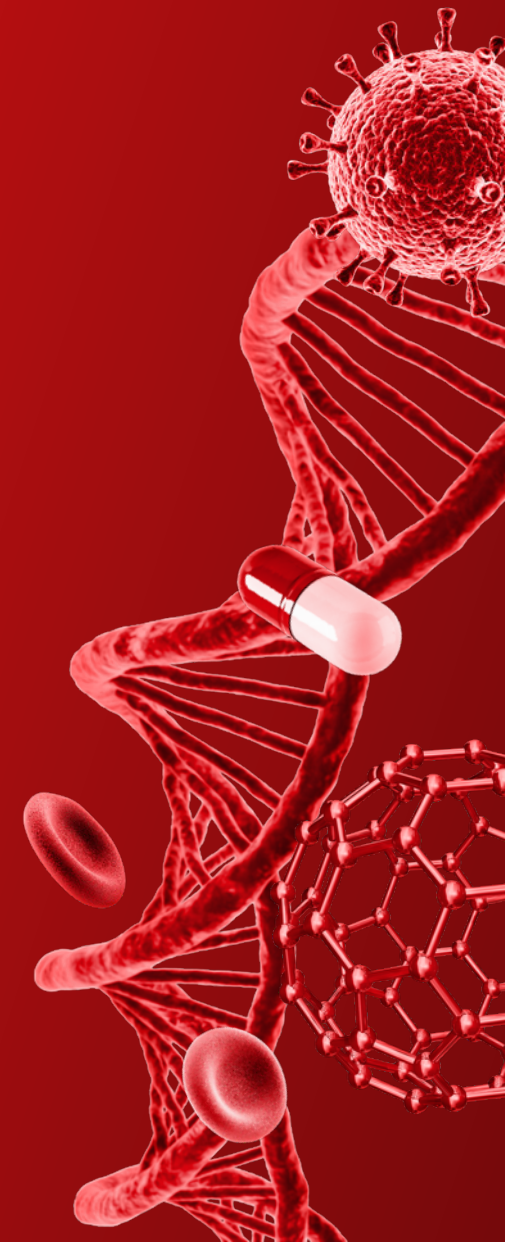


# Case study No 1.

What's the biggest challenge you have with your elemental analysis?

Sample inlet system blockages	26%
Internal standard drift	9%
Interferences, false positives	43%
QC failures	22%

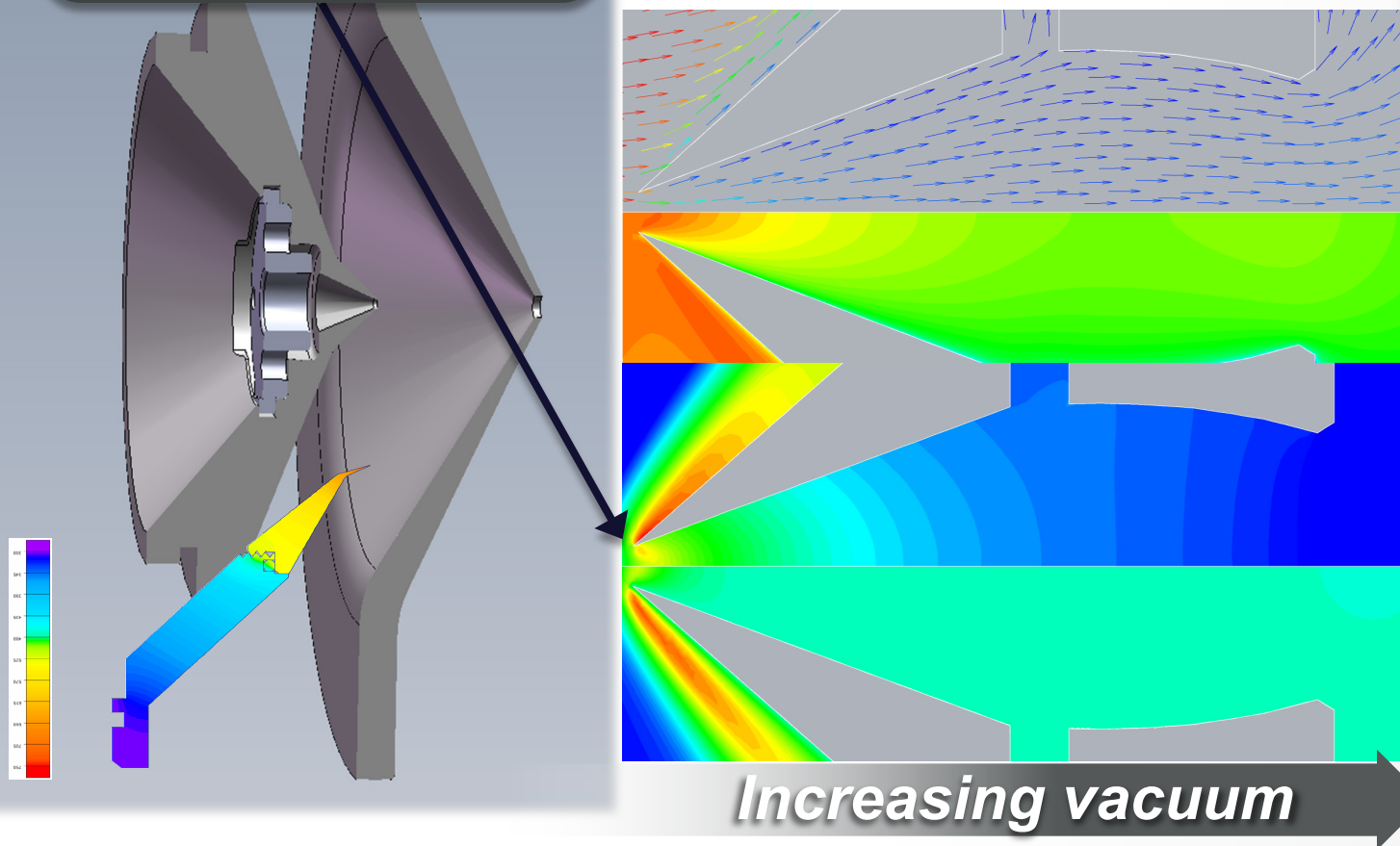
How RQ ICP-MS KED Technology can solve this challenges ...



# What is Specific for RQ Tech?

## Customized Interfaces for Maximum Flexibility and Matrix Tolerance

High flow and high temperature at skimmer cone tip **reduces deposition of material**



- Development research to model various skimmer cone base and tip temperatures
- In-depth studies have shown:
  - Hotter skimmer cone tip leads to **reduced deposition**
  - Improved signal stability
  - **Reduced frequency in cleaning/maintenance**
- High matrix interface produced through:
  - Combination of existing cones
  - Cone orifice changed to 0.5 mm
  - Central channel lengthened

# Improved Matrix Tolerance of Skimmer Cones

Analysis of complex samples diluted 1:10 - 10 hours of continuous analysis

***standard  
skimmer cone***

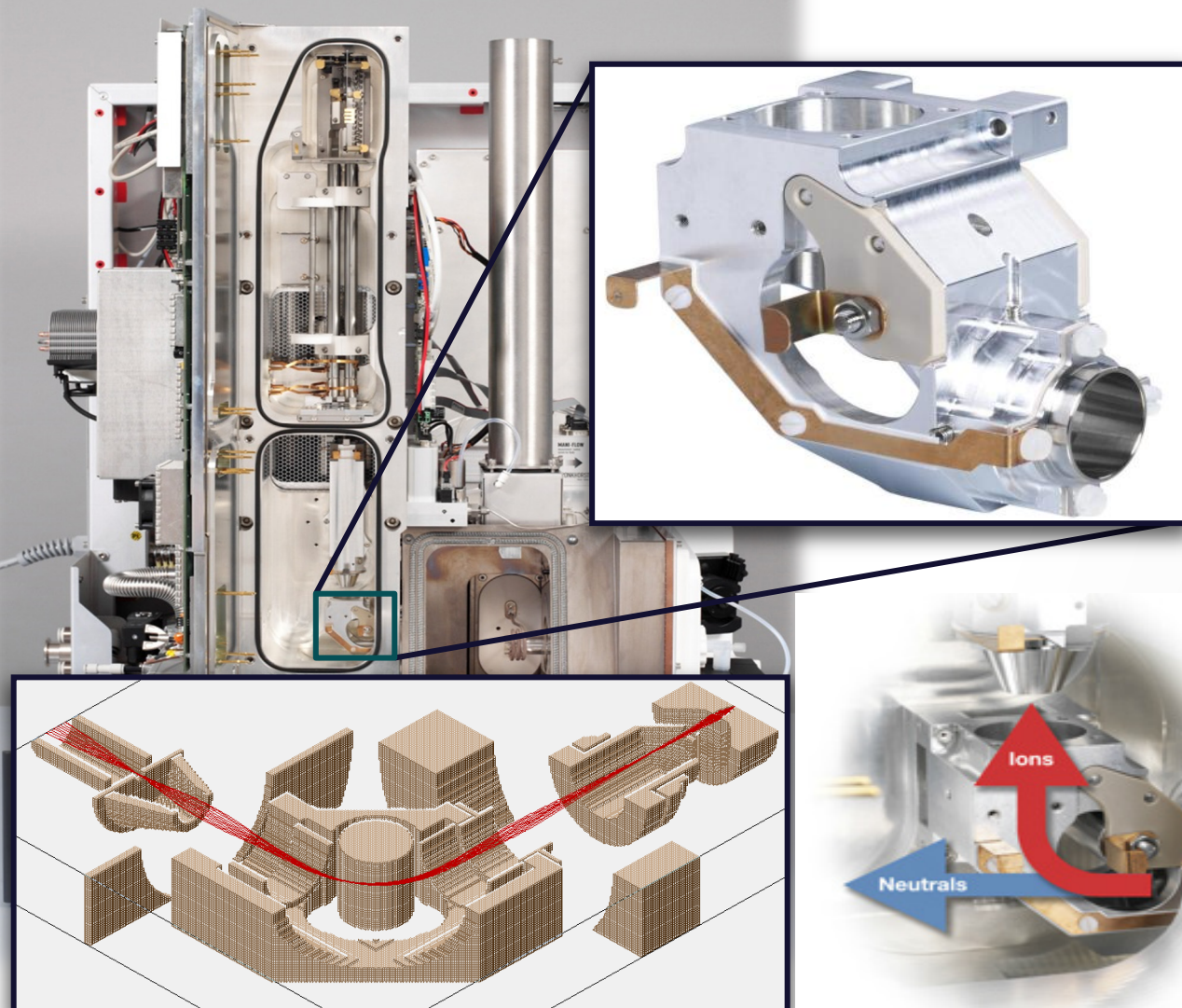


**VS**

***iCAP RQ  
skimmer cone***



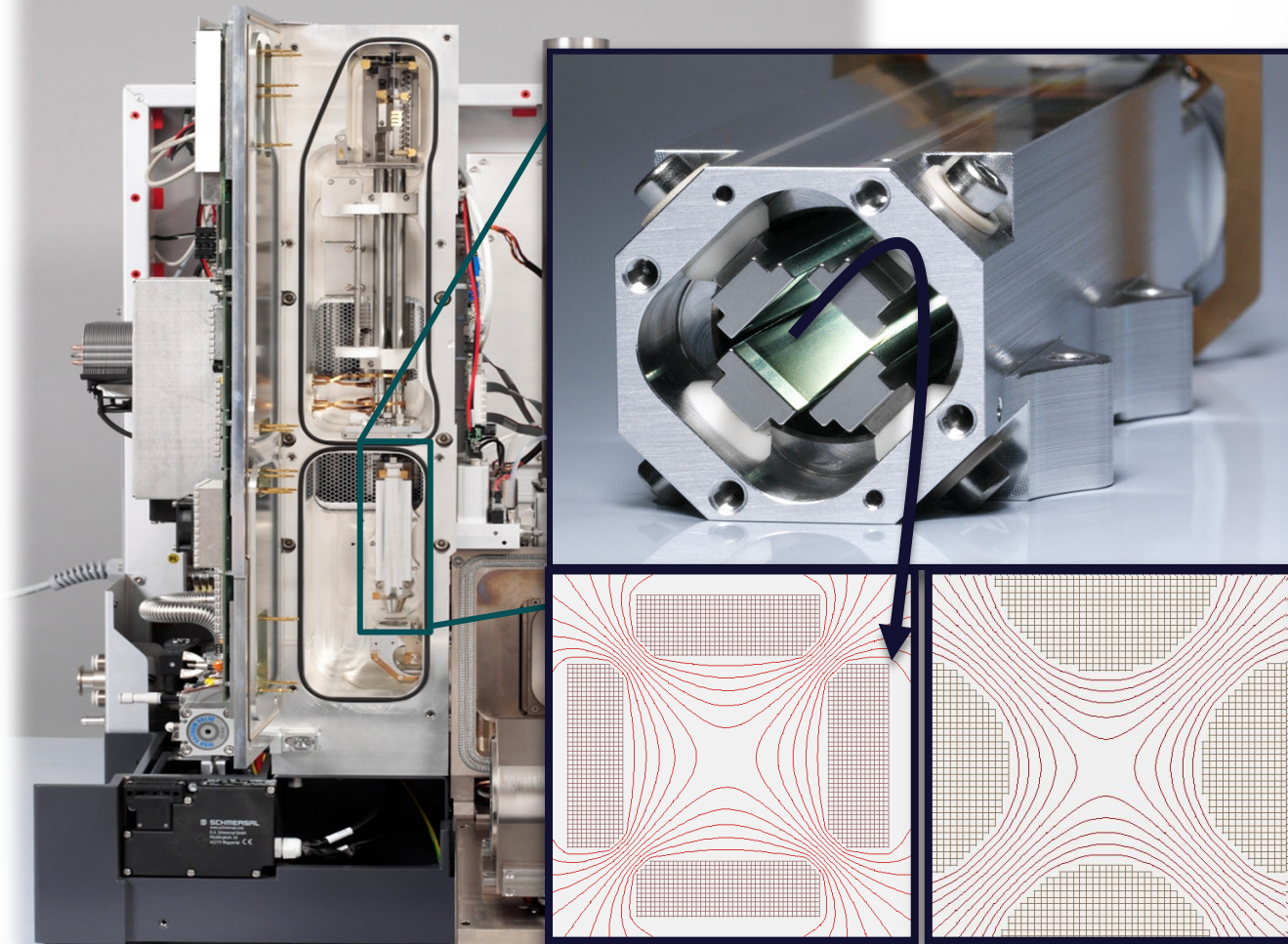
# Unique Right Angle Positive Ion Deflection



## 90° Ion Deflection and Focusing done right

- **focusing properties in all 3 dimensions**  
compared to other ion deflectors → Less ion focusing will require more maintenance due to the higher **material deposition**
- **Highest Signal to Noise ratio of any Quadrupole ICP-MS!**
- **Neutrals pass directly out of the 90° lens** without interacting with an active surface for **improved reliability and < maintenance**

# KEY TECHNOLOGY → QCELL OVERVIEW



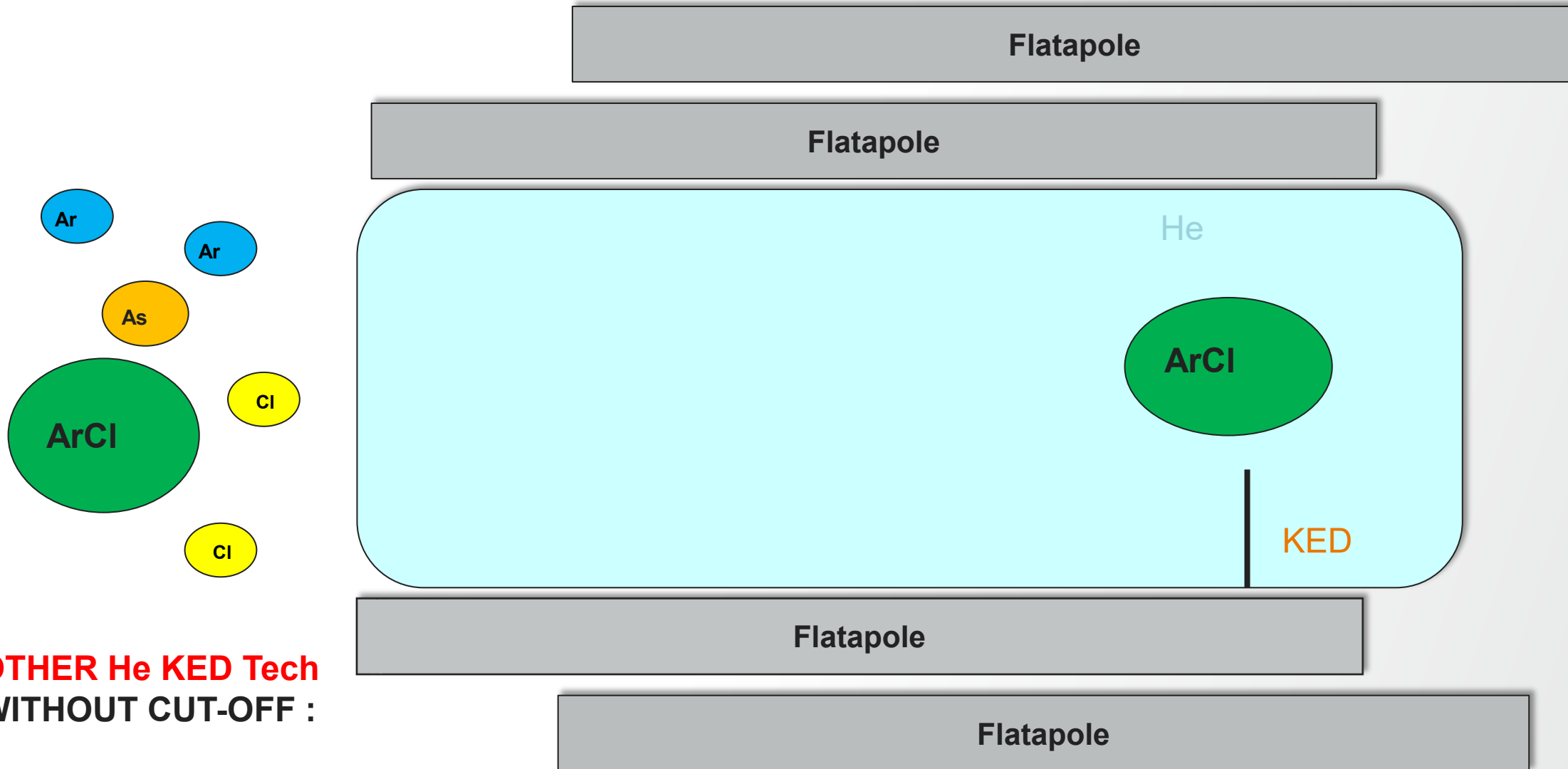
*Electrostatic field simulations*

New **patented QCell with automatic low mass cut-off**

- Non-consumable, **zero-maintenance!**
- 50% smaller volume for **faster mode switching (<10s)**
- **Single mode interference removal** with He for routine applications (KED)
- **High ion transmission** for improved sensitivity when using **kinetic energy discrimination**

= **Save 10-20 seconds** per sample and simplify your method development process

# Interference Removal Collision Cell : Example $^{75}\text{As}$ and $^{75}\text{ArCl}$



**OTHER He KED Tech  
WITHOUT CUT-OFF :**

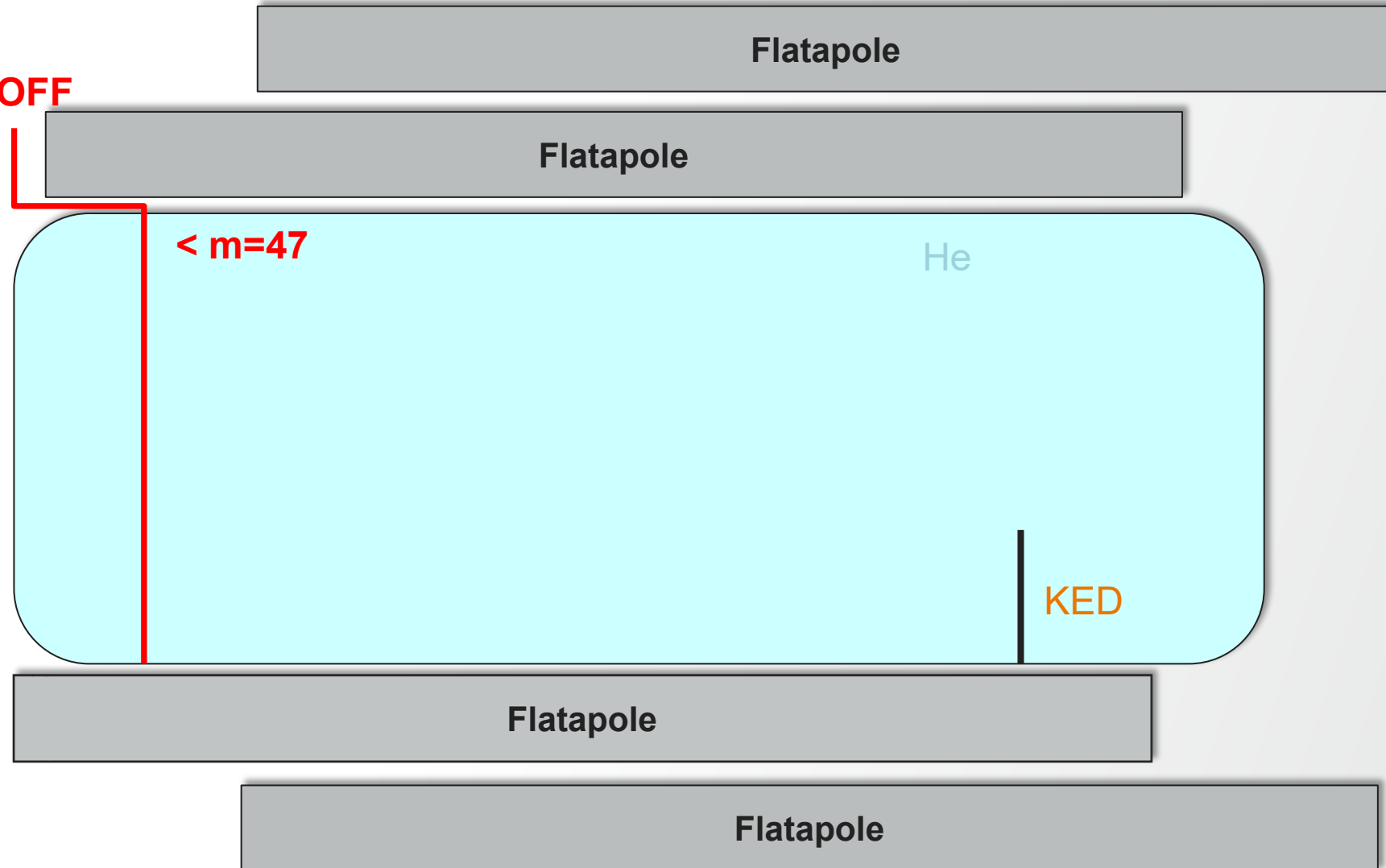
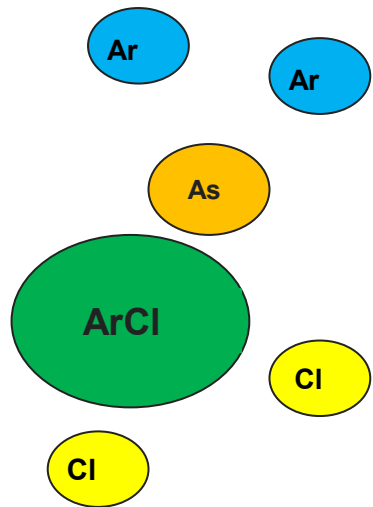
Ar and Cl ions pass through the Qcell → they can re-combine again → interferences was not solved completely  
In order to prevent this problems, in Qcell, we use Low Mass Cut Off technology to prevent it-Let's see how →

# Interference Removal Collision Cell : Example $^{75}\text{As}$ and $^{75}\text{ArCl}$

## OUR TECHNOLOGY

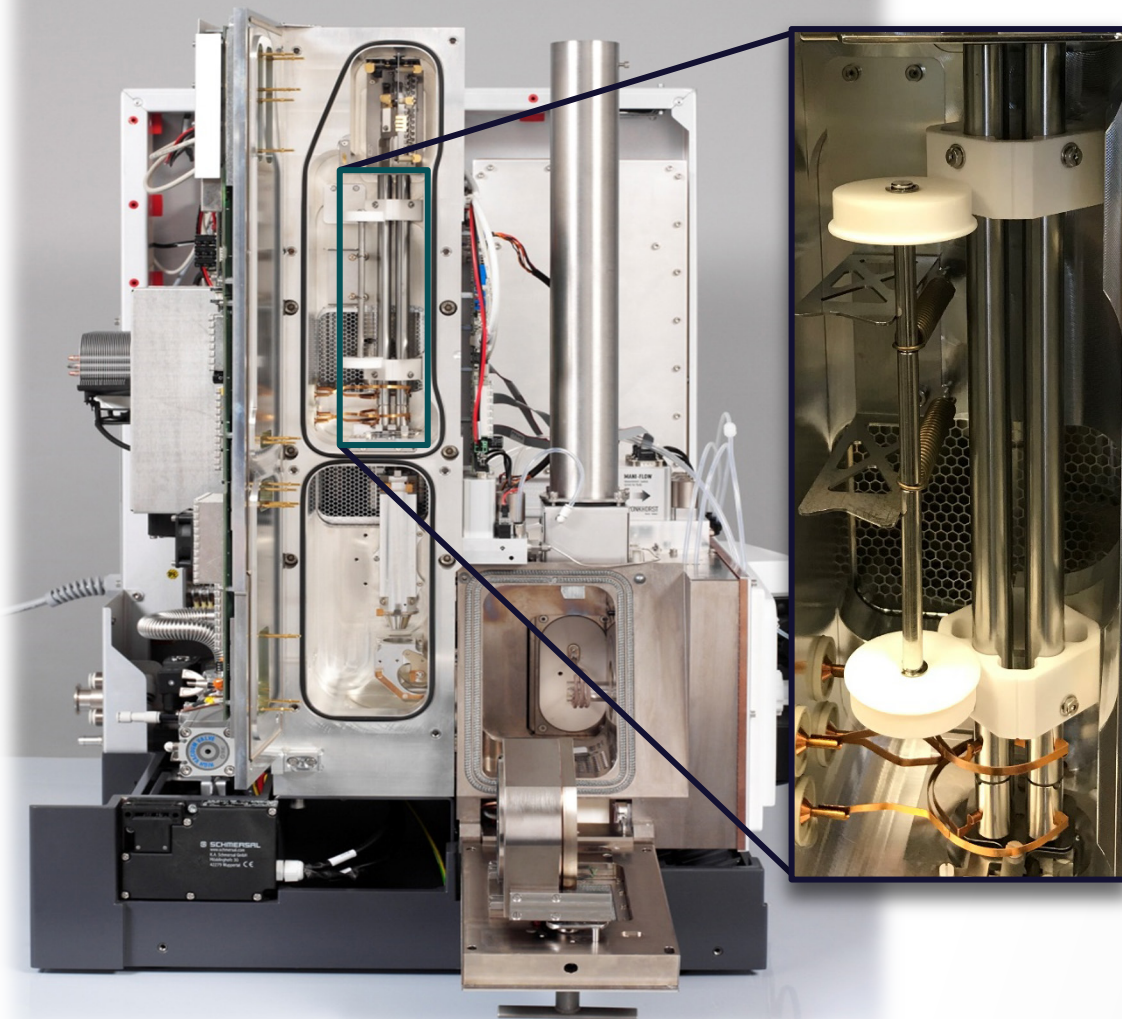
He KED

WITH AUTOMATIC CUT-OFF



- Other systems either don't have this technology or they have manual one rather than automatic !!!

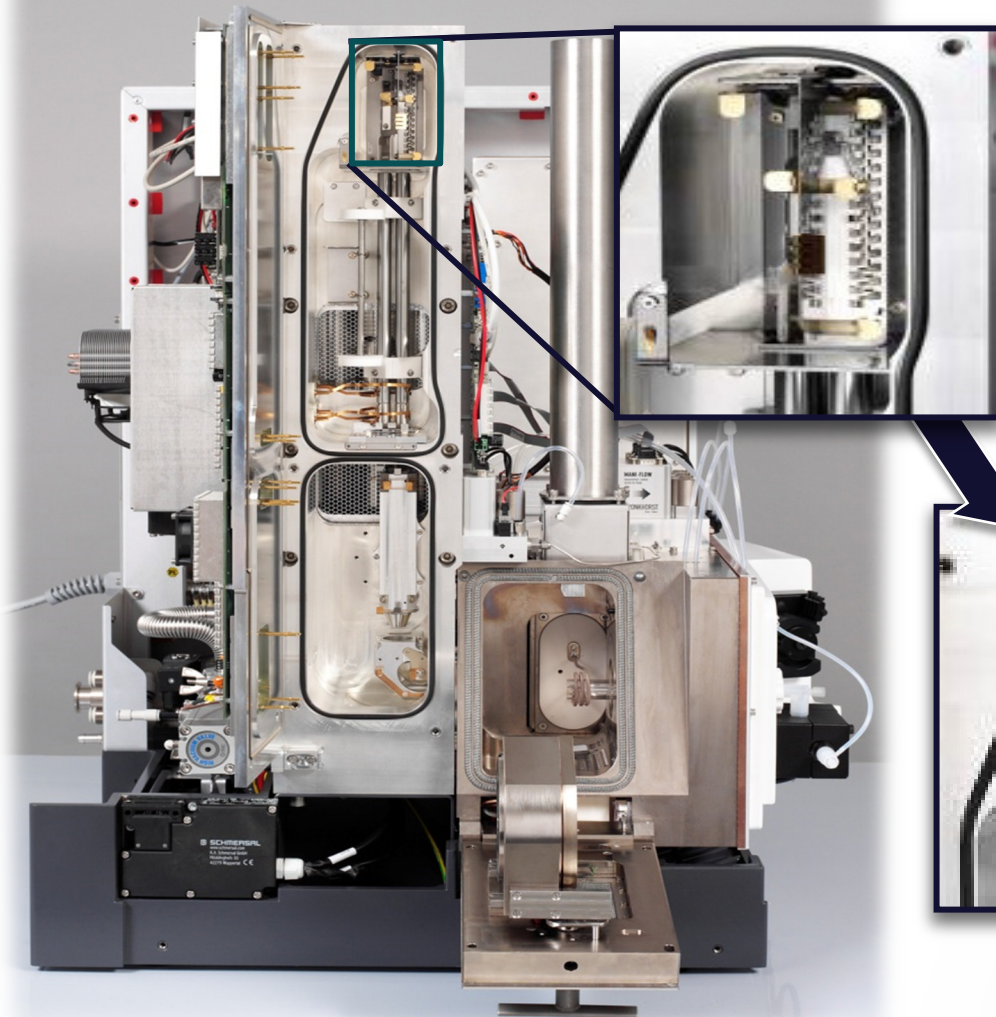
# Quadrupole Mass Analyzer



- Solid Molybdenum Quadrupole rods
- **Class leading mass stability** ( $\pm 0.025$  u / 8 hours).
- High Scan speed:  $>90000$  amu/s (Li-U-Li in  $<5$ ms,  $100\mu$ s at each mass)
- Mass range: 4 - 290 amu
- User definable resolution for improved dynamic range and improved abundance sensitivity



# Industry-Leading Performance from the Plasma to the Detector



- **Easy-fit**, cradle-mount
- **Long-life detector** with >10 orders of magnitude linear dynamic range
- User replaceable, **no tools required!**



# Some Detection Limits in PPT per Skimmer Cone Insert

KED mode (ng/L, ppt)			
Insert (mm)	2.8	3.5	4.5
<sup>7</sup> Li	22	61	183
<sup>9</sup> Be	15	56	168
<sup>23</sup> Na	238	216	1289
<sup>24</sup> Mg	8.2	7.3	22
<sup>48</sup> Ti	0.7	1.0	6.6
<sup>51</sup> V	5.5	2.5	19
<sup>52</sup> Cr	3.1	2.5	18
<sup>57</sup> Fe	4.2	6.6	18
<sup>59</sup> Co	2.3	1.5	6.1
<sup>63</sup> Cu	1.1	0.9	4.6
<sup>66</sup> Zn	5.1	7.1	16
<sup>75</sup> As	4.4	3.5	22
<sup>78</sup> Se	24	51	118
<sup>89</sup> Y	<0.01	<0.01	<0.01
<sup>107</sup> Ag	0.7	0.5	0.2
<sup>111</sup> Cd	0.3	0.2	<0.01
<sup>121</sup> Sb	1.9	1.7	3.7
<sup>197</sup> Au	0.3	0.2	0.9
<sup>202</sup> Hg	3.3	4.8	9.2
<sup>205</sup> Tl	0.3	0.4	0.4
<sup>208</sup> Pb	0.2	0.1	0.2
<sup>238</sup> U	0.03	0.05	0.07

ALL low (ppt) detection limits achieved using the standard configuration for the iCAP RQ

Parameter	Value
<b>Spraychamber</b>	Quartz cyclonic, cooled at 3 °C
<b>Nebulizer</b>	MicroMist borosilicate pumped at 400 µL·min <sup>-1</sup>
<b>Injector</b>	2.5 mm Quartz injector
<b>Interface</b>	Ni sample cone and insert type skimmer
<b>Plasma power</b>	1550 W
<b>Nebulizer gas</b>	1.1 L·min <sup>-1</sup>
<b>CRC gas</b>	He 4.5 mL·min <sup>-1</sup>
<b>KED</b>	3 V
<b>Lens setting</b>	Auto tune method

For more details, see Technical Note 43427  
– “Thermo Scientific iCAP RQ ICP-MS :  
Typical limits of detection”

# General Performance Comparison

<i>STD Mode</i>	iCAP RQ	System 1	System 2
<sup>7</sup> Li (kcps/ppb)	55 ( <b>100</b> )	55	9 ( <sup>9</sup> Be)
<sup>59</sup> Co (kcps/ppb)	100 ( <b>180</b> )	Not reported	Not reported
<sup>89</sup> Y (kcps/ppb)	( <b>300</b> )	320	Not reported
<sup>115</sup> In (kcps/ppb)	240 ( <b>385</b> )	Not reported	100
<sup>205</sup> Tl (kcps/ppb)	( <b>400</b> )	250	Not reported
<sup>238</sup> U (kcps/ppb)	330 ( <b>600</b> )	Not reported	80
Background m/z 4.5, 220	<1 ( <b>&lt;0.5</b> )	<2	<1
Short Term Stability (%RSD)	<2 (10 min) ( <b>&lt;1.0</b> )	<3 (20 min)	< 3
Long Term Stability (%RSD)	<3 (2hr) ( <b>&lt;2.0</b> )	<4 (2hr)	< 4 (4 hr)
Cell Mode <sup>59</sup> Co (kcps/ppb)	> <b>30 (&gt;45)</b>	-	-

Only ICP-MS on the market to **guarantee KED performance!**

Values in parentheses are **Typical** performance of the iCAP RQ with 2% HNO<sub>3</sub>, 0.5% HCl solution

For more details, see Technical Note 43359 – “Typical Performance of the Thermo Scientific iCAP RQ ICP-MS for Ultratrace Elemental Analysis”

# 3. iCAP RQ Instrument & Software Demo

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19 August 2021

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# Ease of Use Through Innovative Interface Design

## Unique drop-down door



- Bench-level, pop-out interface
- Door unlocks with 180° turn of outer handle
- Provides direct access to load coil, extraction lens and cones **without breaking vacuum**

## Quick-connect design



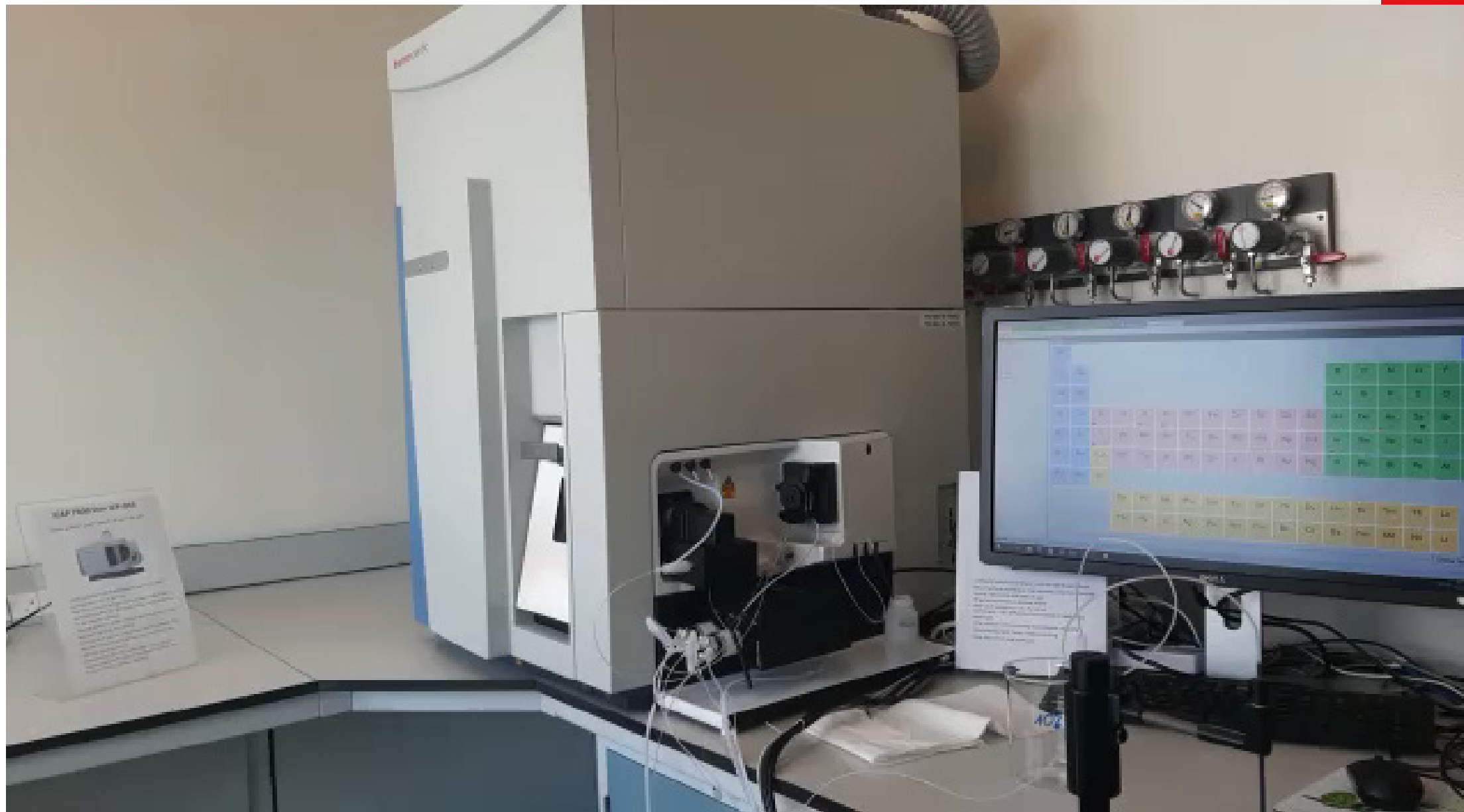
- Push-fit connections
- O-ring free spray chamber
- Easy to access mass flow-controlled gases

## Simple torch assembly



- Innovative holder automatically aligns injector
- Built-in gas fittings (no manual connections)
- O-ring free

# Part 1. ICP-MS Maintenance Operation- Cones Removal



# Part 2. ICP-MS Maintenance Operation- Sample Introduction parts assembly



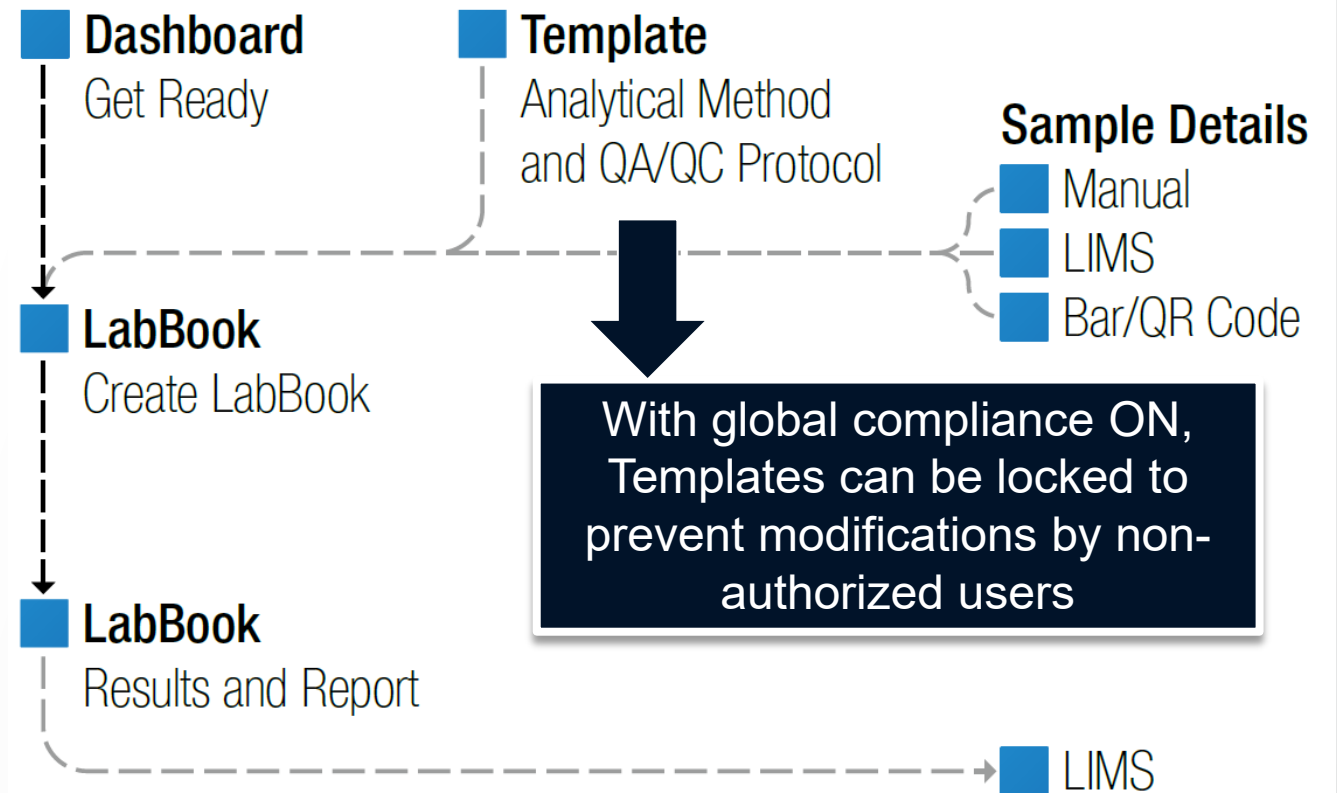
# Thermo Scientific™ Qtegra™ Intelligent Scientific Data

## Simple Workflows to Quality Results...

### Preparing the iCAP RQ



### Method and Sample Setup





# 3. Part – Labbook Creation Example:

- 4 elements (Hg, Pb, As, Cd)
- 2 standards- Low (0.5 ppb); high (10 ppb)
- Sequence List with 2 samples

The screenshot displays the 'LabBooks' section of the software. On the left is a navigation menu with options: Dashboard, LabBooks, Templates, Method Development, LabBook Query, File Manager, System Log, and Help. The main area is titled 'LabBooks' and contains two primary sections: 'Create LabBook' and 'Open LabBook'.

**Create LabBook Section:**

- Name:** A dropdown menu with the placeholder text 'Enter a LabBook name'. A tooltip above it says 'Analysis' and 'Enter a LabBook name or adapt one from a LabBook at the current location'.
- Location:** A dropdown menu with 'LabBooks\System Test' selected.
- Creation Options:**
  - Create a new LabBook from an existing Template
    - Template Name: Test1
    - Samples: 1 (with an 'Import from CSV' checkbox)
    - CSV name: (empty)
    - Mapping Name: (empty)
  - Create a new LabBook from an existing LabBook
    - LabBook Name: testforrecording
    - Import Calibration: (checkbox)
  - Create a new LabBook from a blank Template
    - Evaluation: eQuant

**Open LabBook Section:**

- Open an existing LabBook
- Open... button

**Recent LabBooks Section:**

- Open a recent LabBook
- List of recent LabBooks with expand/collapse icons:
  - testing
  - 01082021
  - testforrecording
  - Vitamins test1
  - DIS analysis 3004202repeat
  - DIS analysis 28042020
  - Disinfectant analysis test1
  - Test25052021(DL2)
  - Multi element Test\_IJC Training\_28November2019\_Trial
  - 8th Oct 2019\_DuraMetal\_Seq02

At the bottom of the interface, there is a 'Completed LabBooks' table with columns: Name, Path, Started At, Stopped At, and Information. Below the table are icons for 'Log View', 'Completed LabBooks', and 'Scheduler'. In the bottom right corner, there is a circular inset image of a woman wearing a headset, likely a customer support representative.

# 5. Summary

Maja Budanovic

SEA Applications Expert TEA

16/06/2021

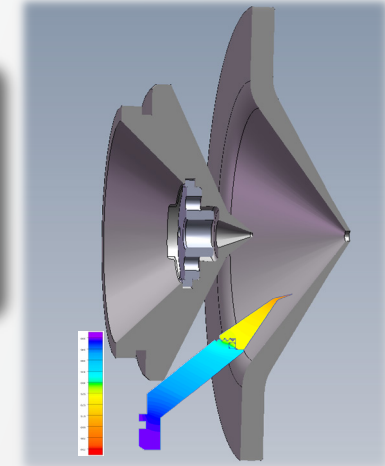
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# Thermo Scientific iCAP RQ ICP-MS

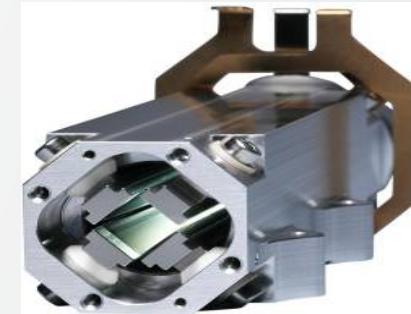
## Reliability

- New interface design configured for your application
- New **robust and reliable design for low maintenance** and service costs



## Performance

- Single measurement mode, integrated sampling valves
- Unique QCell flatapole technology with low mass cut-off + He KED mode → **best signal/noise**



## Productivity

- Built in Simplicity for user-friendly operation and easy installation
- Qtegra ISDS for plug-ins, **easy workflow** and compliance



# iCAP RQ and Qtegra Software Used Worldwide by Top Companies



# Thank you

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