

**Design criteria:**

- Shortest possible distances between source, sample and detector
- Measurement conditions: air, vacuum
- Compact tabletop design
- Detection limits in the pg range (ng/L)
- Sample changer
- Analysis of low Z elements down to C
- High stability
- Low Power X-ray tubes (air-cooled)
- Silicon drift detector (no LN<sub>2</sub> needed)

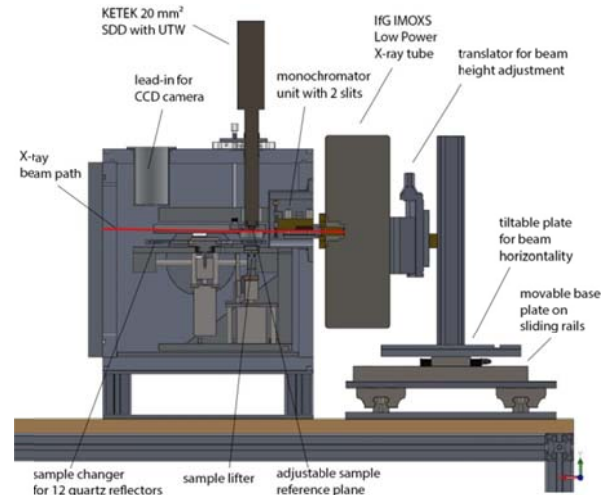
**Features:**

- Multilayer monochromators: high reflectivity, low background
- Vacuum: no air scatter, no Ar peak, reduced absorption → low Z option
- Two X-ray sources (Cr-K $\alpha$ , Rh-K $\alpha$ ): ideal excitation conditions for low and high Z elements
- Sample changer tray for 12 samples
- Detection limits: 100 pg for Sr (Rh-K $\alpha$ ), 20 pg for Ti (Cr-K $\alpha$ )
- Spectra in \*.spe format (AXIL)

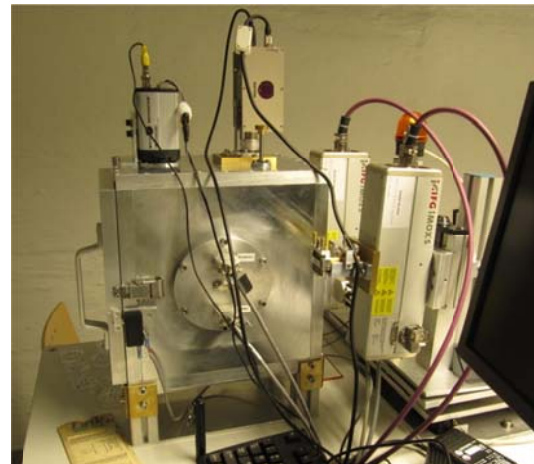
**Components:**

- Vacuum TXRF chamber (Atominstitut, A)
- 20 mm<sup>2</sup> Si drift detector with ultrathin polymer window and integrated pulse processor (KETEK, D)
- Two 35 W air-cooled low power X-ray tubes with Cr and Rh anodes (IfG, D)
- Tabletop HV generator (IfG, D)
- Multilayer monochromators: Ni/C (d = 4.03 nm) and Pd/B<sub>4</sub>C (d = 3.24 nm) (AXO Dresden, D)
- Sample changer (Atominstitut, A) with vacuum stepper motors (Phytron, D)
- WOBISTRAX operation software (Atominstitut, A)
- AXIL deconvolution software (IAEA, A)

**Schematic view:**



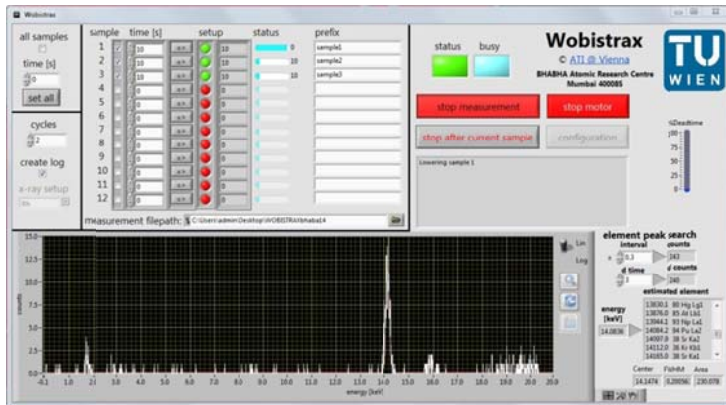
**Total view of the spectrometer:**



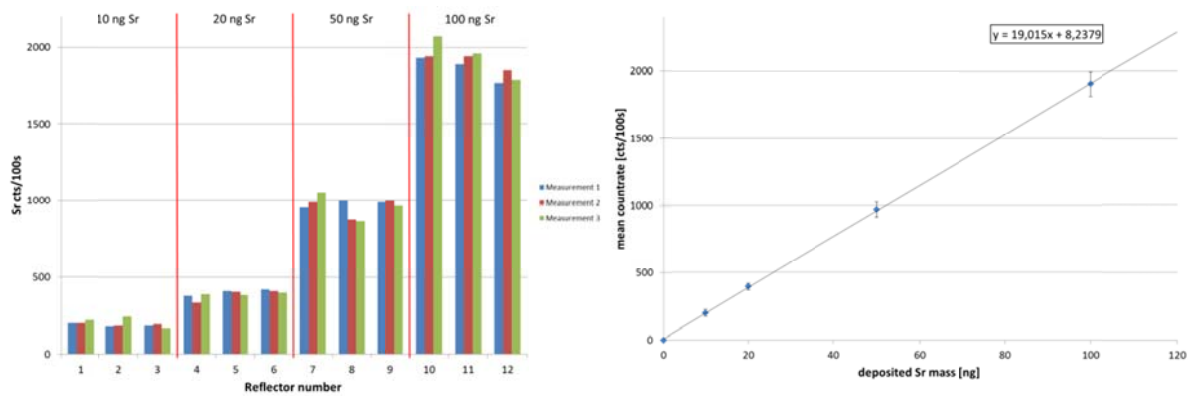
**Technical data:**

<b>X-ray generator</b>	<i>IfG Control and Supply Unit (CSU)</i>
<b>X-ray tubes</b>	<i>Warrikhoff MCB50-0,7G</i> 35 W Cr anode, 35 W Rh anode Air cooled, long fine focus <i>IfG IMOXS</i> tube housing
<b>Operation conditions</b>	30 kV/1300 $\mu$ A for Cr excitation 50 kV/700 $\mu$ A for Rh excitation
<b>Silicon drift detector</b>	<i>KETEK AXAS-D-H20-136 LE with VITUS H20 SDD</i> 20 mm <sup>2</sup> x 0.45 mm detector crystal, 300 nm polymer window Magnetic electron trap on external Ag collimator Integrated digital pulse processor (DPP) FWHM @ 100 kcps $\leq$ 139 eV (Mn-K $\alpha$ )
<b>Multilayer monochromators</b>	<i>AXO Dresden</i> Diameter: 25.4 mm (1 inch) 80 layers Ni/C (d = 4.03 nm) for Cr excitation 100 layers Pd/B <sub>4</sub> C (d = 3.24 nm) for Rh excitation Substrate: polished quartz glass
<b>Operation modes</b>	Rough vacuum (3 mbar) membrane pump for Cr excitation Air for Rh excitation
<b>Sample carriers</b>	any substrate with 30 mm diameter (quartz, acrylic glass, silicon)
<b>Sample changer</b>	Tray for up to 12 samples for sequential measurements
<b>Element range</b>	C-K (Z = 6) to Ti-K (Z = 22) and Mo-L (Z = 42) to Ba-L (Z = 56) for Cr K-K (Z = 19) to Mo-K (Z = 42) and Cs-L (Z = 55) to U-L (Z = 92) for Rh
<b>Detection limits</b>	Cr excitation: < 200 ng C, 12 ng F, 3.3 ng Na; 20 pg Ti Rh excitation: < 100 ng Sr (< 10 ppb for a 10 $\mu$ l droplet)
<b>Operation conditions</b>	10 to 30 °C, 10 to 80 % rel. humidity, non-corrosive environment
<b>Dimensions and weight</b>	320 x 240 x 320 mm
<b>Vacuum chamber</b>	20 kg
<b>Dimensions and weight</b>	550 x 300 x 400 mm
<b>Tube translation unit</b>	20 kg

## Control software:

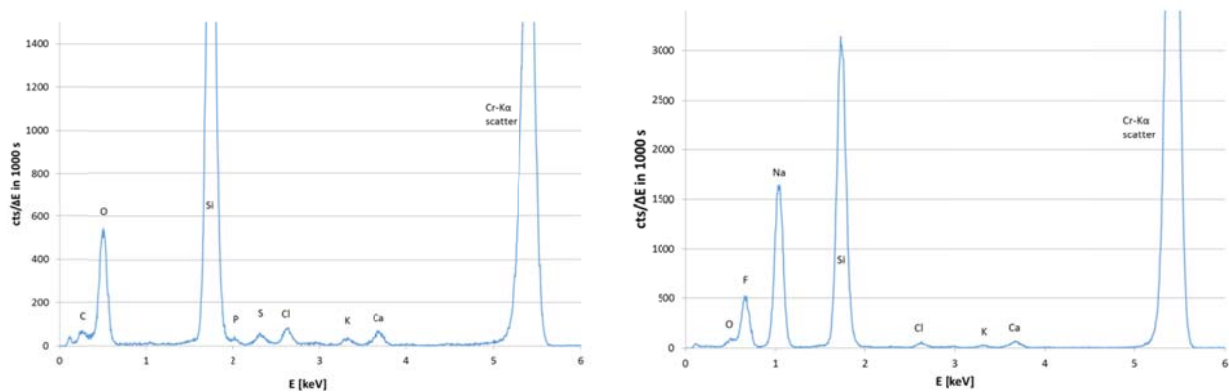


## Sr repro test and calibration curve:



LLD1000(Sr)  $\leq$  100 pg

## Low Z performance:



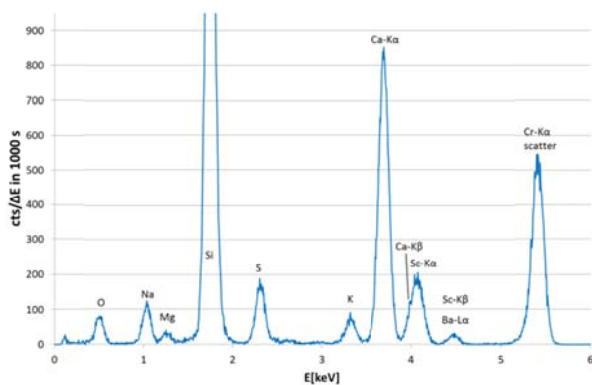
3000 ng TRIS on quartz reflector

2000 ng NaF on quartz reflector

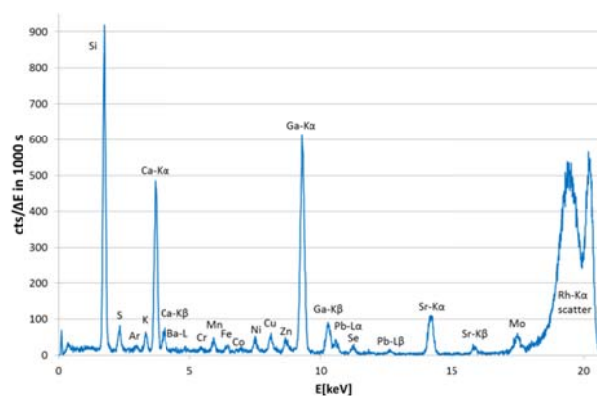
LLD1000(C)  $\leq$  200 ng

LLD1000(F)  $\leq$  12 ng, LLD(Na)  $\leq$  3.3 ng

## NIST 1640:



Cr excitation (vacuum, 30 kV/1300 µA)  
Internal standard: 1 ppm Sc



Rh excitation (air, 50 kV/700 µA)  
Internal standard: 1 ppm Ga

## Future developments:

- Curved multilayer monochromator  
Increase in intensity and reduction of detection limits for all elements
- Large area SDD (100 mm<sup>2</sup>)  
Reduction of detection limits for all elements
- Double anode X-ray tube  
Rh (or Mo) and Cr excitation possible without tube change

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