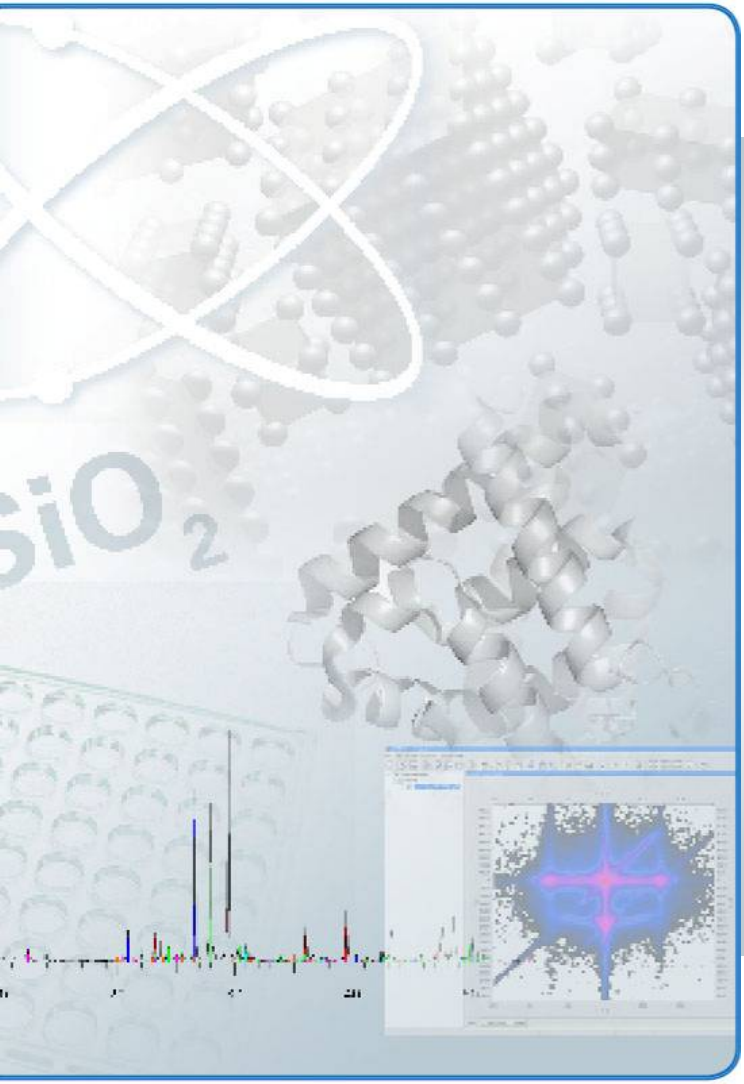
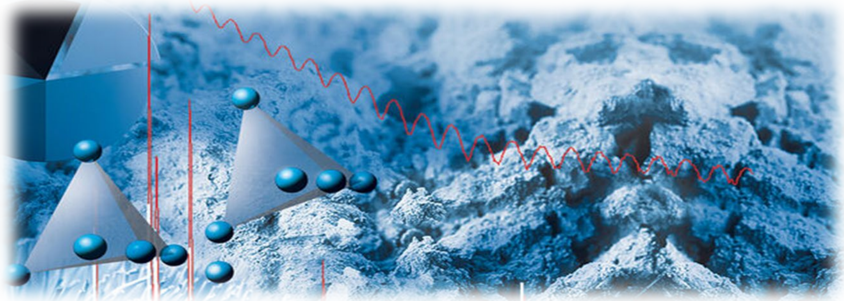
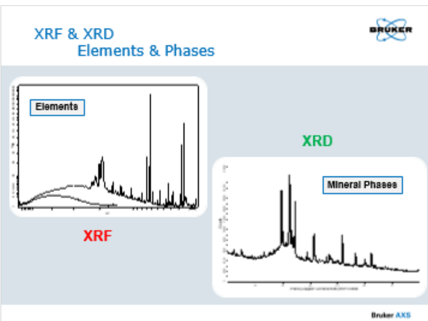


The New D8 ADVANCE

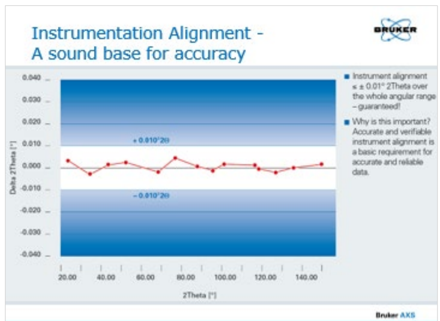
Powder Diffraction at it's Best

Dr. Maykel Manawan

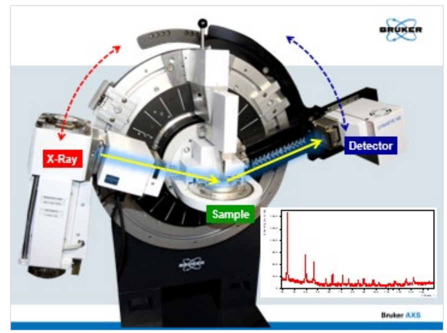




XRF & XRD
Elements & Phases
Elements
XRD
Mineral Phases
XRF
Bruker AXS

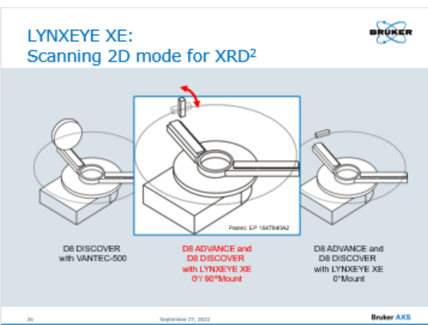


Instrumentation Alignment -
A sound base for accuracy
Instrument alignment ≤ ± 0.01° 2Theta over the whole angular range – guaranteed!
Why is this important? Accurate and verifiable instrument alignment is a basic requirement for accurate and reliable data.
+ 0.010°2θ
- 0.010°2θ
Delta 2Theta [°]
2Theta [°]
Bruker AXS



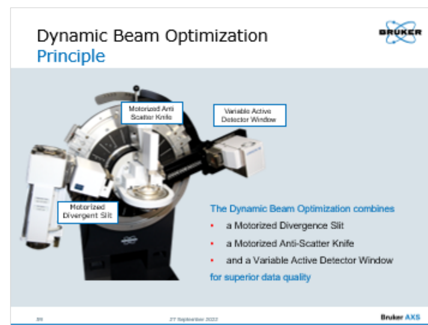
X-Ray
Detector
Sample
Bruker AXS

The Bruker Guarantee
Detector Guarantee
Detectors are guaranteed to be without any defective strips or areas
Bruker AXS



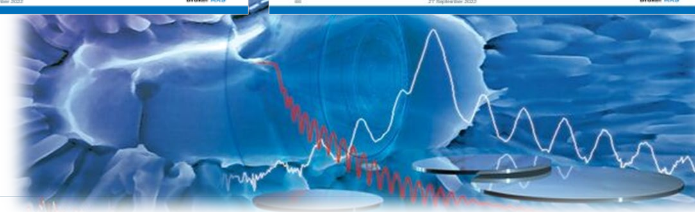
LYNXEYE XE:
Scanning 2D mode for XRD²
D8 DISCOVER with VANTEC-500
D8 ADVANCE and D8 DISCOVER with LYNXEYE XE 0°/ 90°Mount
D8 ADVANCE and D8 DISCOVER with LYNXEYE XE 0°Mount
Bruker AXS

The New D8 ADVANCE
Designed for the New Era in XRD
Bruker AXS

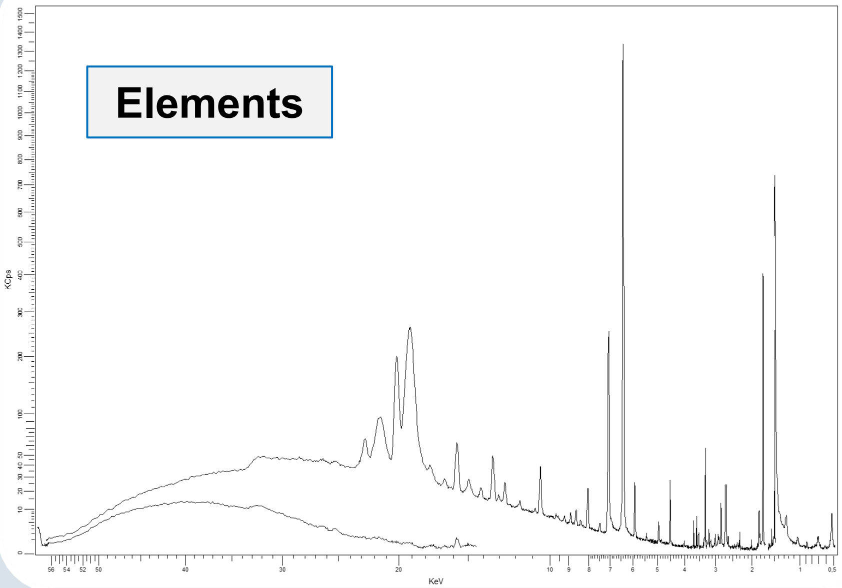


Dynamic Beam Optimization
Principle
Motorized Anti Scatter Knife
Variable Active Detector Window
Motorized Divergent Slit
The Dynamic Beam Optimization combines
a Motorized Divergence Slit
a Motorized Anti-Scatter Knife
and a Variable Active Detector Window
for superior data quality
Bruker AXS

D8 ADVANCE ECO
Efficient 1 kW generator
Single phase power
No external water cooling or chiller
3-year X-ray tube warranty
10-year goniometer warranty
Alignment guarantee
Low power consumption!
No external water consumption!
Bruker AXS

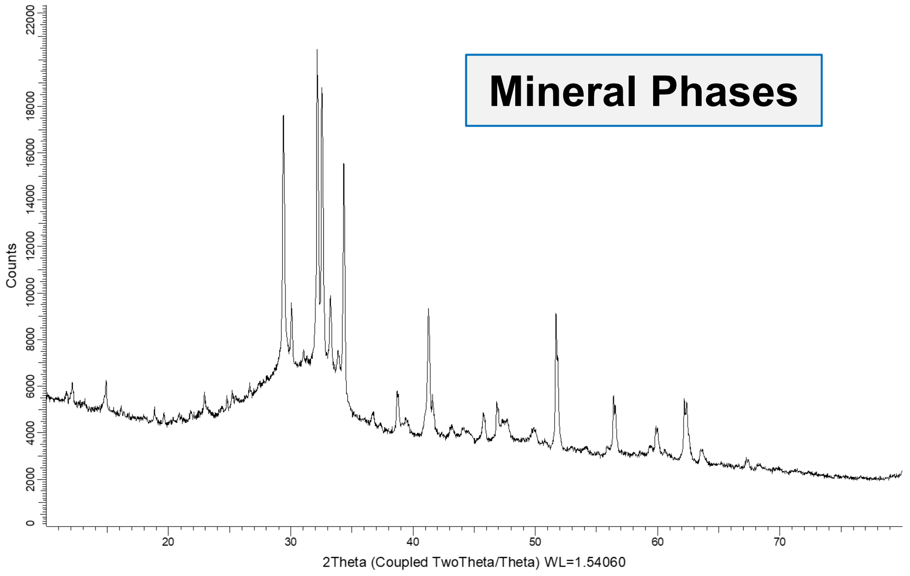


XRF & XRD
Elements & Phases



XRF

XRD



Elements & Phases

- **Phase**:
  A physically distinctive form of matter, such as a solid, liquid, gas or plasma. A phase of matter is characterized by having relatively uniform chemical and physical properties.

H_20

gaseous

liquid

solid

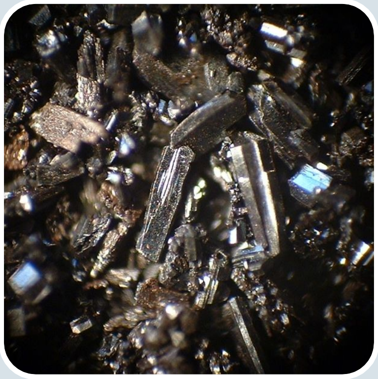
Elements & Phases

- **Phase**:
  A physically distinctive form of matter, such as a solid, liquid, gas or plasma. A phase of matter is characterized by having relatively uniform chemical and physical properties.

C

solid

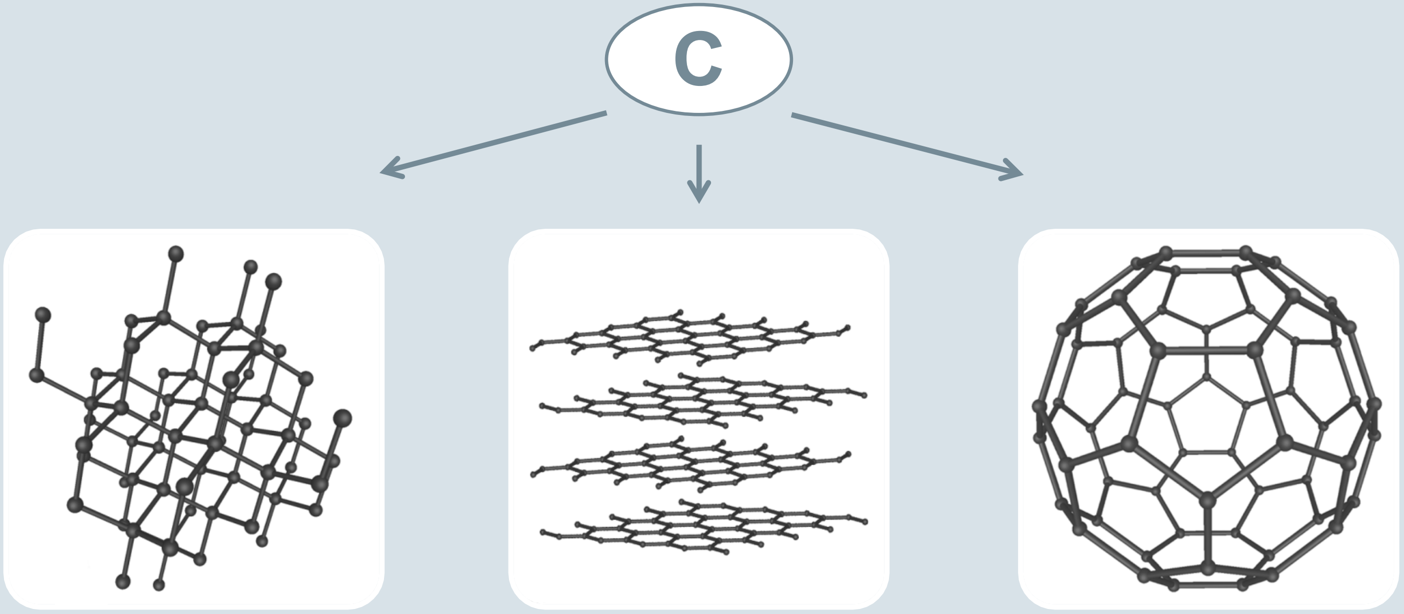
solid



solid

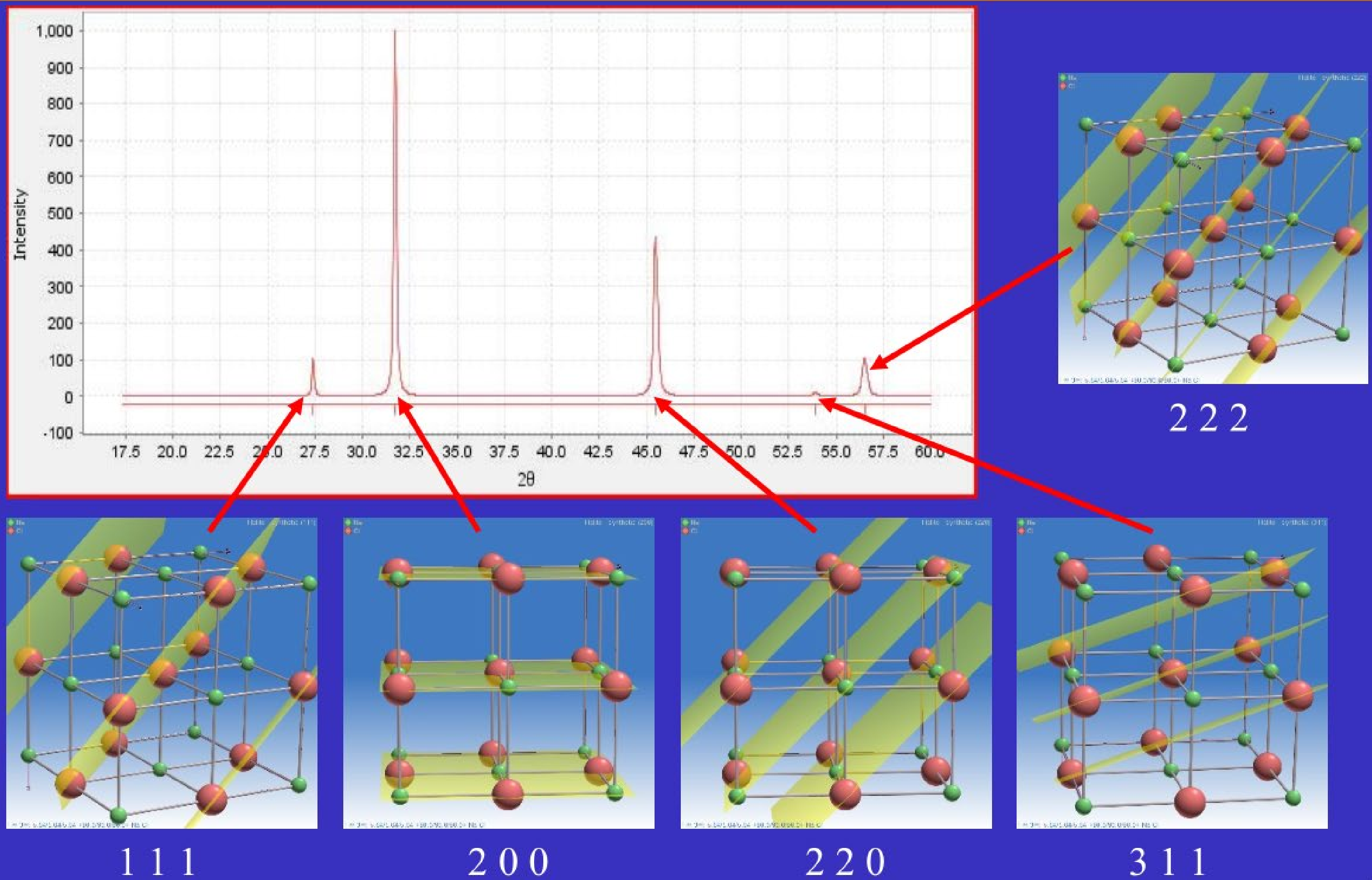
Elements & Phases

- **Phase**:
  A physically distinctive form of matter, such as a solid, liquid, gas or plasma. A phase of matter is characterized by having relatively uniform chemical <u>and</u> physical properties.

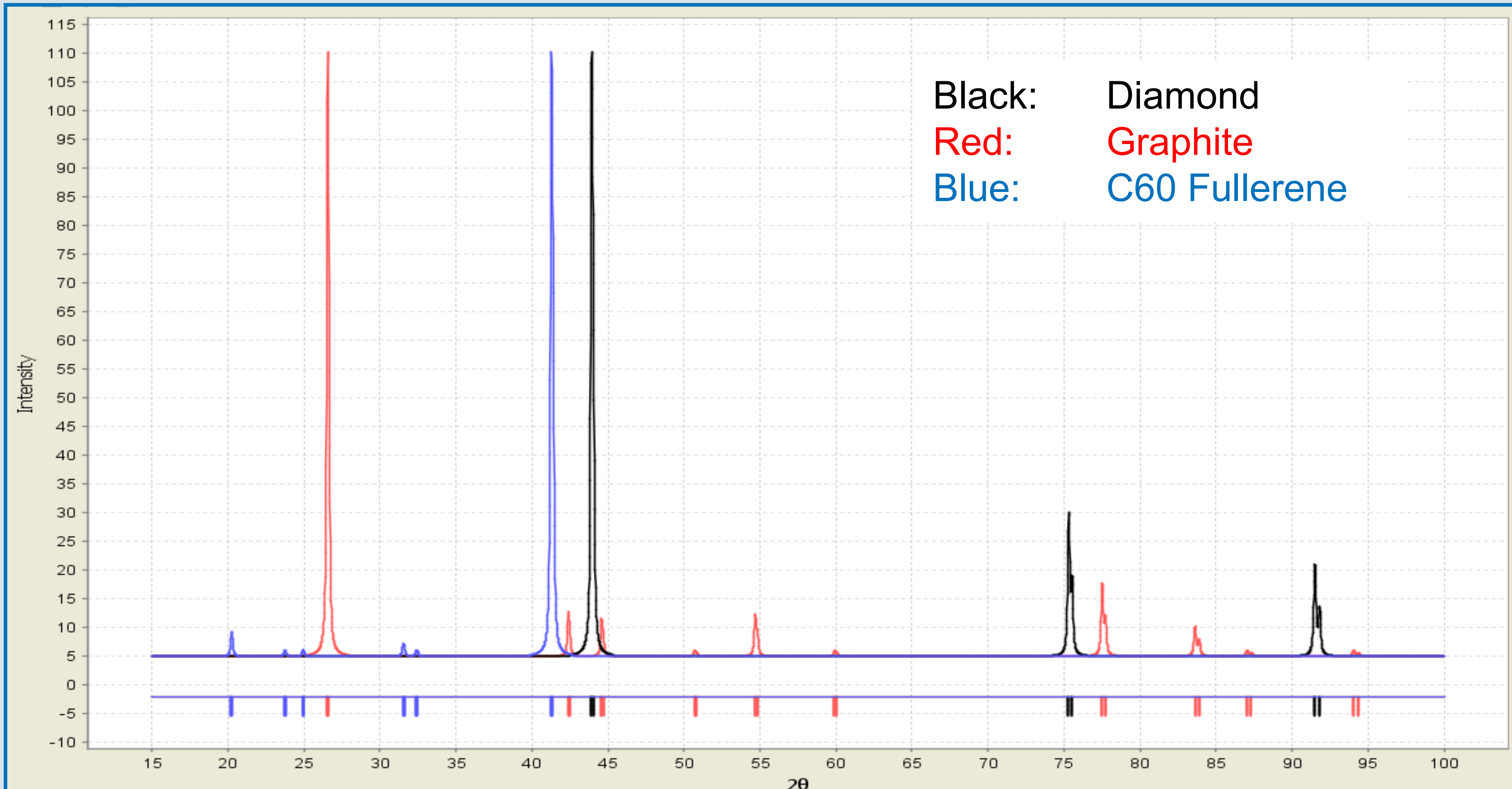


solid solid solid

Classical XRPD
NaCl – An Example

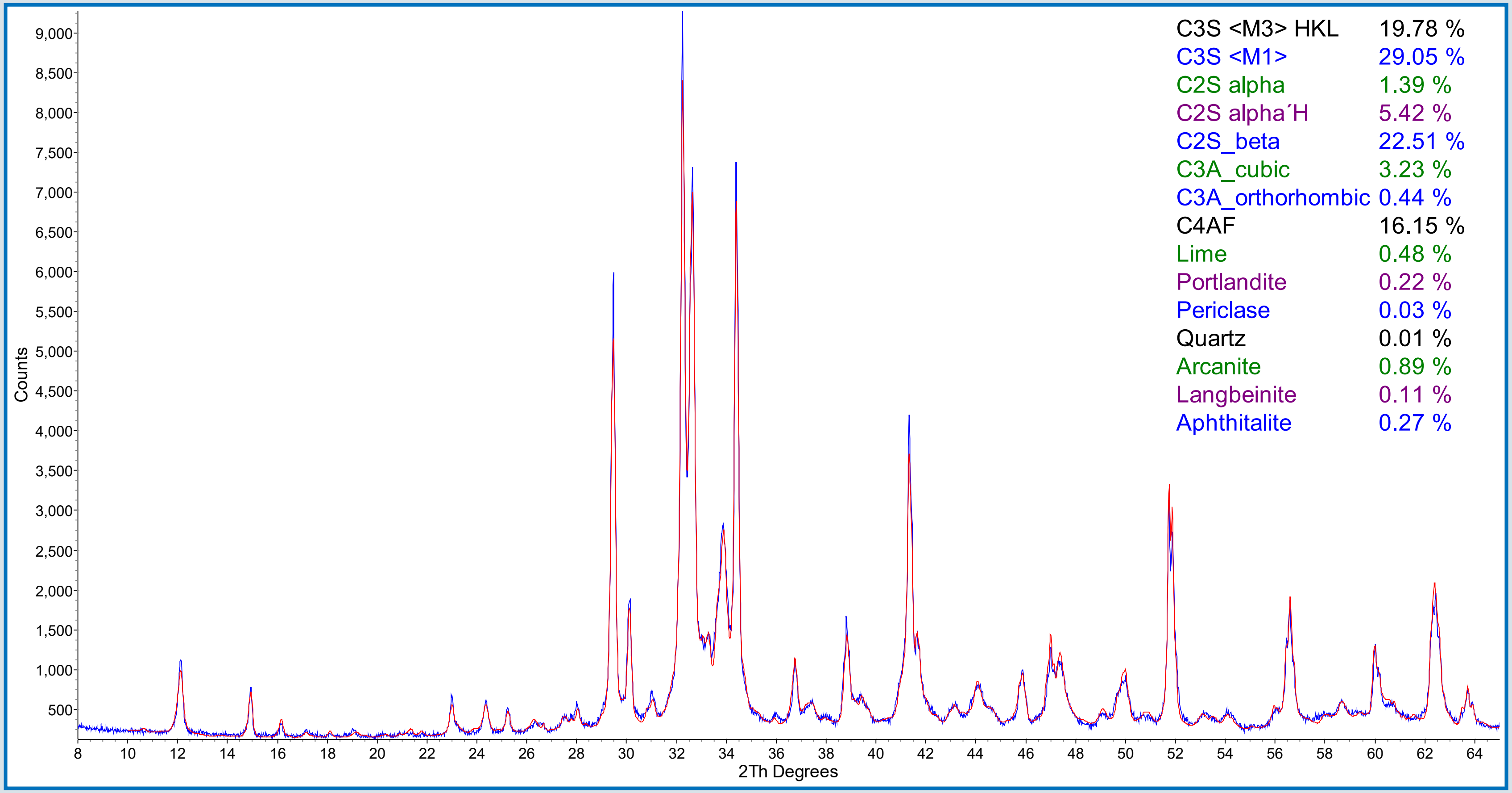


Different Phases:
Different XRD Patterns

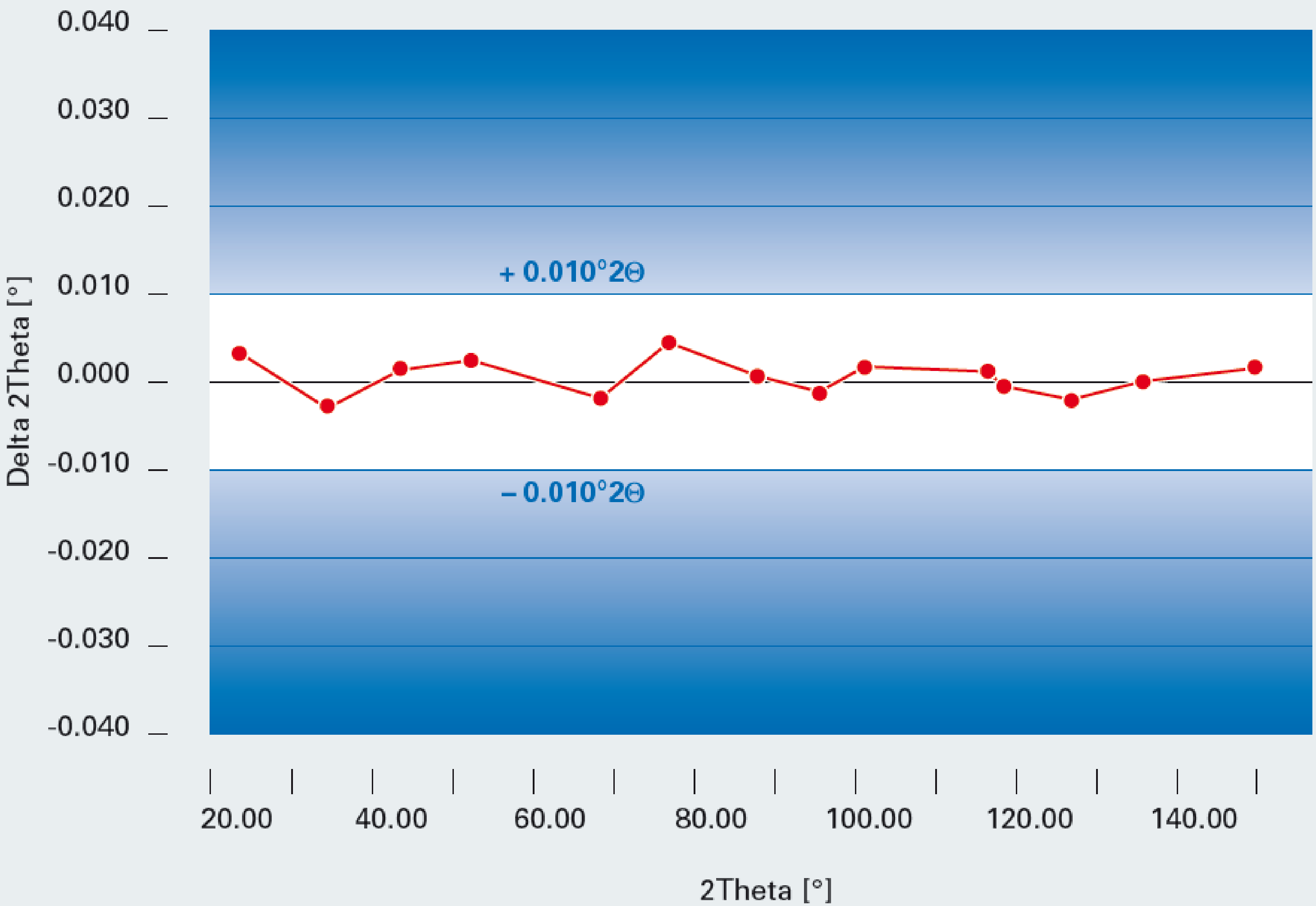


Ideal calculated diffraction patterns from the 3 phases mentioned above

Different Phases:
A Diffractogram (QPA)



Instrumentation Alignment - A sound base for accuracy



- Instrument alignment ≤ ± 0.01° 2Theta over the whole angular range – guaranteed!
- Why is this important? Accurate and verifiable instrument alignment is a basic requirement for accurate and reliable data.

XRPD –Definition of Quality

- ICDD PDF: a pattern is considered to be a high quality pattern if differences between measured and theoretical peak positions:

$$\Delta 2\theta \leq \pm 0.04°$$

- Precision of peak position
- Relative peak intensities
- Peak shape
- Full-Width-at-Half-Maximum (FWHM)
- Peak-to-background ratio

ICDD Database

	PDF-2 2015	PDF-2 2020	PDF-4+ 2020	Additional Entries Since Release 2015 PDF-2 2020	Additional Entries Since Release 2015 PDF-4+ 2020
Total Entries	278,503	311,561	426,189	33,058	147,686
Total No. with Atomic Coordinates	0	0	323,933	0	323,933
Subfile Distribution					
Inorganic	246,032	290,127	404,704	44,095	158,672
Organic	39,831	44,731	46,024	4,900	6,193
Mineral & Related Materials	33,633	37,077	47,169	3,444	13,536
Metal & Alloys	94,379	102,804	151,515	8,425	57,136
Forensics	902	2,099	14,192	1,197	13,290
Ceramics	11,339	14,381	18,166	3,042	6,827
Common Phases	15,339	16,300	22,105	961	6,766
Cement Materials	1,360	1,490	1,626	130	266
Searches	61	70	75	9	14
Display Fields	48	55	128	7	80

NIST SRM 640d (Si) with Bruker

National Institute of Standards & Technology

Certificate

Standard Reference Material® 640d

Silicon Powder

Line Position and Line Shape Standard for Powder Diffraction

This Standard Reference Material (SRM) is intended for use as a standard for calibration of diffraction line positions and line shapes, determined through powder diffractometry. A unit of SRM 640d consists of approximately 7.5 g of silicon powder bottled under argon.

electronics provide ± 1 arc-second accuracy, and approximately 0.035 arc-second precision. The optics, X-ray generator, tube shield, and sample spinner of the machine are conventional in nature; they were originally components of a Siemens D5000 diffractometer, ca. 1992. The sample spinner, however, was modified to allow for remote mounting, and therefore thermal isolation, of its drive motor.

Data Analysis: The certification data were analyzed using the FPA method with a Rietveld [9-11] refinement as implemented in TOPAS [12]. The analysis used the Cu $K\alpha_1/K\alpha_2$ emission spectrum, including a satellite component, as characterized by G. Hölzer *et al.* [13,14]. The Lorentzian breadths of the Cu emission spectrum were refined with

NIST SRM 660d (LaB_6) with Bruker

National Institute of Standards & Technology

Certificate

Standard Reference Material® 660b

Line Position and Line Shape Standard for Powder Diffraction

This Standard Reference Material (SRM) is intended for use in calibration of diffraction line positions and line shapes determined through powder diffractometry. A unit of SRM 660b consists of approximately 6 g of lanthanum hexaboride, LaB_6, powder bottled under argon.

electronics provide ± 1 arc-second accuracy, and approximately 0.035 arc-second precision. The optics, X-ray generator, tube shield, and sample spinner of the machine are conventional in nature; they were originally components of a Siemens D5000 diffractometer, ca. 1992.

Data Analysis: The certification data were analyzed using the FPA method with a Rietveld [6-8] refinement as implemented in TOPAS [9]. The analysis used the Cu $K\alpha_1/K\alpha_2$ emission spectrum, including a satellite component, as characterized by G. Hölzer *et al.* [10,11]. The Lorentzian breadths of the Cu emission spectrum were refined with

NIST SRM 676a (Al_2O_3) with Bruker

National Institute of Standards & Technology

Certificate of Analysis

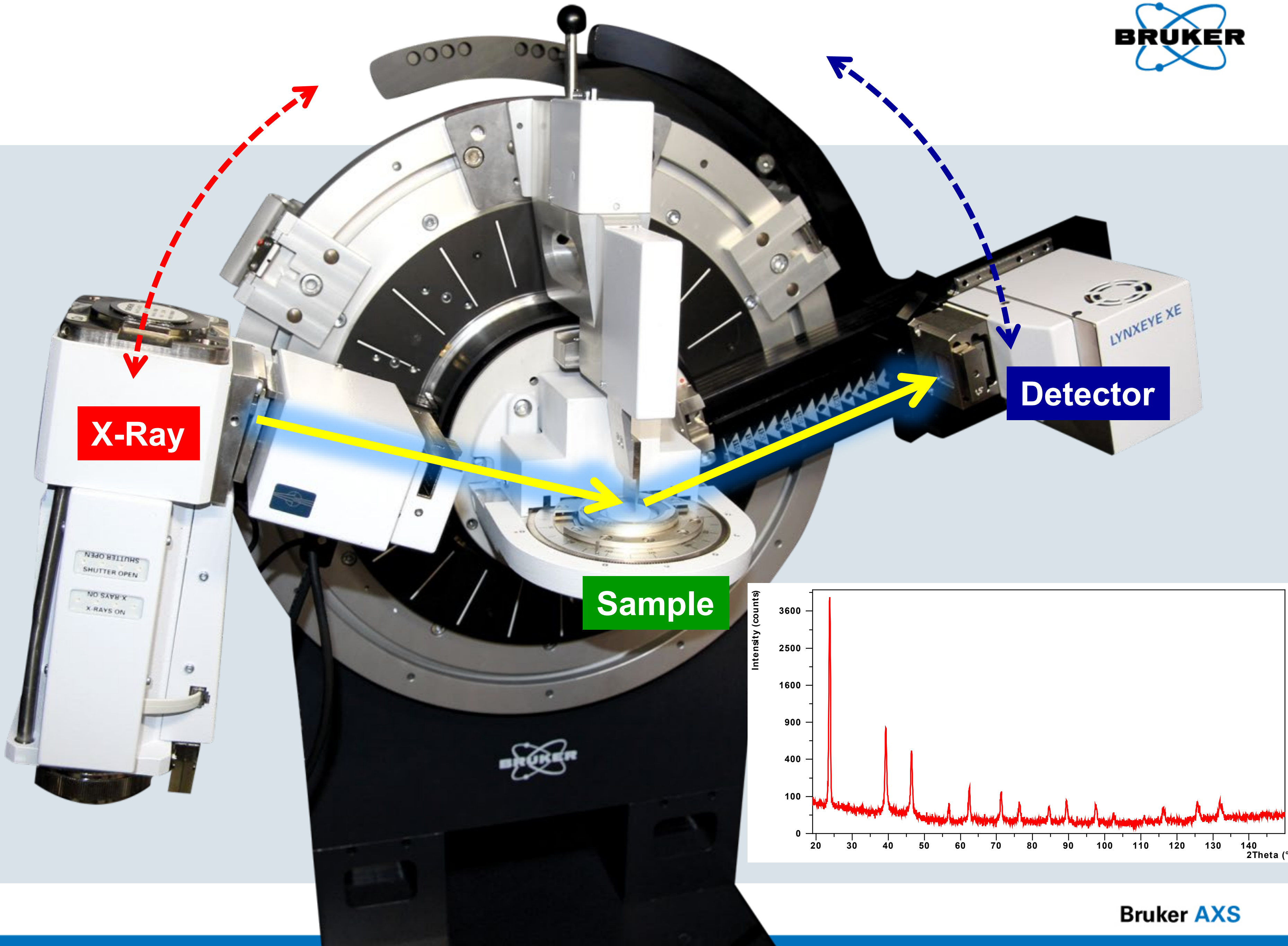
Standard Reference Material® 676a

Alumina Powder
(Quantitative Analysis Powder Diffraction Standard)

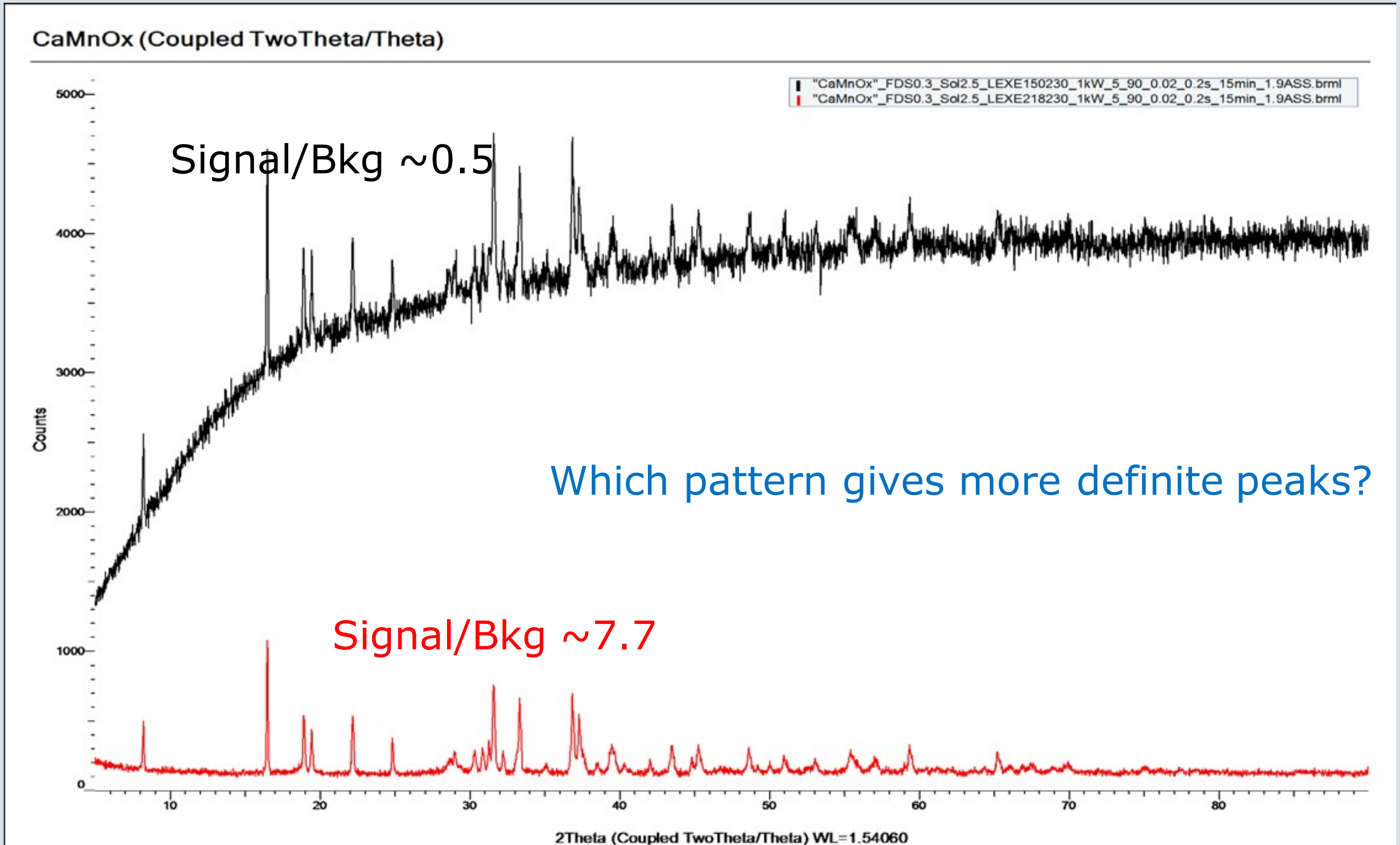
This Standard Reference Material (SRM) consists of an alumina powder (corundum structure) intended primarily for use as an internal standard for quantitative phase analysis using powder diffraction methods. It is also suitable for determination of I/I_c values [1] (for a complete discussion of the I/I_c see [2]). A unit of SRM 676a consists of approximately 20 g of powder, bottled in an argon atmosphere.

Data for relative intensity determinations were collected from 10 randomly selected specimens on a Siemens D500 diffractometer. This machine was equipped with a focusing Ge incident beam monochromator, sample spinner/changer,

two software packages, though the results from only one are reported. The first procedure was to fit the profiles using the split Pearson VII profile shape function (PSF) as implemented within TOPAS. The second involved Rietveld analyses via GSAS [26]. The background in both analyses was represented by a tenth-order Chebyshev polynomial with

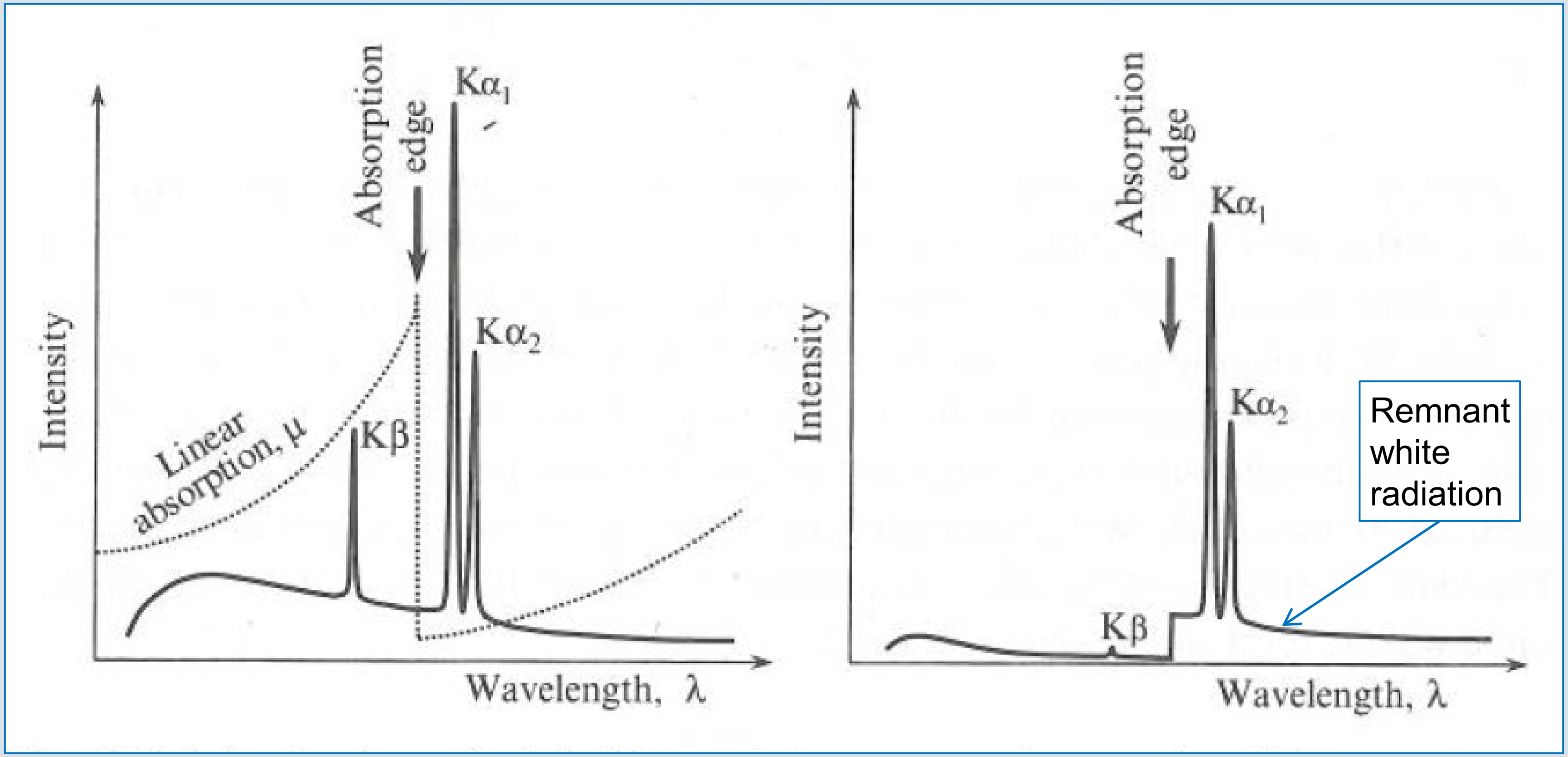

X-Ray
Detector
Sample
LYNXEYE XE
SHUTTER OPEN
X-RAYS ON
Intensity (counts)
3600
2500
1600
900
400
100
0
20
30
40
50
60
70
80
90
100
110
120
130
140
2Theta (°)

Basics Quality of XRPD pattern



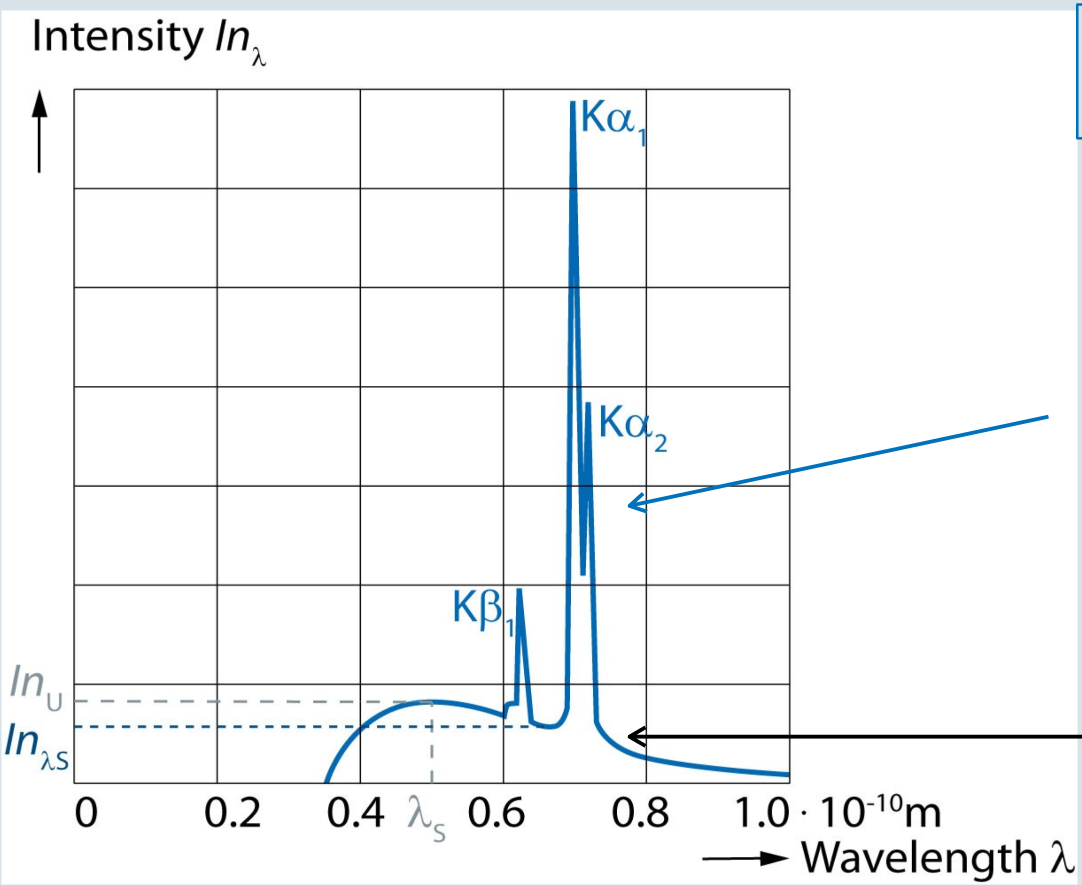
Absolute Intensity Means Nothing!
It is Peak to Background Ratio counts!

XRD Monochromatization
Effect of Kß-Filter



Pecharsky & Zavalij (2009)

Generating X-Rays The X-Ray Spectrum

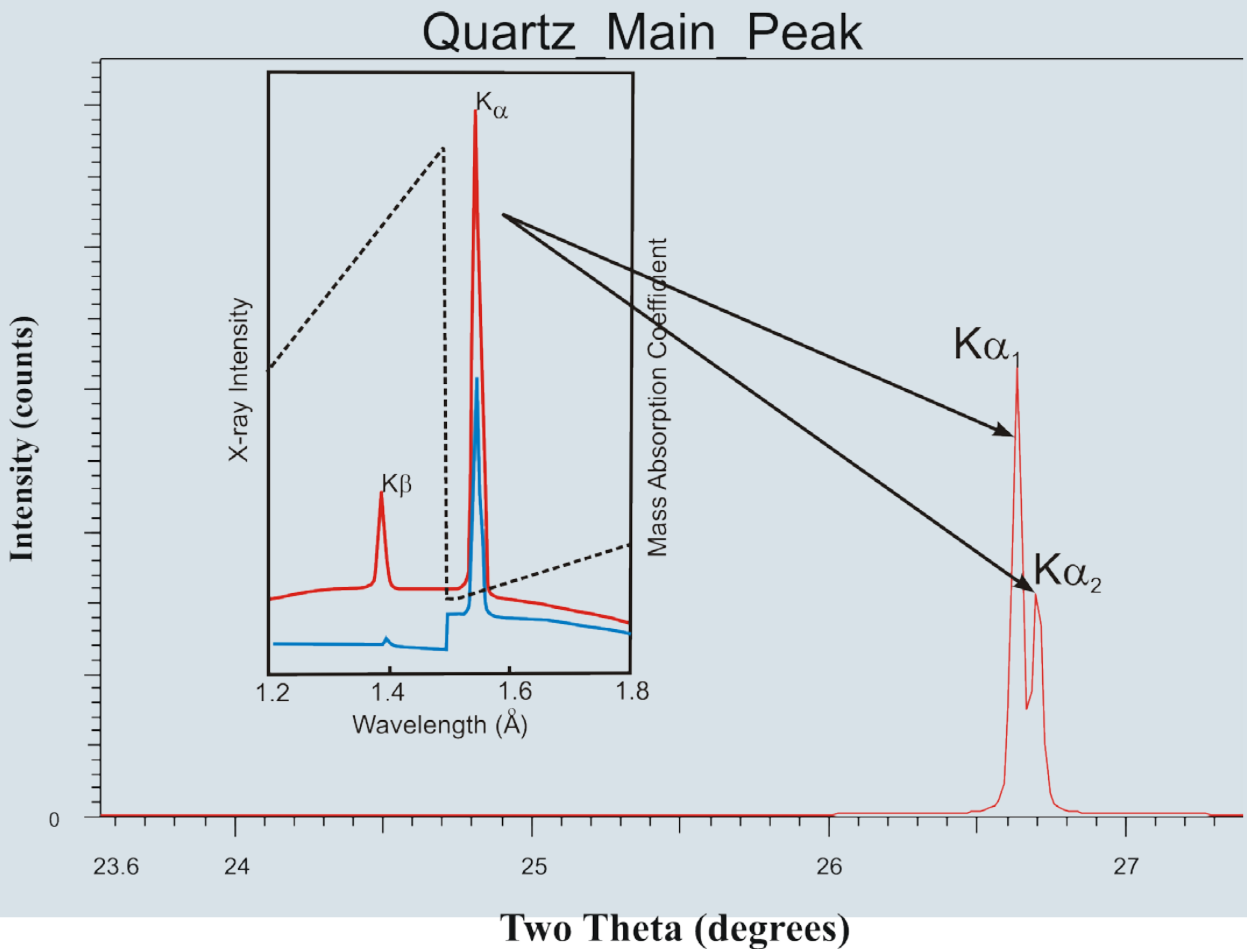


Spectrum from a molybdenum anode

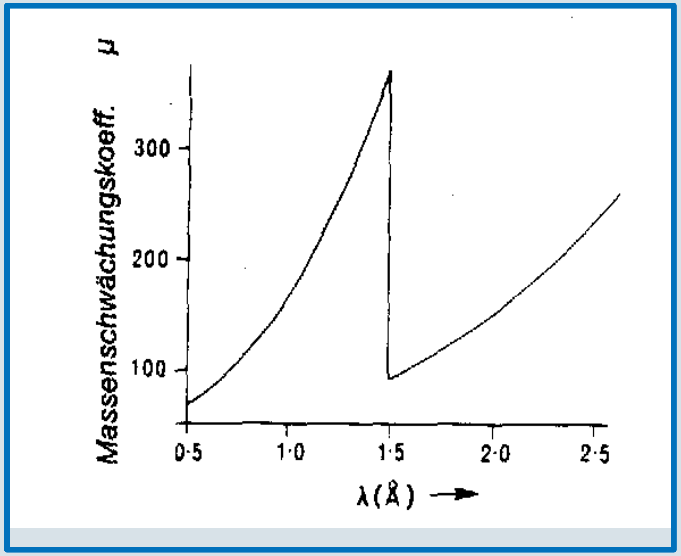
Characteristic Radiation = Line Spectrum

Bremsstrahlung = Continuous Spectrum

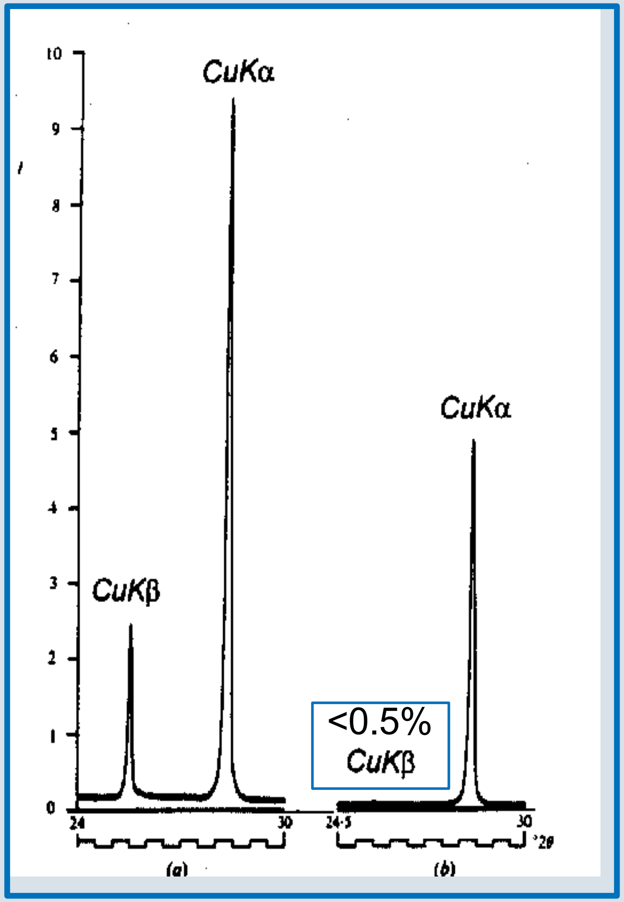
Instrumentation
Kβ-Filters



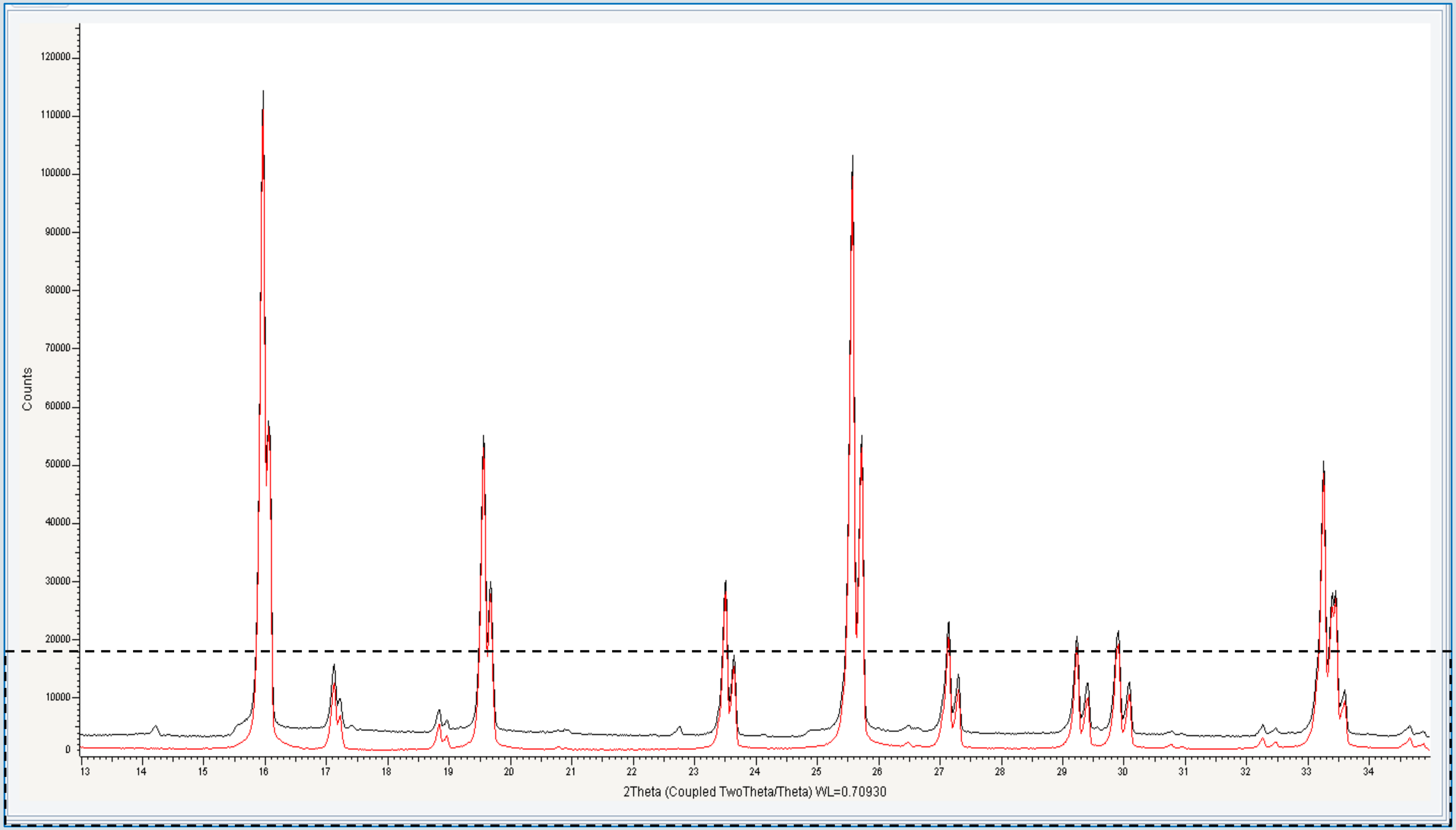
Instrumentation Kβ- Filters



A filter is the simplest type of monochromator. The amount of Kβ- compared to Kα-radiation will be reduced by using metal foils. This consists of an element with a lower atomic number than the anode element and with the absorption edge between Kα and Kβ energy. In the case of Cu-radiation a foil of 0.02mm Ni will reduce the intensity of Kβ to 0.5% instead of 16%.

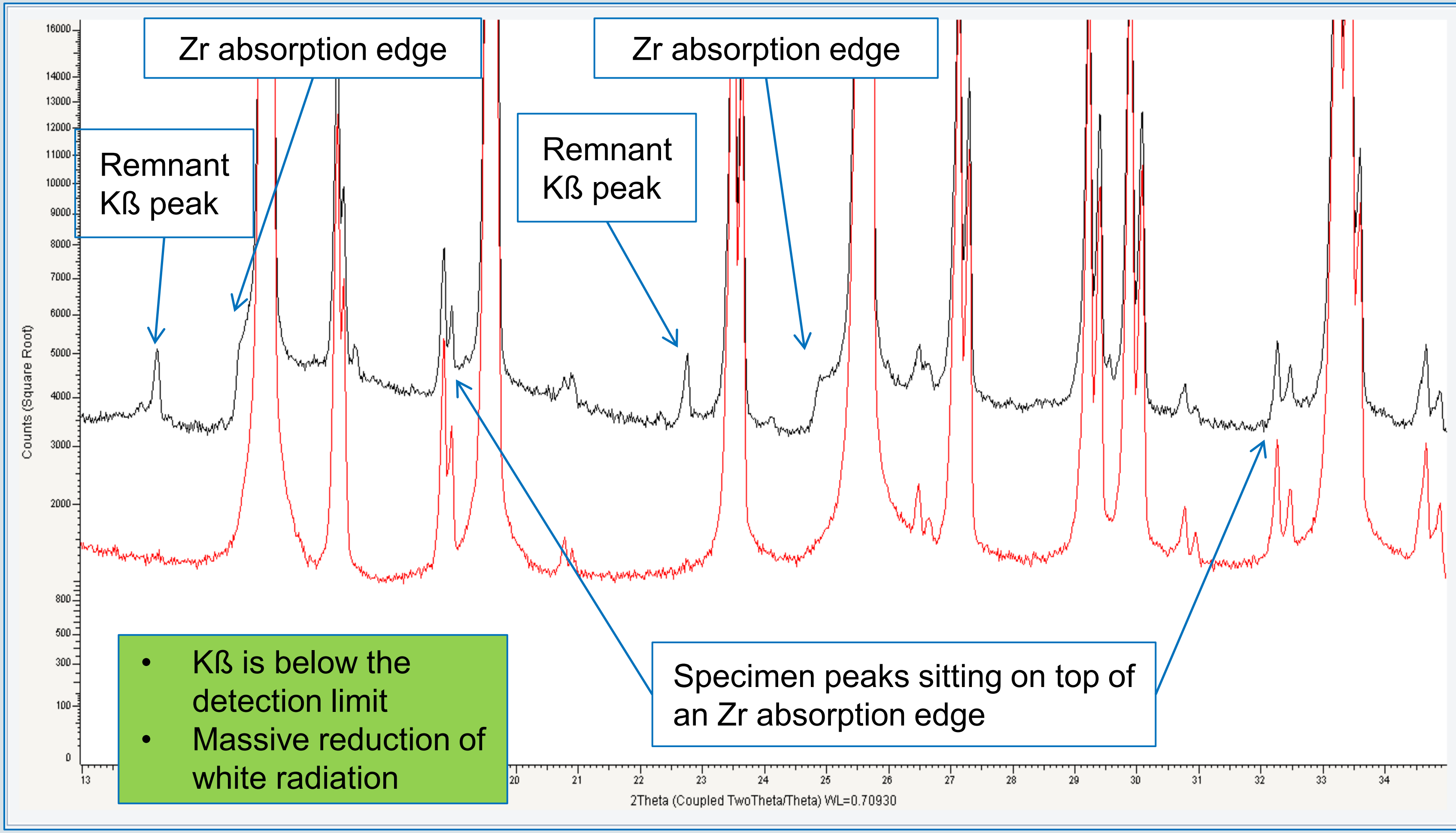


LYNXEYE XE
NIST SRM 1976a, Mo radiation

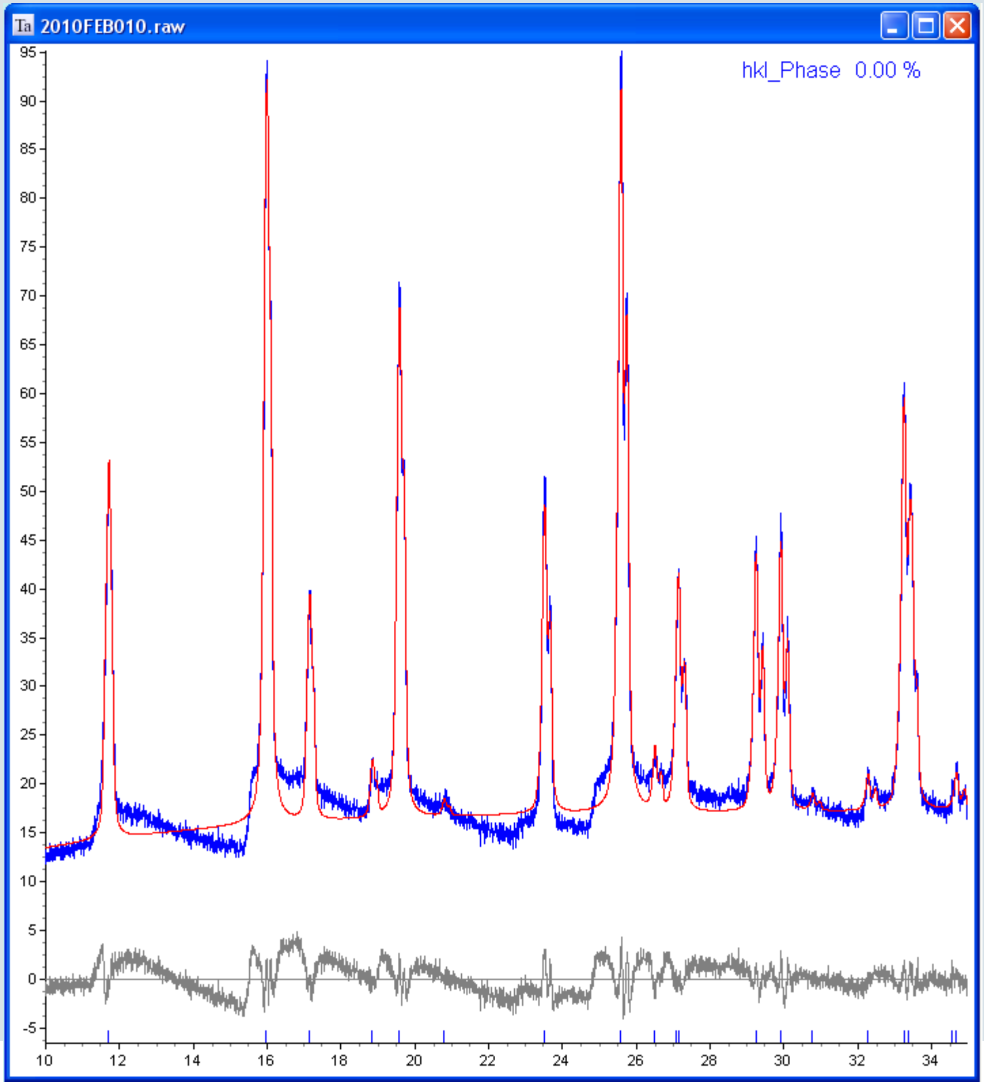


LYNXEYE XE
NIST SRM 1976a, Mo radiation

Square root scale to highlight details



Absorbtion Edge Modelling
Effect of Kß-Filter



- Kß filters do leave some severe artefacts
  - Absorption edges
  - Kß level 0.5-1.5%
  - Poor filtering of fluorescense
- Absorption edge issues with any line profile fitting applications: Goodness-of-fit is poor as background function can't cope

The Bruker Guarantee
Detector Guarantee

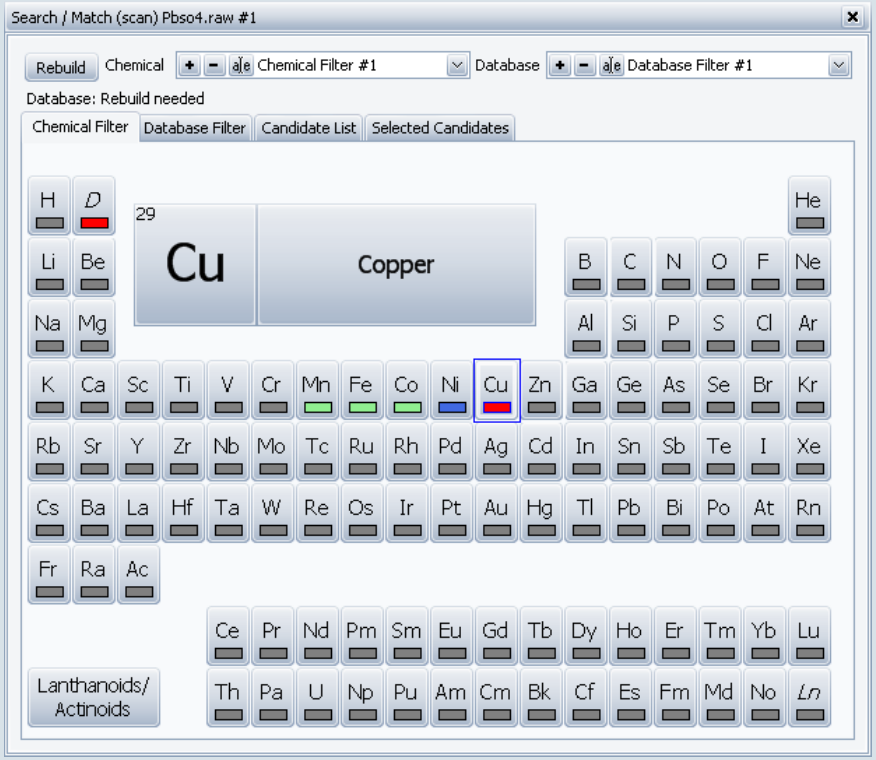
- Detectors are **guaranteed** to be without any defective strips or areas

Introduction
Monochromatization (Cu)

- Kß-Filters
  - Intensity loss ~40-60% with respect to unfiltered radiation
  - Absorption edges, Kß level 0.5-1.5%
  - Poor filtering of fluorescense
- Monochromators
  - Prim. : Intensity loss ~80-90% with respect to unfiltered rad.
  - Sec. 0D : Intensity loss ~70% with respect to unfiltered rad.
  - Sec. 1D : Intensity loss >90% with respect to unfiltered rad.
  - No absorption edges, no Kß
  - Excellent filtering of fluorescense (sec
- Si(Li) detectors (all wavelengths!)
  - No intensity loss, best peak to background
  - No absorption edges, no Kß
  - Excellent filtering of fluorescense
  - Low linear range, low count rates, life time issues
  - Only 0D!

Others:
Intensity gain only 3 - 5 compared to Si(Li) detectors

Introduction
Monochromatization (Cu)



- Employed radiation: Z (Cu)
- Employed metal filter: Z-1 (Ni)
- Strongly fluorescing elements: Z-1 … ~Z-4 (Mn, Fe, Co, Ni)

Introduction
Monochromatization

- ***Energy resolution*** is the ability of a detector to resolve two photons of differing energy
- The ***proportionality*** of a detector determines how the size of the generated voltage pulse is related to the energy of the absorbed X-ray photons
- Electronic methods (so-called pulse-height selection or pulse height discrimination) can be used to discriminate between different energies. Signals corresponding to photons with too high or to low energies are discarded.
- A high proportionality thus allows to apply ***energy discrimination*** as a form of monochromatization, where the energy is filtered by the detector rather than by X-ray optics
- Energy resolution is frequently defined as an energy window determined by the full width at half maximum (FWHM) of the so-called detector efficiency curve, specified for a specific wavelength

Introduction
Monochromatization

Typical energy resolution (FWHM) of selected devices at 8 KeV (Cu radiation):

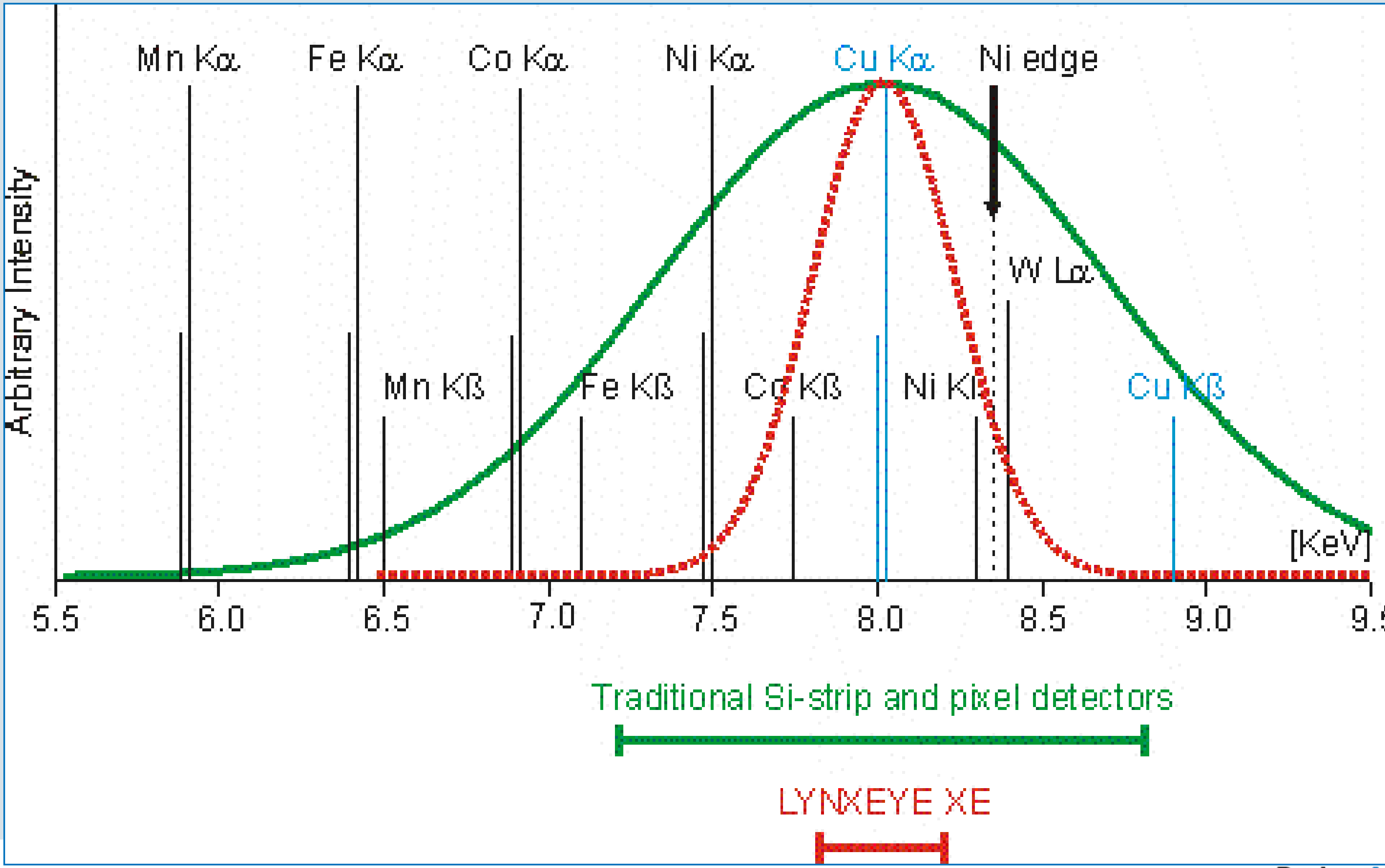
Device	**Resolution (KeV)**	**Resolution (%)**
Scintillation counter	~3.5	~45
Traditional Si-strip and pixel detectors	~1.6 - 2.0	~20 - 25
Proportional counter	~1.1 - 1.6	~15 - 20
LYNXEYE XE	<0.68	<8.5
LYNXEYE XE-T	**<0.38**	**<5**
Graphite monochromator	~0.26 - 0.5	~3.3 - 6
Si(Li) detector (Peltier cooled)	<0.2	<2.5

The LYNXEYE Detector Family

	SSD 160	LYNXEYE	LYNXEYE XE	LYNXEYE XE-T
Nr. of channels	160	192	192	192
Nr. of defective channels	max. 1	0	0	0
Detector guarantee	no	yes	yes	yes
Active window	12 x 16 mm	14.4 x 16 mm	14.4 x 16 mm	14.4 x 16 mm
Angular coverage*	~2.5°2θ	~3°2θ	~3°2θ	~3°2θ
Energy resolution	~1500 eV	~1500 eV	< 680 eV	**< 380 eV**

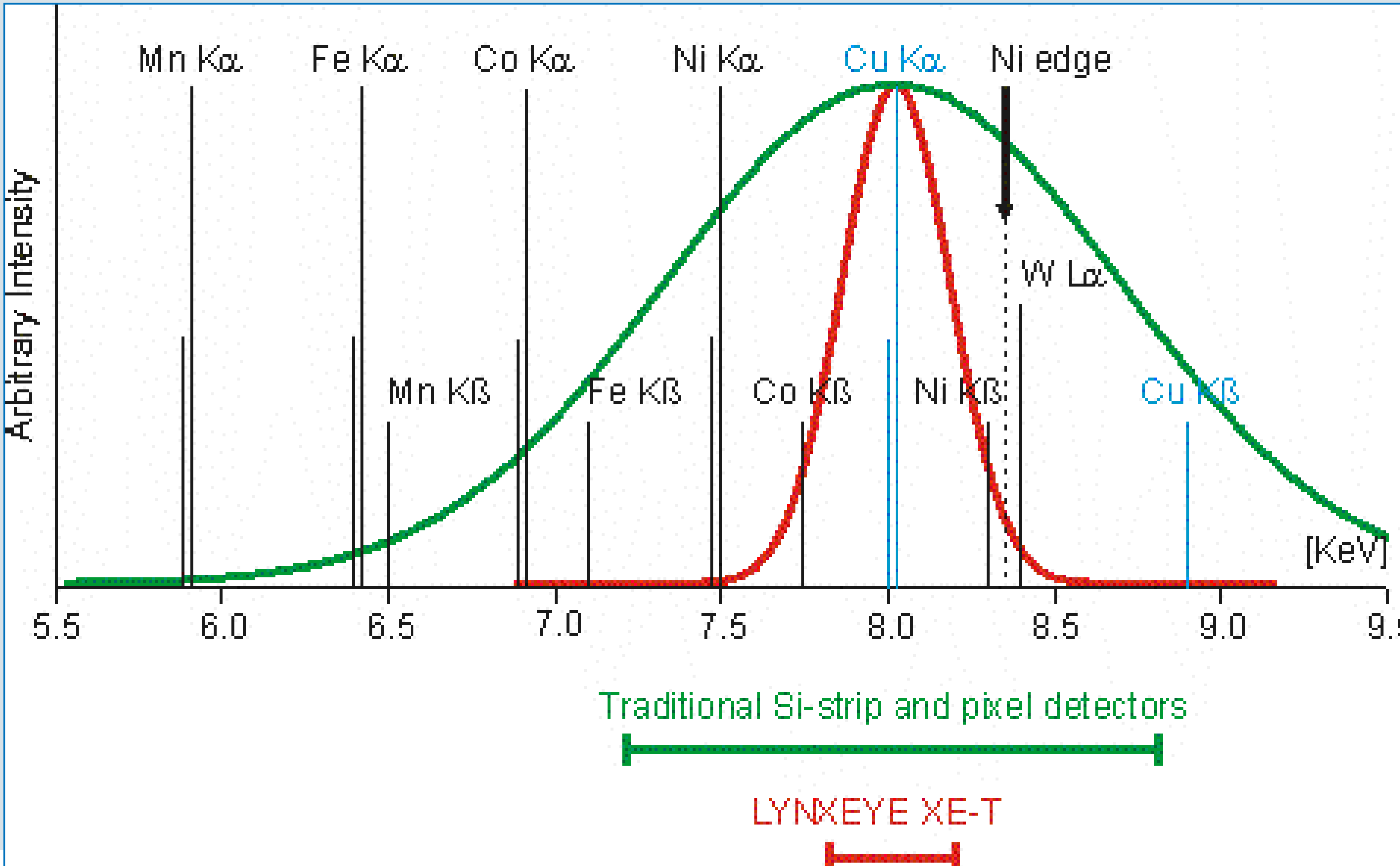
* 250 mm measurement radius

Monochromatization (Cu)
LYNXEYE XE

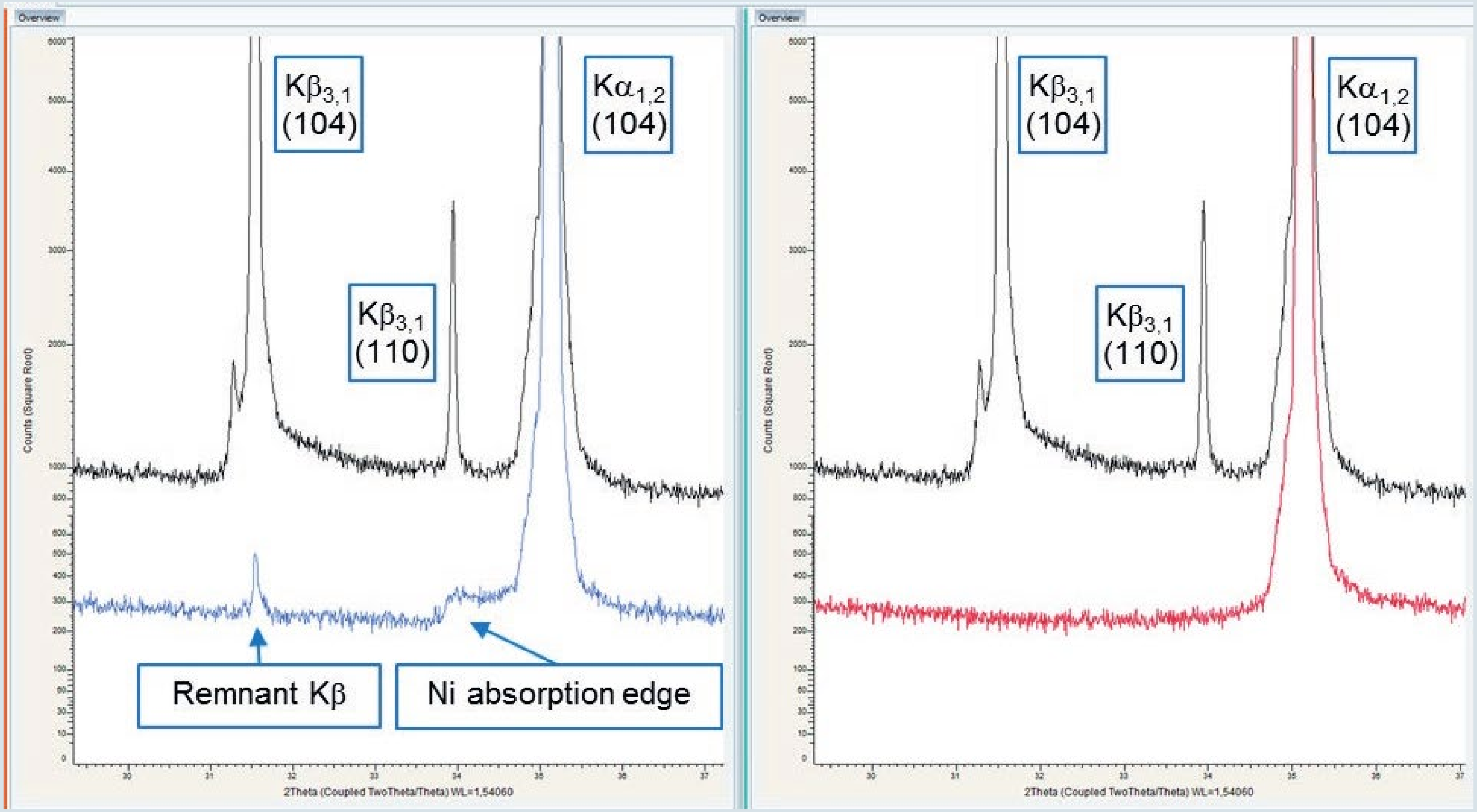


Bruker AXS

Monochromatization (Cu)
LYNXEYE XE-T



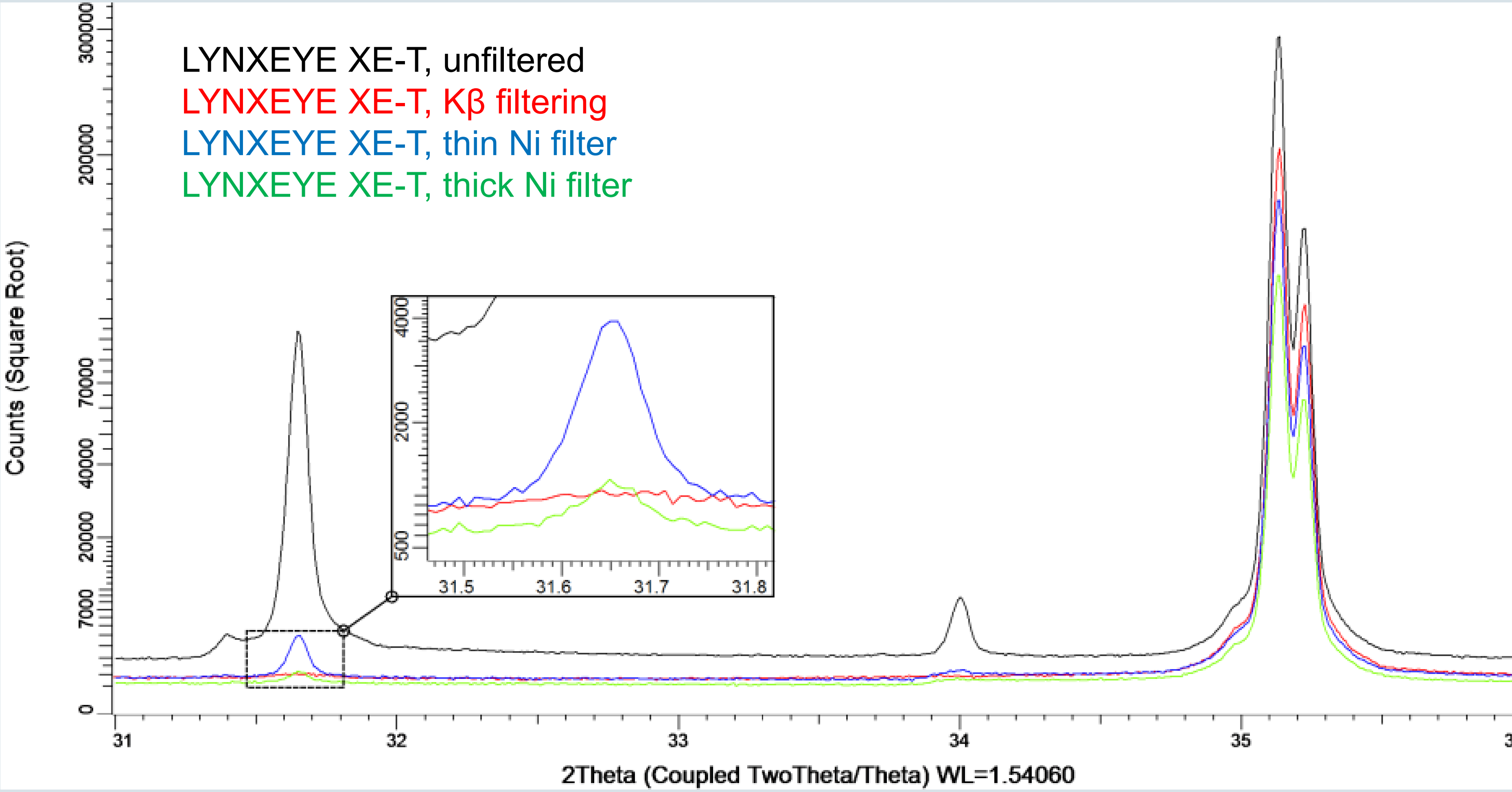
LYNXEYE XE-T - K_{beta} Filtering
NIST SRM 1976a, Cu-radiation



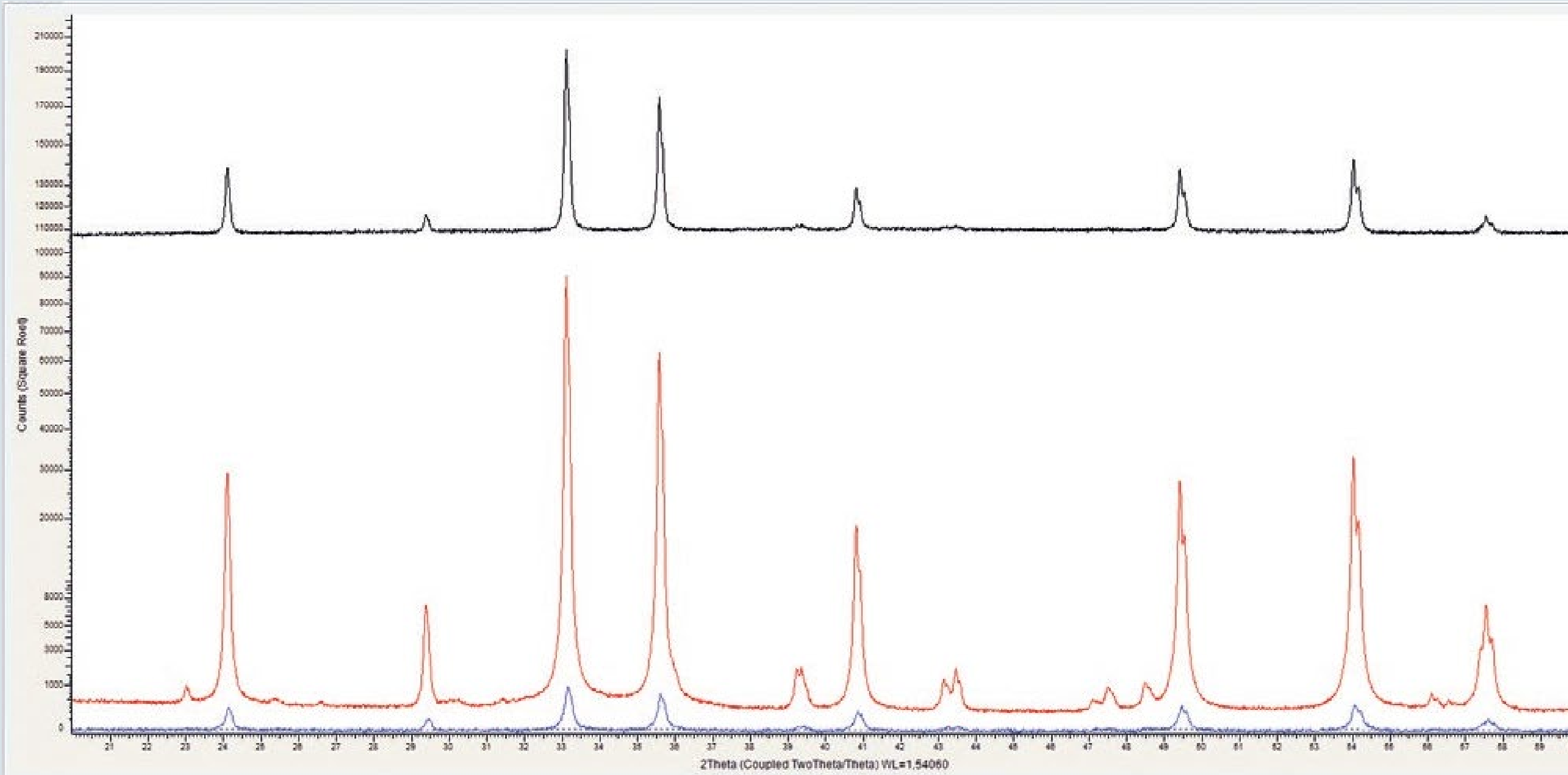
Black line : filter mode disabled.
Blue line : filter mode disabled plus Ni-filter.

Black line : filter mode disabled.
Red line : filter mode enabled

LYNXEYE XE-T - K_{beta} Filtering
NIST SRM 1976a, Cu-radiation

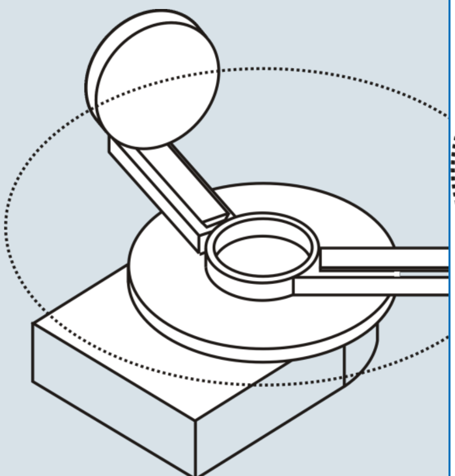


LYNXEYE in Action
Fluorescence Filtering

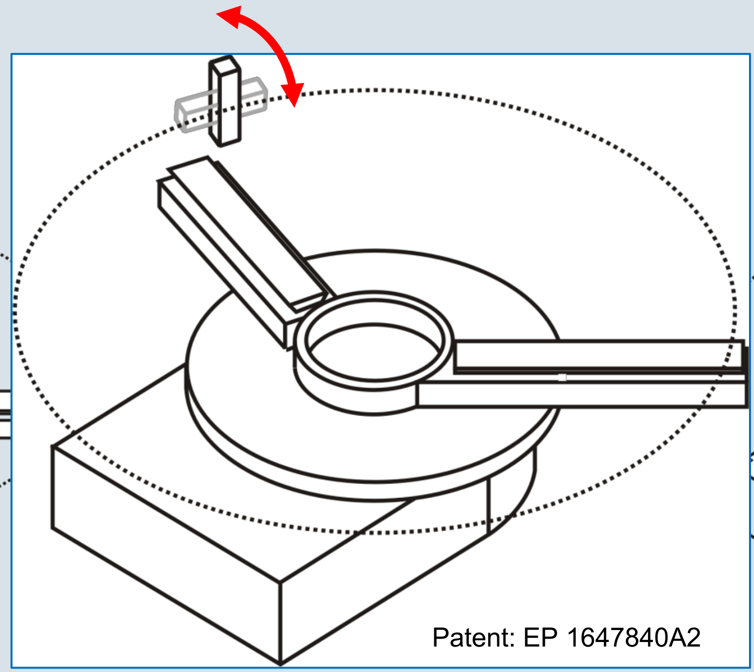


(black line) Unfiltered , (red line) filtered by the LYNXEYE XE-T. The intensity gain over the secondary monochromator data (blue line) amounts to a factor of about 450.

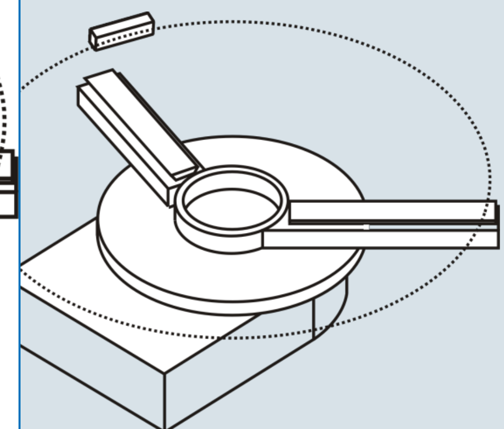
LYNXEYE XE: Scanning 2D mode for XRD^2



D8 DISCOVER
with VANTEC-500



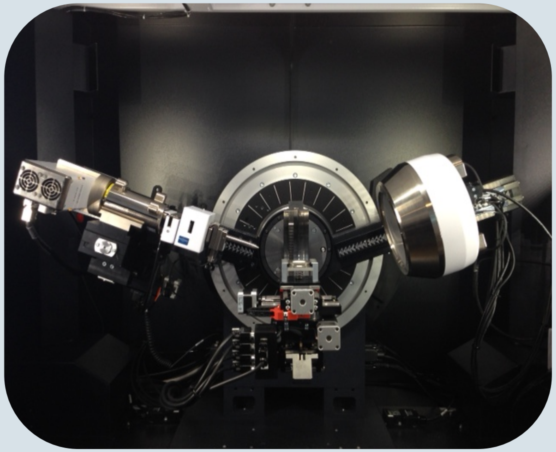
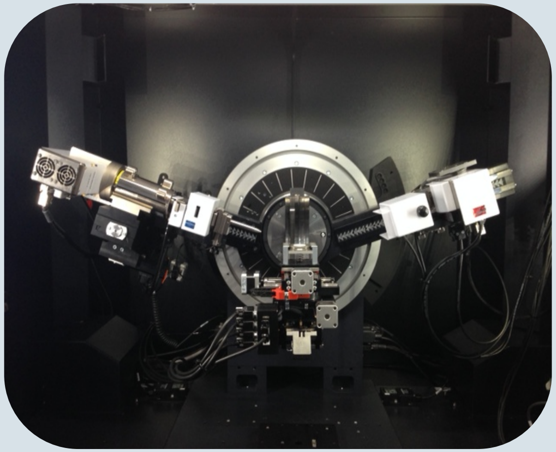
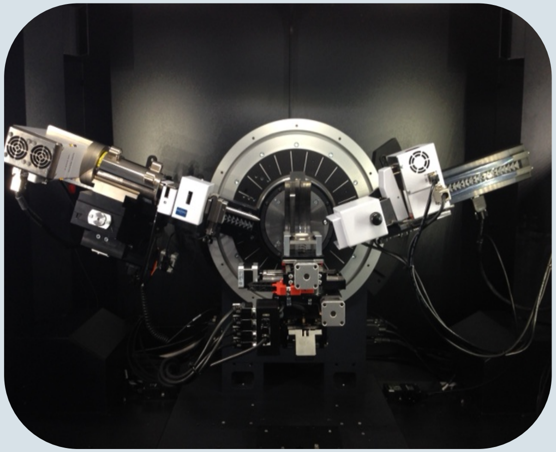
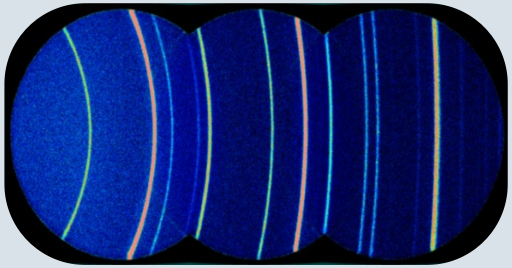
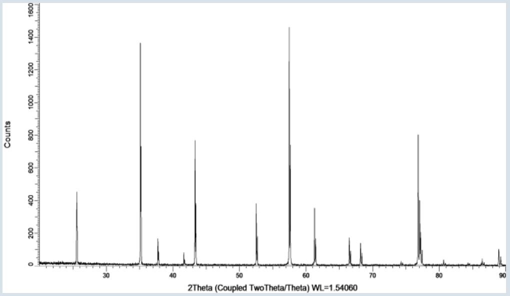
D8 ADVANCE and
D8 DISCOVER
with LYNXEYE XE
0°/ 90°Mount



D8 ADVANCE and
D8 DISCOVER
with LYNXEYE XE
0°Mount

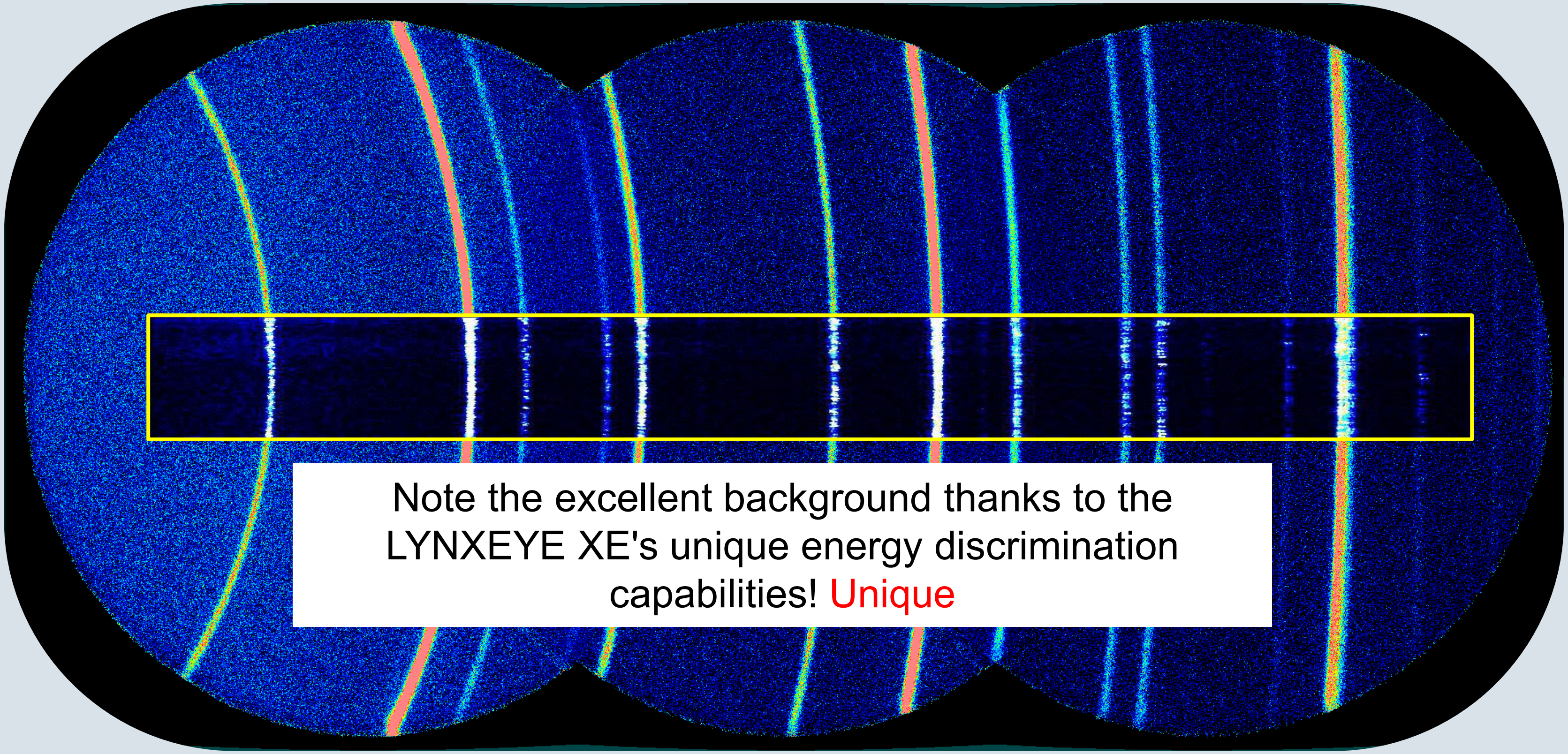
LYNXEYE XE:
Scanning 2D mode for XRD^2

Standard System Configurations

Area Detector	1D Detector 1D mode	1D Detector 2D mode
		
		

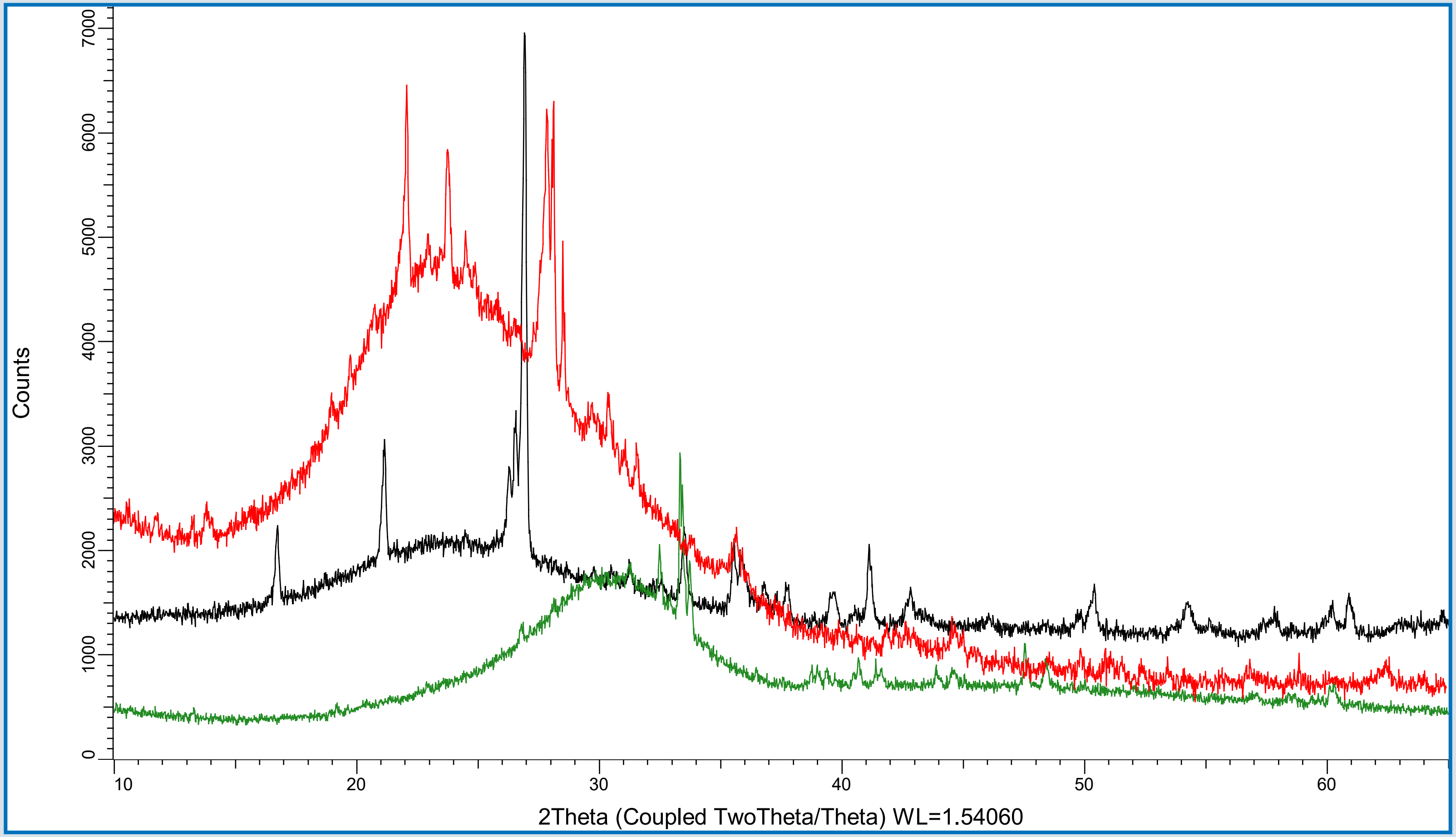
LYNXEYE XE:
Scanning 2D mode for XRD^2

Comparison between VANTEC 500 and LYNXEYE XE (SRM1976)

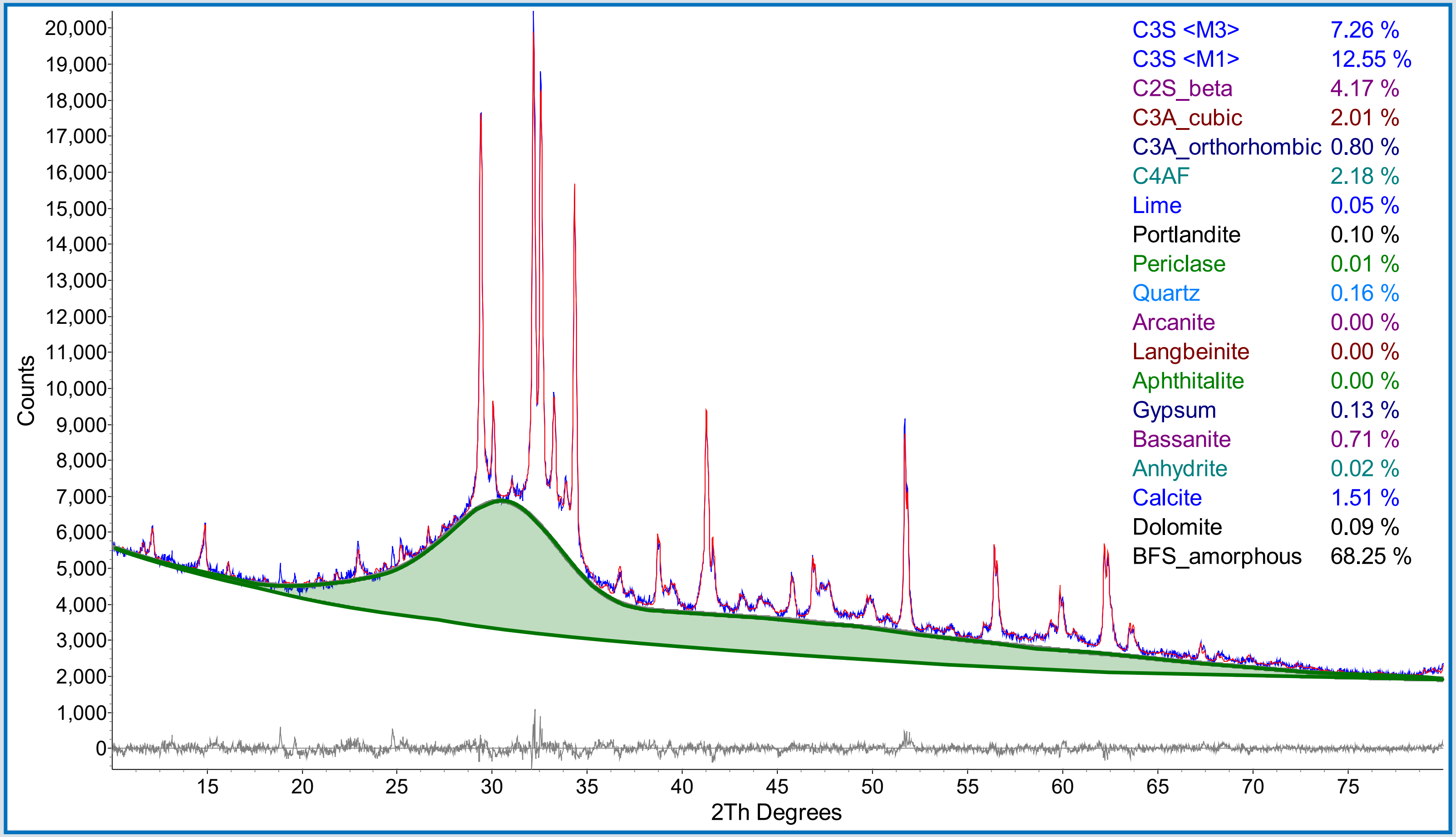


Note the excellent background thanks to the LYNXEYE XE's unique energy discrimination capabilities! Unique

Amorphous Additives in Cement
Fly Ash & Blast Furnace Slag & Pozzolane



Amorphous Additives in Cement
Blast Furnace Slag



Limit of Detection

Following the rules of the statistic of Poisson distribution, the absolute and relative standard deviation σ and σ_{rel} of measured number of count N at a 2θ position are given by:

$$\sigma = \sqrt{N}$$

$$\sigma_{rel} = \frac{\sqrt{N}}{N} = \frac{1}{\sqrt{N}}$$

A usual criterion for the limit of detection (LOD) of a particular reflection, is that $N_{reflections} > N_{background} + 3\sigma_{background}$

Example: measuring an N_{max} of 10,000 counts, the σ_{rel} is 0.01, corresponding to relative error of 1%, the counting statistic error.

Imagine for a background of 100 counts and a small hump of 120 counts. Clearly this cannot be classified as reflection because $3\sigma_{background} = 30$ is obviously higher than 20. The only solution is to increase the measurement time to improve the peak to background ratio

The New D8 ADVANCE
Designed for the New Era in XRD

DAVINCI.DESIGN: A revolutionary 3-level design

1. DAVINCI.MODE
Component Recognition

2. DAVINCI.SNAP-LOCK
Tool-free Change of Optics

3. DIFFRAC.DAVINCI
The Virtual Goniometer

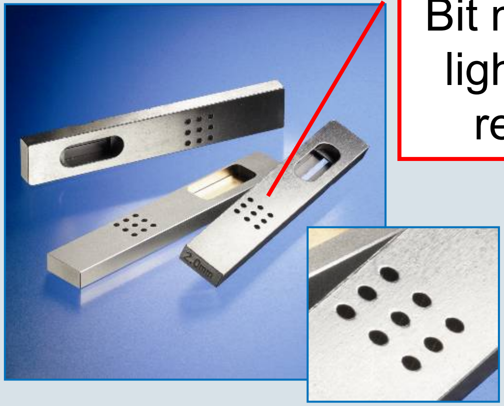
The New D8 ADVANCE
DAVINCI.MODE

DAVINCI.MODE
=
Component Recognition

- Fully automatic recognition of all beam path components in real-time
  - Each component (but slits and filters) is equipped with an unique ID Chip, carrying all component properties
  - Slits and filters are indentified using bit masks with light barrier read-out
- True Plug & Play functionality

Spring contact connectors

ID Chip

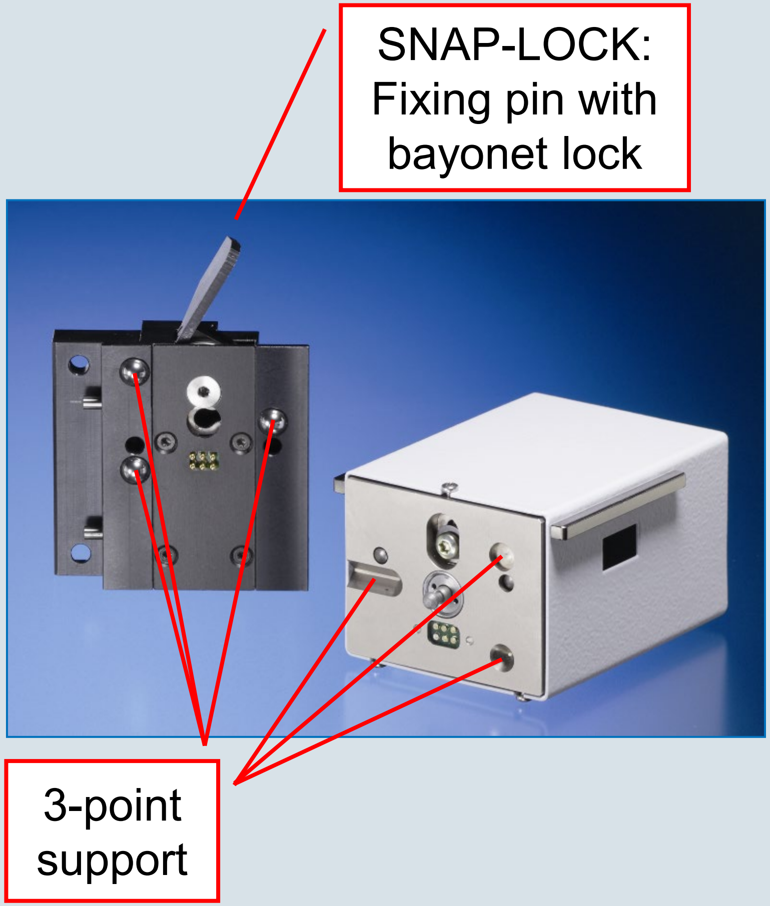


Bit mask with light barrier read-out

The New D8 ADVANCE
DAVINCI.SNAP-LOCK

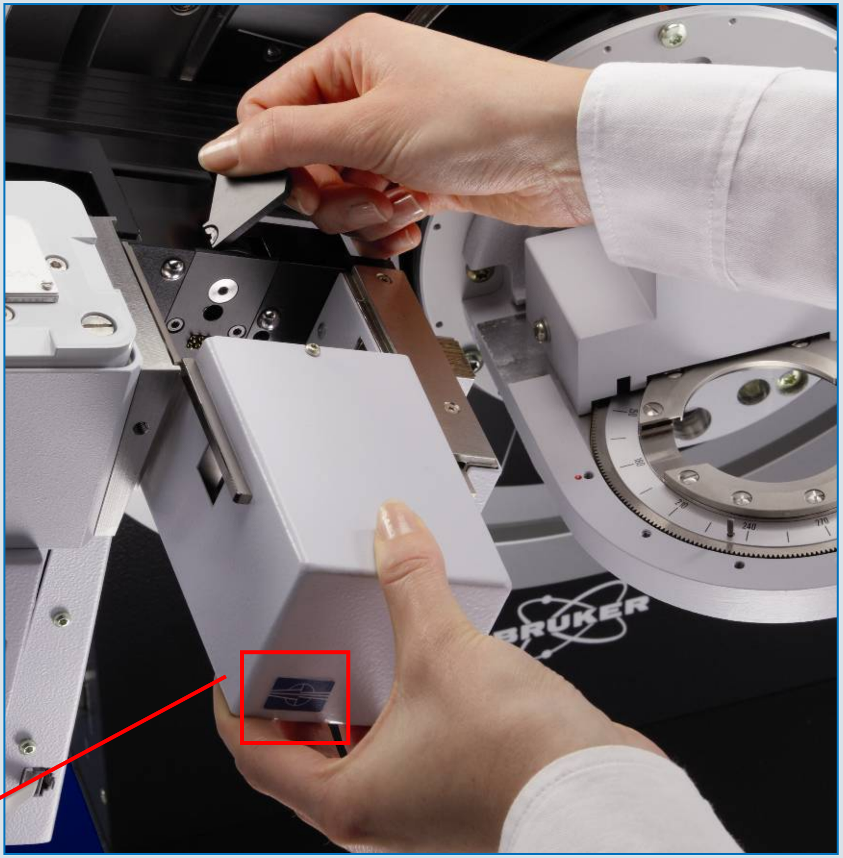
DAVINCI.SNAP-LOCK
=
Tool-free Change of Optics

- High precision snap-lock mechanism: Tool-free change of optics in a second
- High-precision pre-alignment to optics mount with 3-point support

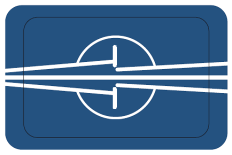


The New D8 ADVANCE
DAVINCI.SNAP-LOCK

- Any change between different optics, instrument geometries and applications is literally child's play
- Alignment-free; all optics return to perfect alignment every time
- Fully automatic optics recognition and instrument configuration thanks to DIFFRAC.MODE

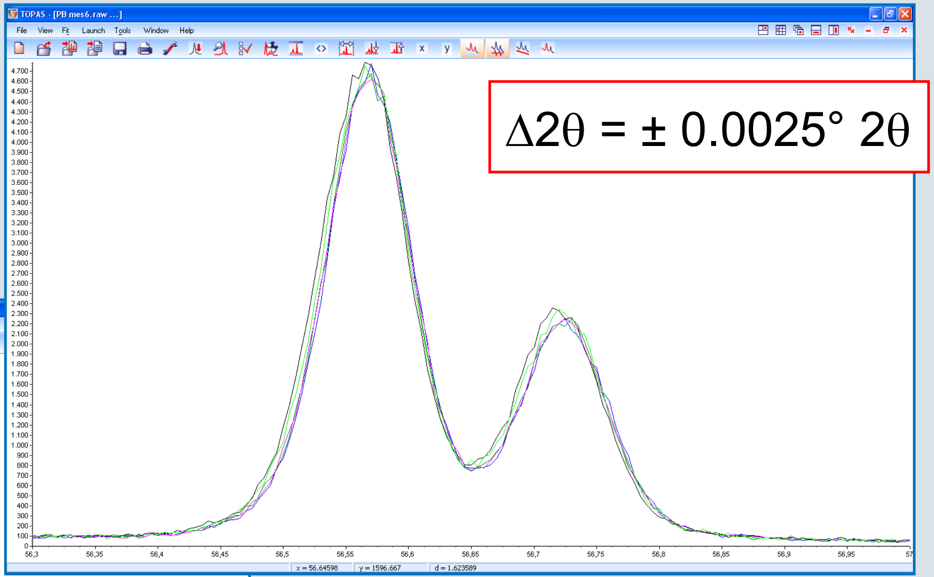


Each optic is identified by an unique icon



The New D8 ADVANCE
DAVINCI.SNAP-LOCK

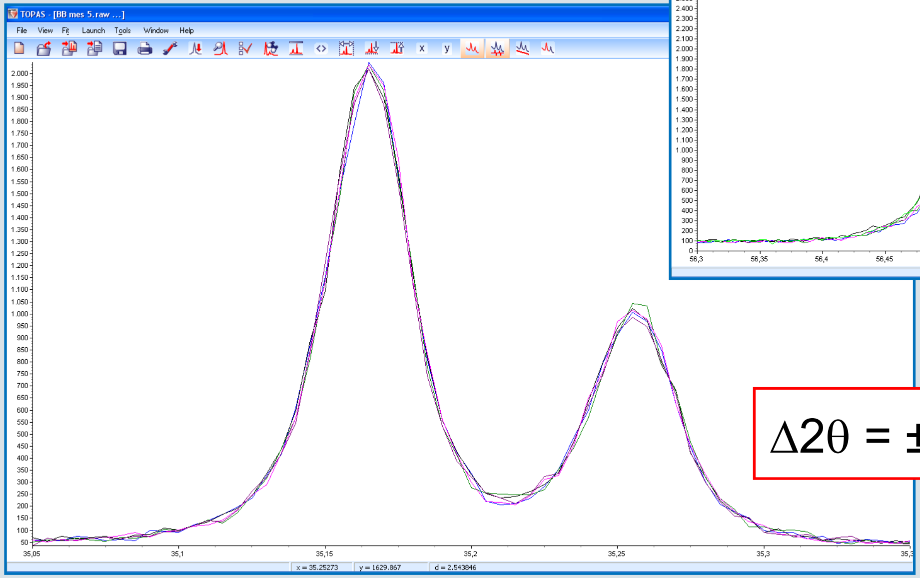
- Repeated switch (5x) between Bragg-Brentano and parallel beam geometry
- SRM 1976a



$\Delta 2\theta = \pm\ 0.0025°\ 2\theta$

Parallel beam (Göbel mirror)

Bragg-Brentano



$\Delta 2\theta = \pm 0.001°\ 2\theta$

The New D8 ADVANCE
DIFFRAC.DAVINCI

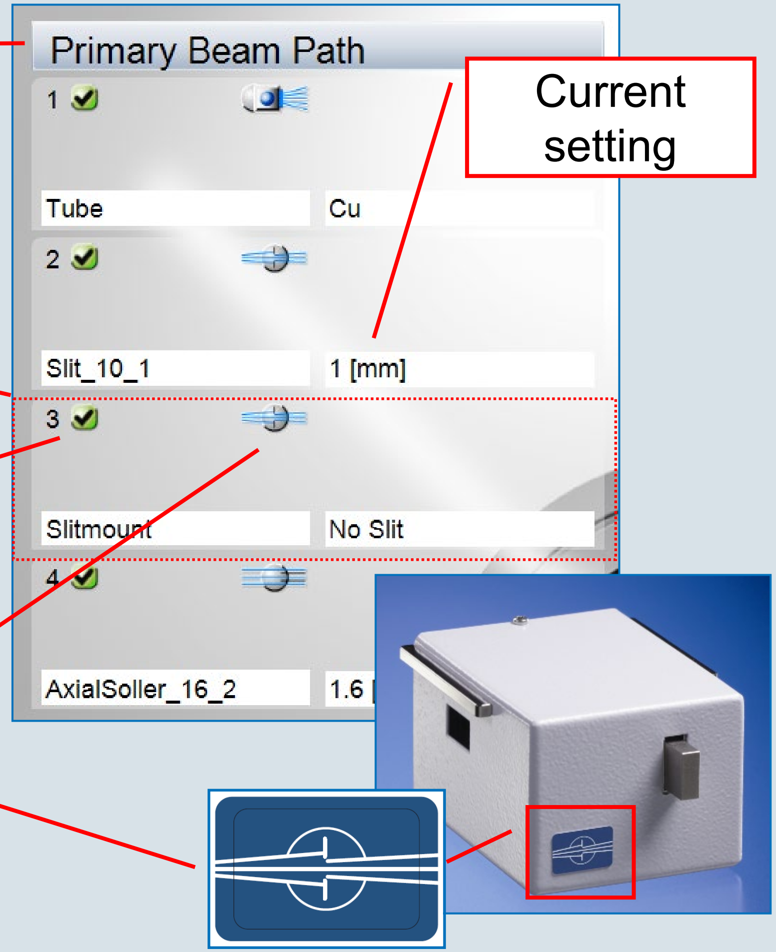
Dynamic list displaying all currently mounted components

Component

Component status

Unique icon of optical component

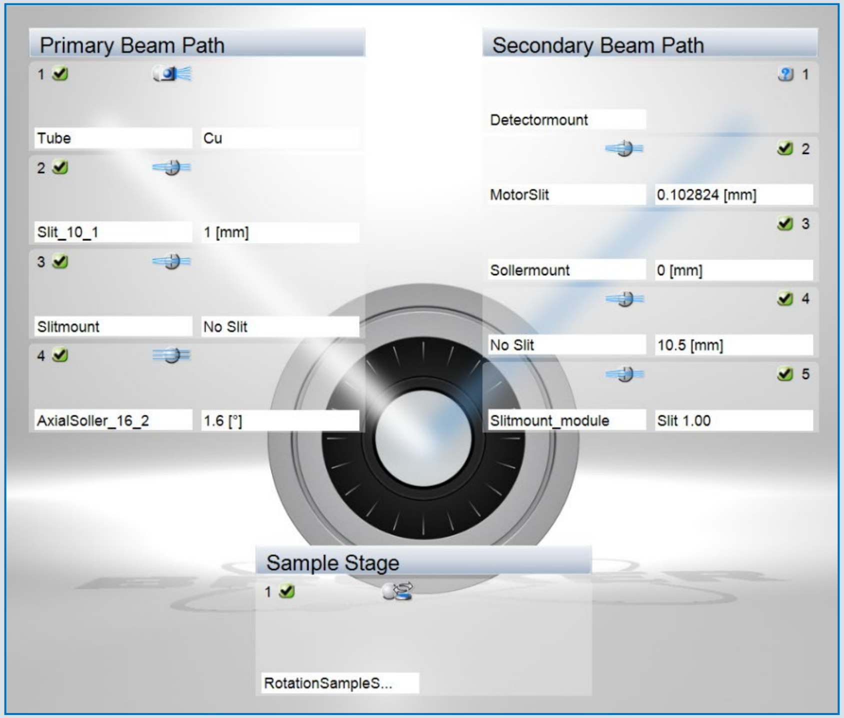
Current setting



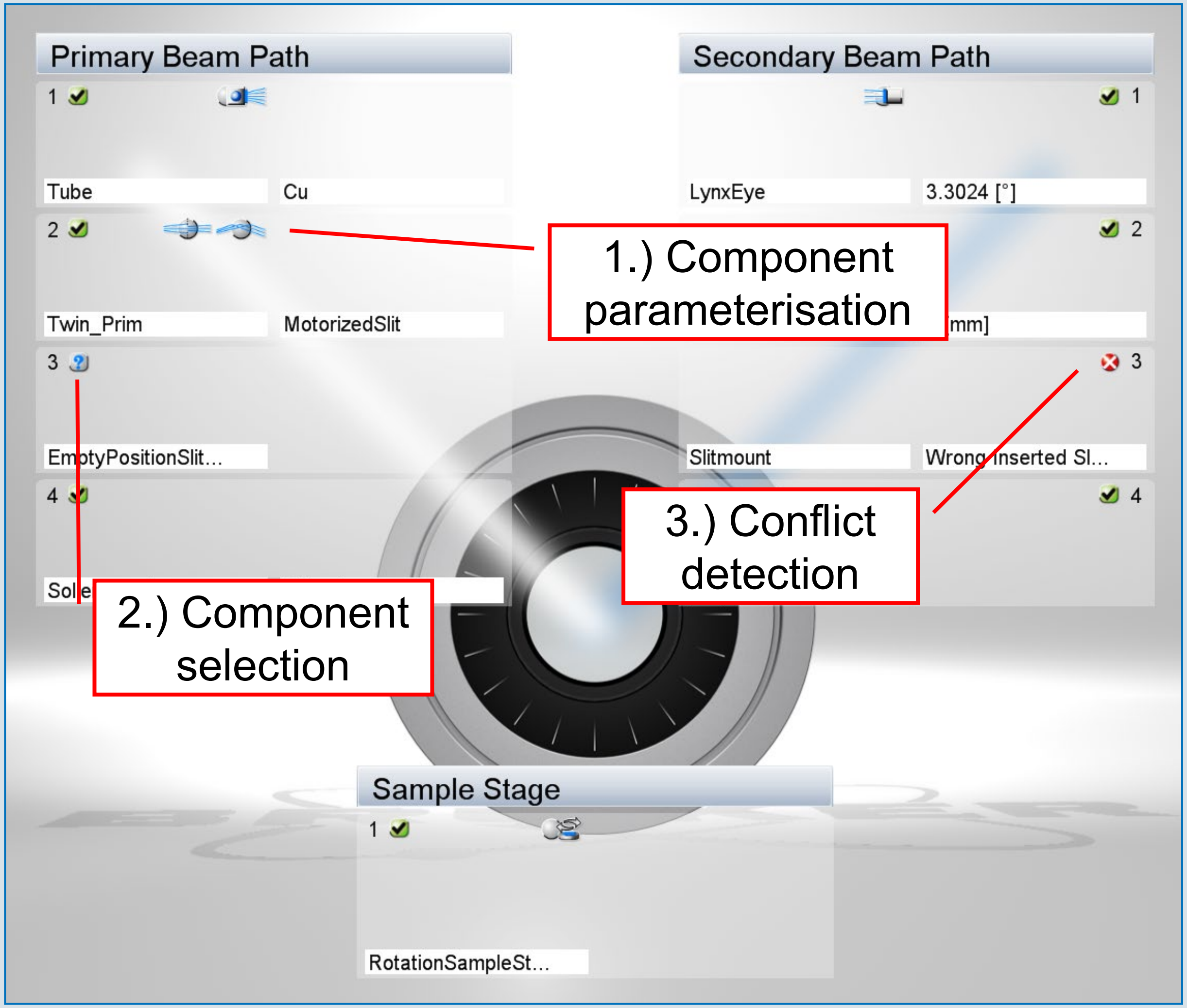
The New D8 ADVANCE
DIFFRAC.DAVINCI

DIFFRAC.DAVINCI
=
The Virtual Goniometer

- Graphical representation of the actual goniometer showing all mounted components plus their status
- Software validated instrument configuration with real-time conflict detection



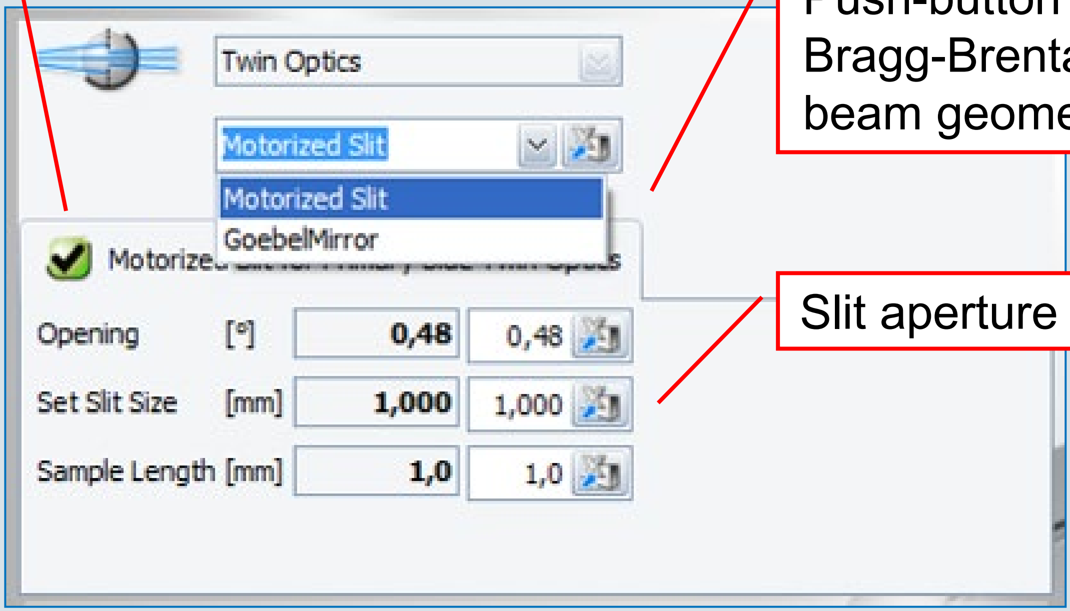
The New D8 ADVANCE
DIFFRAC.DAVINCI in Action



The New D8 ADVANCE
DIFFRAC.DAVINCI in Action

1.) Component parameterisation, e.g. TWIN Optic

Component status: **OK**



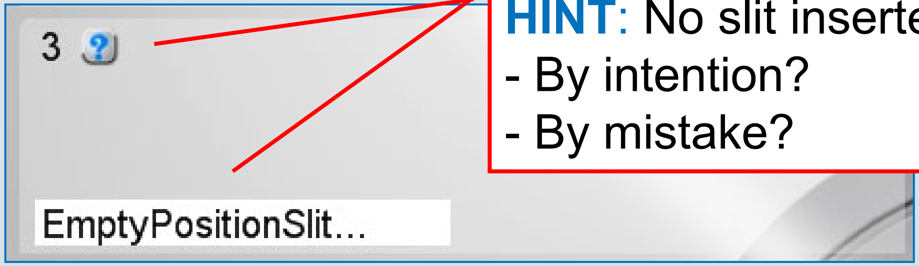
Push-button switch between Bragg-Brentano and parallel beam geometry

Slit aperture

The New D8 ADVANCE
DIFFRAC.DAVINCI in Action

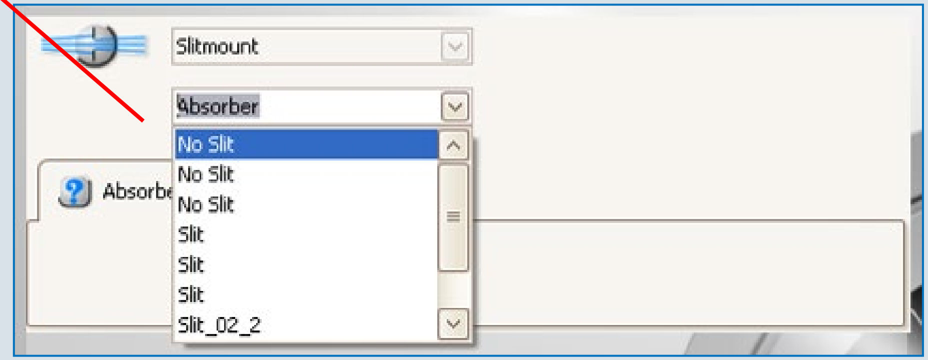
2.) Component selection, e.g. slits

Component status: **HINT**



HINT: No slit inserted!
- By intention?
- By mistake?

Push-button selection of any of the slits configured for the present instrument, e.g.
- Absorber
- Filter
- Divergence slit
- No slit
- ...



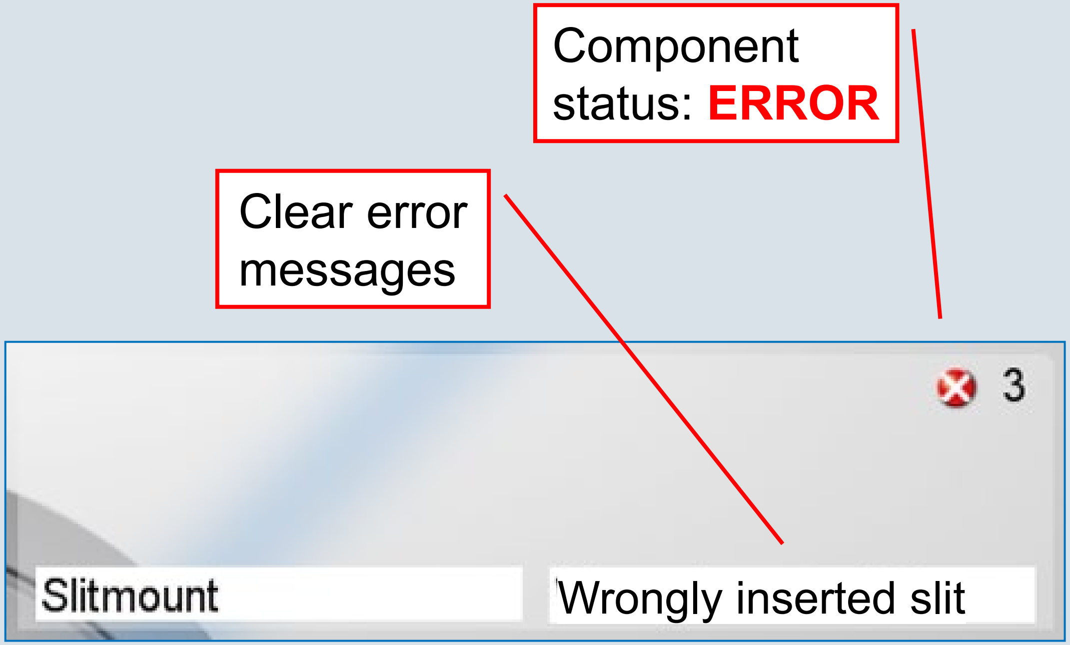
The New D8 ADVANCE
DIFFRAC.DAVINCI in Action

2.) Component selection

Same procedure for
tubes,
optical components,
sample stages,
detectors

The New D8 ADVANCE
DIFFRAC.DAVINCI in Action

3.) Conflict detection, e.g. wrongly inserted slits



The New D8 ADVANCE
with DAVINCI.DESIGN

DAVINCI.DESIGN: A revolutionary 3-level design

1.DAVINCI.MODE
Component Recognition

Intuitive - fail-safe - child's play

Tool-free Change of Optics

3.DIFFRAC.DAVINCI
The Virtual Goniometer

Sample Stages
Large selection for maximum flexibility

Rotation Stage

Flipstick

Autochanger

Capillary Stage

Newport XYZ Stage

Compact Eulerian Cradle

Sample Stages
Autochanger

- Large storage capacity (up to 90 preloaded samples)
- Modular loading station for up to 6 modular towers
- Can measure in both reflection and transmission without need for conversion
- Intelligent robotics with integrated gripper

Non-Ambient Solutions
MTC Modular Series

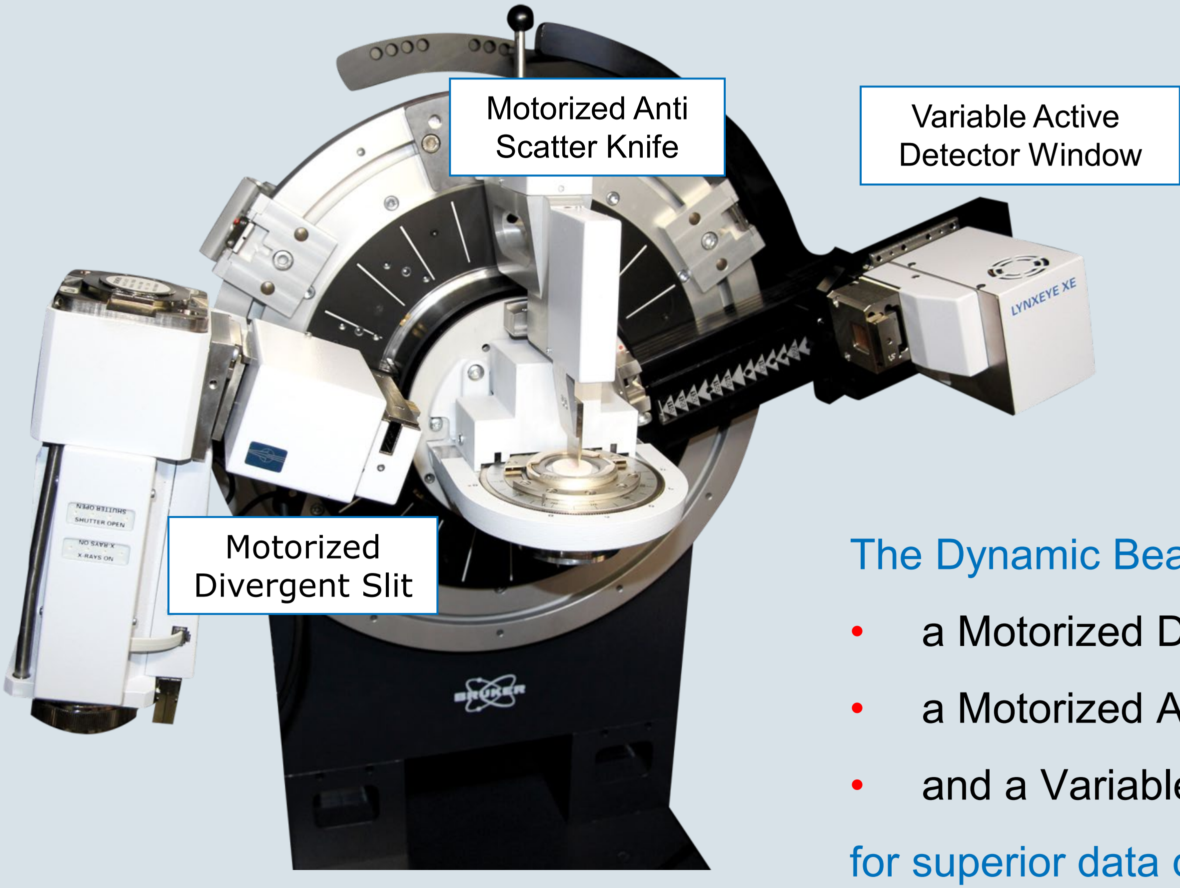
- A single chamber platform designed for various applications and temperature ranges

- Different heater technologies fit the same chamber with reasonably easy re-assembling effort for changing from one heater to another

- One single controller and power supply for all types of heaters

- Support for many 3rd party chambers as well!

Dynamic Beam Optimization
Principle



The Dynamic Beam Optimization combines

- a Motorized Divergence Slit
- a Motorized Anti-Scatter Knife
- and a Variable Active Detector Window

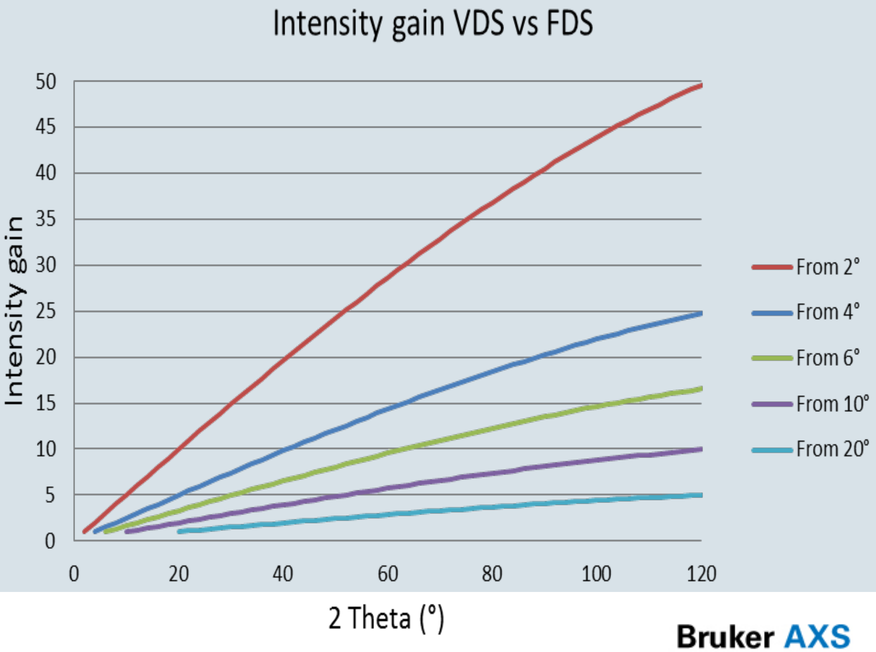
for superior data quality

Dynamic Beam Optimization
(I) Motorized Divergent Slit

Motorized Divergent Slit for fixed illuminated area

- No beam spillover and controlled low angle background
- Reliable quantitative signal from low to high angles

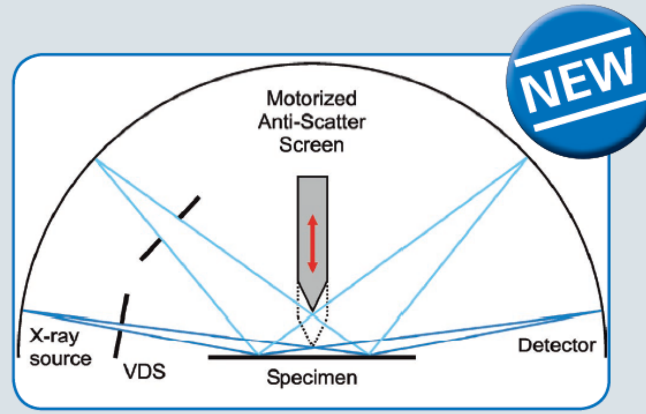
⇨ Variable divergent slit (VDS) enhances intensity at higher angle for superior data quality and/or faster measurements compared to fixed divergent slit (FDS)

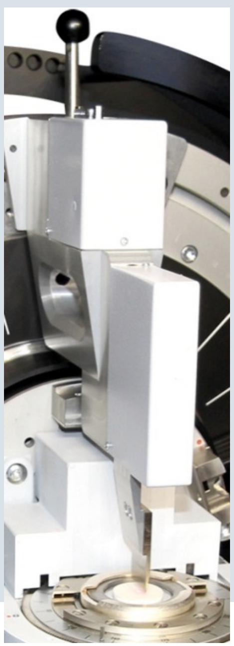


Dynamic Beam Optimization
(II) Motorized Anti-Scatter Screen

MASS

- Fully software controlled retraction of the knife to prevent any cropping of the beam. Compatible with both
  - Fixed Divergence Slits as well as
  - Variable Divergence Slits





- Easy to mount (mechanical repro < 10 um)
  - Reflection geometry only
  - Flat samples only

- Scanning in 2θ range up to 140° (depending on components)

Dynamic Beam Optimization
(III) Variable Active Detector Window

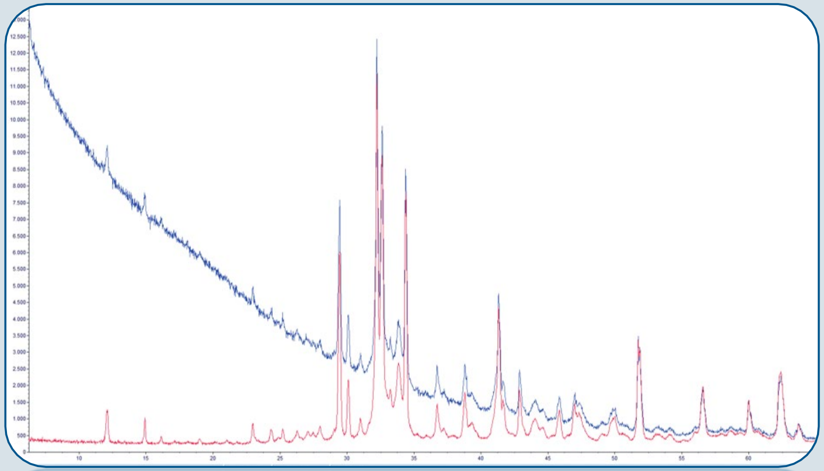
Variable Active Detector Window

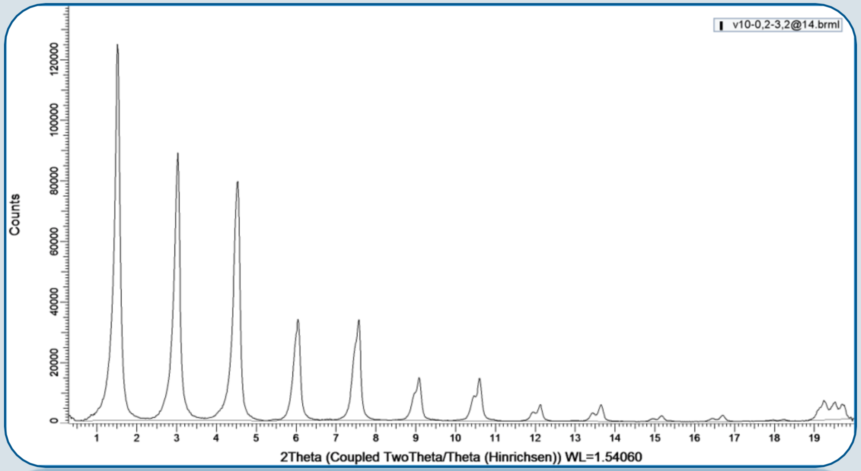
- LYNXEYE XE only
- Fully software controlled switching on of individual strips to open the detector window as a function of 2θ

⇨ In combination with variable divergence slits, the variable active detector window enables <u>reliable data acquisition</u> starting at angles as low as 0.3° in 2θ

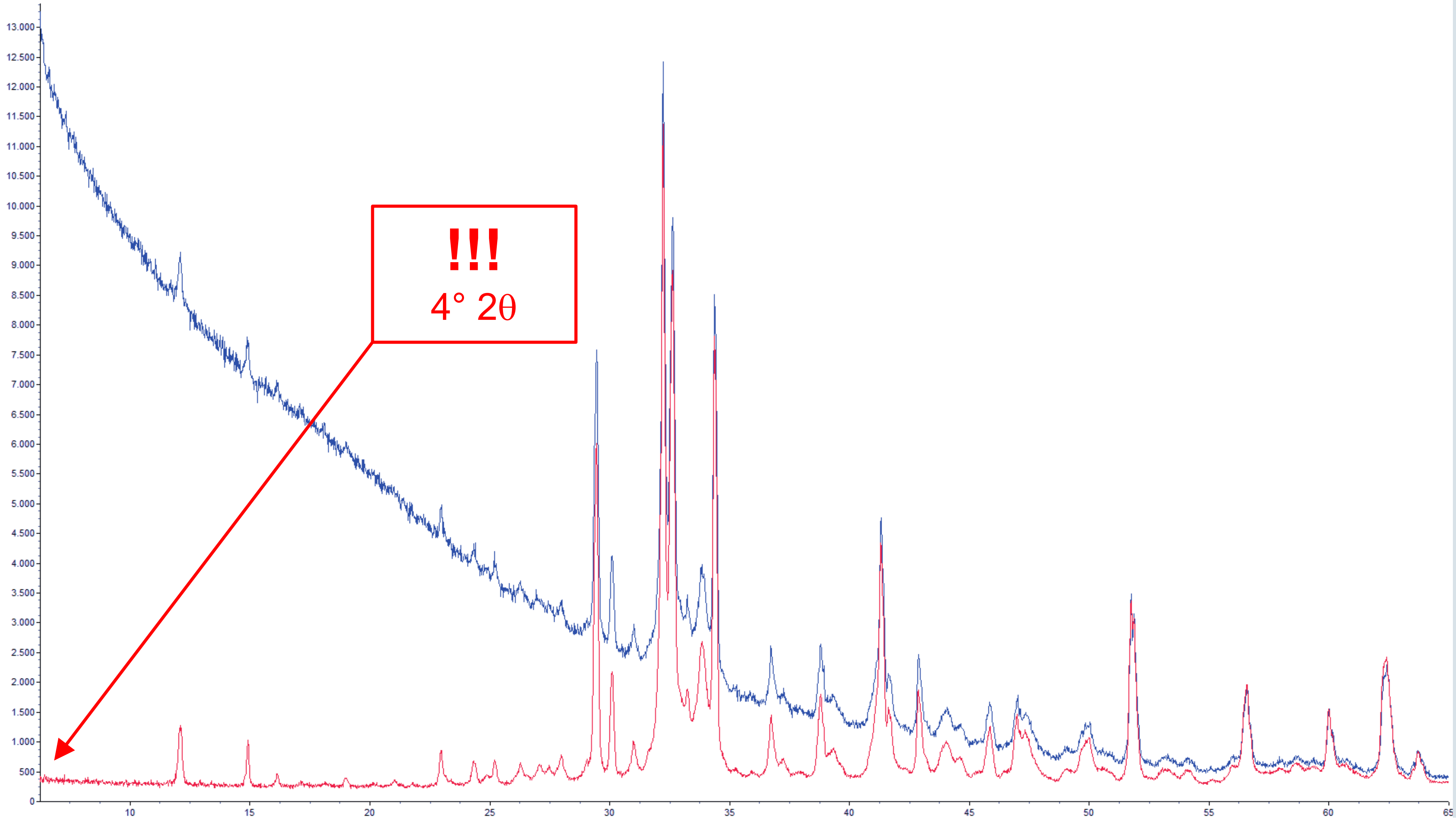
⇨ For very low angles (lower than 4°), measurement starts with reduced active detector window and without undertravel, making the use of <u>beam stop obsolete</u>

Dynamic Beam Optimization
Improved Data Quality

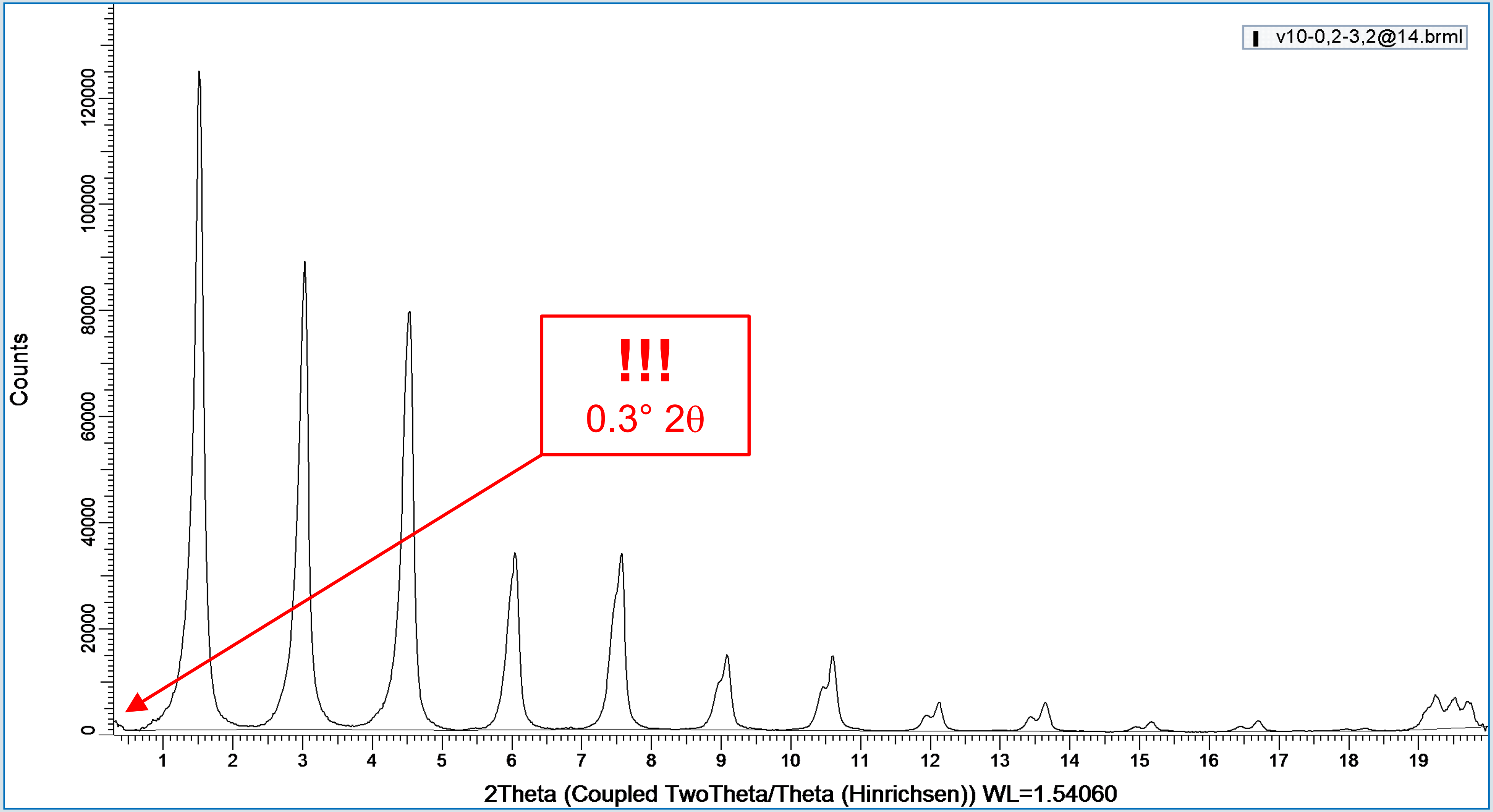




- Low backgrounds for measurements even below 0.3°2θ!
- Lower limits of detection (including amorphous)
- Fully software controlled dynamic scan



!!!
4° 2θ
13.000
12.500
12.000
11.500
11.000
10.500
10.000
9.500
9.000
8.500
8.000
7.500
7.000
6.500
6.000
5.500
5.000
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
500
0
10
15
20
25
30
35
40
45
50
55
60
65


v10-0,2-3,2@14.brml
!!!
0.3° 2θ
Counts
0
20000
40000
60000
80000
100000
120000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
2Theta (Coupled TwoTheta/Theta (Hinrichsen)) WL=1.54060

D8 ADVANCE ECO

- Efficient 1 kW generator
  - Single phase power
  - No external water cooling or chiller
- 3-year X-ray tube warranty
- 10-year goniometer warranty
- Alignment guarantee

- **Low power consumption!**
- **No external water consumption!**

The New D8 ADVANCE ECO

- 1kW X-ray generator / 1 kW high brilliance X-ray source
  - Cu, Co, Cr short fine focus tubes
- Minimal electrical power consumption (<3.5 kW), thus
  - Only single phase power required
- No external water cooling required (optional)
- High performance linear detectors for best sensitivity
  - SSD160, LYNXEYE
  - LYNXEYE XE
- **3 years warranty** for KFF X-ray tubes (ECO only)
- **10 years warranty*** for the goniometer (ECO only)
- Safety guarantee
- Alignment guarantee

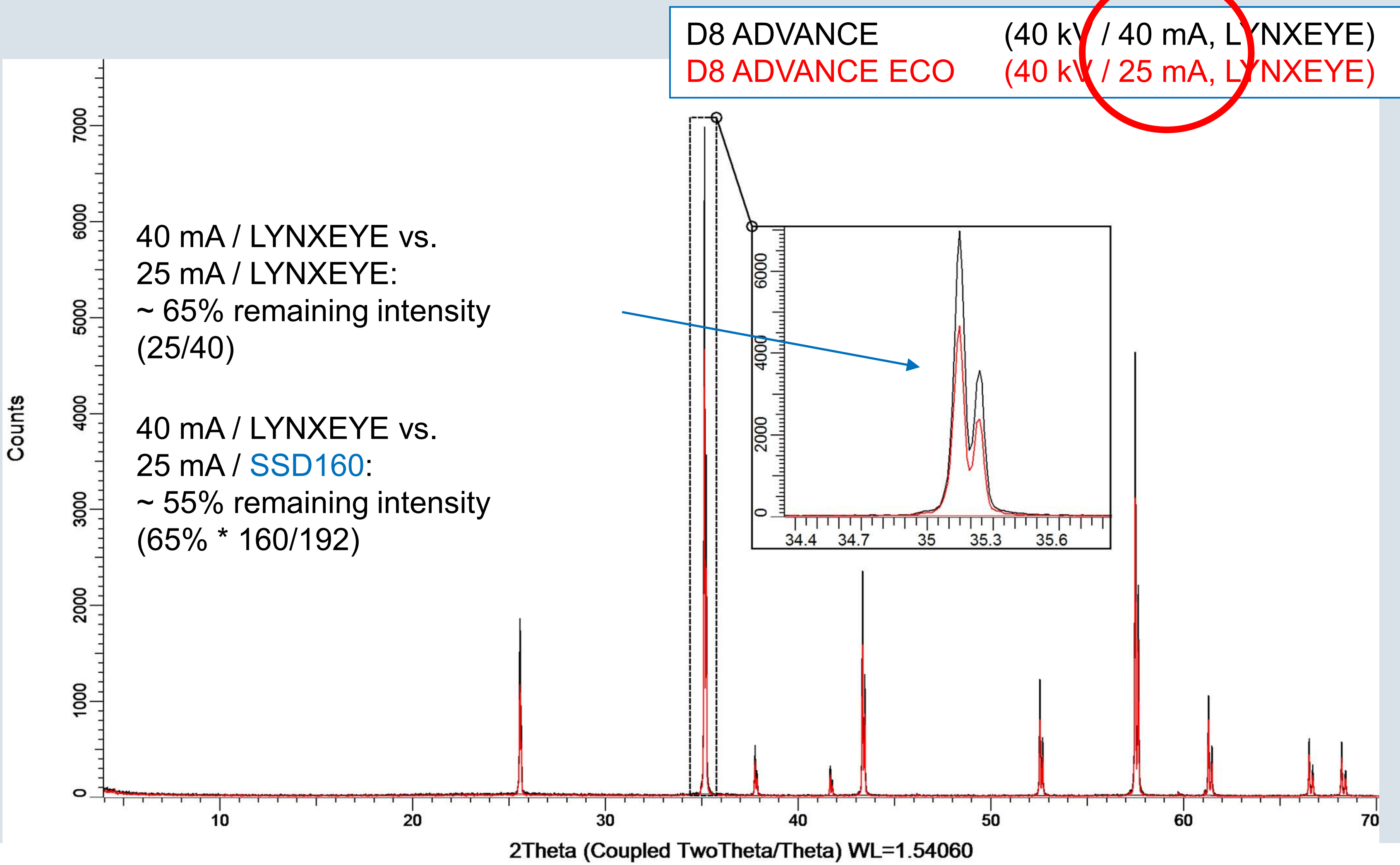
The New D8 ADVANCE ECO SSD160 Detector

Step up! Step up!

	SSD160	LYNXEYE	LYNXEYE XE
Nr. of strips	160	192	192
Nr. of defective strips	max. 1	0	0
Detector guarantee	no	yes	yes
Active window	12 x 16 mm	14.4 x 16 mm	14.4 x 16 mm
*Angular coverage**	~2.5° 2θ	~3° 2θ	~3° 2θ
Maximum global count rate	>80.000.000 cps	>100.000.000 cps	>100.000.000 cps
Wavelengths	Cu, Co, Cr	all	all
Energy resolution	~1500 eV	~1500 eV	<680 eV

* 250 mm instrument radius

The New D8 ADVANCE ECO
Intensity Considerations



Bruker AXS

The New D8 ADVANCE ECO ECOnfigurations

	D8 ADVANCE ECO	D8 ADVANCE
Optical component recognition		X
Vertical goniometer	Th/Th	Th/Th, Th/2Th
Generator	1kW	3kW
X-ray tubes	KFF	KFL
Wavelengths	Cu, Co, Cr	all
Scintillation counter, sec. monochromators		X
SSD160 detector	X	
LNYXEYE, LYNXEYE XE detector	X	X
VANTEC-1 detector		X
Fixed Johansson monochromators		X
Mirrors (parallel, focusing)	X	X
TWIST tube, POLYCAP		X
Specimen holders (single, 9 pos., 90 pos.)	X	X
Compact cradle	X	X
Small XYZ stage	X	X
Non-Ambient	X	X

The New D8 ADVANCE ECO Applications

	D8 ADVANCE ECO	D8 ADVANCE
Phase ID / Quantitative Phase Analysis	X	X
Structure Determination and Refinement	X	X
Micro-Structure Analysis	X	X
Residual Stress Analysis	X	X
Thin Film Analysis (Reflectometry)	X	X
Grazing Incidence Diffraction (GID)	X	X
Small Angle X-ray Scattering (SAXS)	X	X
Pair-Distribution Function Analysis (PDF)		X
Texture Analysis	X	X
Micro-Diffraction	X	X
Non-Ambient	X	X

Note: No Mo/Ag radiation available

The New D8 ADVANCE ECO
Pricing and Quoting

"ECO configurations":

Standard quotation #1
- Vertical goniometer, Th/Th
- 1kW (Cu, Co, Cr)
- Fixed slits
- Sample stage
  - Fixed, rotating, or 9-position
- SSD160 detector

Standard quotation #2:
- Vertical goniometer, Th/Th
- 1kW (Cu, Co, Cr)
- Fixed slits
- Sample stage
  - Fixed, rotating, or 9-position
- LYNXEYE

The New D8 ADVANCE
Good Diffraction Practice

- **Safety assurance**
  - Compliant with the world’s highest statutory requirements regarding X-ray safety, machine and electrical safety
  - Two independent fail-safe safety circuits
  - Maximum X-ray safety with radiation level significantly below 1μSv/h
- **Alignment guarantee**
  - Alignment equal or better than ±0.01° 2θ over the whole angular range at delivery
  - NIST SRM 1976a standard reference material (corundum plate) always included
- **Detector guarantee**
  - Unique LYNXEYE and VÅNTEC-1 detectors - absolutely faultless: no dead strips, no dead areas

The Bruker AXS Alignment Guarantee

Bruker AXS

The Bruker AXS Guarantee – The Benchmark in X-ray Powder Diffraction Data Quality

Only the highest data quality can adequately represent both the value of your samples and your effort.

Bruker AXS is committed to not only provide you with the best possible instrumentation, but also to certify both highest hardware and data quality. This is not only expressed by a smallest step size of 0.0001° 2θ but more important by an accuracy of 0.01° 2θ.

Based on the Bruker AXS Instrument Verification Booklet, each D4 and D8 diffractometer has to pass the strictest quality checks currently in place in X-ray powder diffraction. These tests provide you with the utmost assurance that you have purchased, and are using, the highest-quality X-ray diffraction equipment in the world. These quality checks include:

- NIST corundum standard SRM 1976 included with each new instrument (cut to fit into a standard sample holder)
- Instrument alignment ≤ ±0.01° 2θ over the whole angular range with reference to SRM 1976 at installation – guaranteed!
- Optional IQOQ procedures for regulated industries such as the pharma industry based on the instrument verification booklet.

Bruker AXS's quality assurance measures give you the certainty that your data is correct.

Each single instrument has to successfully pass the Bruker AXS instrument verification procedure since its introduction in 2003. Each system is equipped with the SRM 1976 standard reference material and each of them is capable of measuring peak angles equal or better than ±0.01° 2θ.

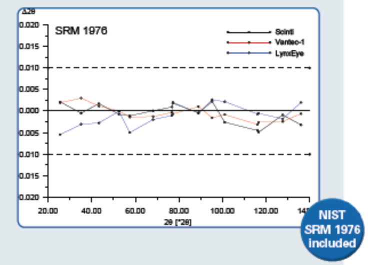
You should compare apples and lemons!

All powder XRD's are not created equal.

Performance is a critical issue in any XRD measurement and starts with the most advanced goniometer on the market. Bruker AXS has this goniometer and it is used in every diffractometer system for powder and single crystal diffraction. Characteristic is its >280 mm globoid tooth gearing system for higher driving efficiency and higher load capacity. This not only provides for higher longevity and higher accuracy, it is also the base of a unique platform concept, which allows a free (re)configuration of any diffractometer system with all hardware components available from Bruker AXS.

Supported by both high precision stepper motors and optical encoders, the system always "knows" its true position, and never has to search for it unlike other goniometers.

Naturally, zero maintenance is required.



Get the best quality data you possibly can!

X-ray powder diffraction systems are expensive capital purchases. You deserve to have a system that produces the highest data quality. Bruker AXS invites you to demand the best of your X-Ray equipment and therefore your X-ray vendor. Insist on 0.01° 2θ tolerances on peak positions for the SRM 1976 standard for your installation testing. It is the only way to truly determine if you are getting the quality you paid for and deserve.

"≤ ±0.01° 2θ" is the Bruker AXS guarantee – defining a new benchmark in data quality in X-ray powder diffraction! Remember, that in the ICDD PDF a pattern is considered to be a high quality pattern if Δ2θ ≤ ±0.04°2θ…

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www.bruker-axs.com

The Bruker AXS Guarantee:
No defective areas (and true 2D) !

MODERN DETECTOR TECHNOLOGIES – THE NEXT GENERATION

- No defective areas
- Fixed scan mode operation without missing data points
- Highly uniform active area, highest data quality

Bruker AXS' one and two dimensional detectors currently revolutionize X-ray powder diffraction analysis in all application areas. This is not only due to a gain in measurement speed of a factor of up to 2000 compared to point detectors (dependent on the 1D/2D detector type). Even more important is the ability to obtain a data quality, which is comparable to point detectors in terms of both resolution and line profile shape.

The major break-through achieved by the Bruker AXS' new detector technologies relates to a most notable boost in manufacturing quality. **In contrast to conventional 1D/2D solid state detectors, neither the LynxEye™ nor the VÅNTEC™ detectors have any defective or even dead areas.** This unique property of both detector types, together with a factory-made calibration, makes them particularly suited for fixed mode measurements including detection of very weak signals.

No defective areas – only with detectors from Bruker AXS

If the measurement software of your supplier does not offer measurement modes with fixed detector, this feature is most likely disabled or even not implemented due to defective areas in your detector.

LynxEye™: 1D detector based on Bruker AXS' **compound silicon strip technology**

VÅNTEC-1™ (top) and VÅNTEC-2000™ (bottom): 1D and 2D detectors featuring Bruker AXS' unique and patented **MikroGap™ technology**

BRUKER AXS – THE DETECTOR COMPANY

Both the underlying VÅNTEC and LynxEye technologies are the result of continuous detector development by the globally leading X-ray diffraction equipment manufacturer. Since decades X-ray analyses in single crystal and powder diffraction have been revolutionized by Bruker AXS as e.g. can be seen from this impressive milestone list:

1982	First scanning linear PSD for X-ray diffraction
1984	HI-STAR – multiwire 2-dimensional detector
1991	GADDS – the first general diffraction system with 2D detector (winner of R&D 100 award)
1993	SMART – the first CCD detector system (winner of R&D 100 award)
1999	SMART APEX – the first direct imaging (1:1) CCD detector system
2001	PROTEUM 300 – lens coupled CCD (Winner of R&D 100 award)
2001	Sol-X – energy-dispersive detector with large 4 x 15 mm active area
2004	Super Speed VÅNTEC-1™ 1D detector with 50 x 16 mm active area, based on Bruker AXS' patented MikroGap™ technology
2004	APEX™ II – the first 4K CCD detector
2004	PLATINUM 135 – 4K CCD detector (16 Mega-Pixels) coupled to a 135 mm fiber-optic taper
2005	Super Speed LynxEye™ 1D detector with 100 million cps count rate capability, based on Bruker AXS' compound silicon strip technology
2005	Super Speed VÅNTEC-2000™ 2D detector with 14 x 14 cm active area, based on MikroGap™ technology (Winner of R&D 100 award)
2005	AXIOM – detector with 200 mm Ø active area, based on MikroGap™ technology

All configurations and specifications are subject to change without notice. Order No. DOC-H88-EXS016.

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