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INTERNATIONAL



CONVENTION

01 - 04 Aug 2019, Radisson, Amritsar

TECHNICAL ADVANCES IN HALLMARKING

Rakesh Bhan – Managing Director

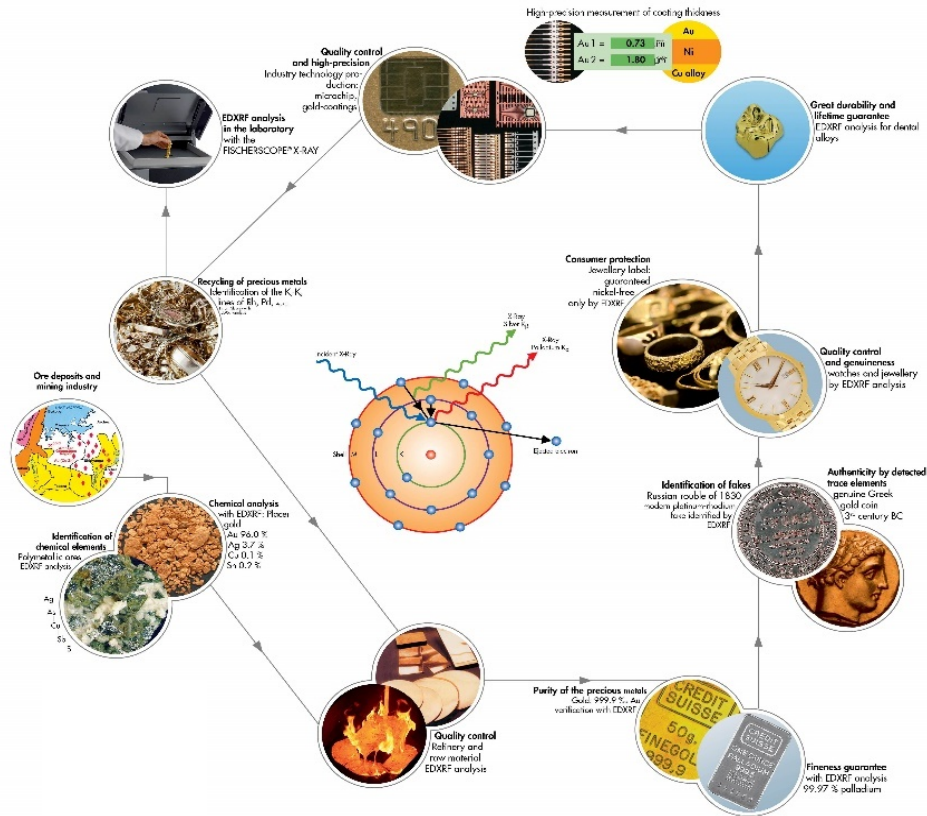
Fischer Measurement Technologies (India) Pvt. Ltd.

03.08.2019

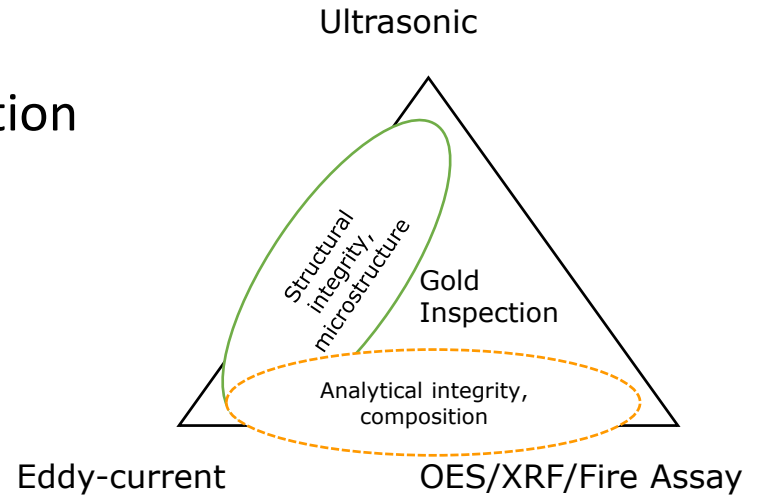


Gold Stages and Analysis

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- Various analytical methods
 - OES
 - **X-ray Fluorescence Analysis (XRF)**
 - Fire Assaying
 - Etc.
- Methods giving macro structural information
 - Ultrasonic Transmission and Resonant Ultrasound Spectroscopy (RUS)
 - Eddy-current analysis (EC)
 - Etc.



Benefits of EDXRF Technique

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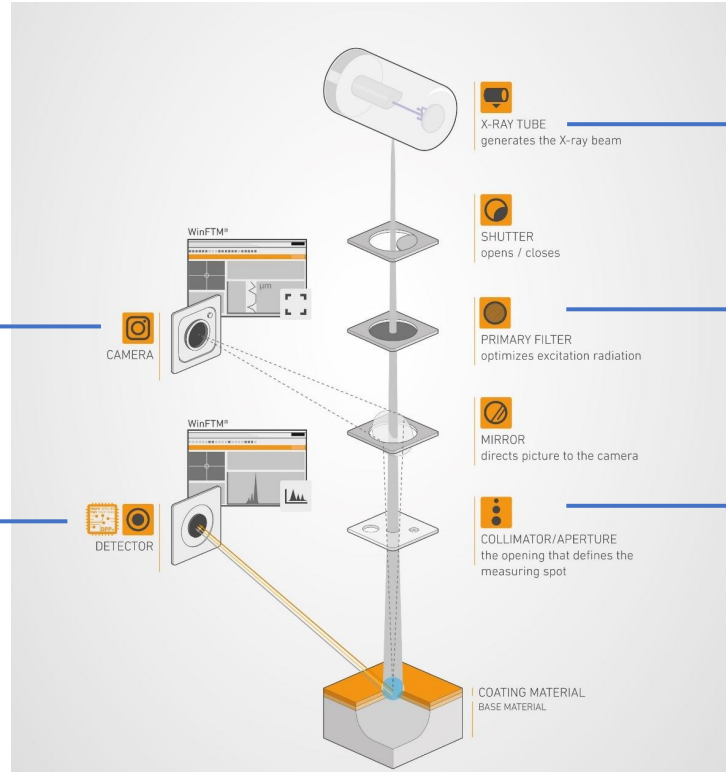
- Fast, Quick, Accurate and Non Destructive
- Requires no or very less sample preparation
- Measurement is done directly on solid sample and does not rely on acid digestion
- Quantitative Analysis of gold alloys including Platinum Group Metals (Pt, Pd, Rh, Ru, Ir, Os)
- Easy to use and practically feasible
- Quantification of all metals of interest in one single measurement.
- Advances in detection sensitivity has improved precision and accuracy of the measurement comparable to fire assay method.

Major Components of an EDXRF

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Camera:
High Resolution CCD Camera

SDD Detector / Si PIN Detector/PC :
Resolutions : 140eV/ 180eV/ 800eV



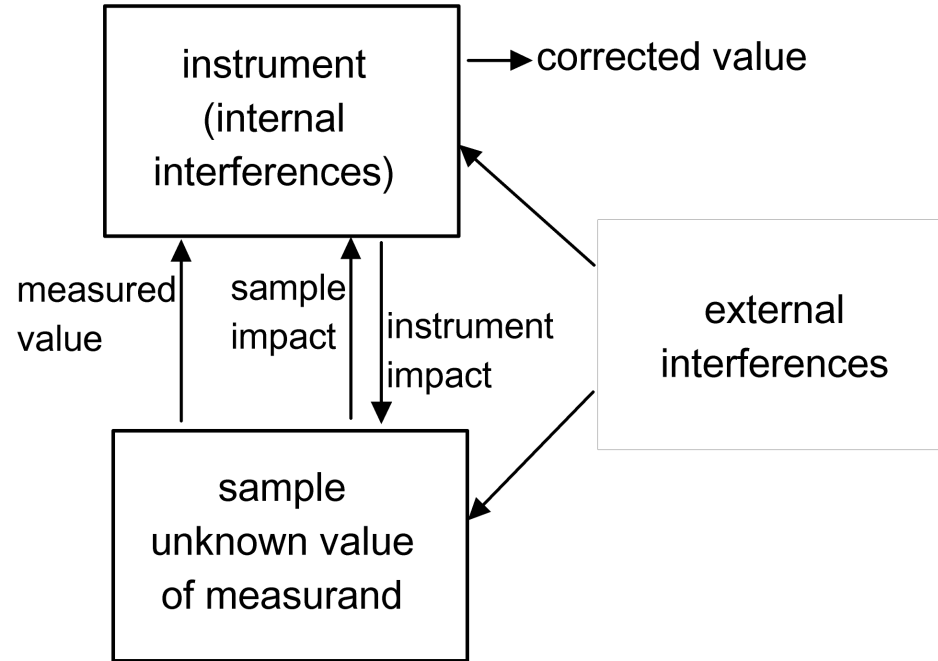
X-Ray tube:
Micro Focus tube with Beryllium Window

Primary Filter:
Fixed or Multiple Changeable Filters like Nickel, Aluminum , Mylar etc.

Collimator:
Fixed or Motorised Changeable Collimators like -
Ø 0.2 mm (7.9 mils), Ø 0,6 mm (23.6 mils), Ø 1 mm (39.4 mils), Ø 3 mm (118 mils) others on request

Measurement – Effects and Interferences

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Factors Affecting Accuracy and Reproducibility of XRF Measurements

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Instrument Factors:

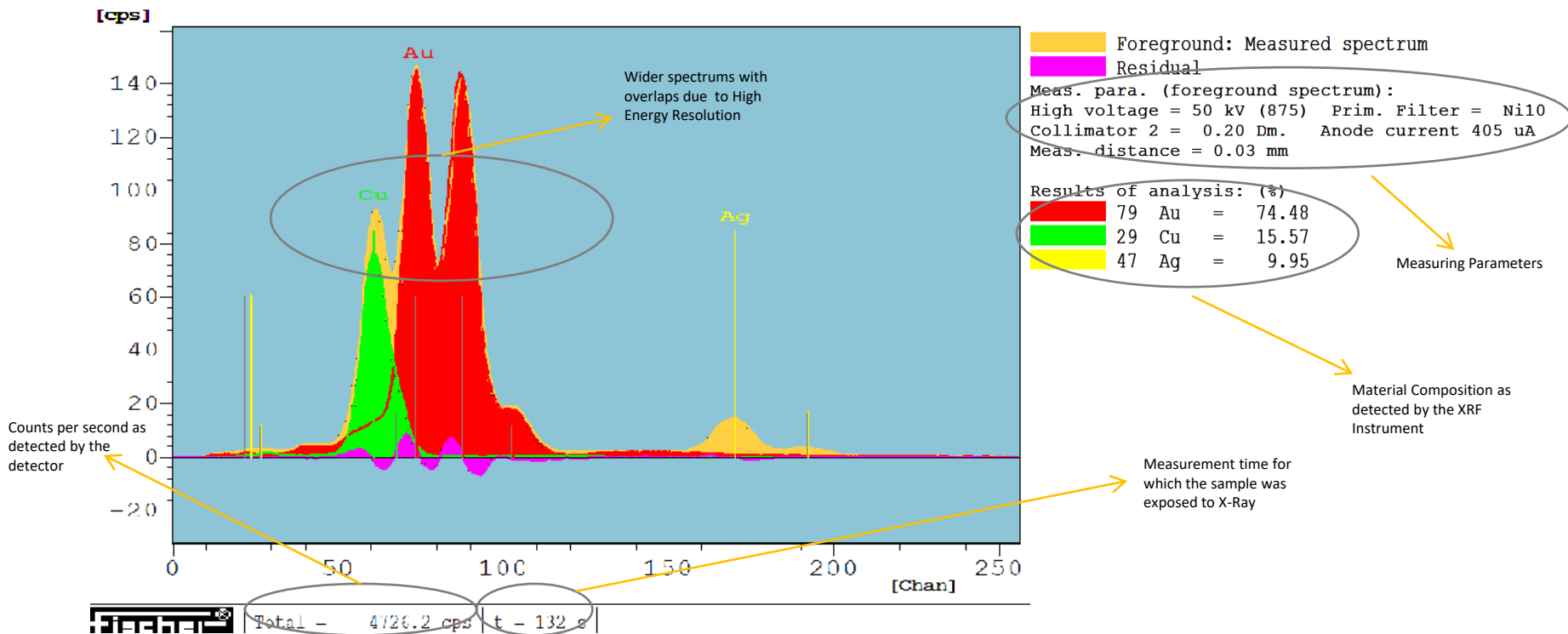
- Resolution of the Detector
- Collimator
- Measuring distance
- Measuring time
- Calibration

External Factors:

- Sample Homogeneity
- Environmental Conditions
- Positioning of the Sample
- Focusing
- Operator Skill
- Measurement Approach

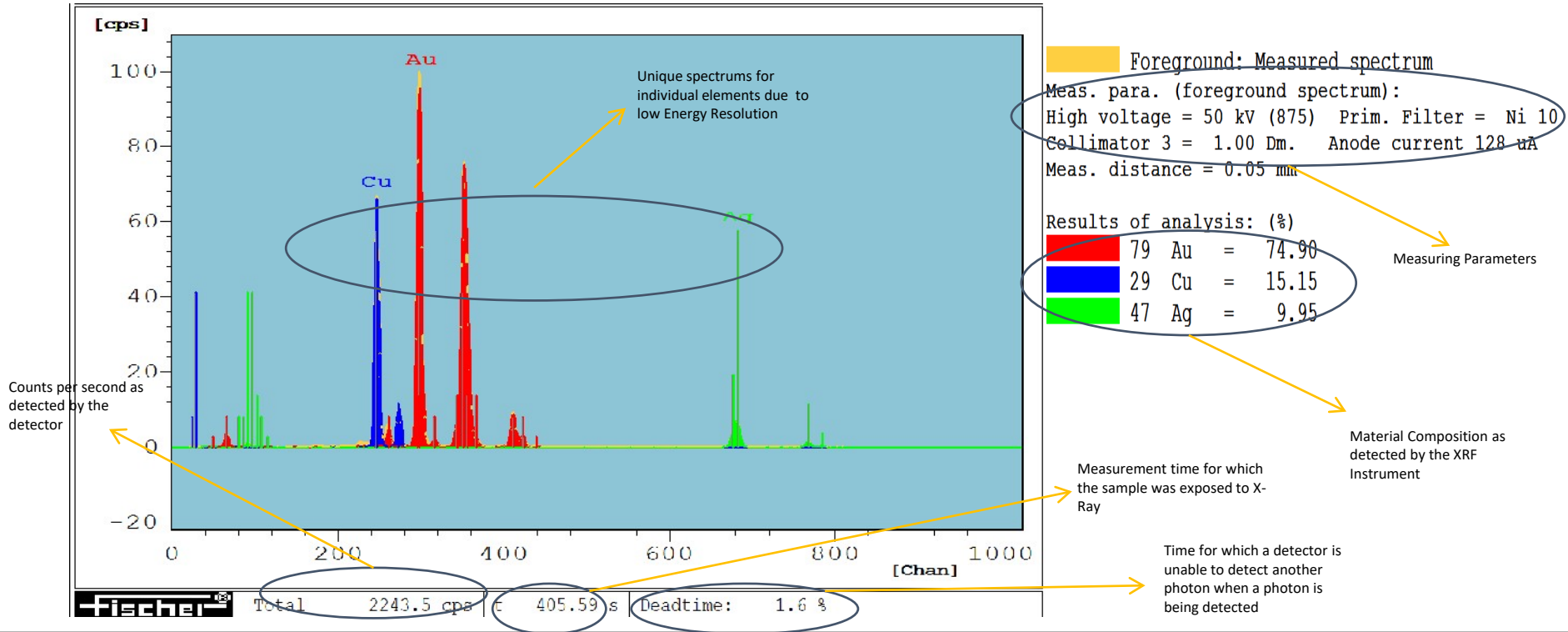
Spectrum – Proportional Counter Tube

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Spectrum – Si PIN / SDD Detector

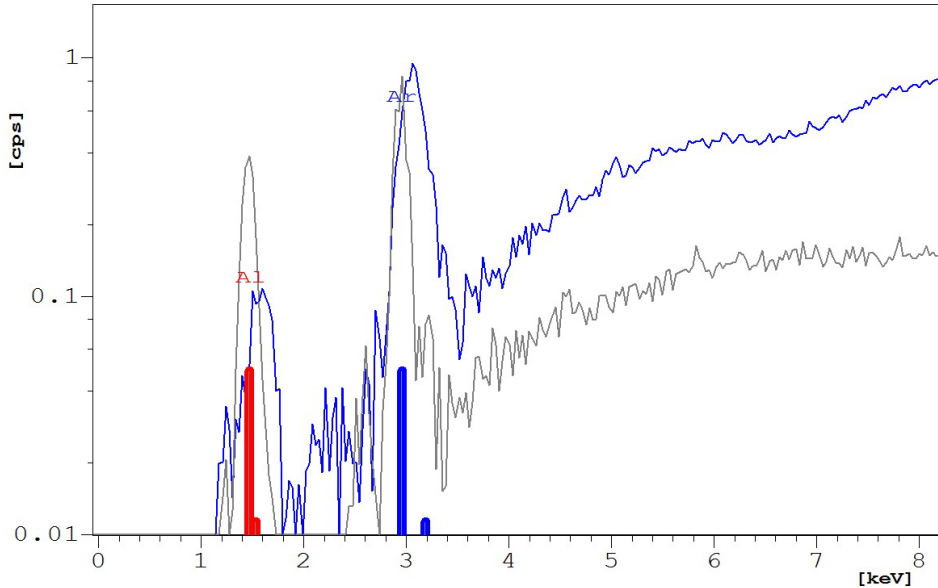
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SDD Detector

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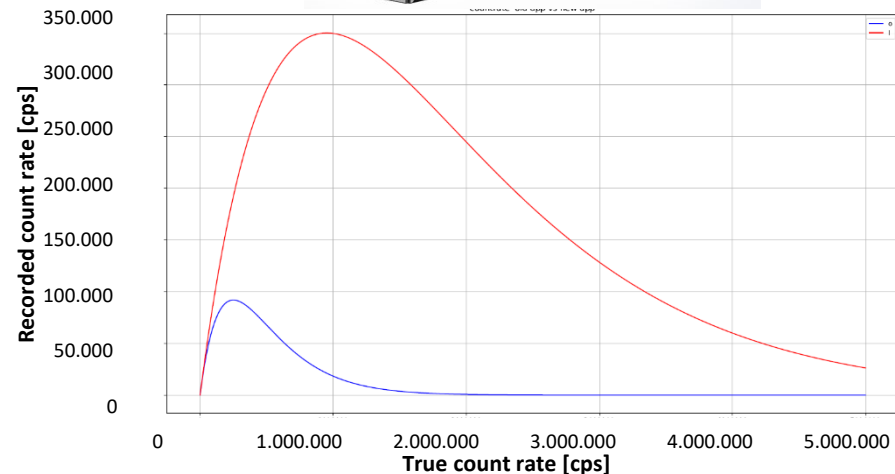
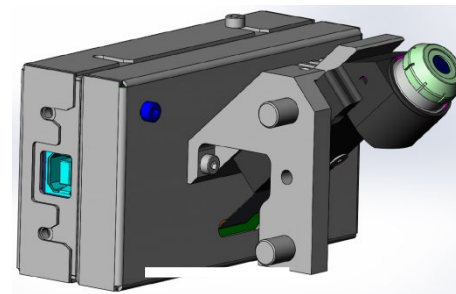
- Better sensitivity at low energies
Al peak for PIN (blue) and SDD (grey)



New Improvements in Detector Technology

Function	Existing Setup 20/30 mm ² SDD + old DPP electronics	New Setup (SuperSense) SDD + DPP: DPP+
Max. energy resolution Fe₅₅	< 165 eV	< 140 eV
Time to peak	1.6 μs	0.4 μs
Top width	0.4 μs	0.125 μs
Count rate in cps	up to 100.000	up to 500.000
Diagnostic features	Bus Errors	<ul style="list-style-type: none"> Tracking power supply voltages and currents BIAS voltage cooler current detector temperature HT operation

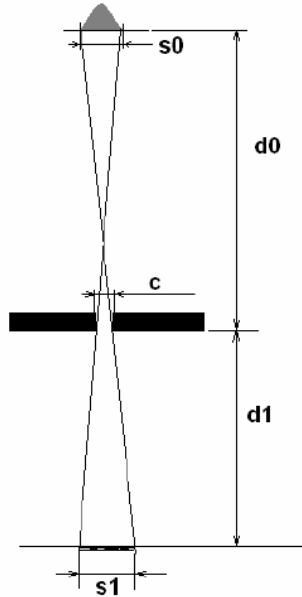
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Measurement Spot Size

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X-ray tube



Sample

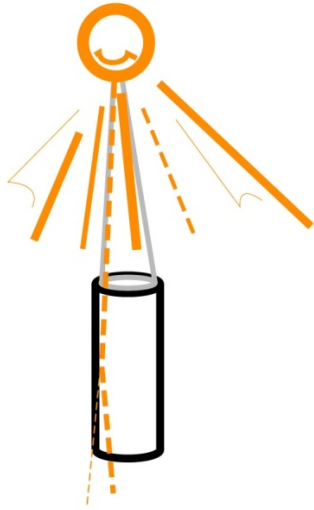
$$M = c \cdot (d_0 + d_1) / d_0 + s_0 \cdot d_1 / d_0$$

The size of the measurement spot depends on

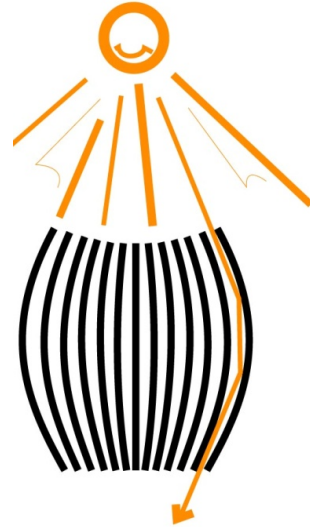
- size of collimator c ,
 - focal spot of the anode s_0
 - ratio d_0/d_1 .
-
- Small Measurement spot allows for the best determination of inhomogeneity's
 - Large Measurement spot allows for low influence of inhomogeneity

Advanced Optical Collimation Systems

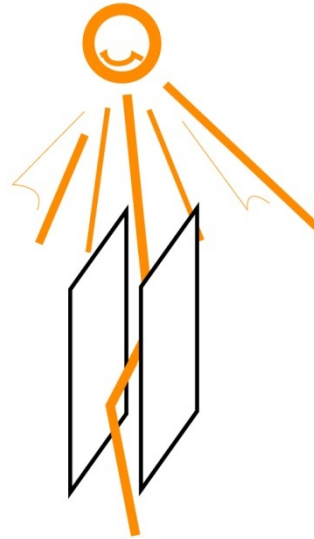
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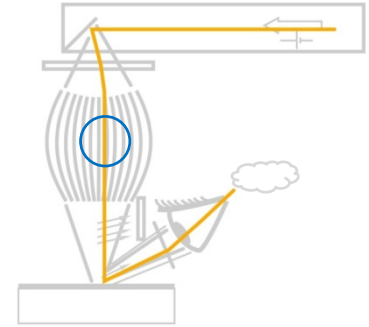
mono capillary
100 – 300
~ 10



poly capillary
~ 10 - 60
~ 500



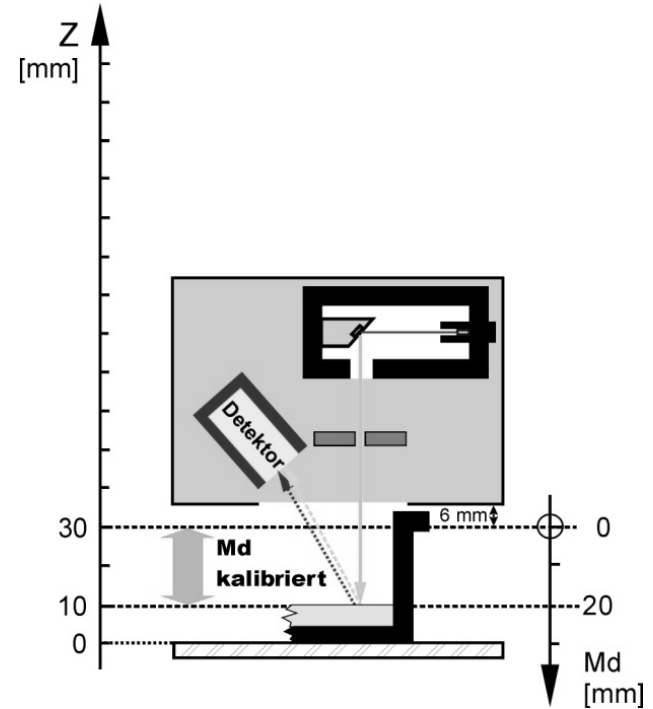
mirror optics
20 x 50
~ 10



spot size [μm]
amplification

Measuring Distance - Md

- Automatic correction of the reading
- Any md in the valid calibrated range can be chosen
- Signal (count rate) $\sim 1 / (\text{measuring distance})^2$
repeatability $\sim \sqrt{\text{count rate}}$
- → keep measuring distance small!



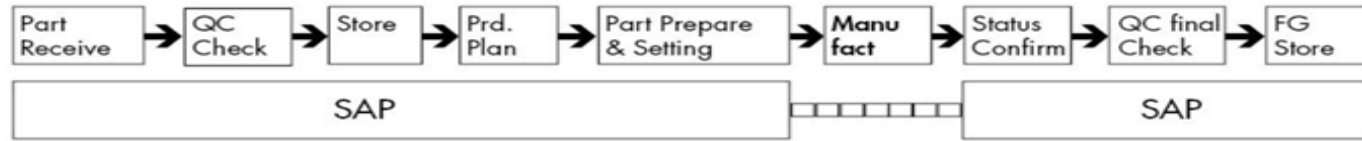
- Repeatability: $s \sim \sqrt{t}$ measuring time
- Four times longer measuring time will improve the repeatability by a factor of 2.
- Sometimes very long measuring time will not further improve the standard deviation. It is better to utilise the mean value of several measurements
- With advances in signal processing electronics, very accurate results can be obtained with a measuring time of 30 mins.

- To ensure valid results, measuring equipment shall be calibrated against measurement standards traceable to international or national measurement standards.
- Ensures Traceability of measurement results
- Helps to minimize the Systematic Error
- Integrity of the calibration standards is very important



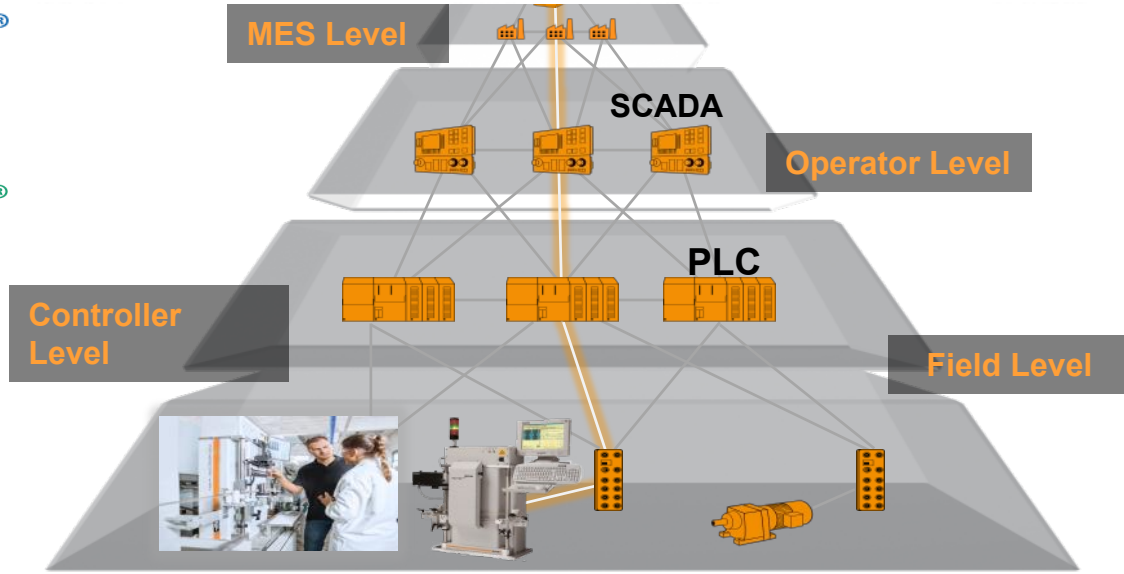
Automation and Data Integrity

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**PROFI
BUS**

**PROFI
NET**



ERP
Ether**CAT**

fischer®

Thank You for Your Attention!

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