



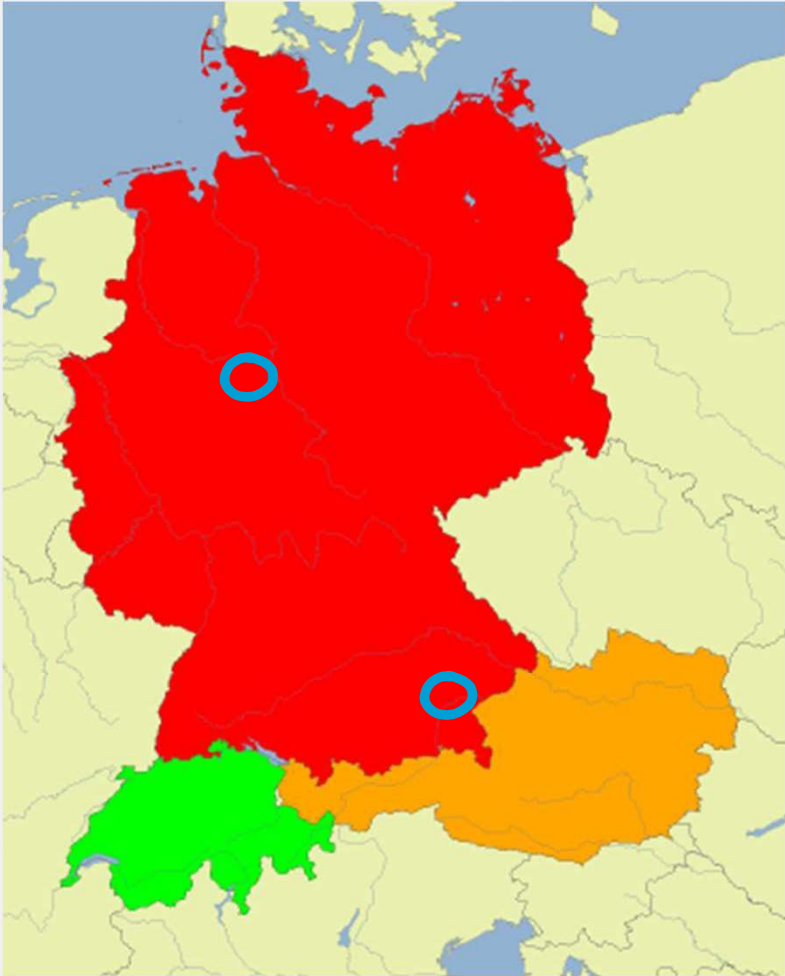
AMAP Kolloquium September 2022

Laser OES – the alternative to XRF and Spark OES

Andreas Kunz
Kleve, September 22



shaping the future of OES – QuantoLux



- 2016 - Foundation of QuantoLux GmbH in Kleve, Germany
- 2017 - Pilot series QLX3
- 2019 - Pilot series AlloyChecker & QLX1
- 2019 - Product launch QLX3 Spark
- 2021 - Expansion of shareholder base
- 2021 - Foundation of the subsidiary QuantoLux Innovation GmbH near Ulm, Germany

Deliver Results !

QuantoLux



About QuantoLux

Deliver Results !

QuantoLux was established in April 2016
in Kleve, Germany.

The company designs and manufactures
benchtop and portable optical emission
spectrometers with laser excitation.

A strong focus is to provide customer
value throughout the lifetime of the
products.

Mission Statement

We want to provide analytical solutions to
our customers that deliver results! We
want to be accountable for bringing true
value propositions. QuantoLux follows a
holistic approach to understand and
improve our end-user's processes.



Experienced Founders

40+ years of Competence

Being a team for many years, Andreas Kunz and
Mischa Ounanian are now launching their second
start-up.

- Stationary laser-OES
 - QLX3, QLX5, QLX9
- Portable & handheld laser-OES
 - QLX1, AlloyChecker
- Portfolio of metal apps
- First non-metal apps
- Value-adding services

Products





Optical Emission Spectrometry (OES)

+

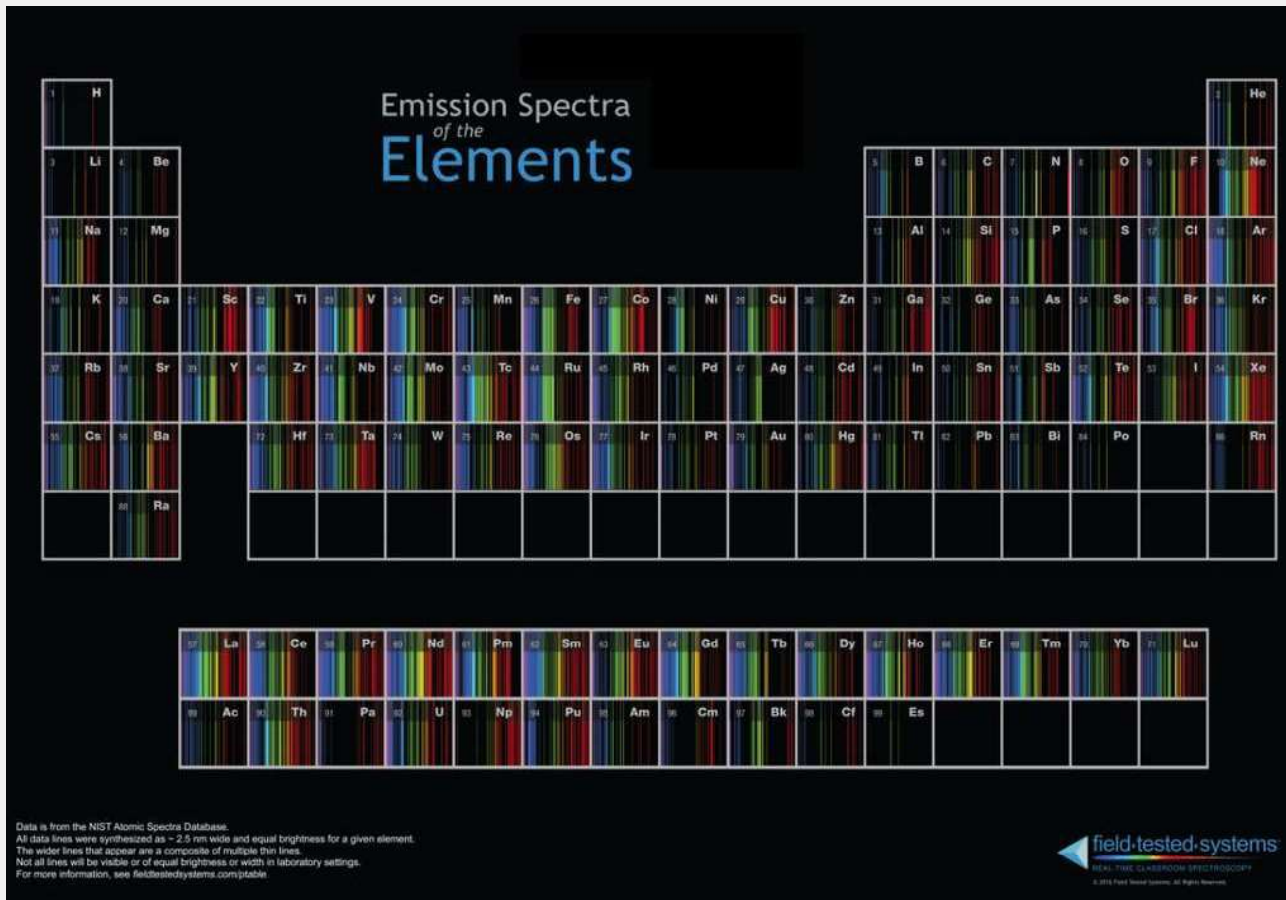
Laser

(Light Amplification by Stimulated Emission of Radiation)

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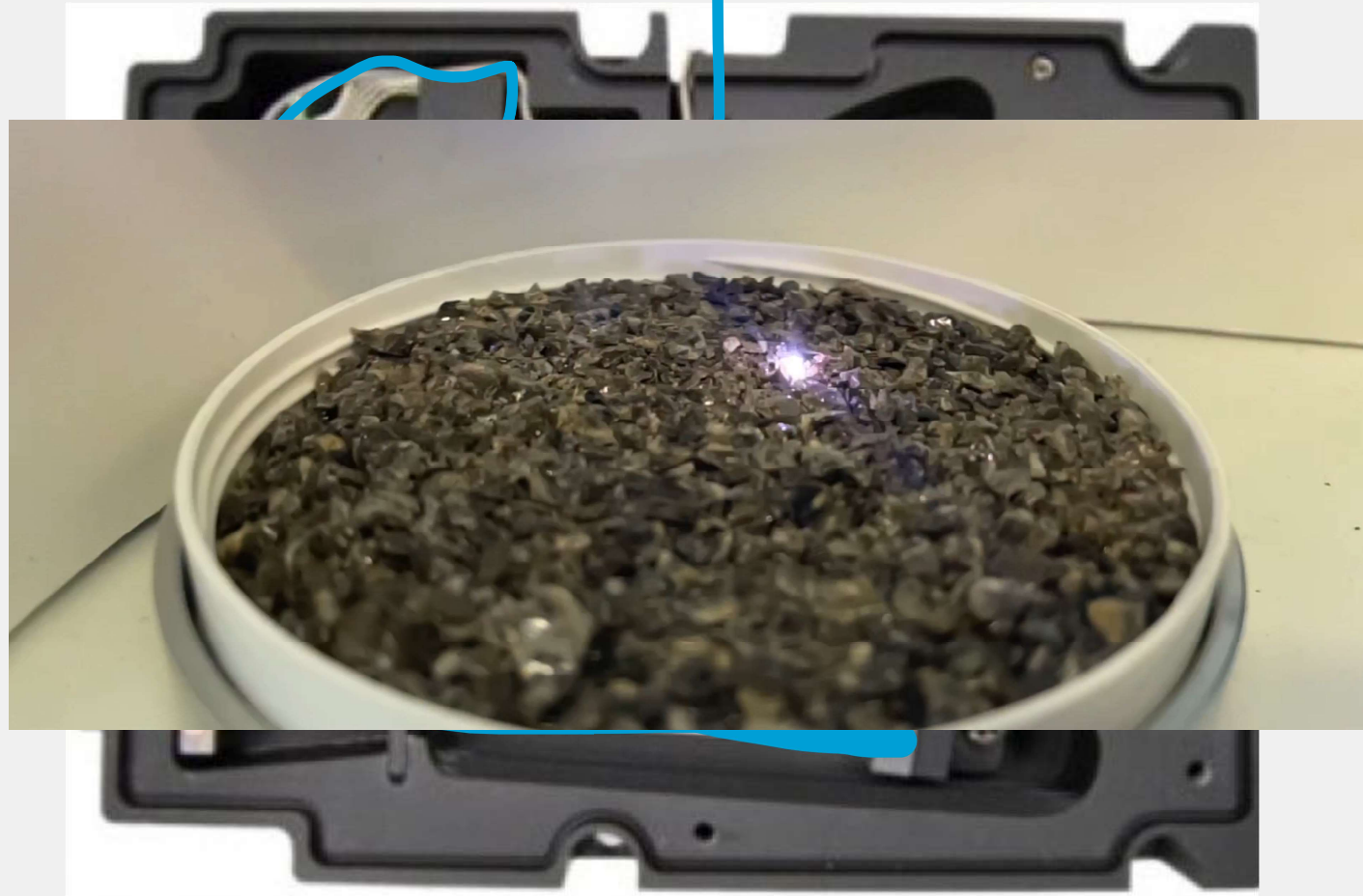
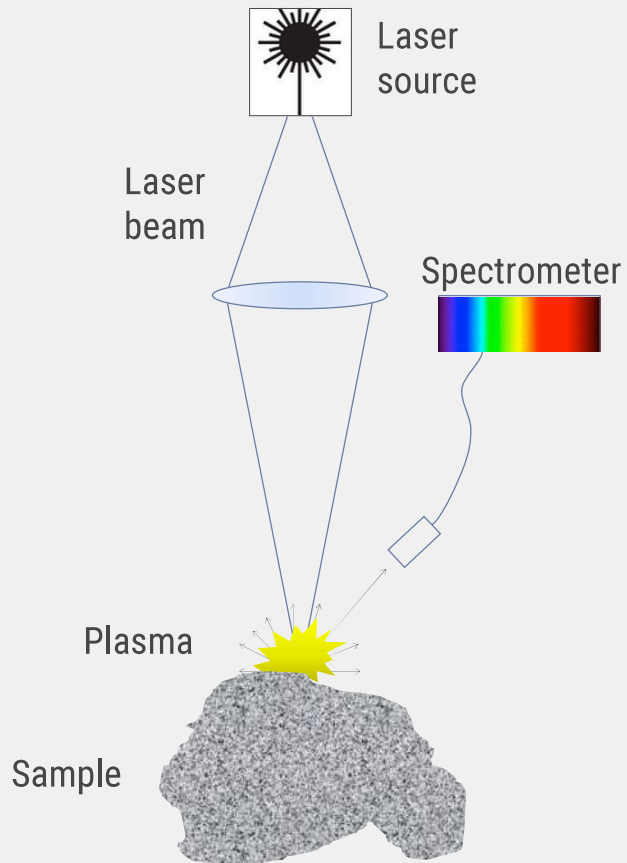
Laser-OES

OES and the periodic table



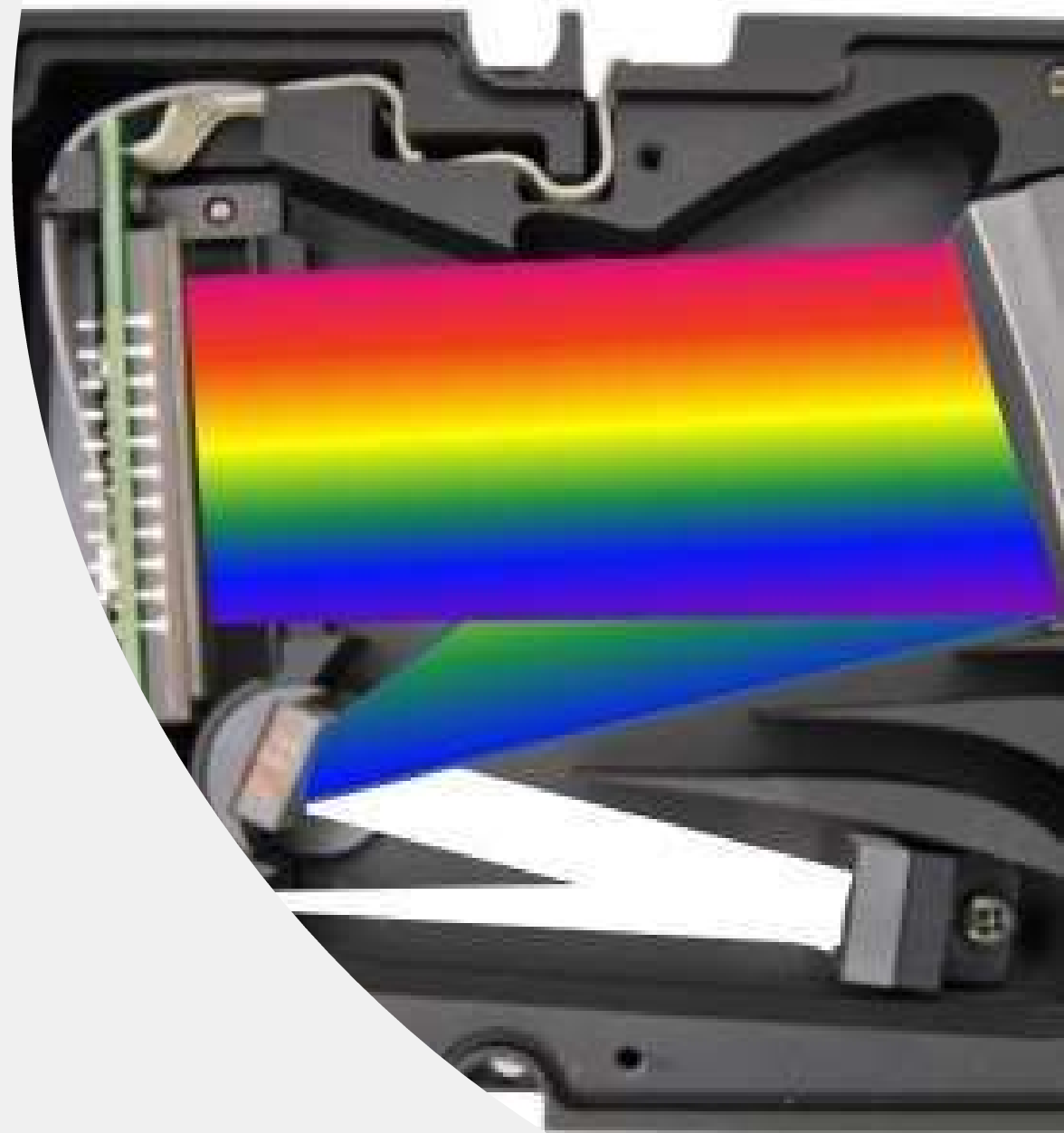
- OES covers almost the entire PToE
- Suitable for any inorganic element analysis application
- Short measurement times
- Typically, simple sample prep
- All elements in the same regime
- Low to very low detection limits
- many different sample excitation techniques available (spark, ICP, LIBS, GD-OES, DC-Arc)
- **It is the fastest and easiest technique in elemental analysis**

Shaping the future laser OES – the alternative.

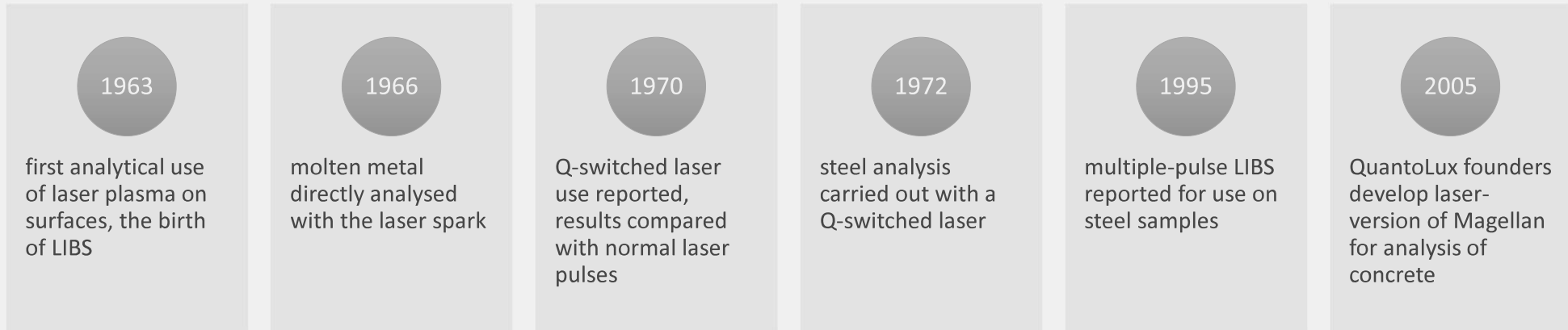


How does the optics work?

- Laser-optimization leads to different concepts than spark
- Optics are Czerny-Turner layout
- 10 μm entrance slit
- Different gratings for optimized resolution
- UV optic with 3600 grating
- Detectors are CCD or CMOS
- Spectral range covers UV-VIS-NIR
- Designed for all matrices
- Ultra-stable in all environments



the future laser OES – background.



- OES stands for Optical Emission Spectrometry“
 - Optical refers to radiation in the visible part of the spectrum
 - Emission represents the element specific light emissions
 - Spectrometry is the science of the electromagnetic spectrum, in our case the dispersion of emitted light
- Sources that create the plasma which emits the light:
 - Inductively coupled plasma (ICP) is a plasma torch into which a liquid sample is sprayed to create emissions
 - Electric Arc/spark is created with a high-voltage ignition where the conductive sample acts as a counter-electrode. The arc/spark between electrode and sample is the plasma.
 - Laser light creates a smaller plasma and, thus, does not destroy the sample or leave a big „burnspot“ on the surface. It also does not require a conductive metallic sample or extensive sample preparation (like ICP). It is also the fastest method.

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the future

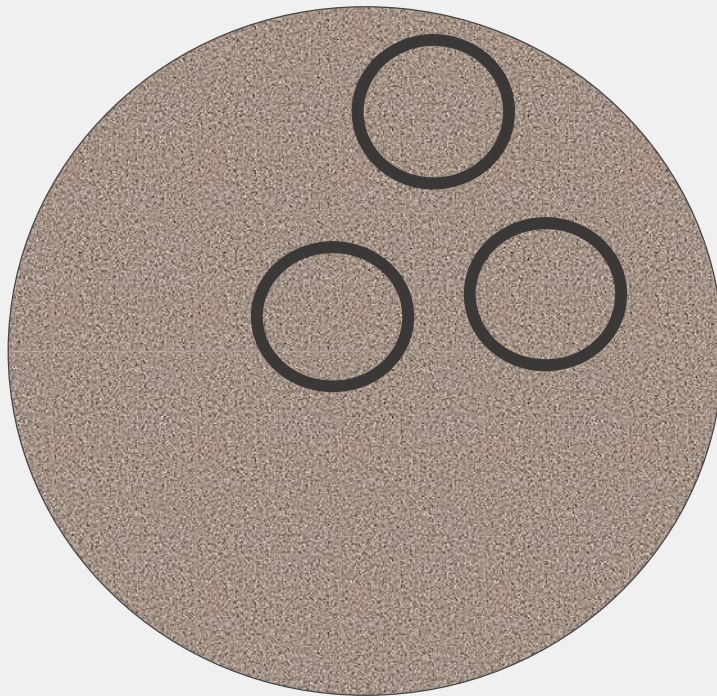
Advantage – non-contact analysis



No-contact = no-cross contamination

Advantage speed – digital homogenization.

XRF



= physical homogenization **necessary**

Laser OES



= digital homogenization **possible**

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Advantage speed – **the promising alternative.**



- High sample throughput
- Energy savings
- Increased efficiency of processes
- 100% quality check



laser OES – additional benefits.

- Small plasma with minimum sample destruction
- Very fast assay of result, typically in 1-5 seconds
- No lock-out elements, light and heavy elements can be analyzed equally fast
- No high-voltage or x-ray hazard, safe class 1 operation
- Simple sample preparation
- No mechanical wear (like electrodes, etc.)
- Metal and non-metal applications available
- No or very little inert gas (Argon) consumption
- No cross contamination; quick change between alloys or matrices
- **Overall very safe and simple to use and the most economical solution!!**

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Advantage Lightweight – **mobility I.**



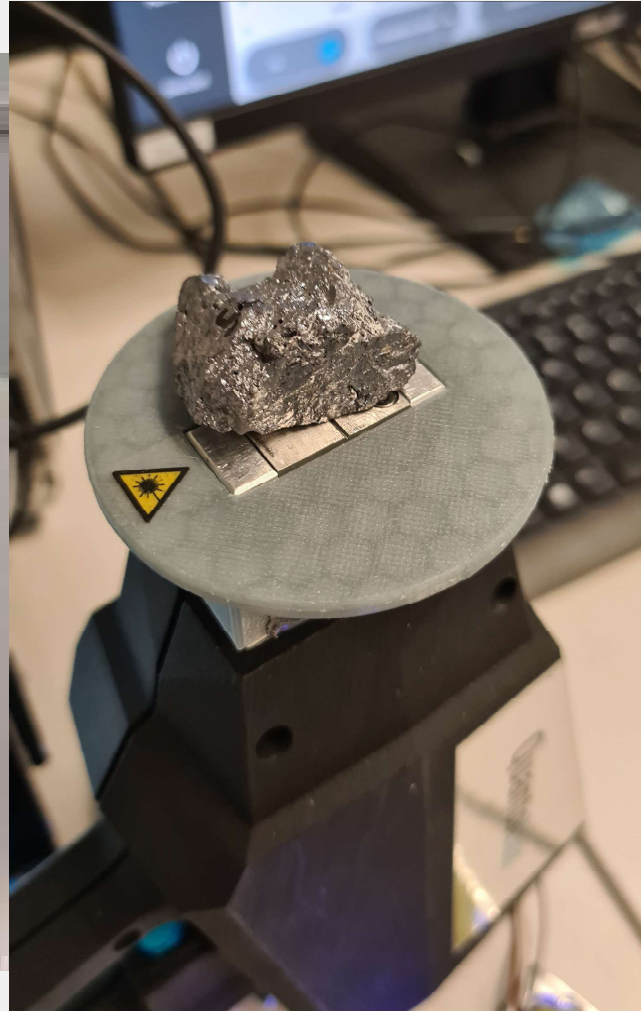
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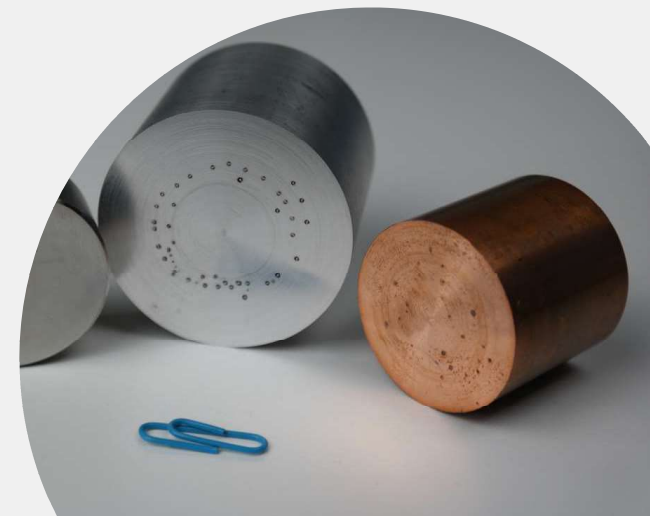
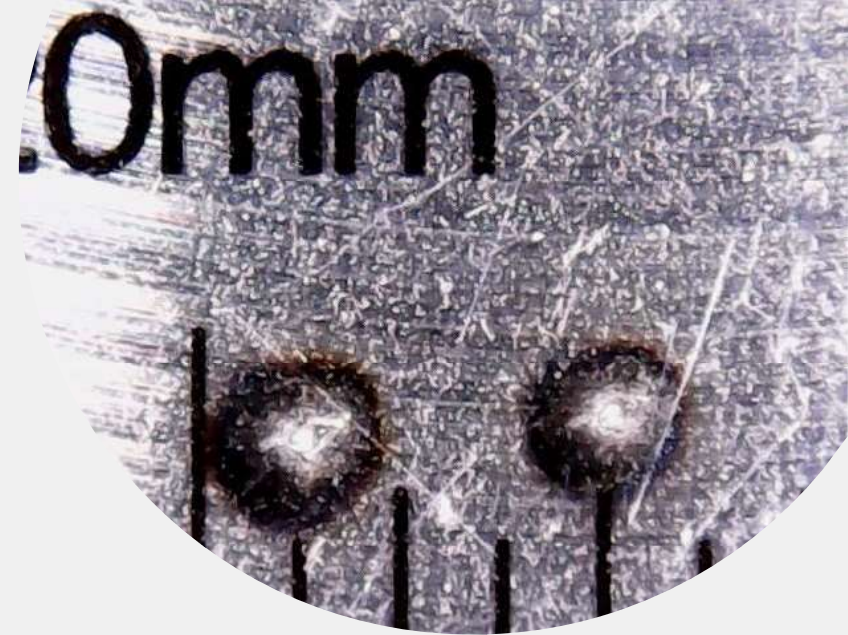
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Advantage Lightweight – mobility II.



How big is the „burnspot?“

- Geometry & appearance similar to spark burnspot
- Typical measurement spot is around 1 mm, excited plasma area is <math><0.1\text{mm}</math>
- We call this a „ μ Burnspot“ !
- Can easily be polished away
- Requires sample prep for clean surface
- Surface roughness does not matter (unlike spark-OES where it should be rough)

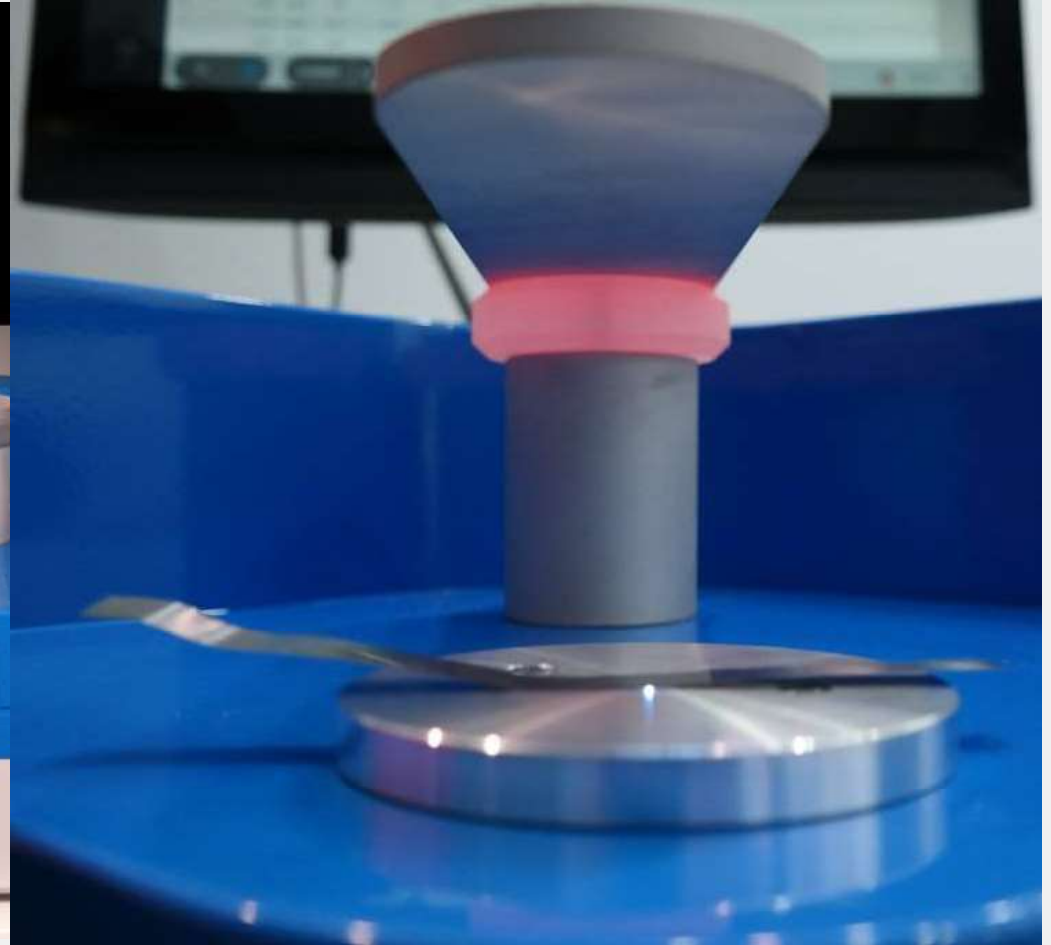


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Advantage small burn spots – **thin parts.**



LIBS and Laser OES – **similarities.**

Is there a
difference
between Laser-
OES and LIBS?

- Laser-OES is same as spark-OES with the only difference in excitation: the laser replaces the spark generator with electrode
- First laser-OES has been developed in 1963; but lasers where too big and expensive – until recently
- The term LIBS summarizes all techniques used in laser-induced spectroscopy which also include absorption and fluorescence.

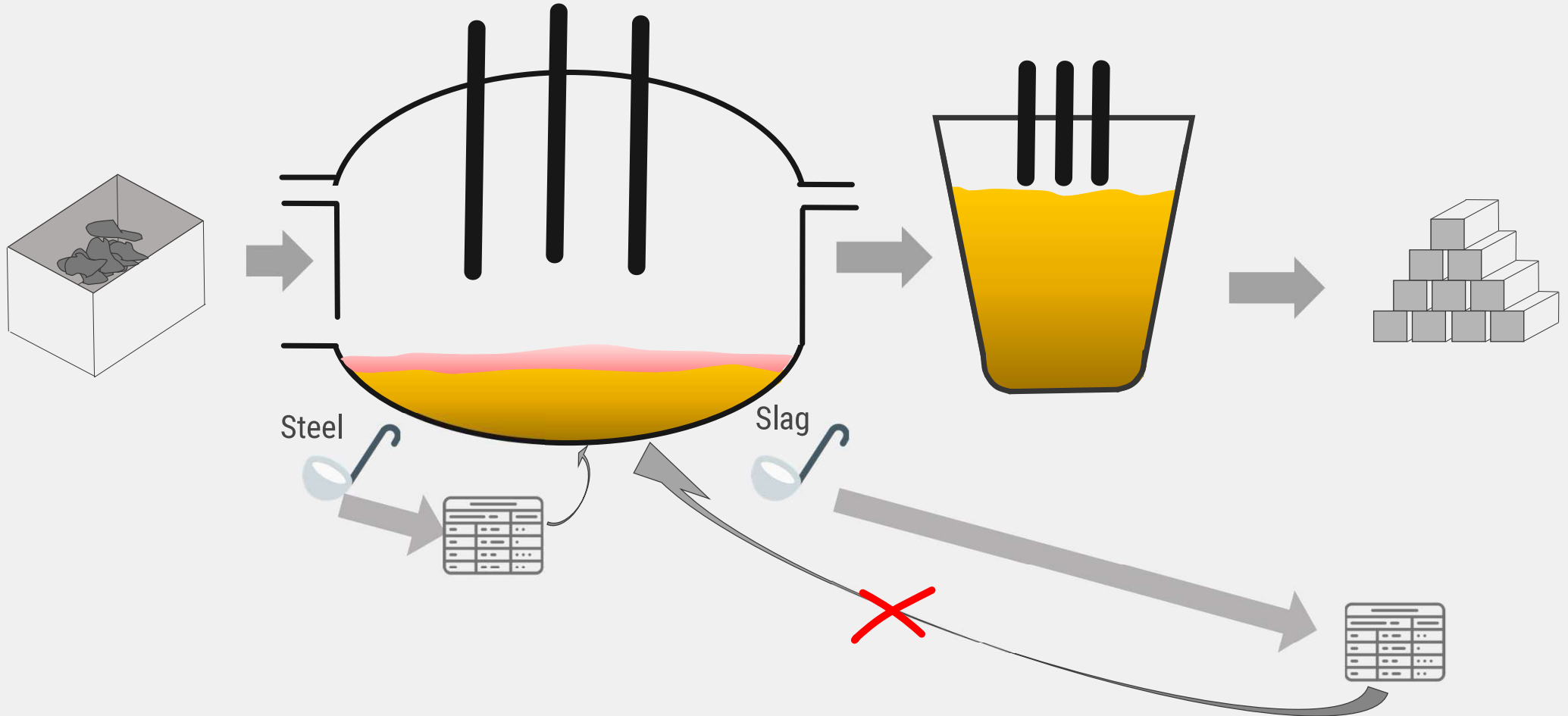
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Advantage non-conductive samples

Slow analysis – post mortem reaction.



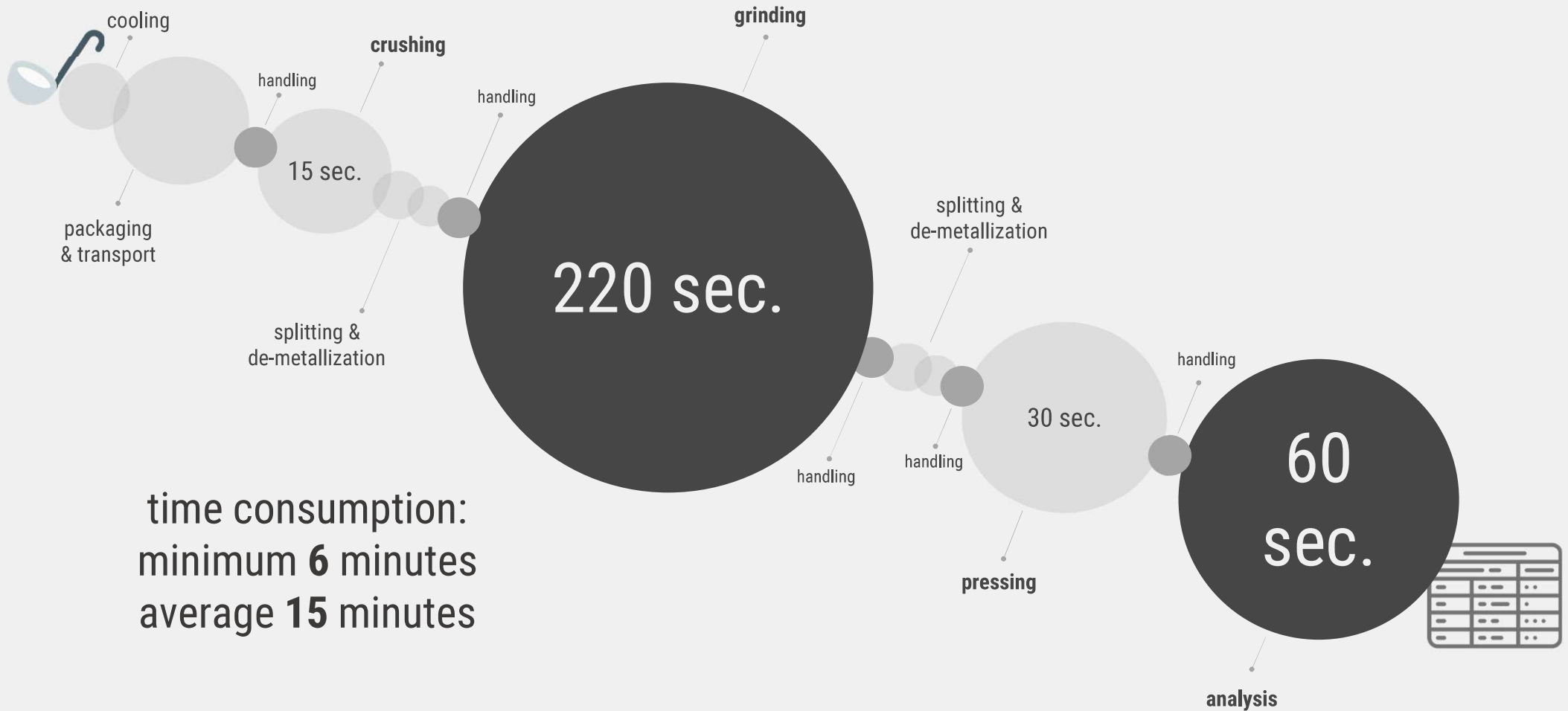
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reason for slow analysis

established slag analysis – **complex and slow.**



time consumption:
minimum **6** minutes
average **15** minutes

Deliver Results !

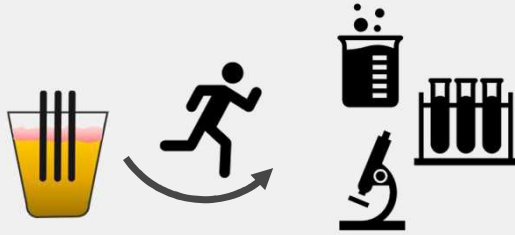
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other issues with the existing approach



time consumption
→ Up to 40x
faster



complex analysis
→ on-site analysis



initial investment
→ no sample prep
equipment



maintenance
→ No wear parts

today

Sample prep. – “real life” issues.



sample prep.
errors



cross contamination



sample dividing (2x)



large grain size
- grinding speed & time
- variations in mill loading



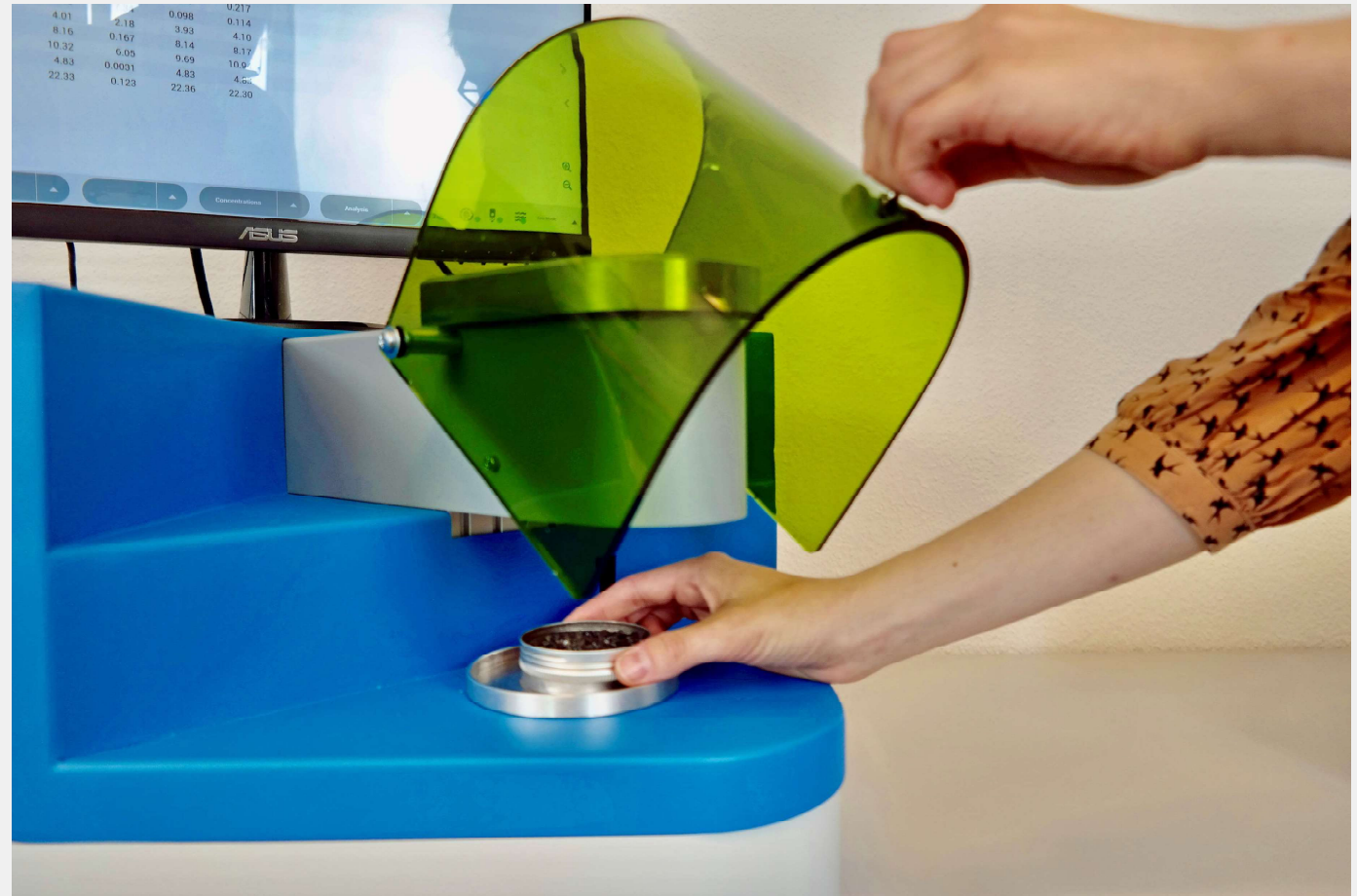
segregated pressed pellet
- pressing & releasing speed
- pressing force
- uneven surface

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the future High end Laser Spectrometer – QLX9 Pre-series.



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High end Laser Spectrometer – QLX9 Pre-series.



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High end Laser Spectrometer – QLX9 Pre-series.



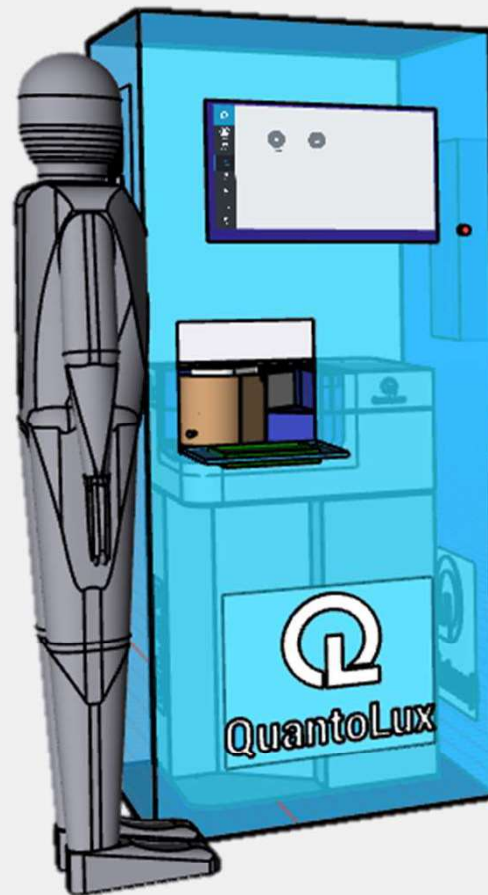
Heavy Duty Option

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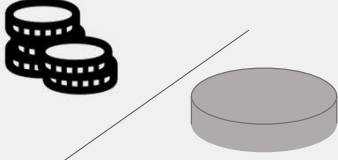

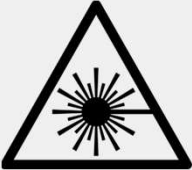
no transport to the lab

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Results within
20 seconds



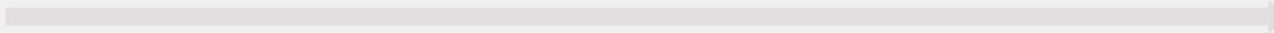
Sample prep. – initial invest & maintenance.

	 initial investment	 maintenance	 cost per analysis
	<p>~ 300 k€ - 1 Mio. € (>150k€ sample prep. equipment + >150€ for x-ray analyser)</p>	<p>~ 15 k€ p.a. (annual service, sample prep. tools, x-ray excitation source, automation, ...)</p>	<p>~ 1 € / analysis (sampling equipment, transport, binder, metal ring, etc.)</p>
	<p>150 k€ - 200 k€ (150k€-180k€ Laser OES system + 12-15k€ crusher)</p>	<p>3,5 k€ p.a. (annual service)</p>	<p>< 1cent / analysis (energy, pressurized air)</p>

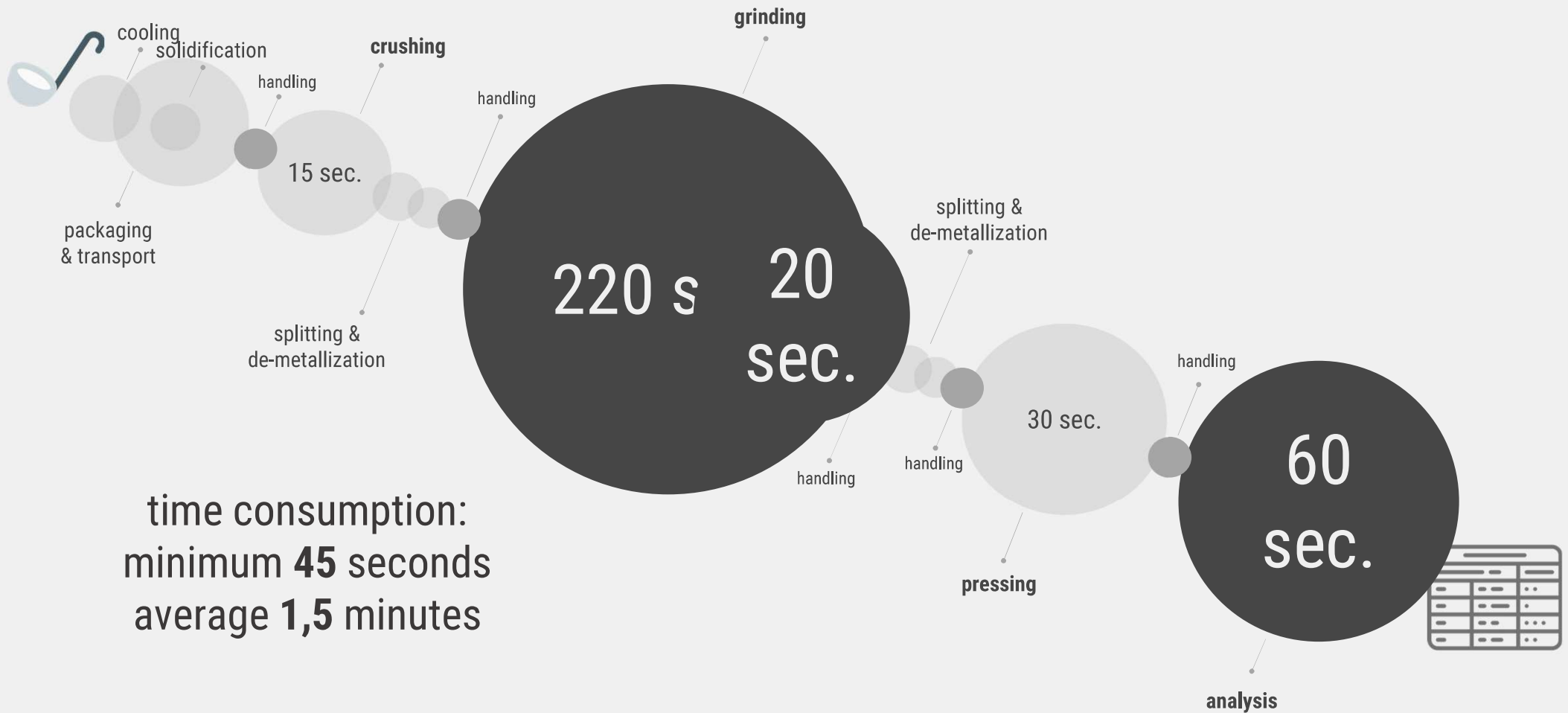
the future
additional value – **precision.**

Source of errors

representative results



slag analysis – simple and fast.





Laser OES = **Why now?**

Why is laser-OES coming only now?

- Laser-OES has been explored since the 1980s. Why did it take so long to come into an instrument?
- Until recently lasers were big and required external cooling. Now they are smaller.
- Early lasers were very powerful. Now we understand that we achieve better results with lesser power. However, we need to meet the optimum excitation potential of required elements.
- Lasers used to be very expensive. Many new applications and use of lasers have dramatically increased recently. This jump in production numbers had a positive effect on the cost. However, a laser source is still approx. 10x higher in cost than a digital spark source. At QuantoLux we decided to reduce our margins to make the technology more competitive and penetrate market faster.
- Up to now, laser-OES and LIBS spectrometers were mainly offered by laser manufacturers. While they benefit from laser



- Laser-OES is the evolutionary next step in OES
- It provides leap-frog advantages over established technologies
- It covers many different analytical applications, metals and non-metals
- For many applications very economic solutions are available
- Due to its multiple value propositions it has quickly gained acceptance
- Return-on-invest is remarkable quick
- Technology addresses economical and ecological aspects
- QuantoLux drives the technology to become the gold standard in inorganic elemental analysis
- **Check out what benefits this technology can bring for your analytical needs!!**



QuantoLux

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Thank you for your attention!

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