SPECTRAL IMAGING IN THE FOOD PROCESSING INDUSTRY

Smart AgriFood Industry Congress
Wednesday, 26th of May, 2021
LLA Instruments
Valentin Regir

LLA Instruments – Who We are

25 YEARS

founded in 1993
in Technology Park Adlershof BERLIN
spin-off German Academy of Sciences
30 employees

Proven High Technology

harsh industrial environments
worldwide installations
1999: 700 KUSTAx.xMPL
2011: 500 KUSTAx.x.MSI
trusted OEM partner

MADE IN GERMANY

In-house

Research & Development
Design & Engineering
Manufacturing
Optics, Electronics, Mechanics
Applications and Software

FOCUS

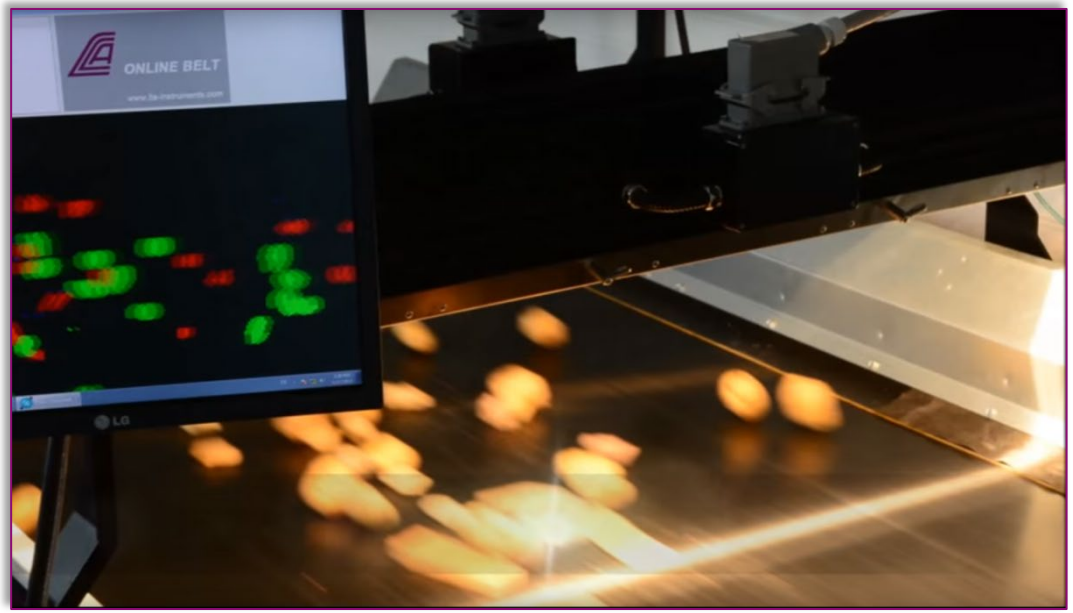
High-speed technology for
real-time analysis and sorting

Developer & manufacturer

NIR & UV-VIS spectrometers
hyperspectral imaging cameras

Advantages of Spectral Imaging Cameras

- ✓ Fast, real time results (online-process up to 800 Hz measurement speed)
- ✓ Cost-efficient due to high throughput and time saving
- ✓ No or very easy sample preparation
- ✓ Non-contact, non-destructive measurements
- ✓ Full material stream can be monitored
- ✓ Low maintenance effort, suitable for 24/7 applications



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- ✓ Non-contact, non-destructive measurements
- ✓ Full material stream can be monitored
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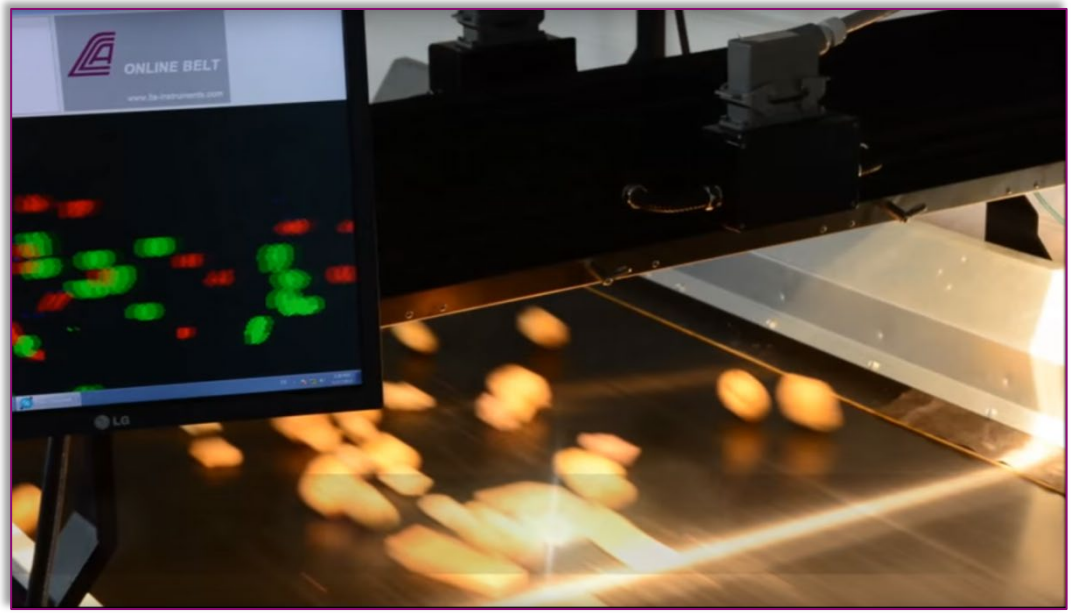
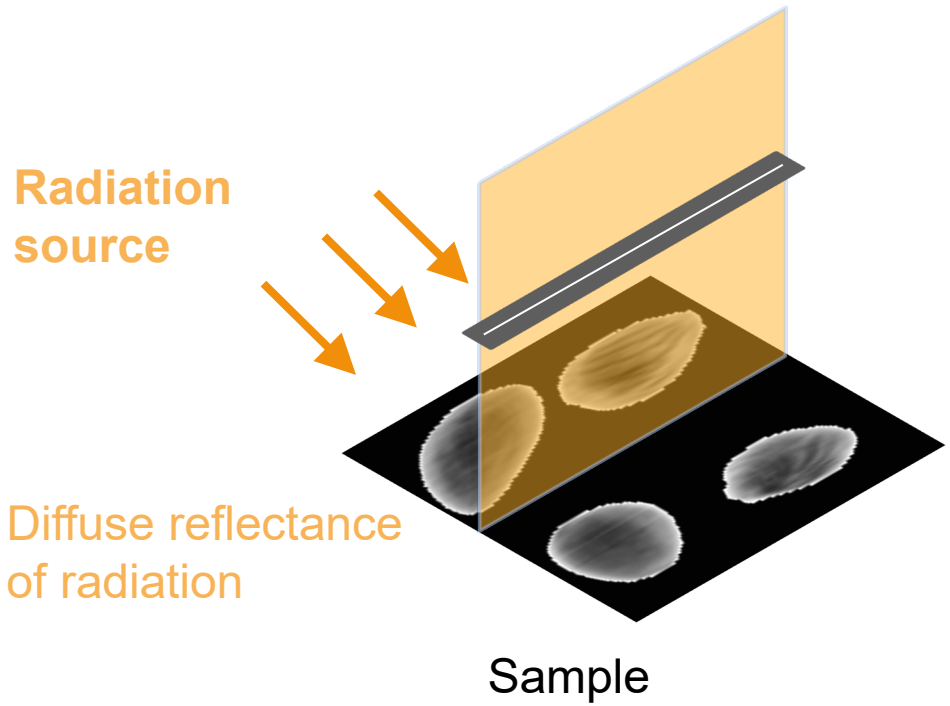
NIR: monitoring of chemical composition

VIS: monitoring of dye-specific colour information



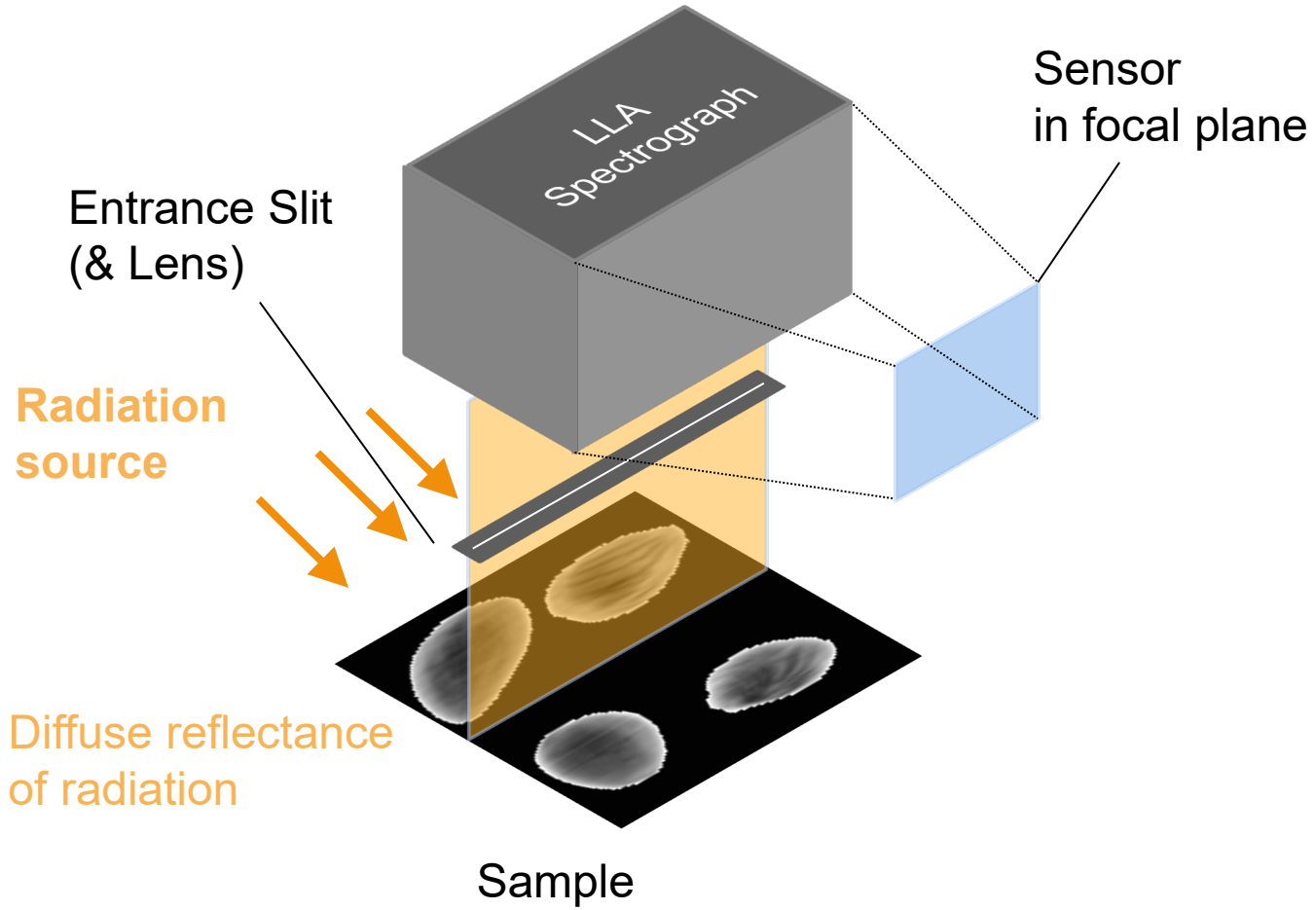
LLA Instruments:
push-broom type of
spectral imaging cameras

Push-broom - How Does it Work?



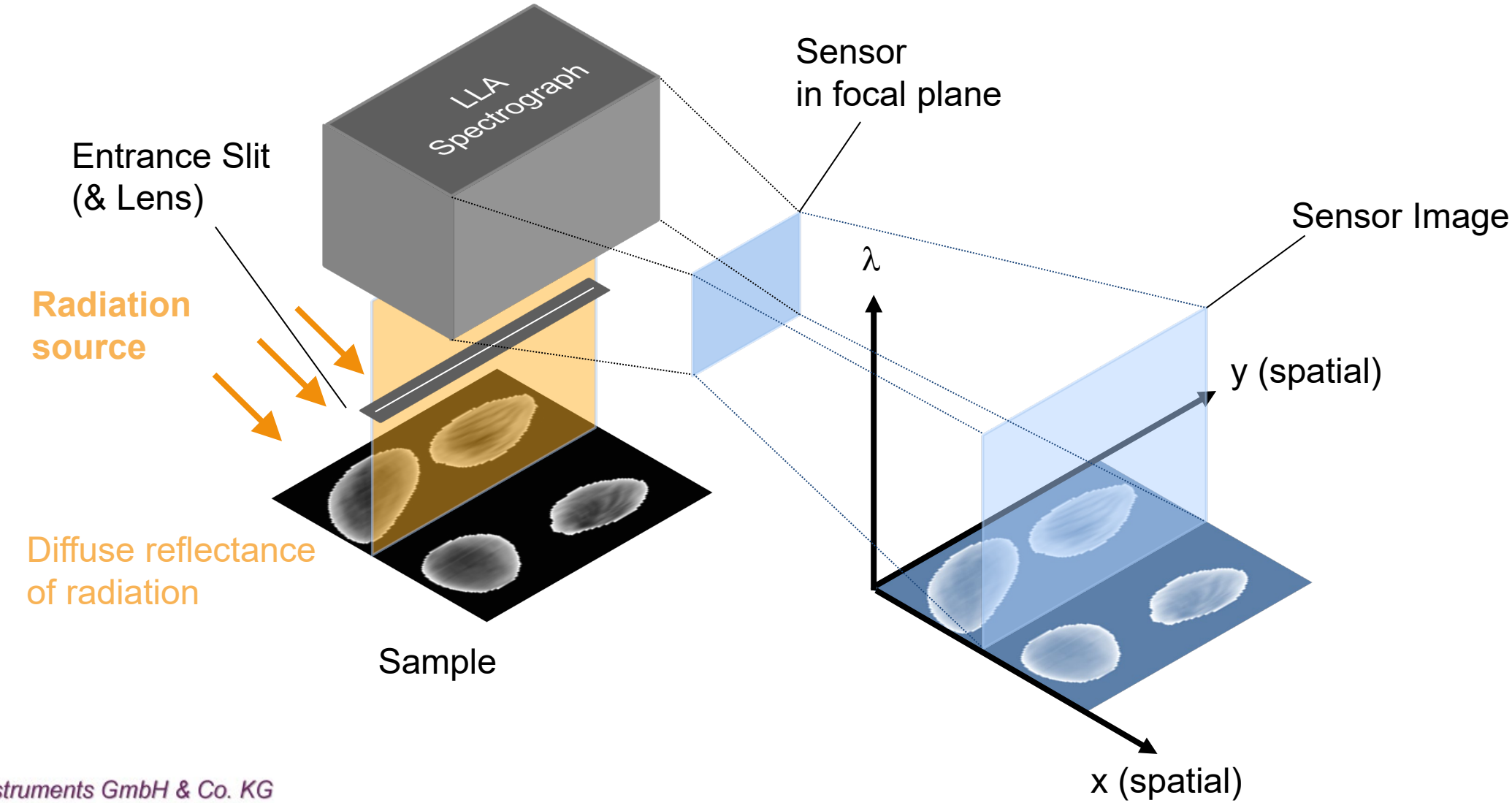
Push-broom - How Does it Work?

Push-broom spectrograph & camera



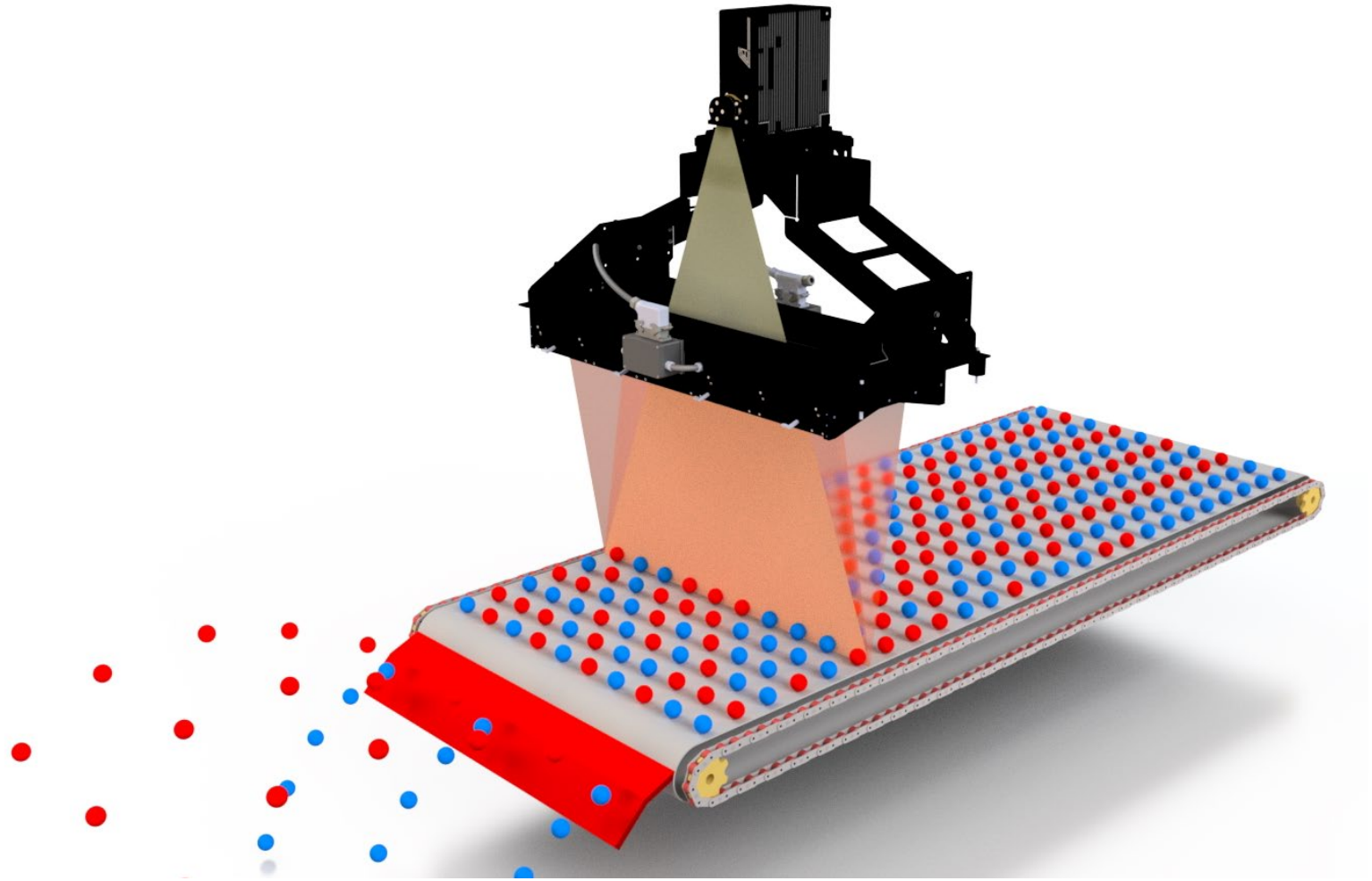
Push-broom - How Does it Work?

Push-broom spectrograph & camera **3-D Spectral Image**



Sorting or Monitoring Setup – Plant Implementation

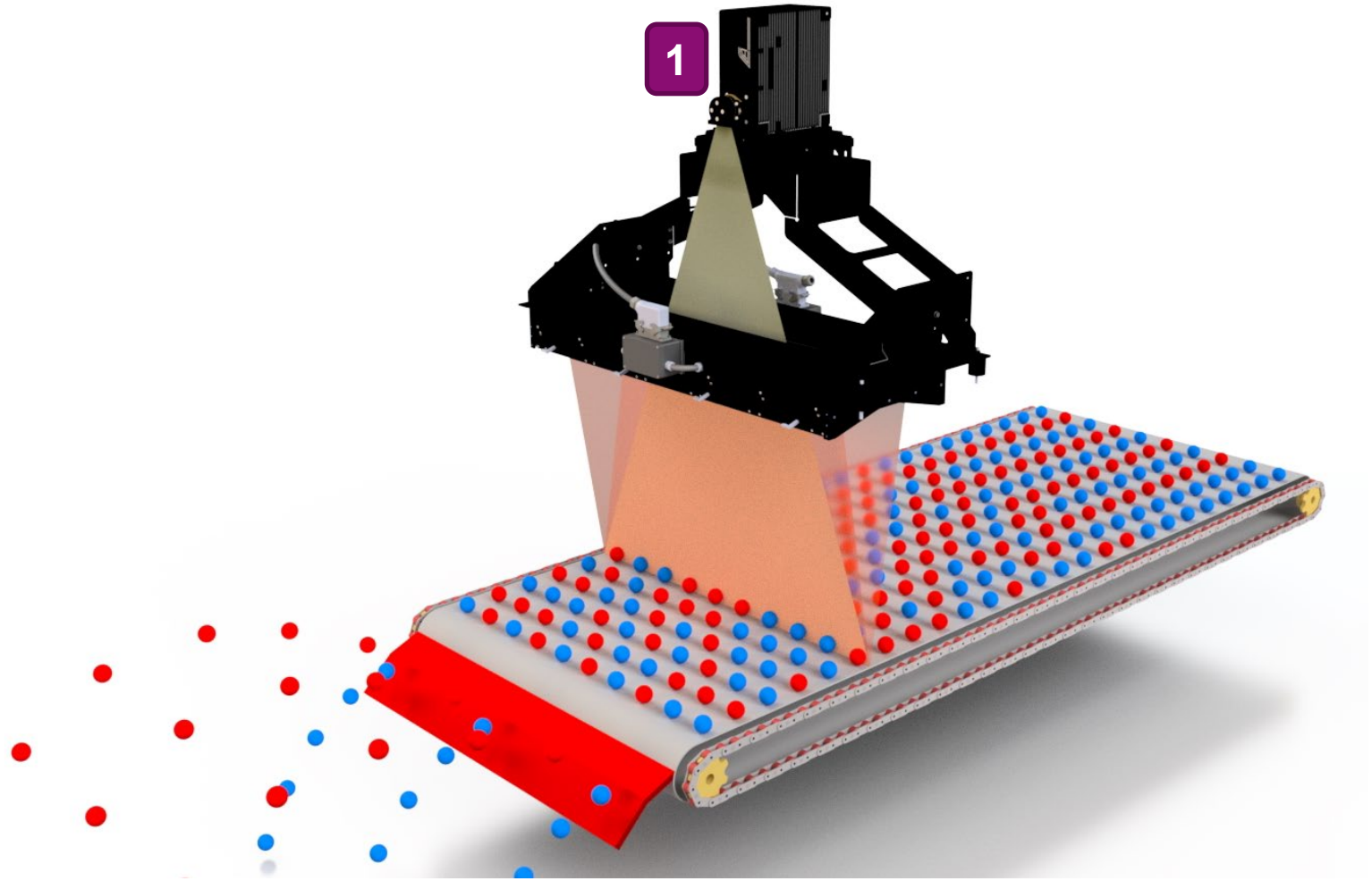
System Setup for Sorting and Monitoring



Sorting or Monitoring Setup – Plant Implementation

System Setup for Sorting and Monitoring

- Spectral Imaging camera 1

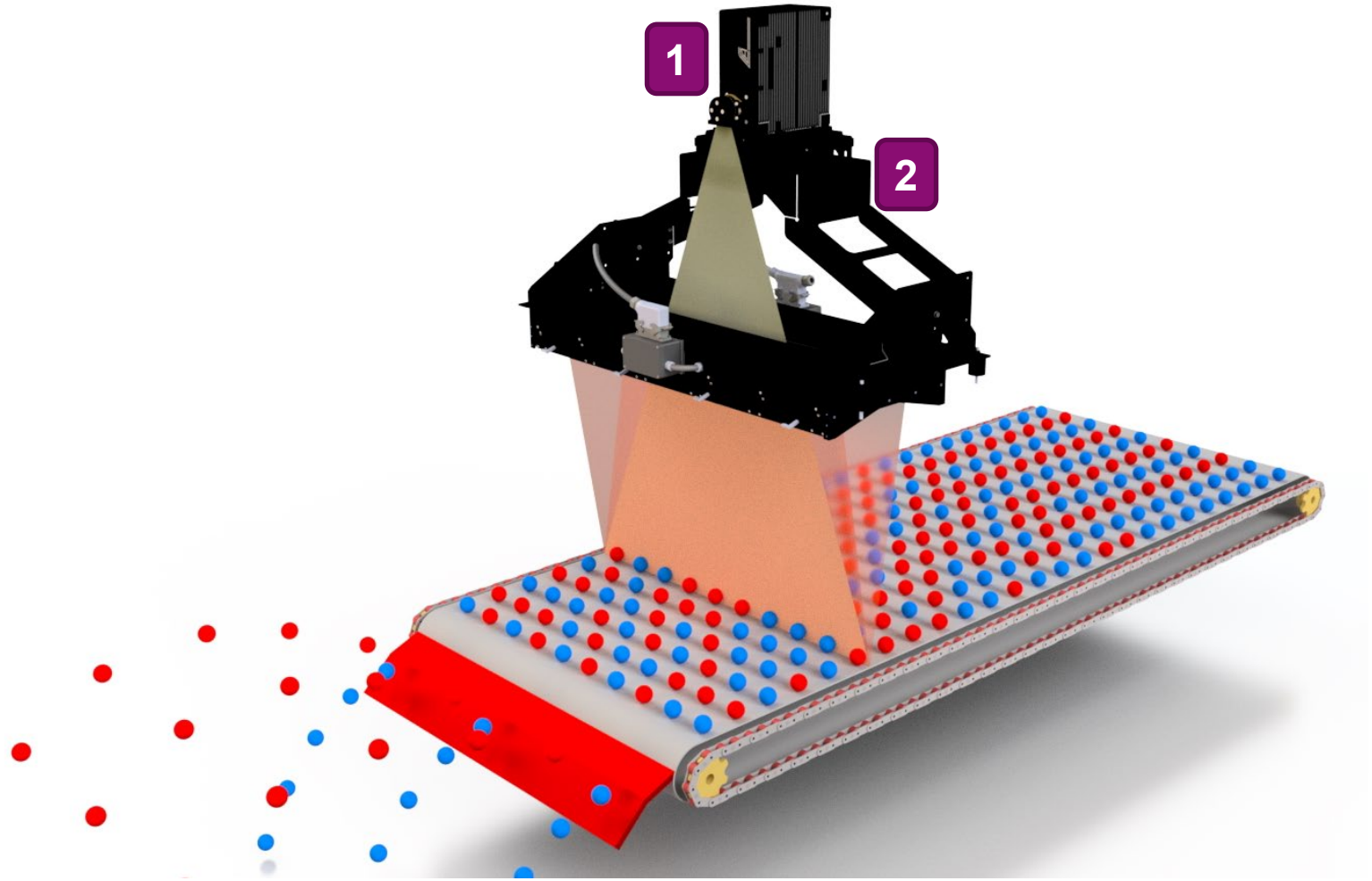


Sorting or Monitoring Setup – Plant Implementation

System Setup for Sorting and Monitoring

- Spectral Imaging camera **1**

- installation platform for camera alignment **2**



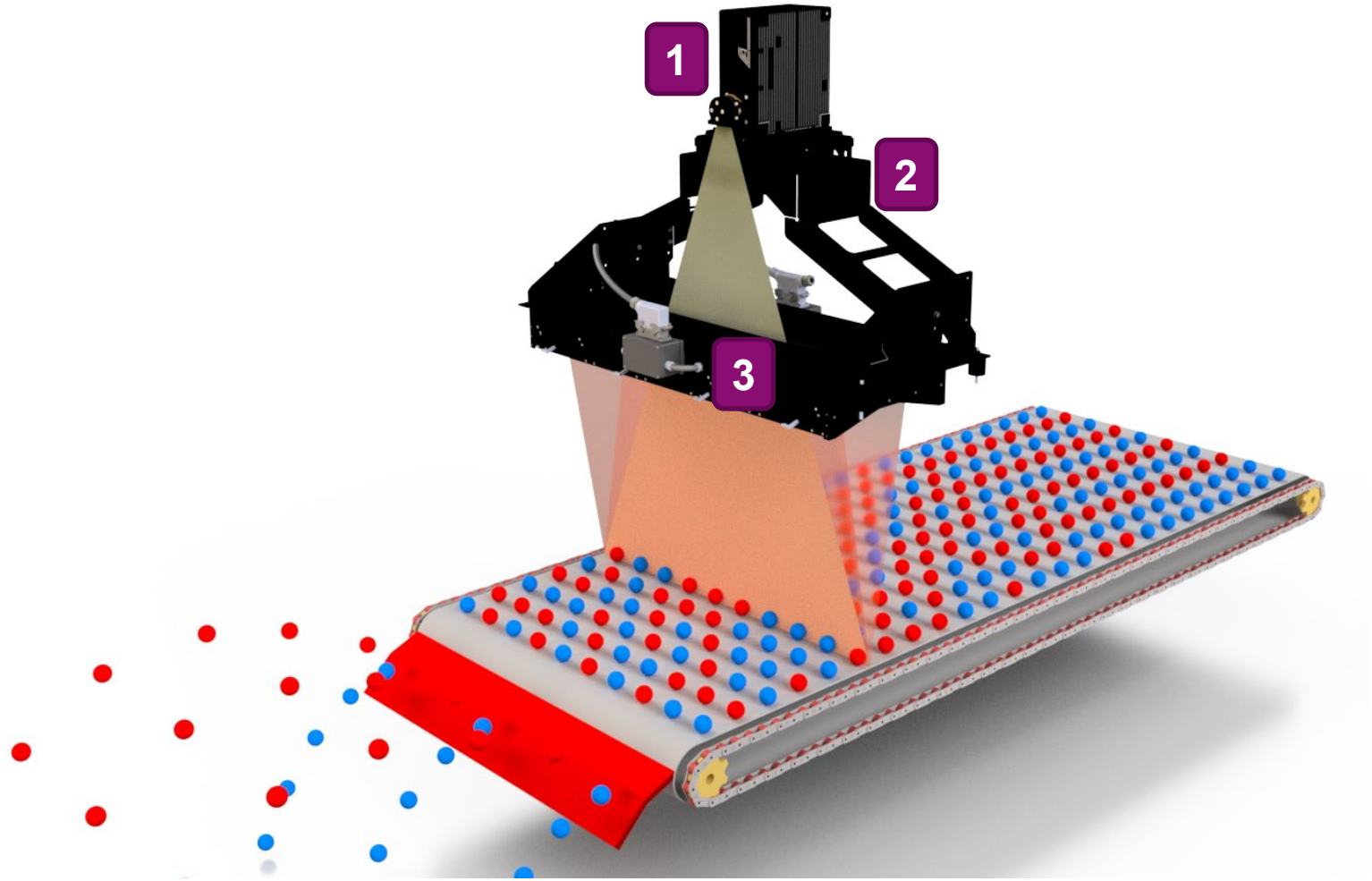
Sorting or Monitoring Setup – Plant Implementation

System Setup for Sorting and Monitoring

- Spectral Imaging camera **1**

- installation platform for camera alignment **2**

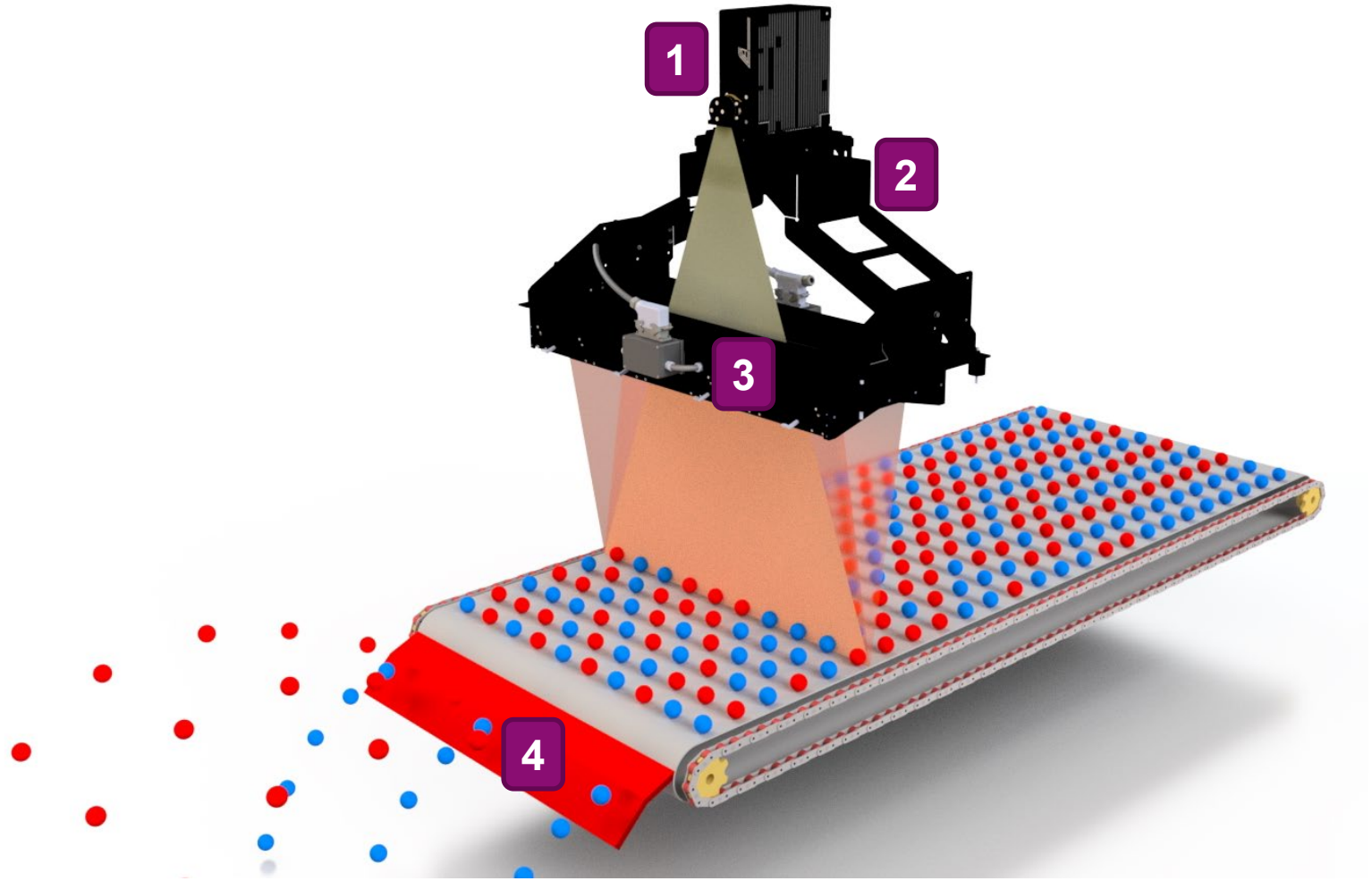
- Illumination unit **3**



Sorting or Monitoring Setup – Plant Implementation

System Setup for Sorting and Monitoring

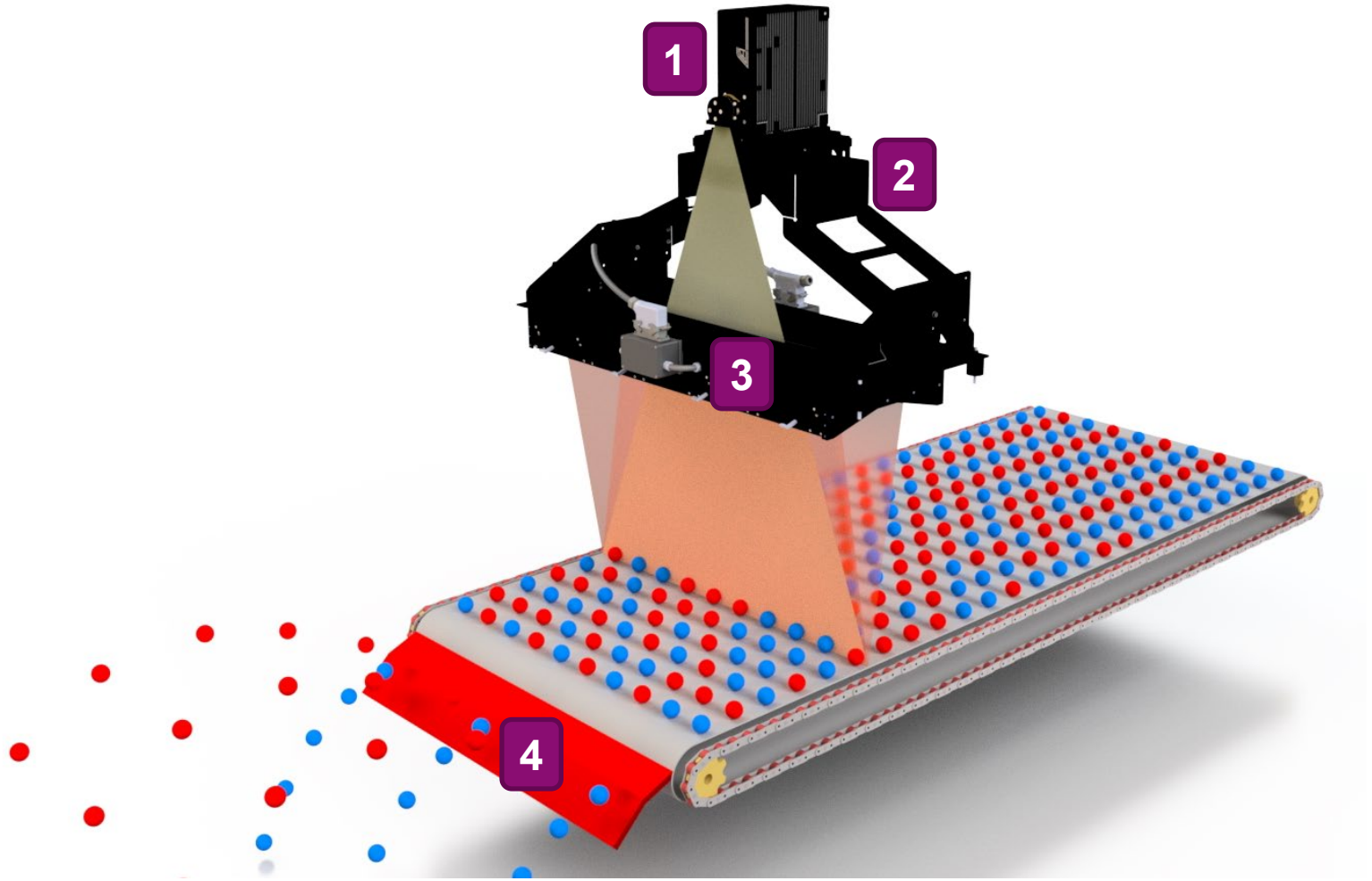
- Spectral Imaging camera 1
- installation platform for camera alignment 2
- Illumination unit 3
- Ejection of reject material 4



Sorting or Monitoring Setup – Plant Implementation

System Setup for Sorting and Monitoring

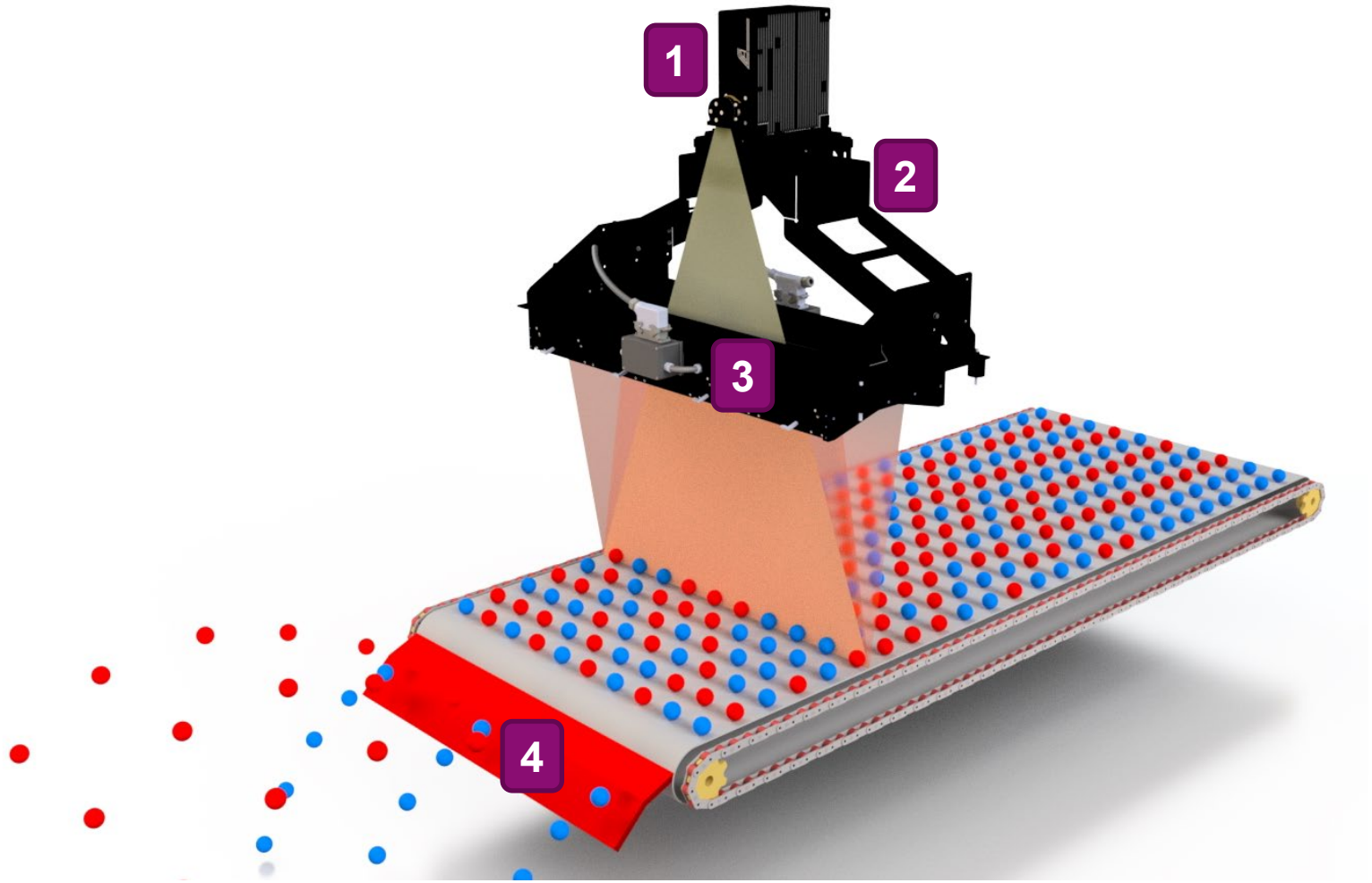
- Spectral Imaging camera 1
- installation platform for camera alignment 2
- Illumination unit 3
- Ejection of reject material 4
- Computer equipped with camera control software and classification model



Sorting or Monitoring Setup – Plant Implementation

System Setup for Sorting and Monitoring

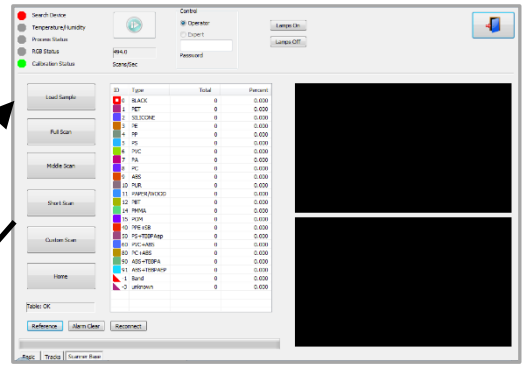
- Spectral Imaging camera 1
- installation platform for camera alignment 2
- Illumination unit 3
- Ejection of reject material 4
- Computer equipped with camera control software and classification model
- Integration in PLC



Software and Calibration Model Development

Control software and calibration model development

Device control software **KustaMSI**

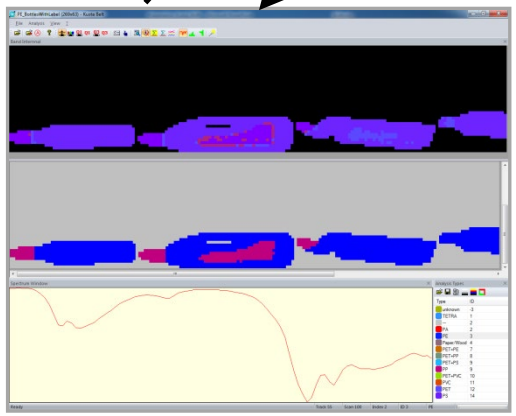


calibration model development

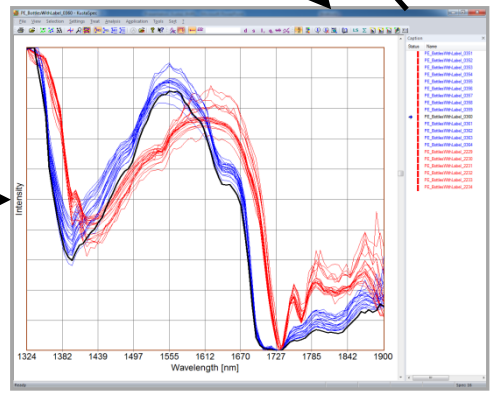
calibration model evaluation

HSI data

HSI data



Spectra or object selection



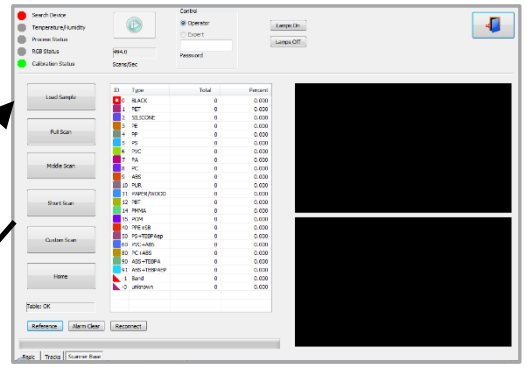
Visualisation of HSI Data
KustaBelt

Spectra evaluation / calibration model development
KustaSpec

Software and Calibration Model Development

Control software and calibration model development

Device control software **KustaMSI**

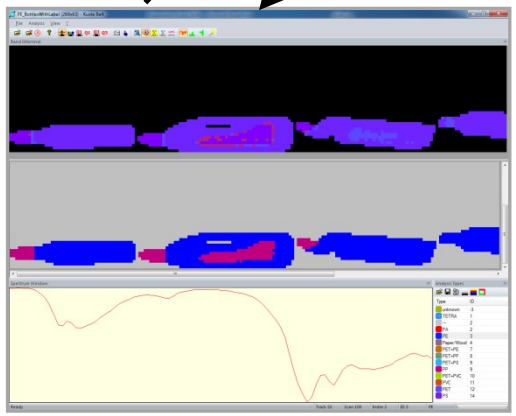


calibration model evaluation

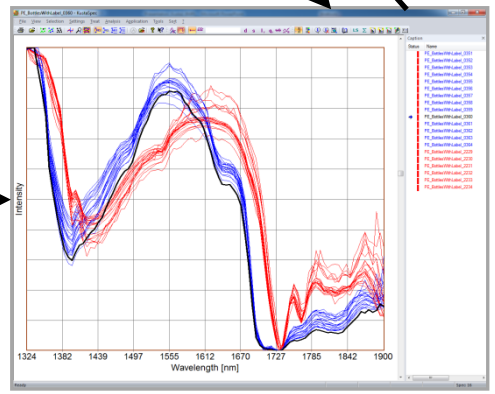
HSI data

calibration model development

HSI data



Spectra or object selection



Visualisation of HSI Data
KustaBelt

Spectra evaluation / calibration model development
KustaSpec

AI model development

GENICAM

LLA Instruments GmbH & Co. KG

Food & Agriculture Applications - Overview

Food Sorting and Monitoring

- Fruits
- Vegetables
- Fish, Meat & Poultry
- Nuts and Seeds

Products

Nutrients

- Fatty acids
- Carbohydrates
- Proteins
- Moisture content

Plant health monitoring

- Evaluation of plant health
- Calculation of vegetation indices

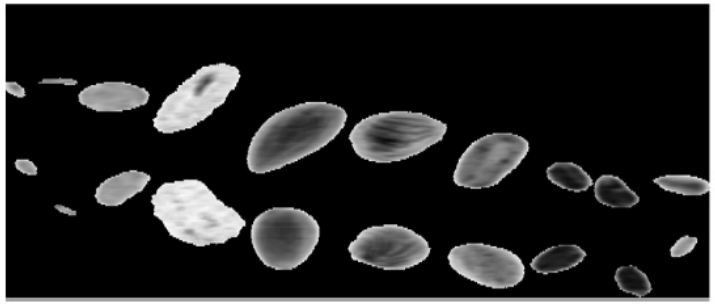
Foreign Body Detection

- Plastics, Wood & Paper
- Insects
- Other Crops
- Bone

Products: Content Verification in Products

Example: Cereals

Greyscale Image



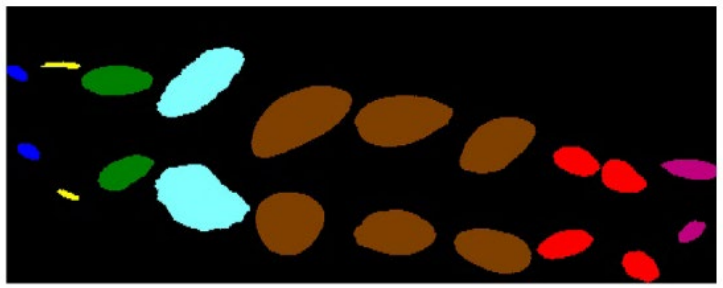
Products: Content Verification in Products

Example: Cereals

Monitoring of cereal batch composition

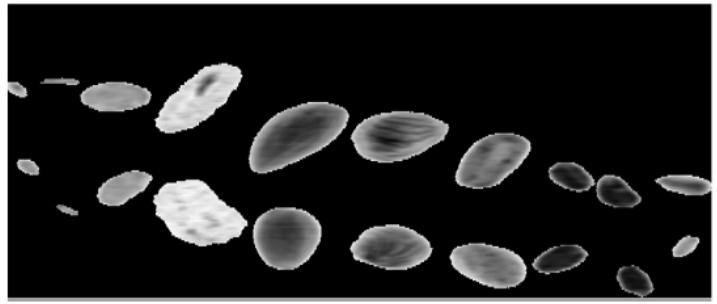
Monitoring of ingredient quality according to nutrient

Classification result
qualitative model



- Cornflakes
- Oatmeal
- Coconut flakes
- Linseeds
- Nuts
- Raisins
- Sunflower seeds

Greyscale Image



Nutrients: Meat Processing

Example: Chicken

Monitoring of meat part composition in chicken breast

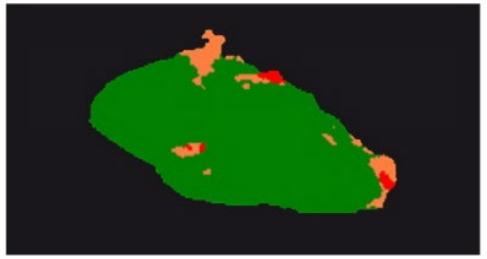
Monitoring of quantitative parameters: fat and moisture

Nutrients: Meat Processing

Example: Chicken

Monitoring of meat part composition in chicken breast

Monitoring of quantitative parameters: fat and moisture



Lean

Bone + Cartilage

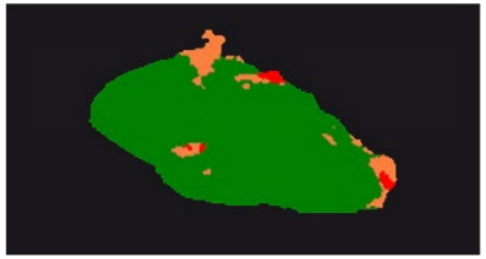
Fat

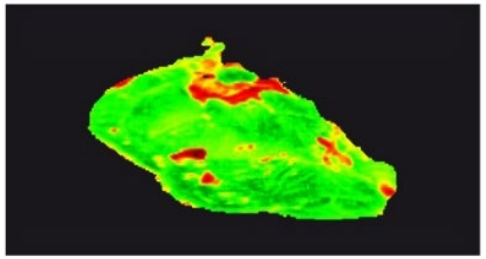
Nutrients: Meat Processing

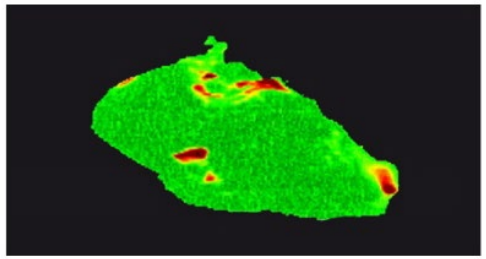
Example: Chicken

Monitoring of meat part composition in chicken breast

Monitoring of quantitative parameters: fat and moisture







Lean

Bone + Cartilage

Fat

Water Content

min. max.

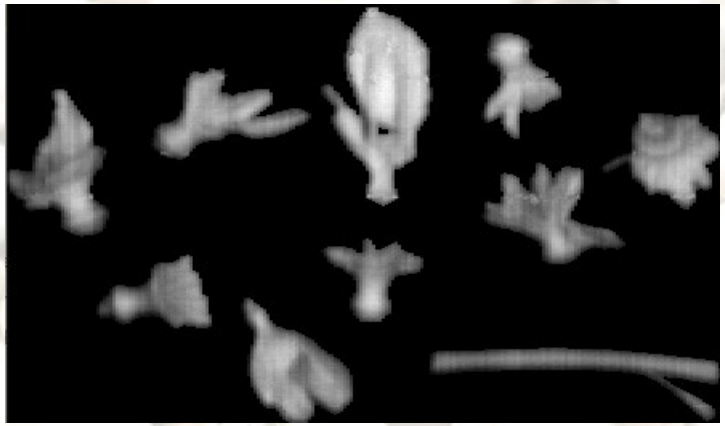
Fat Content

min. max.

FB Detection: Herbs for the Pharmaceutical Industry

Example: Incoming goods inspection

Greyscale Image

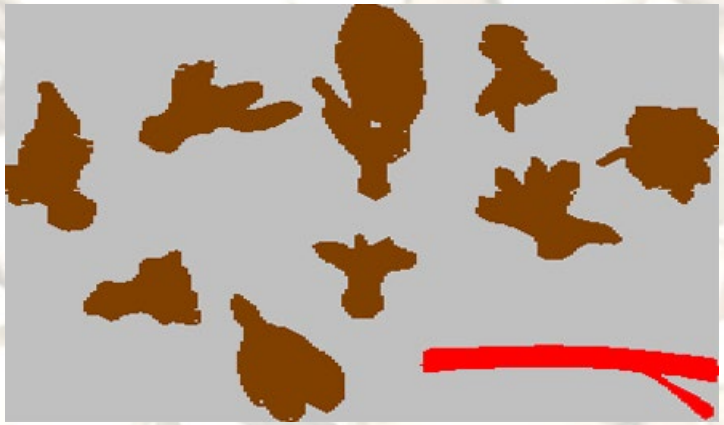


FB Detection: Herbs for the Pharmaceutical Industry

Example: Incoming goods inspection

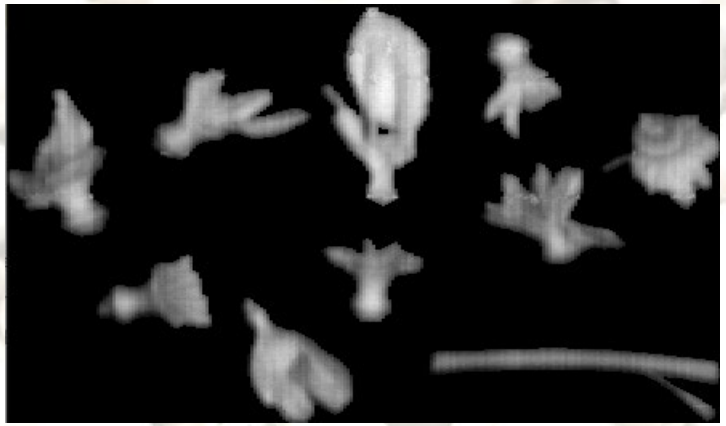
Monitoring of batch composition for seed vessels of herbs

Classification result
qualitative model



Caption: *Seed Vessel* *Stem*

Greyscale Image

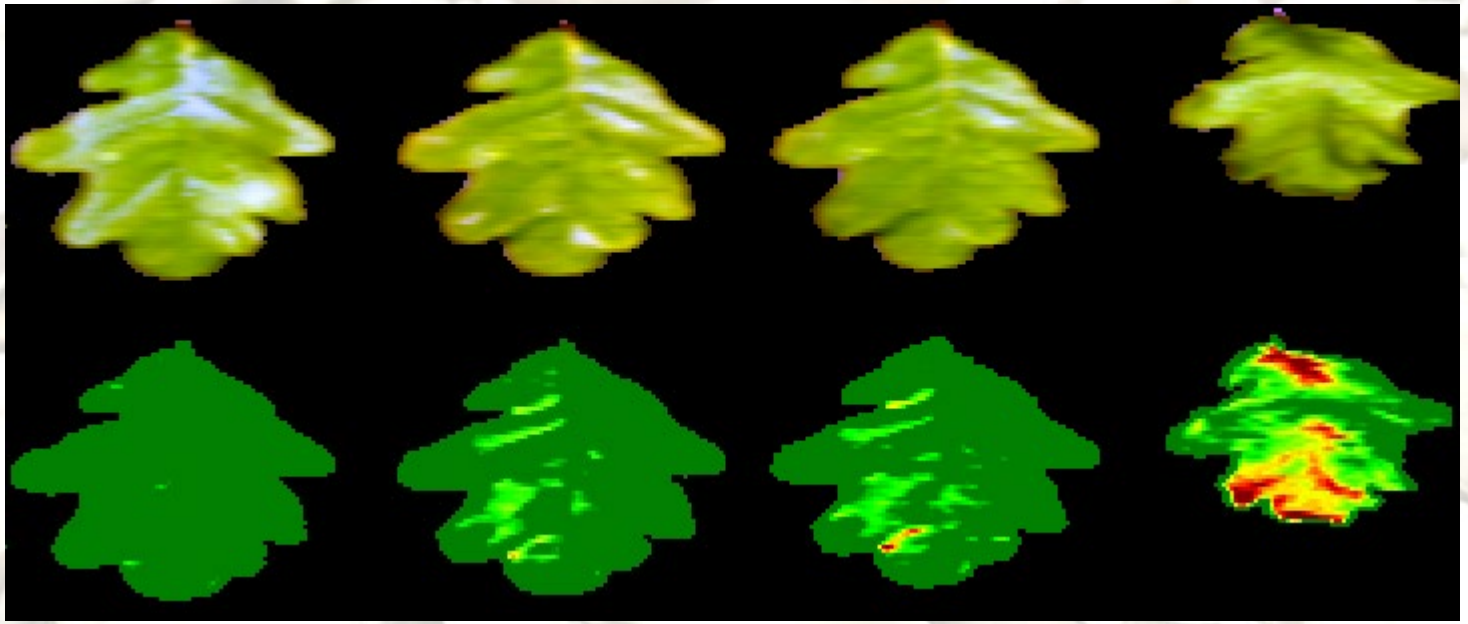


Plant Health Monitoring: Monitoring of Vegetation Indices

Plant Health Monitoring

Visualisation of Vegetation Index for Farming

Example: “Aging” of Leaf



Time t = 0 t = 3 h t = 7 h t = 24 h

RGB values

Simple Ratio (SR) Index

Legend:

2 < SR < 8

SR > 11

Thank You for Your Attention!

More Information at:

www.lla-instruments.com