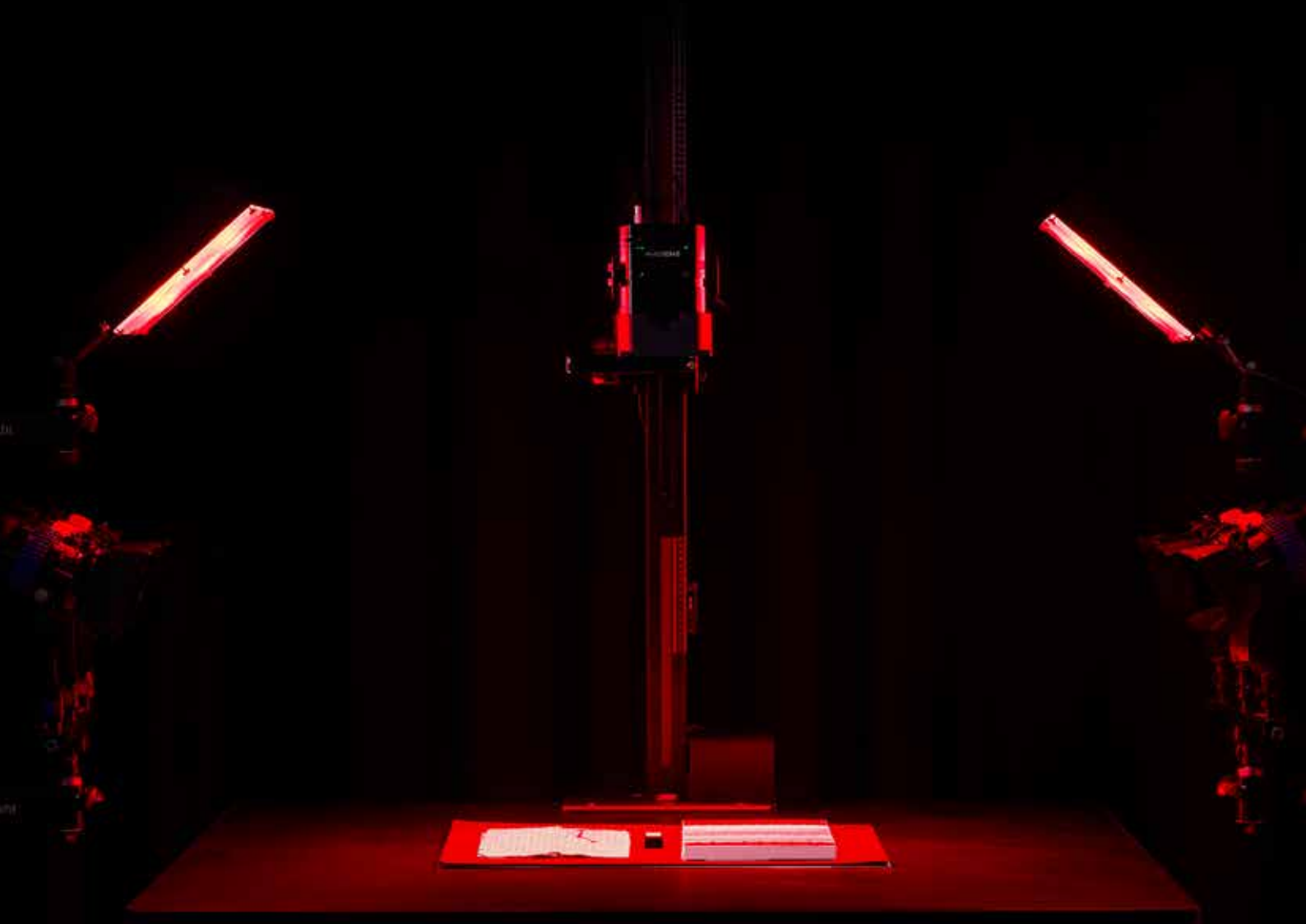


Fully Automated
Phase One Rainbow
Multispectral Imaging Solution



Unveil the invisible

PHASEONE

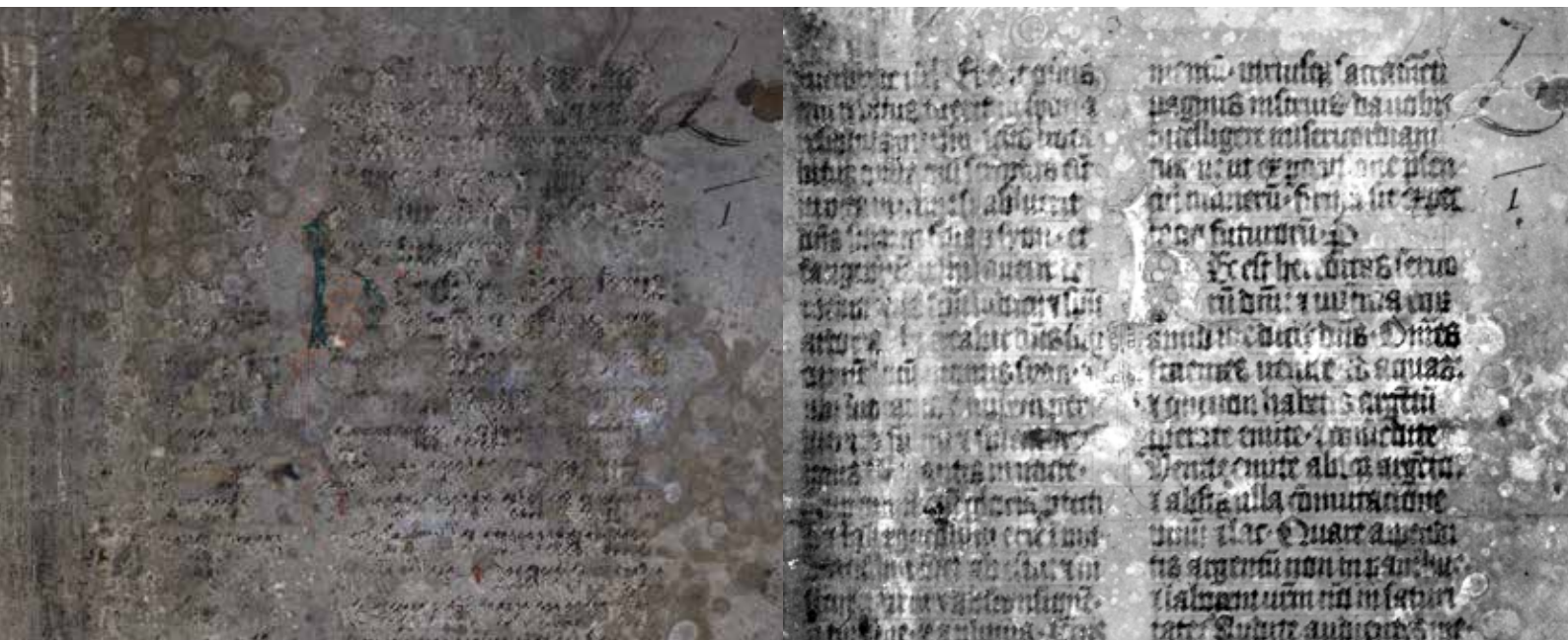
Discovering Multispectral Imaging (MSI)

Multispectral Imaging (MSI) captures light from a range of wavelengths - visible and invisible to the human eye - across the electromagnetic spectrum using special camera technology, light sources and filters.

The "stack" of images produced by the multispectral imaging solution is used to analyze substances and surfaces to determine **readability, authenticity, age and material-characterization and distribution.**

MSI in a wide range of applications:

- Analysis of documents - readability of text on parchment, scrolls, and paper, often in poor condition.
- Analysis of polychrome surfaces such as paintings - on canvas, wood, stone, and other materials. Applications include non-invasive analysis for conservation work and authentication.
- Analysis of fabrics of all kinds - such as historic research to determine age and material.
- Police, forensic and crime scene investigation. Analysis for residue of human fluids on fabric, fingerprints, marks from use of weapons, and crime scene evidence.
- Materials characterization and sorting. Applications include quality assurance, research and development of new materials, and analysis for machine vision.
- General: MSI is used to differentiate subject matter based on the differentiated response from materials with different chemical compositions.

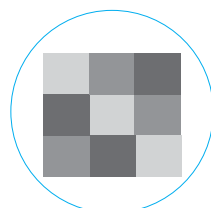


Images credits Aare Vesi / University of Tartu Library

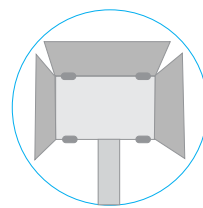
MSI outstanding benefits for analysis



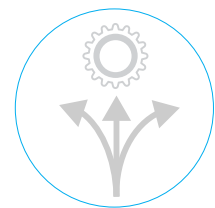
Non-invasive &
Non-destructive
contactless analysis



Quick first step for
further analysis -
Do it once, do it right



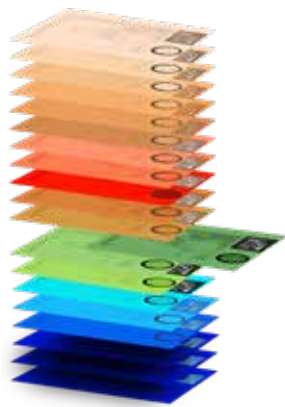
Nondestructive
thanks to low energy
LED lighting



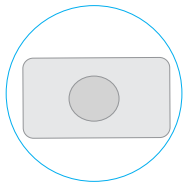
Modular & mobile
capturing solutions

The Phase One Rainbow Multispectral Imaging Solution

Multispectral cameras have been available in the market for many years but the calibration process, as well as the techniques for changing material sizes whilst maintaining consistent images that can be stacked and analyzed efficiently, has been a challenge and created significant overhead. Phase One has worked with specialists on MSI projects over years. Based upon this experience and learning, we have devised a fully automated, and powerful tool for both multiband and narrowband multispectral imaging applications, delivering in-depth insights into materials, pigments and other traces in documents, paintings, and artefacts, without physical contact with the object. Simply press 'Capture'. The full stack of captures are then made with automated focus, automated "flattening", automated exposure normalization, and automated alignment to deliver the Perfect Stack, again and again – with perfect repeatability and stability.



Credits Loa Ludvigsen (SMK) & Annette T. Keller (Phase One)



Rainbow MSI Solution Cameras

The iXH 150MP and iXG 100MP cameras employ high resolution, color accurate CMOS sensors and advanced focusing to deliver sharp, reliable and repeatable results through the entire sweep of the light wavelengths involved.

The Wide Spectrum RGB sensor, tailored for multispectral imaging, can also be used for normal digitization work. Just attach the included IR/UV cut filter using the stepping rings provided to the lens and you are good to go, following Metamorfoze, FADGI and ISO 19264 guidelines. "Do it once, do it right".

The CMOS sensor provides a responsive live-view for quick and safe positioning of subject matter.

To keep out stray light, the camera comes with a custom lens shroud mounted on the filter wheel.

Schneider Kreuznach 72mm and 120mm lenses are available for Phase One Wide Spectrum Cameras, perfectly suited for the wide range of MSI imaging tasks, as well as normal flat copy digitization work.

The RS leaf shutter of the camera guarantees 1 million actuations. Working with the electronic shutter of the camera gives you Infinite durability. The precise focusing mechanism measures distances accurately, and provides for Auto PPI functionality which makes digitization work at different resolutions quick and easy.

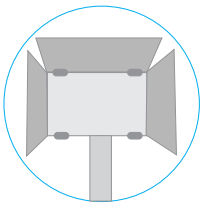


Software

The software controls all the elements – Focusing the camera, moving the filter carousel on the filter wheel, turning the lights on and off in the correct order and timing, aligning the images, and finally creating the Perfect Stack.

The Rainbow MSI Software includes an analysis module that lets you see results instantly, based on Principal Component Analysis, Independent Component Analysis and Clustering (K-Means).

Additionally, a Spectral Readout tool gives an instant overview of the spectral composition at a given point in the image for narrowband stacks, an extremely useful feature for identification and classification of materials used in the subject.

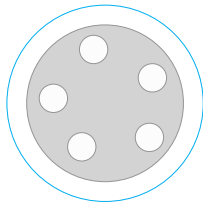


LED Lights

Rainbow supports two types of LED lights for a wide range of applications:

- Multiband lights, delivering narrowband UV, broadband visible light, broadband and narrowband IR. This light is often used for MSI applications related to Art Conservation and to Police Forensics. Recipes for the capture of images following the CHARISMA guidelines are included.
- Narrowband lights, delivering 16 narrowbands of light from UV, through visible to IR.

Narrowband MSI is used for a range of research disciplines, including the analysis of inks, paints, residues, and features in manuscripts, readability of old, damaged or faded documents, objects and artwork.

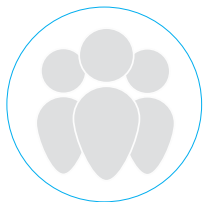


Filter Wheel

The filter wheel can hold up to five filters. It is configured to support the filtering needs of accurate visible imaging and luminescence imaging, which fits many applications, including following the CHARISMA guidelines.

The carousel which holds the filters is removable and can be configured with any 2" filters for future scientific applications. The factory capture settings can be adjusted to suit different filter configurations.

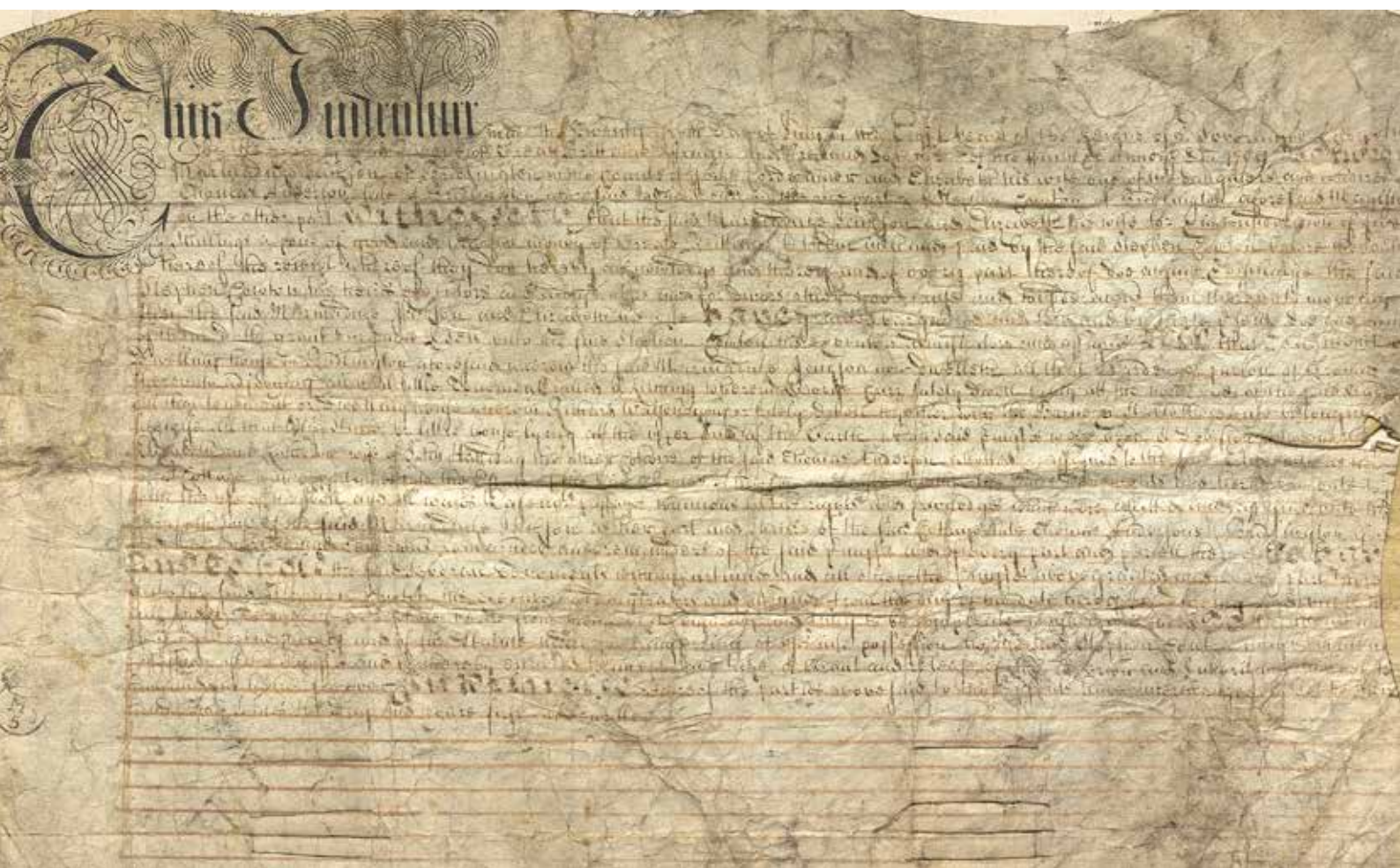
To support different MSI applications, you can simply work with two or more filter carousels.



Phase One Expert Team

The Rainbow MSI solution can be tailored for a wide range of applications. The Phase One Expert Team is ready with customer guidance to configure the best solution for a given application. Advice is backed up with online demonstrations and sample imaging from the Phase One MSI demo center in Cologne, Germany.

For feasibility studies, smaller projects, and operational support, Phase One offers workshops in which specialists can take the customer through the basics of MSI and the capturing of relevant samples, directed at the MSI projects in question.



Multispectral Imaging in Use

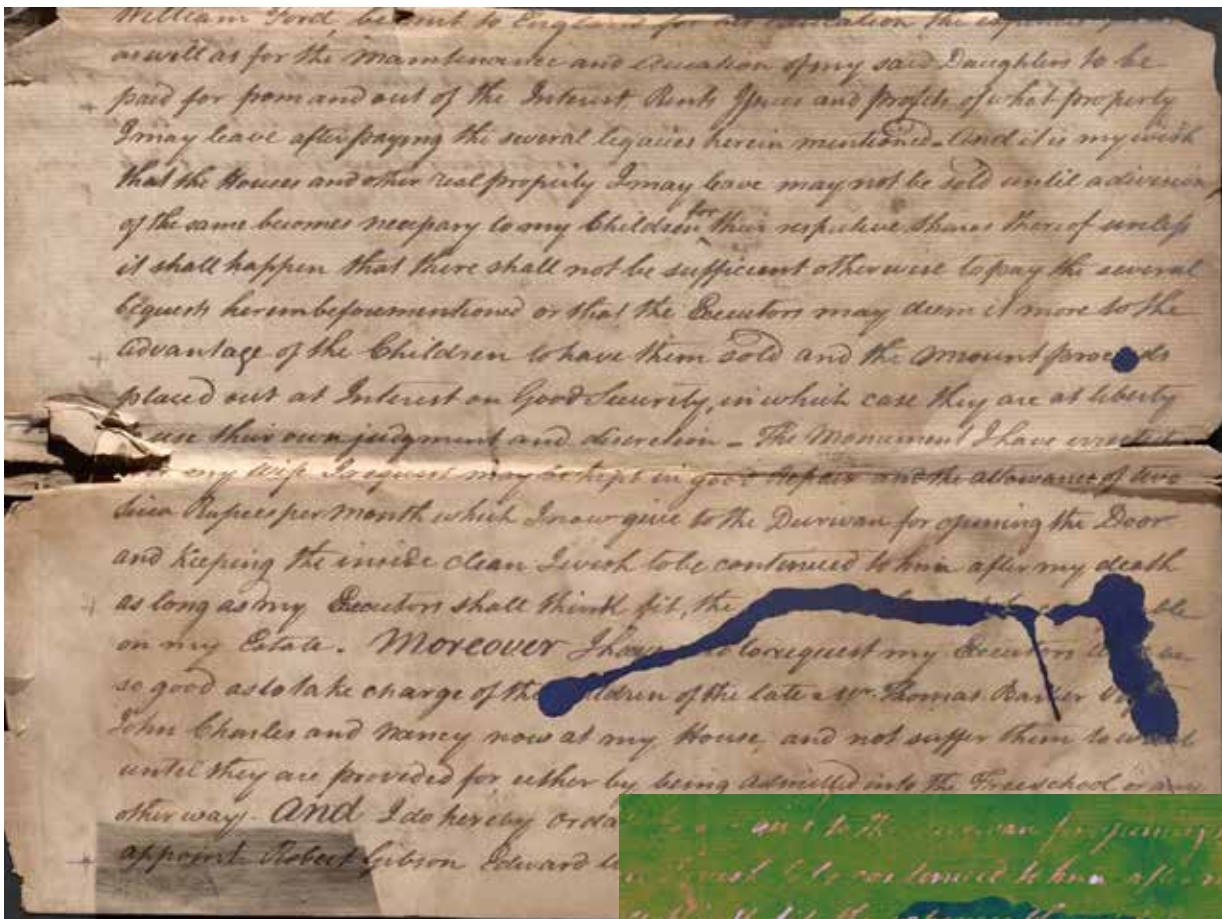
The National Gallery of Denmark

The National Gallery of Denmark owns a painting acquired hundreds of years ago through the Danish Royal Family. The painting has been inspected and analyzed several times to determine its origin and creator, without success. In the fall of 2019, the painting was analyzed again by using wide spectrum photography at a high resolution with a sequence of different lighting, including UV light, visible light in reflectance and photo-induced luminescence, and IR light. The IR image disclosed the painted signature "BRUEGHEL 1562" in the upper right corner. Authentication of a Pieter Bruegel the Older masterpiece was well under way.



Credits Loa Ludvigsen (SMK) & Annette T. Keller (Phase One)





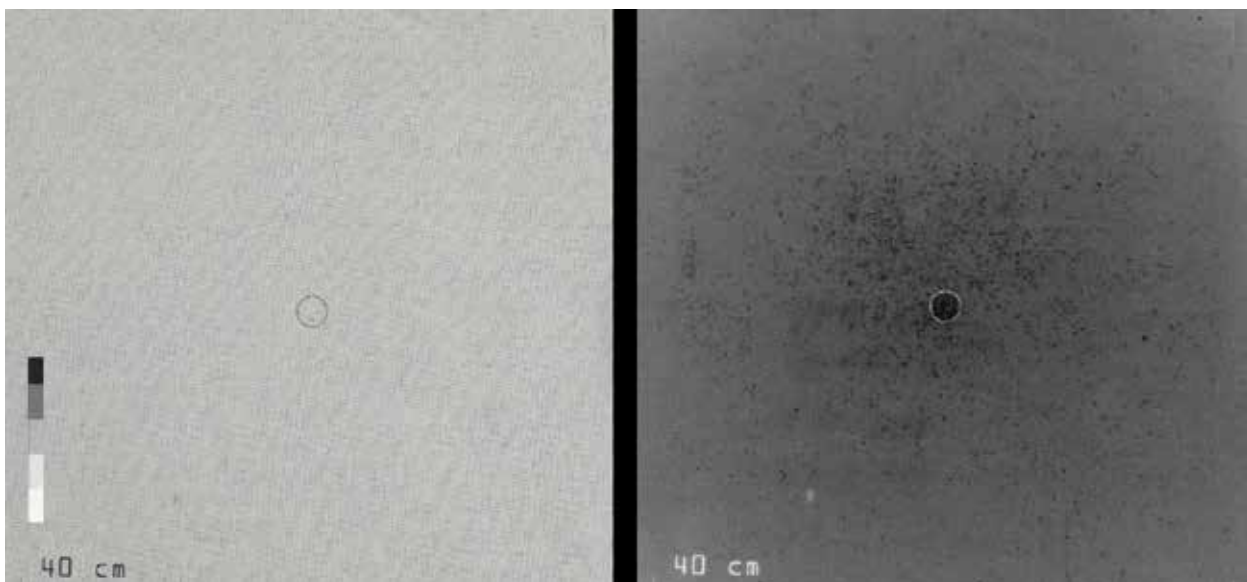
Revealing hidden text

Some of the text in this old document has been obscured. With our narrowband MSI Solution we are able to make all the text visible and legible.



Police and Forensics

Many disciplines of MSI analysis are applied within Police work. Here is an example of gunshot residue - discovered by photo-induced IR luminescence.



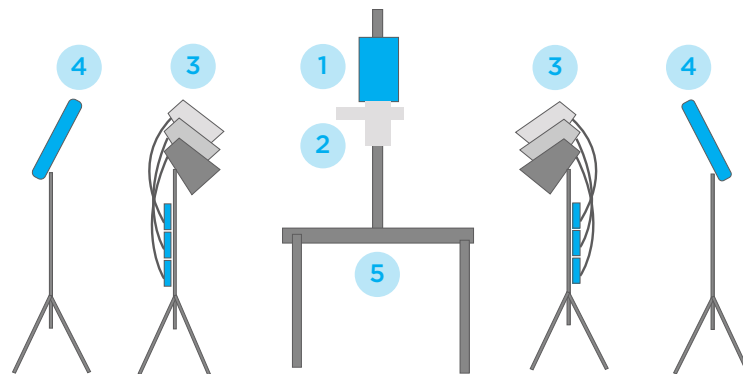
The Rainbow MSI Solution

Camera specification

	iXG 100MP WS	iXH 150MP WS
Sensor size	53.4 x 40.0	53.4 x 40.0
Resolution	11608 x 8708	14204 x 10652
Pixel size (µm)	4.6µm	3.76 µm
ISO Range	50 - 800	50 - 800
Data Interface	USB3	USB-C/ 10G Ethernet
File Formats	Raw 14bit, Raw 16bit	
Lenses	Schneider Kreuznach RS 72mm and/or 120mm	
Weight (gr) with 72mm lens	2,300 inc. L - Bracket	2,500 inc. L - Bracket
Dimension (mm) with 72mm lens	174 x 130 x 130 inc. L - Bracket	177 x 130 x 130 inc. L - Bracket
Approvals	FCC Class A, CE, RoHS	
Operating Temperature (°C)	0 to 40	
Operating Humidity (%)	15 - 80 (non-condensing)	
Accessories	S8612 filter for normal photography with stepping rings for lenses Custom lens shade suited for the supplied filter wheel	

System specification

	Multiband Solution	Narrowband Solution
Included LED lights	2 x UV, inc. UG11 filters (365 nm) 2 x VIS, inc. BG39 filters 2 x IR (860nm & 960nm)	Wavelengths (nm): 365, 385, 410, 420, 450, 480, 510, 530, 550, 600, 630, 640, 660, 740, 850, 940
Configuration	2 banks with UV-, VIS-, IR- emission each	2 panels with 16 LEDs in each
Filter Wheel (5- position)	Included, controlled via USB	
Communication with lights and filter wheel	USB via 7 - port powered hub	
Light stands	Light stand and copystand not included	
Workflow Software	Phase One Rainbow MSI software	
Output	8-image stack, according to Charisma Guidelines	16-image monochrome stack, ready for statistical analysis
Output Luminescence	3 channels	15 channels



1. iXG 100MP or iXH 150MP Wide Spectrum camera incl. magnetic IR/UV cut filter & hood
2. MSI accessory kit incl. Filter wheel, mounting rail, USBU hub and software
3. Multiband/Charisma Dedolights, including filters, power supplies and USB power switches
4. Narrowband Eureka Lights
5. Copystand (desktop/ floor/ wall)

Solution at a Glance

Phase One Rainbow Unique Features

1. Fully automated workflow

We have developed a fully automated workflow for capture and processing of image stacks for both multiband and narrowband multispectral imaging applications. Each captured image is processed on the fly, producing a full set of images according to the CHARISMA guidelines for multiband, or a full set of greyscale images ready for further statistical analysis for narrowband.

2. Visible & luminescence imaging

The Rainbow MSI solution supports both multiband and narrowband imaging applications, providing a single, simple workflow for both techniques.

With multiband, images are captured using UV, white and IR lights and pre-defined filters to capture reflectance and luminescence images.

With narrowband, images are captured under 16 distinct wavebands from UV, through the visible spectrum to near IR.

3. A mobile & multi-purpose solution

With a long track record in the imaging industry, we have put an extensive effort into building our products and solutions with a flexible and modular design. The solution can be used on any sturdy copy stand, a studio stand or heavy duty tripod. You can easily switch between a vertical or horizontal set-up, so subjects can be imaged while remaining wall-hanging for maximum flexibility. With full automation and extreme ease of use, virtually everybody in an institution can produce perfectly sharp, exposed, and aligned image stacks, ready for immediate analysis.

4. Capture more & better data

The Phase One Rainbow Multispectral Imaging Solution includes high resolution cameras with huge dynamic range, ensuring the smallest details and slightest traces are captured noise-free and ready for analysis.

Phase One is renowned for producing the best quality images, and this same philosophy is brought to bear with the Phase One Rainbow Multispectral Imaging Solution, ensuring crisp, detailed images are captured at every wavelength, whether using multiband or narrowband lights.

5. Premium Phase One service & support

With the Phase One service & support, you will be assisted in all steps of getting the solution up and running, from selecting the right components to the installation and usage. Phase One has worked with specialists in multispectral imaging projects for years. Based upon this experience, we have developed a flexible, easy to handle and robust MSI solution centered around a best practice workflow. You also get access to the Rainbow MSI Knowledge Center which connects you with multispectral affiliates, Phase One experts and support specialists in the industry.



Useful Links



The Phase One Expert team is ready with customer guidance. Contact them for any question



artIMAGING, Annette T. Keller

For more information, please visit
www.phaseone.com/cultural-heritage

Follow us on:

Facebook @phaseoneindustrial
LinkedIn company/phase-one-ch
YouTube youtube.com/c/PhaseOneIndustrial

PHASEONE