Phase One Rainbow

Fully Automated 100MP
Multispectral Imaging Solution

*Unveil the invisible*

PHASE**ONE**

Discovering Multispectral Imaging

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 resulting "stacks" of images are 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 is one application.

- 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 upon the differentiated response from materials with different chemical compositions
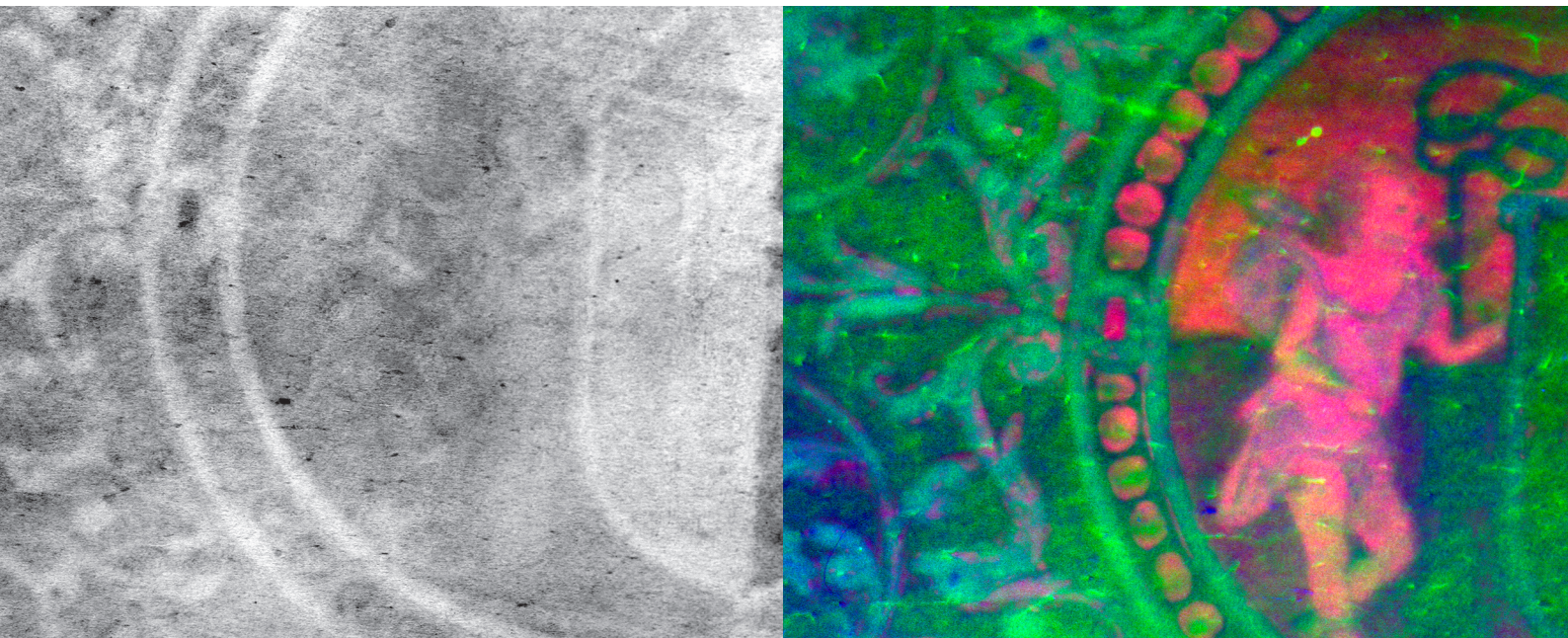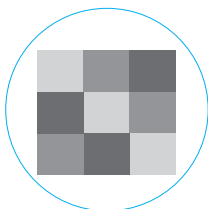

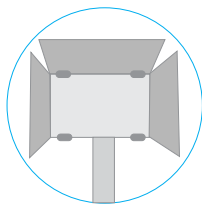Images credits R.B. Toth Associates / Equipoise Imaging

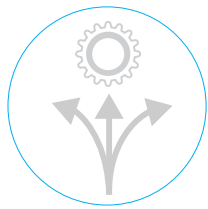## MSI outstanding benefits for analysis

Non-invasive 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 Rainbow Multispectral Imaging Solution

The Rainbow Software

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 flexible and easy to handle, yet robust MSI solution with a workflow based on best practices.

The Rainbow capture process is fully automated: simply position the subject matter and 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.

The Rainbow MSI 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.
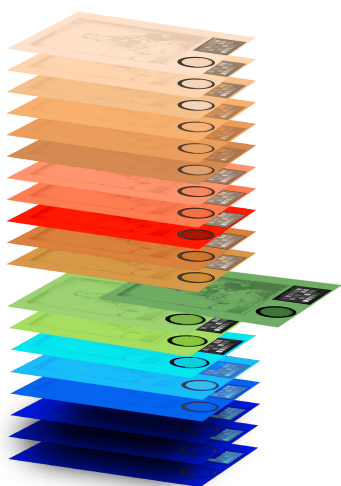
Credits Loa Ludvigsen (SMK) & Annette T. Keller (Phase One)
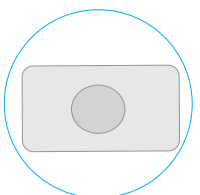
The Rainbow Camera

The iXG 100MP Wide Spectrum camera employs a high-resolution color accurate CMOS sensor 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 multi spectral work, with the added benefit of being able to also do normal digitization work "Do it once, do it right". Just attach the included IR/UV-cut filter to the magnetic holder of the lens, and you are good to go, following Metamorfoze, FADGI and ISO color standards.

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 shade tube mounted on the filter wheel.

The iXG 100MP Wide Spectrum camera comes with 72mm and a 120mm lenses and extension tubes, all suited for the wide range of MSI imaging tasks, as well as normal flat copy digitization work.

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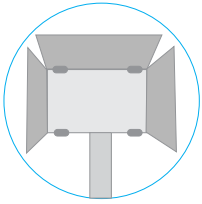
The Rainbow LED Lights

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

• Multiband DedoLight, 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 standard manual are included.

• Narrowband EurekaLight, delivers 16 narrowbands of light from UV, through visible to IR. This light is often used for MSI applications related to Document Readability.
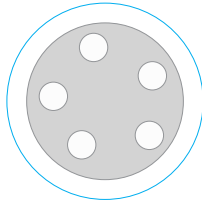
The Rainbow Filter Wheel

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 the CHARISMA standard manual.

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.
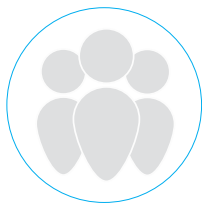
Phase One Expert Team

The Rainbow MSI solution can be tailored for a wide range of applications. The Phase One MSI 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.
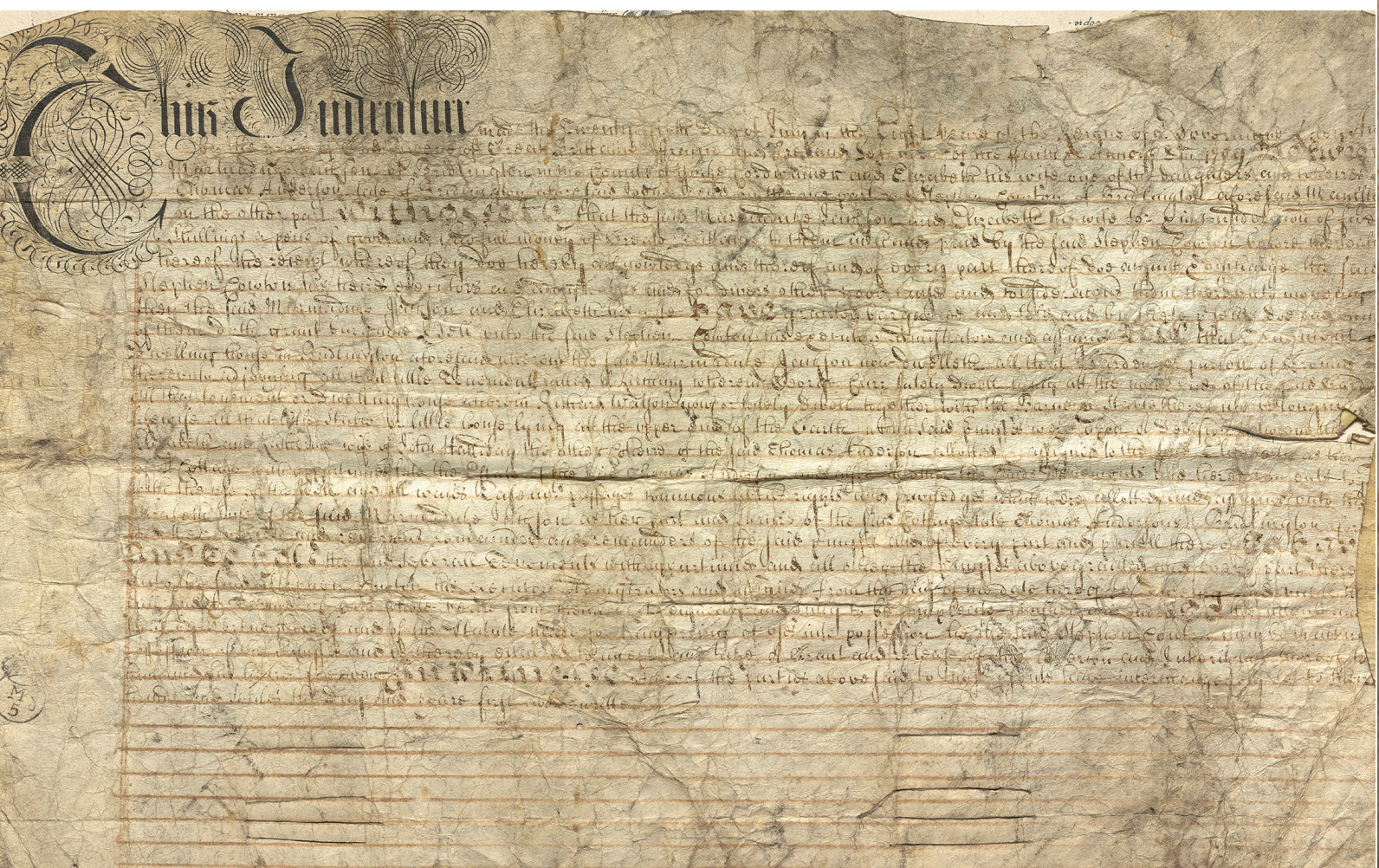
Multispectral Imaging in Use

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)
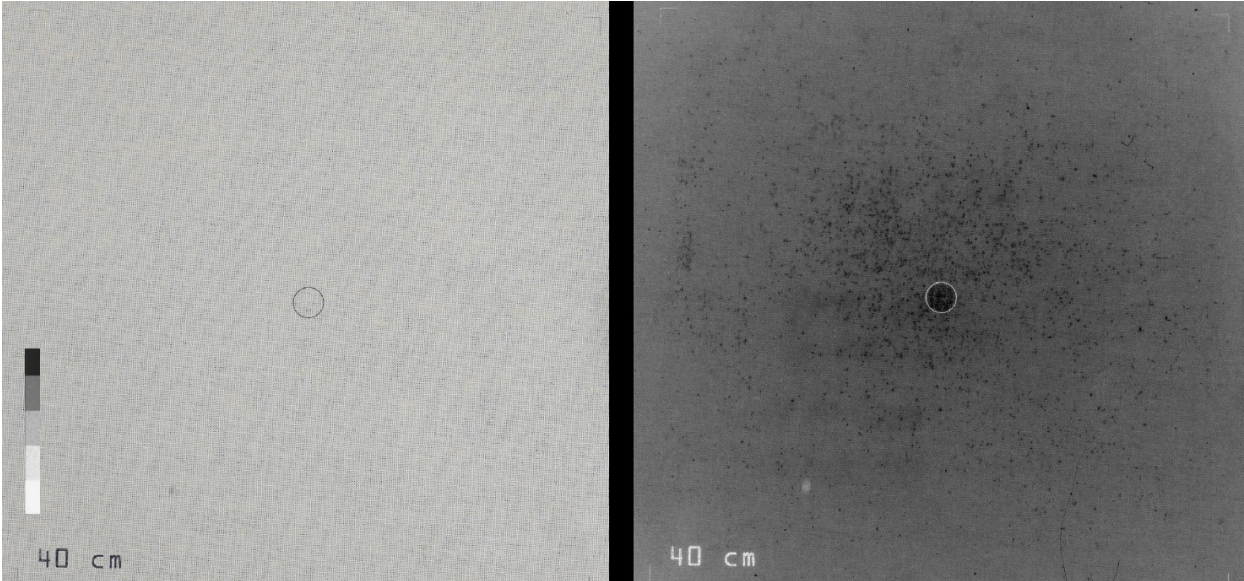
The Royal Library of Denmark

The Royal Library of Denmark holds collections of handwritten letters and records from the former Danish colonies in Tranquebar, India (1620-1845) and St. Croix, the West Indies (1672-1917). Many of these documents are faded and decayed by age, by moisture and from bugs. In 2017 samples from the collections were captured using Multi Spectral Imaging and the results included the recovery of readability and the appearance of watermarks in the paper.

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

	iXG 100MP Wide Spectrum
Sensor size	53.4 x 40.0
Resolution	11608 x 8708
Pixel size (μm)	4.6μm
ISO Range	50 - 6400
Data Interface	USB3
File Formats	Raw 14bit, Raw 16bit
Lenses	Schneider Kreuznach RS 72mm and/ or 120mm
Weight (gr) with 72mm lens	2,300 inc. L - Bracket
Dimension (mm) with 72mm lens	150 x 130 x 130 inc. L - Bracket
Approvals	FCC Class A, CE, RoHS
Operating Temperature (°C)	-10 to 40
Operating Humidity (%)	15 - 80 (non-condensing)
Accessories	BG39 filter for normal photography, with magnetic adaptors. 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 μm) 2 x VIS, inc. BG39 filters 2 x IR (860μm & 960μm)	Wavelengths (μm): 365, 385, 410, 420, 450, 480, 510, 530, 550, 600, 630, 640, 660, 740, 850, 940
Configuration	2 banks of 3 lights 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	Not included	
Included Capture Computer	DELL Mobile Precision 7740 CTO BASE, 17.3", i9 processor, 64GB RAM, 1TB SSD, Windows 10 OS	
Workflow Software	Phase One Rainbow MSI software	
Output	8-image stack, according to Charisma Guidelines	16-image monochrome stack, ready for statistical analysis

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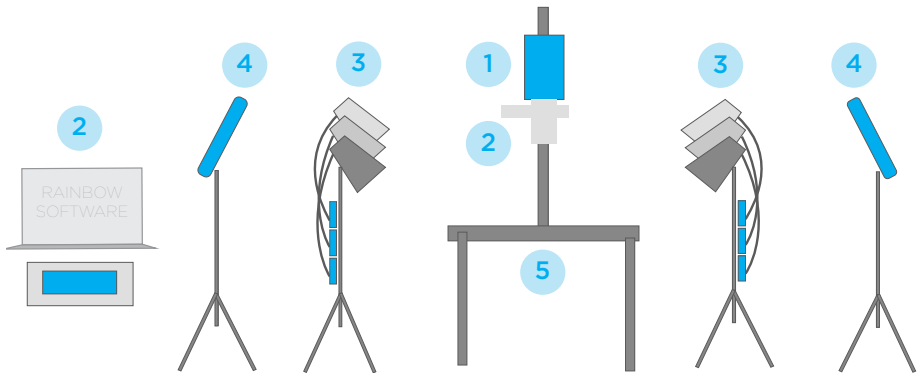
1. iXG 100MP Wide Spectrum camera inc. magnetic IR/UV cut filter & hood
2. MSI accessory kit inc. Filter wheel, mounting rail, USB hub, PC and software
3. Multiband/ Charisma Dedolights, including filters, power supplies and USB power switches*
4. Narrowband Eureka Lights*
5. Copystand (desktop/ floor/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

*Light stand and copystand not included

Phase One Rainbow Unique Features

1. **Flexible and Mobile Capturing Solutions** with iXG 100MP Wide Spectrum camera system, filter wheel, and flexible lighting options of Multiband DedoLight for visual analysis (CHARISMA method) and Narrowband EurekaLight for statistical analysis.

2. **Fully automated high-resolution** capture workflow, including all relevant calibration stages and the full capture Stack.

3. **One button repeatable, accurate and simple workflow with Phase One Rainbow Software** which delivers the **Perfect Stack** of normalized images according to the chosen lighting method (Multiband or Narrowband).

4. Designed for **Multispectral as well as for High volume standard digitization.** Easy switch by use of a magnetic IR filter holder placed on the lens.

5. **Ultimate Image quality** throughout the spectrum, **from UV (365 nm), through visible, into IR (ca. 1050 nm)**, with:

   • **iXG Wide Spectrum camera, 100Mpixel, high dynamic range CMOS-sensor**

   • **72mm and 120mm iXG lens** line with extension tubes

   • **One million guaranteed actuations** with Phase One Reliance shutter, and option for infinite Electronic Shutter actuations

6. **Responsive Live View** for fast and accurate positioning of the subject-matter

7. **Phase One MSI Knowledge Center** provides Network of Multispectral affiliates, Phase One experts and support specialists to bring best practice to any potential customer or project

Useful Links

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

The CHARISMA standard manual made by British Museum in collaboration with EU partners

artIMAGING, Annette T. Keller

RB Toth Associates, Mike Toth and Bill Christens-Barry

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