

Data

Structure

Scans

Cells 17

Counters

Files

Cell Gallery

Cell List

Combined Karyogram

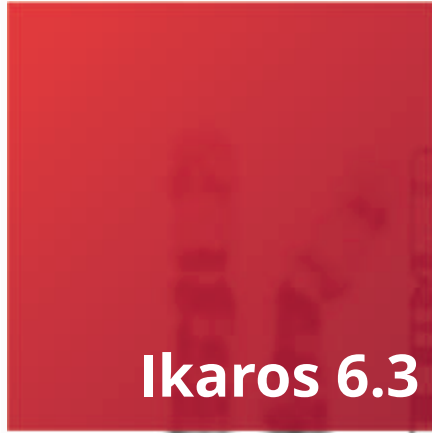


Whole Case ▾



- ▾

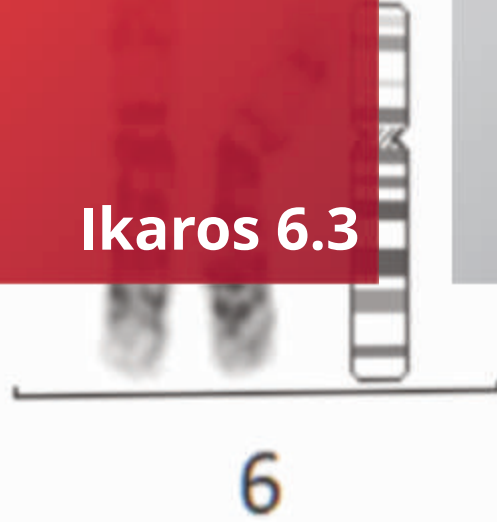
↕ ↓ Cel



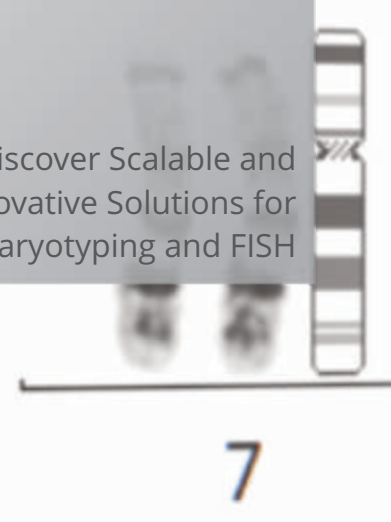
Ikaros 6.3



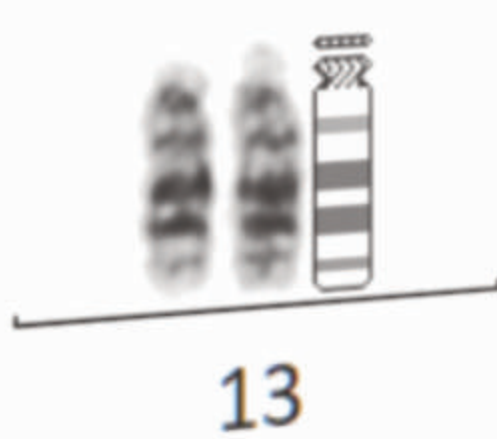
Discover Scalable and Innovative Solutions for Karyotyping and FISH



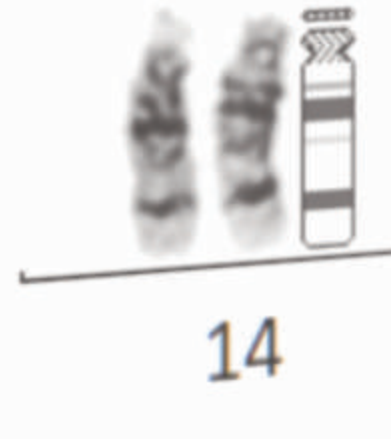
6



7



13



14

# IKAROS



# INNOVA

## INTELLIGENT WORKFLOW

### AI and Karyotyping

Chromosome analysis is a routine method of cytogenetics and has been considered the "gold standard" in genetic diagnostics for decades. Until today, the generation of a karyogram has remained a highly interactive procedure.

Mesmerizing developments in the field of Artificial Intelligence (AI) have opened up entirely new horizons for image analysis in recent years. In the latest versions of Ikaros, MetaSystems has implemented algorithms based on Deep Neural Networks (DNNs). DNNs use self-learning algorithms for pattern recognition in images.

The new Ikaros supports automatic separation of chromosomes and overlaps, as well as intelligent assignment of chromosomes to karyogram classes. Ikaros is able to generate karyogram proposals with an unprecedented high probability of accurate chromosome assignment, thus, simplifying the task for the reviewing expert.



*Our lab had the opportunity to be the first user to test the beta-version of MetaSystems' new AI-based karyotyping software Ikaros. We experienced a time gain of up to 50% in the karyotype analysis of bone marrow metaphases. This enormous gain in efficiency allows us to keep pace with the ever-increasing workload in times of shortage of personnel resources.*

**Prof. Dr. Claudia Haferlach**

MD from MLL (Münchner Leukämielabor GmbH, Germany)  
[www.mll.com](http://www.mll.com)

# IKAROS



# ATION



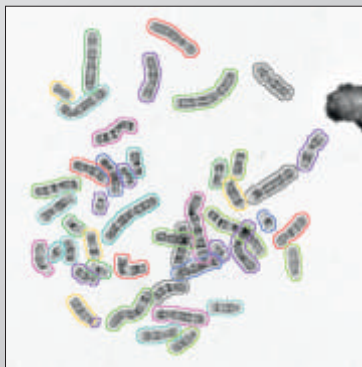
## METAPHASE FINDING

- 1** The scanning software Metafer\* manages the automatic acquisition of the best metaphases as raw digital images.
- 2** Ikaros prepares all new images for intelligent karyotyping.



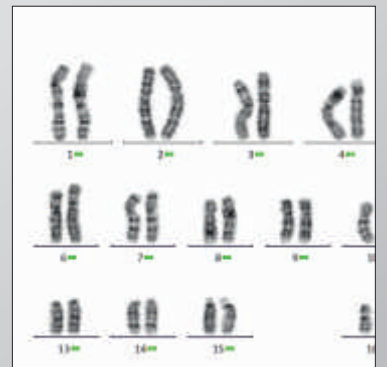
## CHROMOSOME SEPARATION

- 3** The chromosome clusters of each metaphase are separated with the help of a DNN-based classifier.
- 4** Artifacts and chromosomes of neighboring metaphases are excluded using a specialized algorithm.



## KARYOGRAM ASSIGNMENT

- 5** A karyogram proposal is created and made available for all connected workstations. Icons indicate assignment probability by colors.
- 6** All rejected chromosomes and/or artifacts remain accessible for review and correction, if necessary.



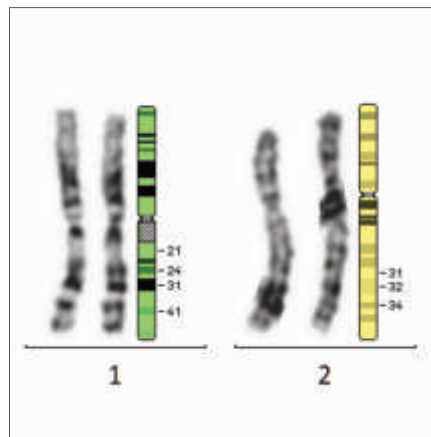
\* If the automated imaging of slides is not demanded, the user manually captures microscopy images with Ikaros BASE M (see our Modules Overview on the last two pages).

# KARYOT

## DIGITAL HELPERS

### Quality

Images can be acquired at the microscope with Ikaros or automated with a Metafer managed scanning system. In both cases, the quality of the captured images is excellent due to the sophisticated combination of high-resolution digital cameras\* with a variety of special software features. The latter include automatic contrast adjustment, intelligent focusing aids, and a comprehensive banding enhancement filter that is simply applied with the mouse.



▲ Colored idiograms bands annotations.

### Ease of Use

The clear design of the user interface enables fast and fatigue-free analysis. Working with Ikaros is extremely easy, and therefore, training times can be reduced to an absolute minimum. Generally, it takes only a few minutes until a user's first karyogram is prepared, and the skills required to operate the tools in Ikaros can be easily shared among colleagues and new members of the laboratory.



▲ Combined karyogram with annotated chromosomes.

### Speed

Time and accuracy are of the essence in routine cytogenetics. Ikaros was developed to enable extremely fast processing of metaphases. To achieve this goal, we established a remarkably lean software architecture and added artificial intelligence for chromosome separation and assignment. Ikaros thus provides direct and hassle-free access to all required functions with minimal user interaction.

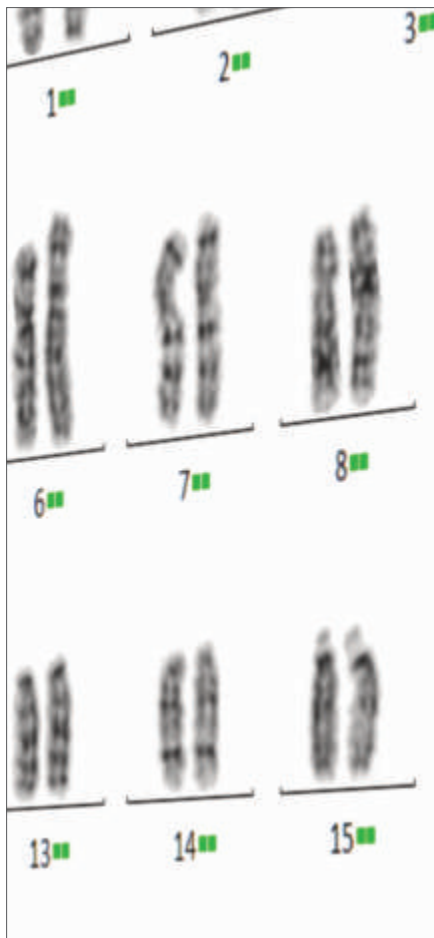
### Productivity

With Ikaros, the user can switch between different band types, brightfield and fluorescence illuminations. Furthermore, in addition to karyotyping, various methods in the cytogenetic field can be processed, such as chromosome FISH, mFISH, mBAND and interphase FISH. Since all necessary settings for the respective method are combined in so-called "Experiment Types", switching between methods is possible at any time with a mouse click.

# IKAROS

 MetaSystems

# TYPING



▲ Colored icons indicate the assignment probability.

## Highlights

### Manual Image Acquisition

- One-click image acquisition of G-, R-, Q-, and DAPI-banded metaphases, or of metaphases with other staining patterns.
- Focusing aid for automated best focus acquisition.
- Zoomable live image display on screen.
- Automatic contrast adjustment.
- Automatic integration time adjustment in fluorescence mode.
- Additional captures to encompass all chromosomes of widely spread metaphases in one karyogram.

### Image Enhancement

- Automated or manual background reduction and object threshold setting.
- Powerful image filter tools for banding enhancement.
- Unlimited undo, processing steps list, and any-time access to original image.
- Regional thresholding.
- High flexibility due to adaptable parameter sets (*Experiment Types*).

### Chromosome Separation

- Deep Learning (AI, Artificial Intelligence)-assisted separation of chromosomes.
- Separation of chromosome clusters with the chromosome brush tool.
- Image zoom function on the mouse wheel.
- *Check Objects* -function to identify clusters.

### Karyotyping

- Deep Learning (AI, Artificial Intelligence)-assisted assignment of chromosomes.
- Shifting, swapping, rotating, mirroring and exchanging chromosomes with the mouse in the karyogram view.
- Manual and semi-automatic count function and classification of chromosomes in the metaphase.
- Idiograms (ISCN 2016) with different resolutions, flexible annotation function, and karyogram form editor.
- Karyogram comparison and partial karyograms with aberrant chromosomes.

## KARYOGRAM

In Ikaros, the workspace is the central part of the screen. The smaller preview images on the right can be configured to show the original image, the false color image or other content. Switching between karyogram and meta-phase image is possible at any time in the workflow.

## BUTTON BAR

The central, configurable button bar allows quick access to all required functions. The buttons are arranged to reflect the usual workflow in karyotyping. Within each function, many subfunctions are immediately available without having to navigate through other menus.

## IMAGE DATA

Image-related data fields are displayed directly below the work area. Here, information such as the image number and coordinates can be viewed at a glance. The user can enter the image-related karyotype and comments, but also assign the culture or slide designation.



# IKAROS



## METADATA

Below the icons under the main button bar is the area where the current user and experiment type are displayed. The icons above allow easy access to less frequently used functions, including the settings where experiment type specific adjustments can also be made.

# FISH IM

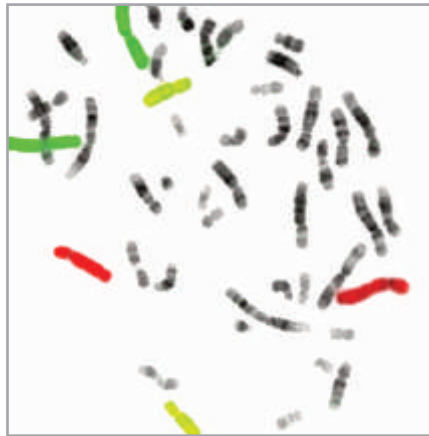
## COLORS

### Quality

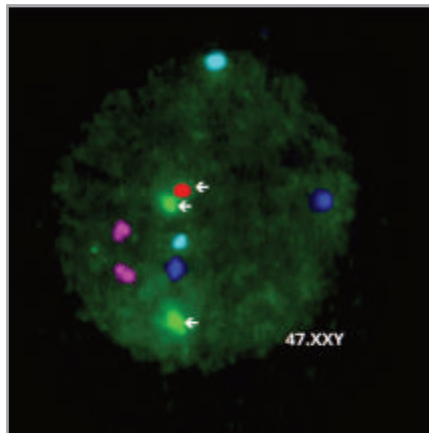
It is not uncommon for fluorescence images to show a high background, artifacts, or weak signals. For Ikaros users, however, this is no reason to reject the image. With just a few clicks, the grayscale thresholds in each image can be adjusted. This is possible separately for each of the color channels and even for individual areas within the image. The original image is retained in Ikaros, so that changes can also be selectively undone.

### Ease of Use

Both in karyotyping mode and in color image mode, users have access to the same highly convenient user interface. This means that the same processes, links and functions are available at the same place. In the case of color image processing, these are supplemented by specific functions for fluorescence image processing. So if you are familiar with karyograms, you will need little to learn to evaluate fluorescence images. This also applies vice versa, of course.



▲ Various false color modes facilitate the interpretation of the images..



▲ In fluorescence mode, Ikaros supports up to 12 color channels.

### Speed

In fluorescence microscopy, several repetitive steps are often required to prepare each image for analysis. Ikaros' color mode provides ultra-fast tools for this, some of which can be applied with just one mouse click or keystroke. This enables an extremely fast workflow, allowing the user to focus on the important part of the job: the actual analysis.

### Productivity

Sometimes it is necessary to detect and identify very fine structural changes in chromosomes. With the multicolor FISH (mFISH) module, Ikaros helps the user to obtain precise information about the origin of each chromosome fragment, even the smallest, by evaluating the color channel intensities pixel by pixel. With the multi-color banding (mBAND) evaluation, this even works for intra-chromosomal rearrangements.

# IKAROS





# AGING



▲ *mBAND is a method to visualize intrachromosomal structures with multicolor bands.*

## Highlights

### Image Acquisition

- One-click acquisition of fluorescence images with up to 12 color channels.
- Support of most motorized microscopes\*.
- Focus stack imaging.
- Automatic integration time adjustment separately for each color channel.
- Focus offset settings for individual fluorochromes.

### Image Enhancement

- Automated or manual background reduction and gray level threshold settings.
- Quick image enhancement with shortcuts.
- Separate enhancement of each individual color channel.
- Regional thresholding.
- High flexibility due to adaptable parameter sets (*Experiment Types*).
- Fluorochrome profile measurement.
- Flexible annotation functionality.

### Color Karyotyping

- Chromosome separation and assignment in either full color, grayscale, or inverted counter stain.
- Selective display of color channels in the karyogram.
- Idiograms (ISCN 2016) with different resolutions, flexible annotation function, and karyogram form editor.
- Karyogram comparison and partial karyograms with aberrant chromosomes.

### Multicolor FISH

- Analysis of fluorochrome combinations and false color display of chromosomes.
- Labelling scheme display in karyograms.
- Tooltip identification of chromosomes.
- Single-color binary view for quick identification of rearrangements.
- *Single Color Gallery* to identify the origin of chromosomes, chromosome parts, and markers.

# MODUL

## SCALABLE SOLUTIONS



◀ *Ikaros is also prepared to handle non-human chromosomes and comes with a variety of karyogram forms and idiograms for different species.*

### **Bespoke Multi-User Networks**

The sub-modules of Ikaros support the easy configuration of multi-user environments with separate imaging, analysis, and review stations for de-centralized working. With the solutions of MetaSystems, it is possible to extend the scalable multi-user network at any time and grow with the prospective demand.

Every Ikaros module comes with a sophisticated case and workflow management called Neon. Neon takes care for data security, easy content access, and user management.

For a higher degree of automation, MetaSystems optionally offers the Metafer software for use as a metaphase finding or a FISH imaging system. With Metafer, the generation of karyograms can be completely automated.



# IKAROS

# ARITY



## Ikaros Modules

- **Ikaros BASE M**  
Monochrome image acquisition (transmitted light and fluorescence)  
Cat.-No.: P-0040-001-MS
- **Ikaros BASE C**  
Color image acquisition and image processing (fluorescence)  
Cat.-No.: P-0040-002-MS
- **Ikaros Karyo M**  
Monochrome karyotyping  
Cat.-No.: P-0040-003-MS
- **Ikaros Karyo C**  
Color karyotyping, multicolor FISH , and mBAND  
Cat.-No.: P-0040-005-MS
- **Ikaros Review**  
Decentralized case and karyogram review  
Cat.-No.: P-0040-007-MS
- **Ikaros DNN**  
Smart karyotyping with artificial intelligence  
Cat.-No.: P-0040-010-MS
- **DNN Server**  
Centralized DNN processing  
Cat.-No.: P-0040-011-MS



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The described functions refer to the following software versions: **Ikaros 6.3** | **Metafer 4.3**

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Some hardware components supplied by other manufacturers are not included in MetaSystems IVD products and are therefore not IVD medical devices.

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