

## Andromeda iMIC – High-speed Live Cell Imaging with Confocal Resolution

### A Revolutionary Spinning Disk Confocal Unit on the Most Versatile Microscope Platform

Superb resolution, minimal photo-toxicity, unprecedented light efficiency and utmost 3-D acquisition speed, these are the features that single out the Andromeda Spinning Disk iMIC as the only true live cell confocal system on the market.

The iMIC digital microscope is the fastest, most precisely controlled scientific imaging platform on the market. With its modular concept and sub-millisecond real-time control it is at the core of the TILL Photonics microscopy systems; best-value turn key solutions for general fluorescence imaging and special applications.

#### **Low noise—high image quality**

The superior optical design of Andromeda with its unequaled light efficiency allows the use of “standard” CCD cameras for high quality images—noisy and expensive EMCCD cameras are not required.

#### **Low photo-toxicity**

The excellent light-efficiency of Andromeda and non-point-scanning nature of the spinning disk principle ensure that your living cells survive long-term observation.

#### **Flexibility**

The flexibility of the iMIC allows upgrading the Andromeda to multi-purpose stations tailored according to your specific applications.

#### **Combine your colors**

Freely combine lasers as decreed by your selection of fluorophores. Choose from 10 different wavelengths.

#### **Price vs. quality?**

Not with TILL’s Andromeda iMIC, confocal microscopy at a price that can’t be beat.

# Andromeda iMIC Spinning Disk Confocal

## Andromeda and cell viability

For decades laser scanning microscopes (LSM) were seen as the epitome of high-end light microscopy. However, one big caveat of LSM was simply ignored: focusing a high power laser beam into the object plane as done by LSM kills living cells—plain and simple.

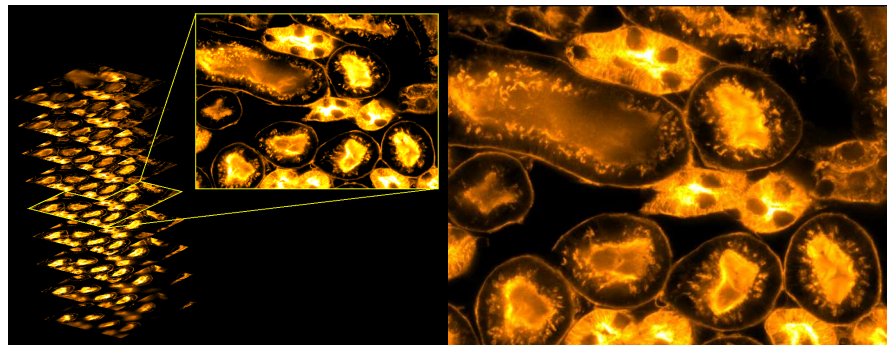
Spinning disk confocals (SDC) are much less harmful for living specimens. The beam intensity is distributed over a multitude of pinholes that simultaneously scan the field of view. Each image pixel is thus exposed several times, but at much reduced photon density as compared to the situation in conventional LSM.

Hence, the Andromeda iMIC with its real-time light management and efficiency is the perfect solution for live cell applications.

## Andromeda and speed

A second major drawback of LSM was always taken as given: the intrinsic slowness of the technology.

The completely motorized iMIC platform with its fast modules in interplay with the superior optical



Z-sectioning of mouse kidney with Alexa Fluor 488 WGA, iMIC Andromeda, CCD camera Imago QE, 50 ms exposure

design and light efficiency make the Andromeda iMIC the system of choice high speed optical sectioning.

## Andromeda and resolution

The spinning disk with its pinhole pattern serves the removal of out-of-focus fluorescence blur and thus the increase of spatial resolution.

SDC systems are often labeled with “trading resolution for speed”. This is not the case with Andromeda. At 60x and 100x magnification and with dry 40x objectives the resulting XY and Z resolution equals that of a LSM. Andromeda easily outclasses conventional SDC systems at lower magnifications especially with respect to the Z resolution.

## Andromeda and noise

The light efficiency of Andromeda produces excellent images when using “ordinary” CCD cameras, even with comparably short exposure times. This fact makes the default use of prohibitively expensive EMCCD cameras with their typically noisy images unnecessary—unless single photon counting is the application and signal enhancement and highest sensitivity are crucial: another clear advantage of the Andromeda iMIC with immediate impact on the required budget.

## Andromeda and flexibility

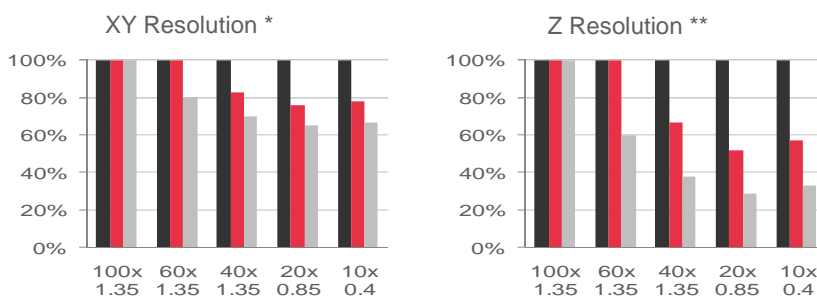
Up to four different laser lines out of a selection of 10 different wavelengths can be used simultaneously in one experiment.

The modularity of the iMIC platform allows combination of Andromeda with TIRF and FRAP modules, or the configuration of multi-purpose systems.

## Andromeda and value

The Andromeda iMIC: confocal imaging at high speed, ideal for live cell observations, and all this at a price that can't be beat.

Relative optical resolution at different magnifications and NA

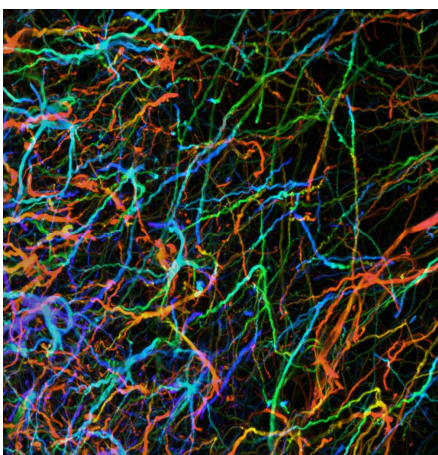


Black: ideal LSM; red: Andromeda; gray: conventional SDC

## Andromeda – optical design and transmission

The main feature that Andromeda has in common with conventional spinning disk confocal microscopes is—of course—a rotating disk with a pattern of pinholes in a conjugated image plane. Many conventional SDC systems rely on a second disk with microlenses aligned with the pinholes of the first one to increase excitation transmission. Not so Andromeda. Its pinholes are surrounded by focusing micromirrors that send the incoming collimated laser beam back into a corner cube retroreflector. This reflects the light back in the direction of the disk with a lens focusing each beamlet through its corresponding pinhole.

The use of multi-mode laser fibers and a rectangular field of illumination result in additional gain in light efficiency.



Rat brain axons imaged with Andromeda, color-coded Z-projection

Optical resolution (diagrams on previous page)

$$* R(XY) = 1.22\lambda / (NA_{obj} + NA_{eff})$$

$$** R(Z) = 2\lambda\eta / [\text{sqrt}(NA_{obj} * NA_{eff})]^2$$

$NA_{obj}$ : NA of objective;  $NA_{eff}$ : NA effectively used by optics for illumination  
 $\lambda$ : wavelength;  $\eta$ : refractive index of immersion media

## Andromeda – optical design and beam quality

The dual-disk design of conventional SDCs has a major drawback. The dichroic mirror that separates laser light and emission needs to be placed between the two disks. Consequently it needs to be small and coated on a thin substrate. Also, it cannot be exchanged easily and is right in the focusing beam path. This has severe negative impact on the quality of the resulting point spread function and thus on image quality and resolution.

Andromeda does not fall victim to such limitations. The dichroics are placed in a non-critical position without spatial limitations and are coated on 5 mm substrate to insure utmost planarity of the reflecting surface. This guarantees perfectly symmetric point spread functions.

Five multi-band dichroics are placed on a motorized slider for quick switching and to allow the use of a diversity of different laser combinations.

Additionally the optical path is telecentric throughout, which likewise avoids psf distortions.

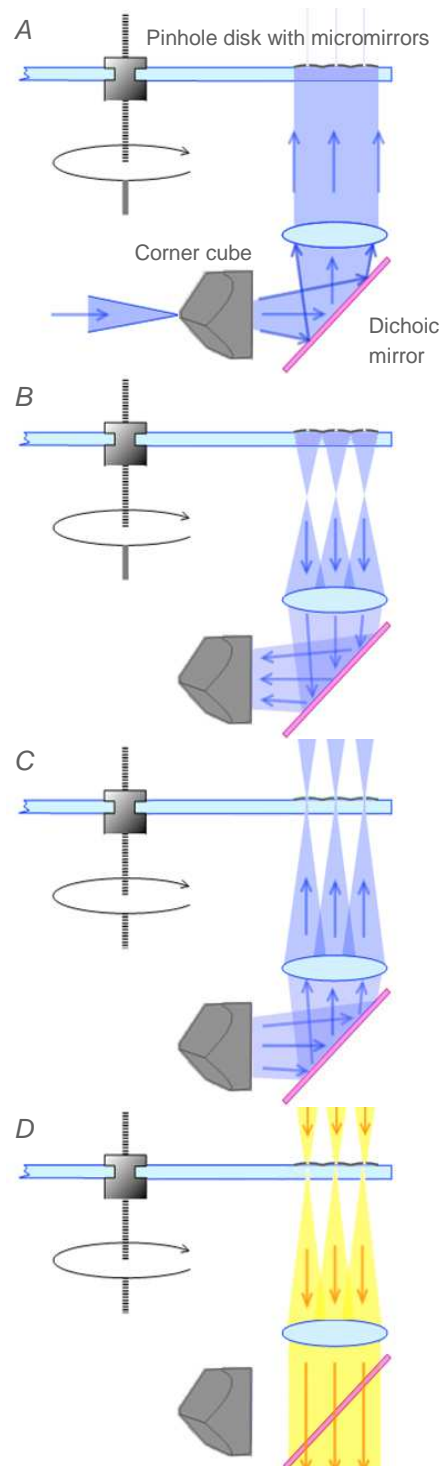
Andromeda, optical principle

A. The laser beam is focused through a hole in the corner cube and sent collimated towards the disk.

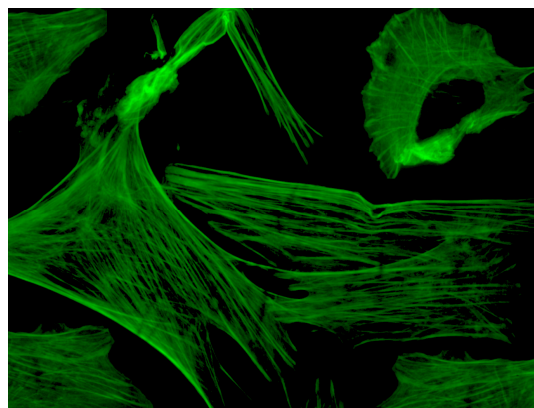
B. Micromirrors around the pinholes reflect a beam bundle back into the corner cube.

C. Each sub-beam is retro-reflected and focused through the pinholes.

D. Fluorescence emission is focused through the pinholes and transmits the dichroic mirror.



# Andromeda iMIC Spinning Disk Confocal



## Typical Andromeda iMIC Configuration

Unit	Module	Technical details
Microscope	iMIC digital microscope	Full software control, all modules motorized
	Objective revolver	4 positions for Olympus objectives
	Filter cube switch	TILL beam multiplexer, 3 positions, standard filters
	Coarse focus	Stepper motor, range 25mm, 2mm/s, res. < 1mm
	Fine focus	Piezo drive, range 250µm, res. 50nm
	XY stage	Range 25mm x 25mm, res. < 1mm, 7.5mm/s (other on request)
	Transmission	Green LED, dimmable, long distance phase contrast condenser, NA 0.55
	ICU real-time controller	3 digital outs (BNC), 1 digital in (BNC), 1 analog out (BNC), 5 analog out (D-sub 15), RS232, camera and illumination trigger
Spinning disk confocal unit	Andromeda	Synchronized with camera, illuminated field (rectangular) corresponds to max. 9x9 mm camera chips 9-position emission filter wheel; quad-band emission filter included (446/523/600/677 nm) 5-position dichroic mirror slider; switching speed < 100ms, multi-band dichroics included (405/490/561&594 nm, 405/490/561/640 nm, 405/490/594 nm, 405/532/645 nm, 445/514/645 nm)
Objectives	Olympus	UPLSAPO 20x2, NA 0.75, W.D. 0.6mm
	Olympus	UPLSAPO 40x2, NA 0.95, W.D. 0.18mm
	Olympus	UPLSAPO 60xO, NA 1.35, W.D. 0.15mm (others on request)
Laser	Toptica iBeam smart 405S	Diode laser, 405nm, 110mW
	Toptica iBeam smart 488S	Diode laser, 488nm, 60mW
	Cobolt Jive	Solid state laser, 561nm, 75mW
	Toptica iBeam smart 640S	Diode laser, 640nm, 100mW (others on request)
	PolyLine	Laser line combiner with AOTF, multi mode fiber
Camera	Andor Clara E	Interline transfer CCD, 1.4 Mpix, 2/3", up to 11.6 fps (full res.), 14bit/16bit, cooled to -20°C (other on request)
Imaging PC	DELL workstation	Min. 1TB HD, 4GB RAM, 256MB graphics board, two 19" TFT monitors
Software	LA Live Acquisition	Imaging system & camera control software, experiment control

Product specifications and descriptions in this document are subject to change without notice. © TILL Photonics GmbH 2012



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