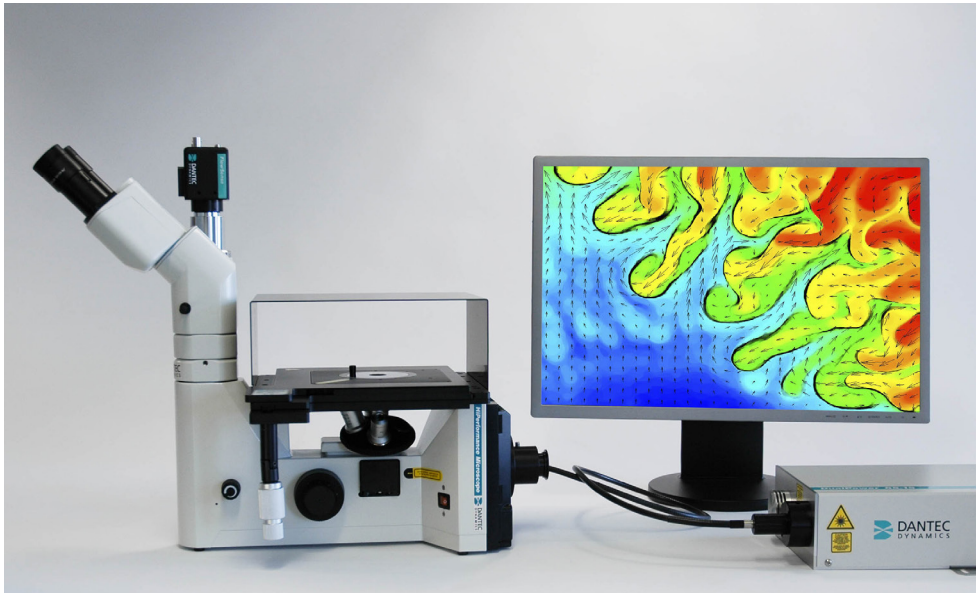


MicroPIV system

All-in-one MicroPIV system for 2D2C measurements in micro scale



MicroPIV system for accurate flow measurements in microscale

The all-in-one MicroPIV system from Dantec Dynamics comes with high magnification, high resolution, and superior measurement accuracy. Different illumination alternatives increase the flexibility during experiment setup, calibration and measurements.

The system is suitable both for conventional dual pulse imaging and for time resolved imaging. This makes the MicroPIV system suitable for experiments simulating biological flows, validation and test of flows in MEMS, design and development of Lab-on-chip devices, two-phase flow microsystems, and mixing enhancement studies. In short, Dantec Dynamics MicroPIV system is the preferred solution for 2D2C velocity measurements in microscale.

Key benefits

- Integrated solution with safe delivery of laser light
- Optional integrated double-pulsed LED illumination
- Optics/seeding optimized for maximum SNR
- Measurements at high optical magnification: up to 100x
- Fluorescent seeding particles: down to 100nm
- Modular system: easy upgrade to/from conventional PIV or LIF systems
- Time resolved measurements: up to 10kHz

MicroPIV and its application areas

Particle Image Velocimetry (PIV) is a mature technique with more than 25 years of application history in fluid mechanics. MicroPIV is one variation of this technique that describes planar two-component velocity field measurements with micron resolution. With the advances in research in medicine, molecular biology and genetics, investigation of fluid flows on a micro scale has received increased interest. MicroPIV systems are proven robust tools in investigating biological flows, validation and test of MEMS and lab-on-a-chip devices. The applications include: flow focusing and separation; cell detection and manipulation; assay implementation; DNA purification; protein crystallization etc. MicroPIV systems are used in two-phase flow microsystems: micro-mixers, droplet and bubble dispensers. Applications are not limited to liquid or two-phase flows; MicroPIV systems are used in validation of slip-flow boundary condition in gas flows in microchannels.

MicroPIV system optimized for high SNR

The MicroPIV system from Dantec Dynamics is the perfect solution for performing planar two-component velocity measurements in microfluidic devices. The system is optimized for high resolution, high magnification and high measurement accuracy.

The all-in-one solution consists of:

- Inverted Fluorescence microscope
- LED illumination for calibration
- Laser illumination for measurement
- Cameras
- Laser safety systems
- System computer and synchronizer
- Software (DynamicStudio)
- Microfluidic device for practicing

With more than 65 years of experience in developing diagnostic tools for fluid mechanics, Dantec Dynamics has developed a dedicated MicroPIV system for performing velocity measurements in microfluidic devices. The turnkey system is optimized for maximum light transmission and therefore for optimized signal to noise ratio (SNR). The components of the system are designed to make PIV measurements safe and user-friendly, so that the researcher can focus on the experiment and not on the equipment or laser safety.

The system components

HiPerformance microscope

The microscope configuration is carefully selected and modified for the requirements of an accurate MicroPIV measurement. The HiPerformance Microscope is an inverted fluorescence microscope that is optimized for microfluidic applications. The microscope can be delivered with a manual XY stage or a motorized XYZ stage. Please refer to the separate HiPerformance Inverted Microscope data sheet for details. On request Dantec Dynamics can implement laser delivery, including a laser safety kit, for other microscopes.

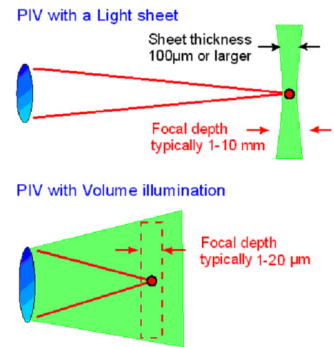
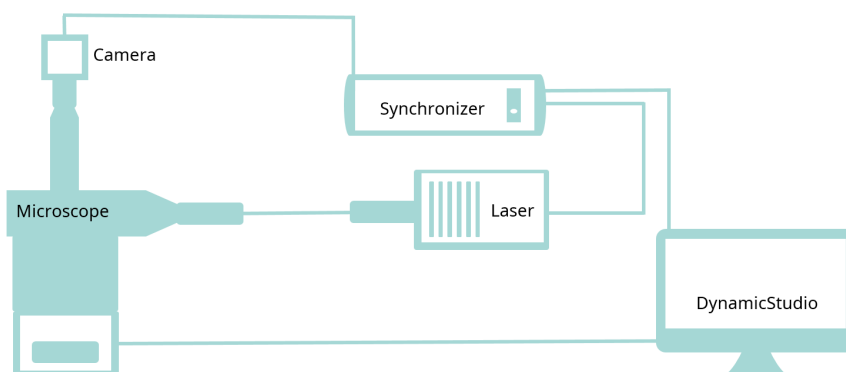
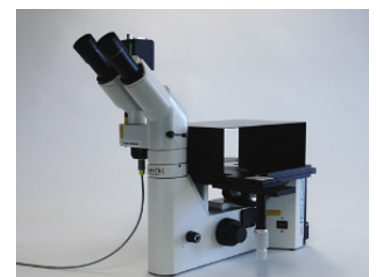
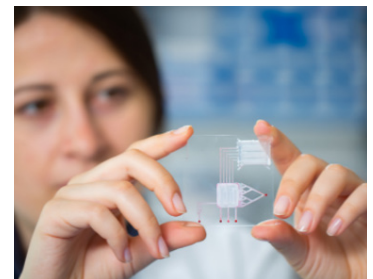


Illustration of light sheet and volume illumination



HiPerformance microscope.

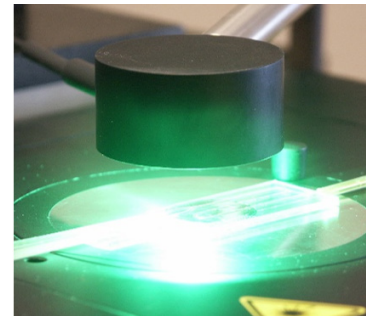
The 2D2C μ PIV system.

Cameras

When it comes to camera selection, Dantec Dynamics is the most flexible choice. With more than 100 different camera models supported, it is easy to pick a suitable camera for the experiment's spatial resolution, pixel sensitivity and temporal resolution requirements: This camera range includes CCD, CMOS and sCMOS detectors, up to 70% absolute quantum efficiency (QE) and up to 25600 frames per second. Different C- and F-camera mounts are available to adapt the field of view to the detector size. Please consult your Dantec Dynamics representative for camera selection.

Illumination

In conventional PIV, a light sheet defines the measurement plane, the camera field-of-view (FOV) defines the measurement area and the light sheet thickness defines the thickness of the measurement volume. For MicroPIV the illumination mode is often volume illumination, as even a thin light sheet often has a thickness similar to the channel dimension. Three types of illumination can be used: A continuous white LED illumination is included in the microscope for quick alignments. For slow and biological flows, the Microstrobe can be used, which is a pulsed focused green LED illumination device. For fast and advanced applications, a PIV laser can be coupled to the microscope.



Transmission microscopy with the Microstrobe LED illumination

Pulsed LED illumination

For slow microfluidic flows in transparent samples with less than 100mm/s velocity, the Microstrobe LED illumination can be used in transmission mode. This compact, dedicated, low cost, pulsed and focused LED illumination eliminates all the laser safety requirements ensuring a completely safe operating environment for the user. LED illumination also allows the investigations of biological flows without destroying the live organisms.

Laser illumination and safety

In addition to the LED illumination a number of high- and low-repetition rate PIV lasers are compatible with the microscope, which can “freeze” the particle motion in a small field of view. The low-repetition rate PIV lasers can be used for measurements in steady flows, and the high-repetition lasers can be used for time-resolved measurements of transient flows. The light coupling is safely achieved using a liquid light guide. For a complete list of compatible lasers, please consult your local Dantec Dynamics representative.



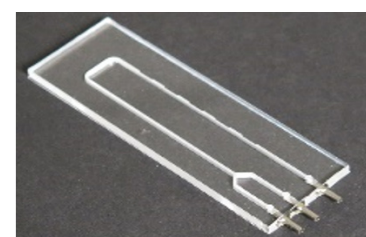
A low-repetition rate PIV lasers can be used for measurements in steady flows, and the high-repetition lasers can be used for time-resolved measurements of transient flows.

The MicroPIV system has unique laser safety features:

- A flexible optical guide ensures safe delivery of laser light into the microscope
- Special laser and microscope optics block emission of invisible harmonics
- A cover plate over the translation stage reduces the amount of light above the microscope
- An interlock system ensures that the laser light is never in the eyepieces of the microscope

2D microchannel

A sample microchannel is included in the Starter Kit so that the user can get familiarized with MicroPIV technique. The microfluidic device has two inlets and one outlet. There are two regions where one can measure 2D flow fields: a Y-junction and a step. Canonical fluid flows can be observed; i.e. channel flow, merging and separating flows or flow upstream and downstream of the step. The channel width and depth is ~1mm, which allows for an easy optical access even with a high viewing angle.



2D Microchannel device

Objectives

High quality objectives are essential for recording the particle positions accurately in PIV images. In volume illumination, the camera FOV defines the measurement area, but it is the numerical aperture of the microscope objective that defines the flatness and the thickness of the measurement plane. The microscope objectives are designed to withstand the high-energy laser pulses in the measurement volume. Finally, the green laser emission and broadband fluorescence emission should be transmitted with minimum loss through the objective. For these reasons, only high-quality dry objectives are used in Dantec Dynamics MicroPIV systems.

Seeding particles

Seeding is one of the most important elements for obtaining successful MicroPIV results. First of all, the seeding particles provide a strong fluorescent signal. Second, the excitation and emission wavelengths of seeding particles, are compatible with the rest of the optical system, which is designed to maximize the signal to noise ratio. Finally, diameters down to 100nm are available in order to address the ever-increasing high spatial resolution requirements in microfluidics community.

Software

The MicroPIV system includes a full version of DynamicStudio, which supports:

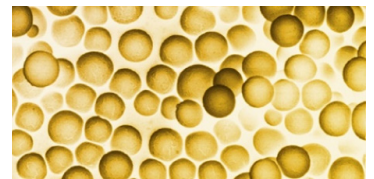
- More than 100 camera models
- Any illumination device through Light Source Wizard
- Distributed data acquisition and distributed data storage
- Easy set-up with plug-and-play connection of cameras, timer devices and other hardware
- Image Processing Library (IPL) – a comprehensive collection of advanced image processing functions
- Proper Orthogonal Decomposition (POD) – advanced energy based flow decomposition
- Stability analysis using Oscillating Pattern Decomposition (OPD)
- Dynamic Masking addon for better accuracy in two-phase flows
- MATLAB link to perform end-user specified analysis routines scripted in MATLAB
- Advanced 2D PIV algorithms: Adaptive PIV and Least Squares Matching (LSM)
- Advanced 2D PTV algorithms based on 2-, 3-, and 4-frame tracking
- Calculation of vector derivatives like vorticity, streamlines, and the λ_2 parameter
- Advanced graphical representation of the measured parameters without requiring additional third party software such as TecPlot
- Pressure from PIV calculation for 2D planar velocity fields

System computer

The MicroPIV system includes a Data Acquisition and Control System, which is preconfigured, tested and ready to use. All necessary hardware and software installation is performed before delivery. The system computer is from an international manufacturer with worldwide presence.



Only high-quality dry objectives are used in Dantec Dynamics' MicroPIV systems.



Fluorescent seeding particles

Technical specifications

Objective specifications						
Magnification	5x	10x	20x	40x	63x	100x
Numerical aperture (NA)	0.12	0.25	0.40	0.60	0.70	0.75
Free working distance [mm]	14	12	6.9	3.3-1.9	2.6	4.7
Cover glass correction [mm]	-	-	0-2	0-2	0.1-1.3	-
Depth of field [μm]	18.5	5.5	1.7	0.9	0.6	0.5

Order information

Item no	Item	Item description
9080M0571	Microscope	HiPerformance Inverted Microscope for PIV & LIF
9080M1331	Manual stage	Manual XY stage for HiPerformance microscope
9080M1341	Motorized stage	Motorized XYZ stage for HiPerformance microscope
9080M1351	4mm coupling	Laser to Liquid Light guide Coupling. Max 4 mm beam
9080M1361	6.5mm coupling	Laser to Liquid Light guide Coupling. Max 6.5 mm beam
9080X0191	LED illumination	MicroStrobe II: Focused microstrobe illumination and electronics
9080X2362	Starter kit	Microfluidics starter kit
9138A1201	5x objective	Objective Lens N PLAN 5x/0.12 WD=14 mm
9080M0571	10x objective	Included in
9138A1203	20x objective	Objective Lens HCX PL x20/0.40 corr. WD=3.2-1.9 mm
9138A1204	40x objective	Objective Lens N PLAN x40/0.55 corr. WD=3.3-1.9 mm
9138A1205	63x objective	Objective Lens HCX PL x63/0.70 corr. WD=2.6-1.8 mm
9138A1213	40x objective	Objective Lens HCX PL 40X/0.60 Corr. WD=3.3-1.9 mm
9138A1214	100x objective	Objective Lens HCX PL 100X /0.60, WD=4,7 mm
9138A1216	F adapter	1x F-mount adapter for 80M57 Comp. w. Cameras <100mm wide
9138A1217	1x C-adapter	1x C-Mount Adaptor for 80M57
9138A1208	0.63x C-adapter	0.63x C-mount Camera Adapter
9138A1209	0.5x C-adapter	0.5x C-mount Camera adapter
9138A1218	Line target	μPIV Line Calibration Target 0.01 mm Resolution
9138A1219	Grid target	μPIV Grid Calibration Target 0.7mm & 0.07 mm Resolution
9138A3086	1 μm particles	Fluorescent Particles, for MicroPIV. 1 μm , (535/575nm)
9138A3098	500nm particles	Fluorescent Particles for Micro PIV 500nm, 1% in 1ml 543/565nm
9138A3099	200nm particles	Fluorescent Particles for Micro PIV 200nm, 1% in 1ml 543/565nm
9138A3100	100nm particles	Fluorescent Particles for Micro PIV 100nm, 1% in 1ml 543/565nm