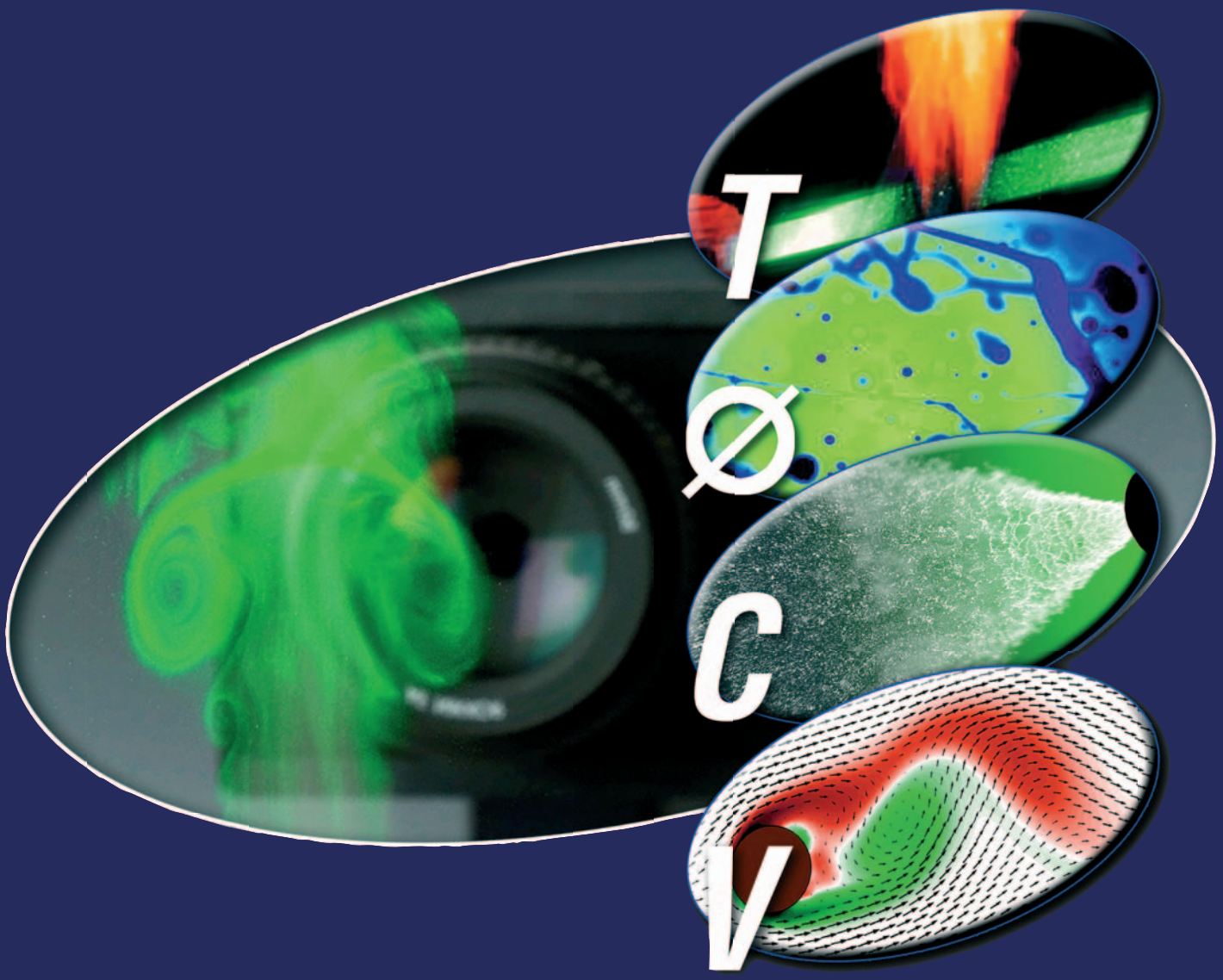


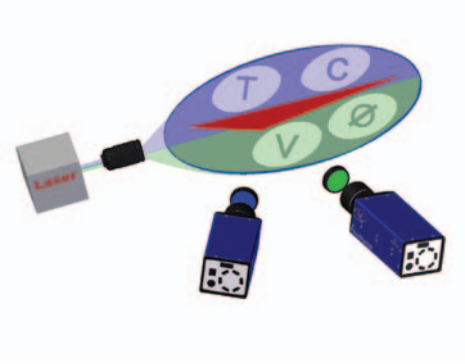
Multi-Parameter Laser Imaging

Intelligent PIV Upgrades

LaVision

We count on Photons

Multi-Parameter Laser Imaging



Multi-Parameter Laser Imaging matrix

Laser Imaging is a powerful tool for **Multi-Parameter Flow Imaging**. LaVision combines, in a unique way, flow velocity imaging based on Particle Image Velocimetry (PIV) with imaging of scalar flow parameters such as concentration, mixture fraction, and temperature applying Laser Induced Fluorescence (LIF), Raman and Rayleigh techniques. High resolution droplet sizing and particle imaging are accomplished using Interferometric Mie Imaging (IMI) and shadowgraphic imaging, respectively. In addition, particle concentration fields are recorded using Mie scattering or Laser Induced Incandescence (LII). **Laser Imaging** builds up a complete framework of seven imaging techniques with complementary information about the flow field.

	Velocity	Concentration total gas	Concentration species	Temperature	Size
PIV	✓				
LIF			✓	✓	
Rayleigh		✓		✓	
Raman		✓	✓	✓	
LII			✓		
Shadow					✓
IMI					✓

Combination of techniques captures additional flow features like:

Heat Transfer, Mass Flux or **Global Droplet Size**

Simultaneous imaging allows instantaneous multi-parameter flow field visualization and quantification.

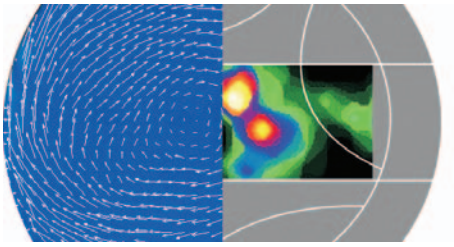
imaging techniques flow field information Nd:YAG laser wavelengths

Technique	Imaged Flow Parameter			Technique
PIV	velocity			PIV
Mie, LII Shadow, IMI	particle *C* particle size		fuel *C* combustion species	LIF
Tracer LIF	*C* , *T* in seeded liquid flows		*C* , *T* in seeded gas flows	Tracer LIF
Rayleigh Raman	*C* , *T* in unseeded gas flows			Rayleigh Raman
λ-Laser	532	355	266	nm

C: Concentration, *T:* Temperature

Nd:YAG PIV lasers operating at 532 nm can be upgraded for UV light sheet imaging by frequency conversion using 3rd or 4th harmonic generators. LIF imaging in gas flows needs UV excitation wavelengths. LIF imaging in dyed liquid flows is performed at 532 nm. Raman and Rayleigh imaging can be applied at any wavelengths with increasing performance at shorter wavelengths.

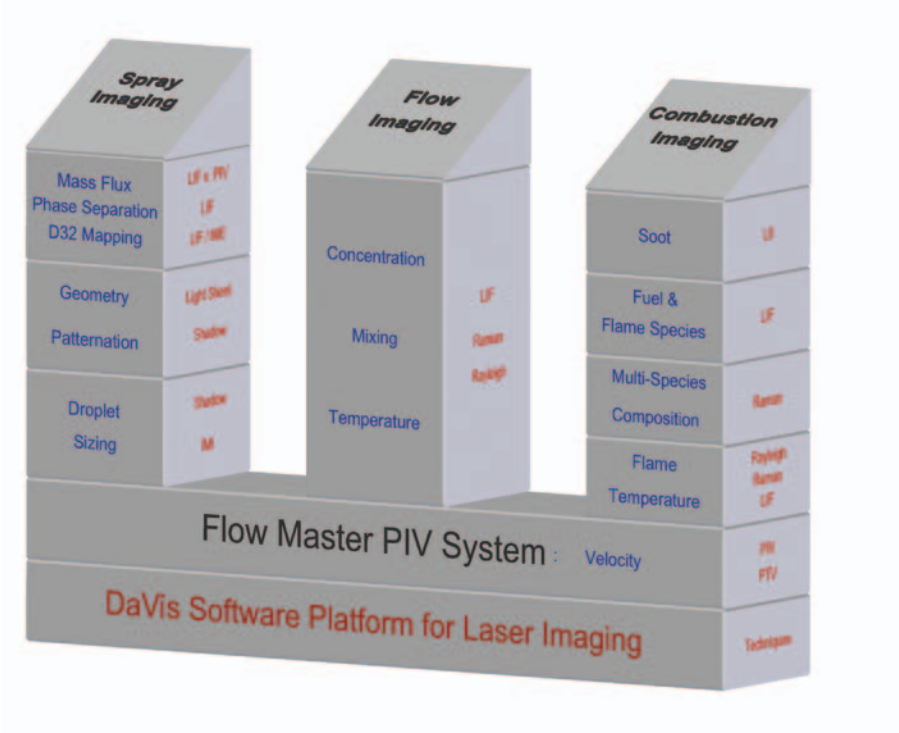
in-cylinder imaging

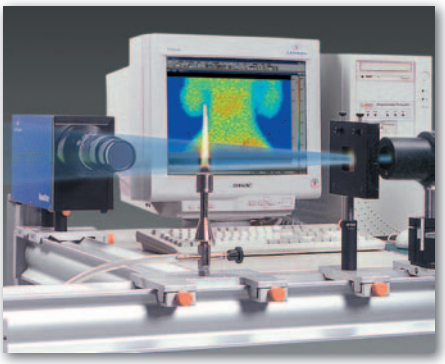


velocity (PIV) soot (LII)

LaVision's **FlowMaster** PIV systems are the key component of this powerful **multi-parameter** flow imaging approach. For each imaged flow parameter a complete hardware and software module is provided. This modular nature of all imaging upgrades provides full flexibility for different imaging solutions.

full system flexibility
for different
laser imaging solutions

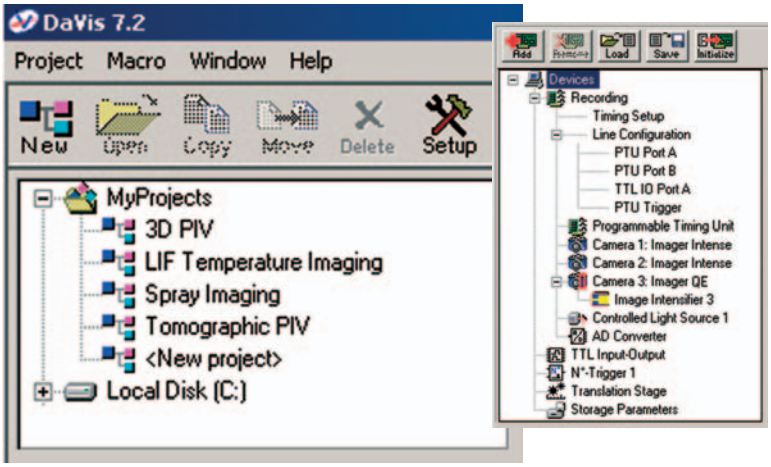




flame imaging on laser light sheets

Multi-Parameter Laser Imaging uses interchangeable hardware components and software modules. All software packages are based on the powerful DaVis imaging software platform. DaVis combines device control, image acquisition, processing and data storage.
LaVision's DaVis software concept is designed for users from the scientific as well as industrial community. Starting with the **FlowMaster** software, additional software solutions are added based on the end user's specific **multi-parameter imaging** application. The DaVis Project Manager guides you through the data acquisition and evaluation process.

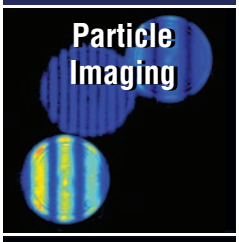
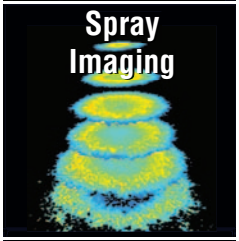
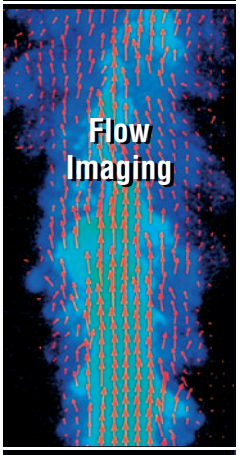
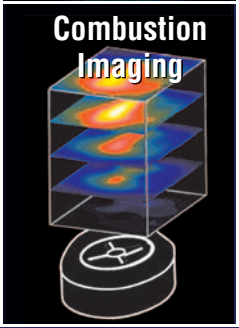
DaVis Project Manager
for Laser Imaging



one source for all your
laser imaging solutions!

Only LaVision offers you this complete laser imaging product line for multi-parameter flow field imaging.

LaVision - get the whole picture!

	PIV Upgrade Modules	Hardware	DaVis Software
 Particle Imaging	**Particle Sizing based on Shadow Imaging**	diffuser, macro lens or long distance microscope	Shadow Sizing
	Droplet Sizing based on Interferometric Mie Imaging (IMI)	macro lens	IMI Sizing
 Spray Imaging	**Spray Geometry (Patternation) based on Mie or Shadow Imaging**	--------	Spray
	Spray-LIF for Mass Concentration, D32 DropSizing, Phase Separation, Mass Flux	laser UV-upgrade, intensifier, filter	Spray, D32, Exciplex, Spray Flux
 Flow Imaging	**Tracer-LIF for Concentration & Temperature Imaging in Seeded Liquid Flows**	dye set, filter	LIF LIF Temp. Calibration
	Tracer-LIF for Concentration & Temperature Imaging in Seeded Gas Flows	laser UV-uprade, intensifier*	LIF LIF Temp. Calibration
	Rayleigh for Temperature Imaging in Unseeded Gas Flows	laser UV-upgrade*, intensifier, filter	Rayleigh Thermometry
	3D-Surface Flow (Wave Dynamics)	stereo camera setup	3D-Surface Flow
 Combustion Imaging	**Raman for Gas Composition (Multi-Species) Imaging**	Raman focusing optics, spectrograph, intensifier	Raman
	LIF for Flame Species Concentration Imaging: NO, OH CH, CN, C_2 ...	tunable laser, intensifier, filter, UV-lens for OH and NO	LIF λ-Scan
	LII for Soot Concentration Imaging	intensifier, filter	LII

*recommended

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10/08