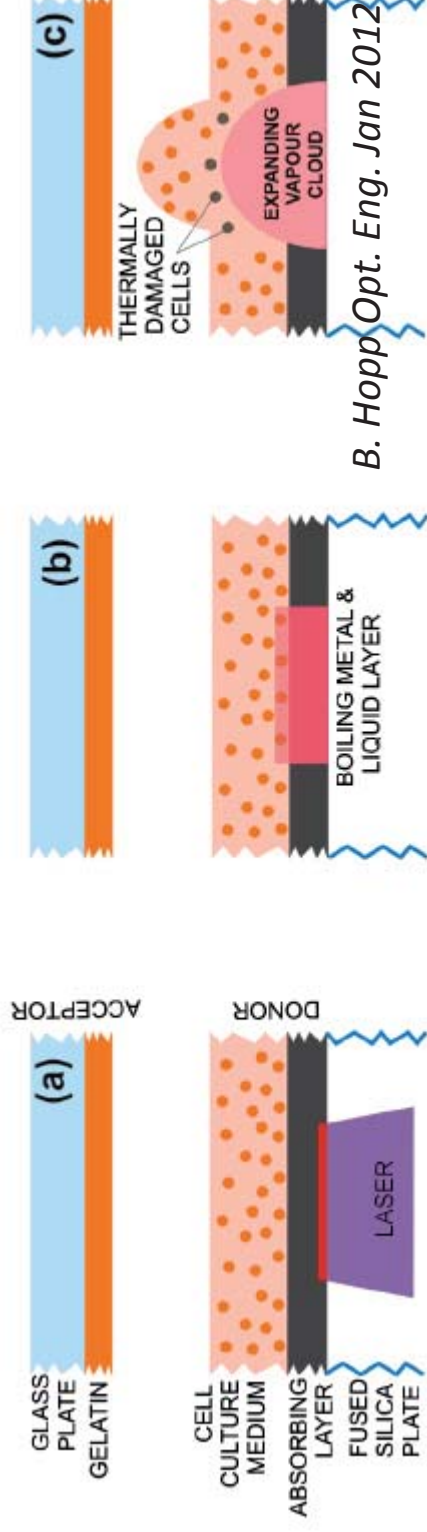


LIFT System in **CMi** EPFL Center of
MicroNanoTechnology

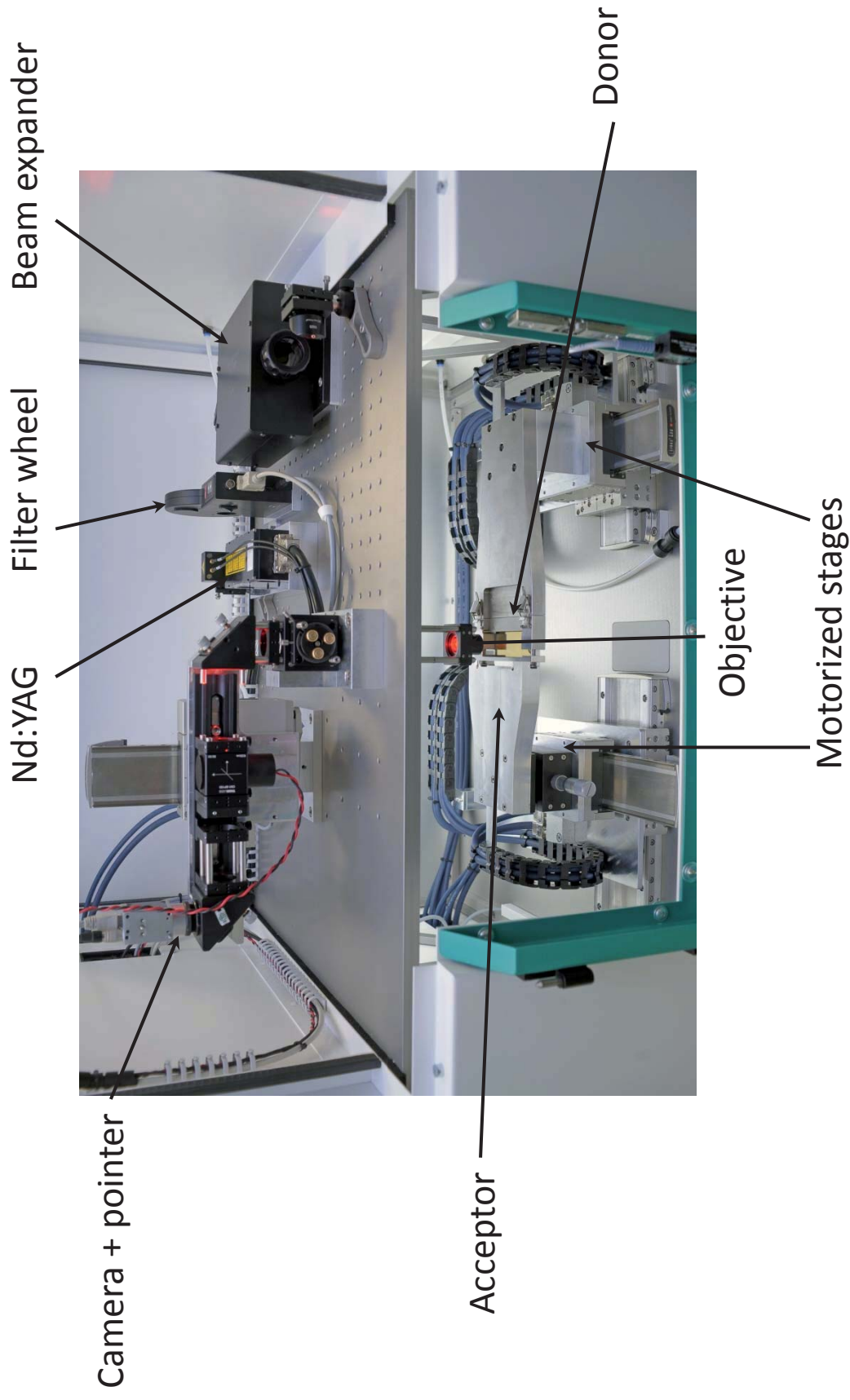
Machine from  **Fraunhofer**
ILT

Operation Principle

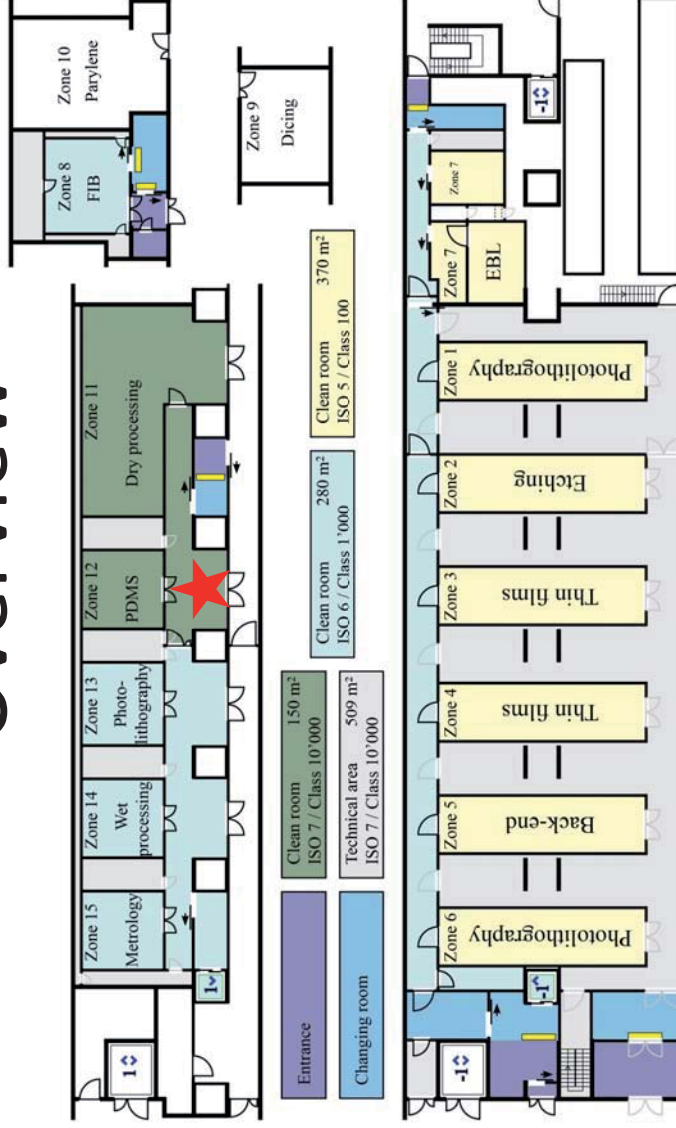


- ns laser pulse
- evaporation of absorption layer
- vapour wavefront expansion and transfer

Operation Principle



Overview



Specifications

- μ -scope slides (25x76mm) or 4" wafers on X-Y motorized stages
- Manual Z adjustment for acceptor (100 μ m -2mm)
- 355nm or 1064nm wavelength
- Power/pulse max 15 μ J, duration 1ns
- External trigger (manual) or internal trigger (free-running)
- Frequency 1 – 300Hz
- Beam waist ~20 μ m
- Class 3B (maintenance) => Class 1 in "User" mode (housing + interlock)
- Control in G-Code (standard in NC programming)
- Existing scripts for test patterns and to calibrate laser focus

Acceptance tests: laser

- Pulse Energy: at least 5 $\mu\text{J}/\text{pulse}$ @ 355 nm & 1064 nm @ 10 Hz

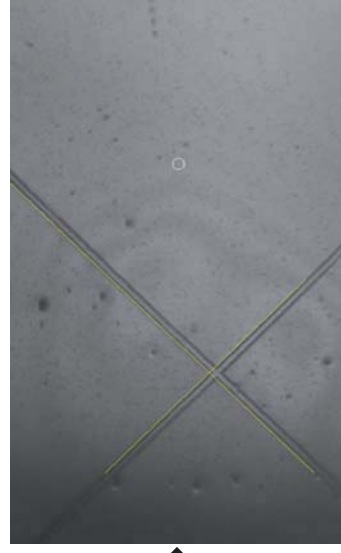
Experimental Setup:

- LIFTSYS GUI laser parameters: [ON], [FREE RUNNING], [10 Hz], [15 μJ]
- Powermeter and calibrated power sensor (SC302C, Thorlabs GmbH)

Wavelength	Power (target)	Power (measured)	Standard deviation (target)	Standard deviation (measured)	Time
355nm	>50 μW	148.7 μW	< 8%	0.57 μW	20s
1064nm ($\mu\text{scope objective}$)	>50 μW	48.9 μW	< 8%	0.39 μW	23s
1064nm (60 mm lens)	>50 μW	151.9 μW	< 8%	0.97 μW	52s

Acceptance tests: stage

- Grid on a microscopy slide: position of the target < +/- 20 μm
- Experimental Setup:**
- LIFTSYS-GUI: markings on the slide are identified (note down the actual position)
 - Looping around these positions at least 10 times and a screenshot is captured
 - The marking position of the screenshot is analyzed by an imaging software and the position variation is calculated
 - It shall not exceed +/- 5 μm per position for transfer stages (X, Y) and receiver stages (U,V)



Position 1	X [Pixel]	Y [Pixel]
1	288	531
2	293	532
3	294	531
4	294	533
5	292	532
6	293	533
7	292	532
8	292	532
9	292	531
10	292	532
11	292	532
Total Mittelwert	292.2	531.9
Total STABW	1.6	0.7
Abweichung in μm	1.6	0.7

Acceptance tests: stage

Position 1		X [Pixel]		Y [Pixel]		Position 3		X [Pixel]		Y [Pixel]		Position 1		U [Pixel]		V [Pixel]		Position 3		U [Pixel]		V [Pixel]	
1	288	531	1	1014	601	1	291	531	1	1013	603	1	291	531	1	1013	603	1	291	531	1	1013	603
2	293	532	2	1013	601	2	293	531	2	1012	604	2	293	531	2	1012	604	2	293	531	2	1012	604
3	294	531	3	1019	601	3	293	529	3	1018	603	3	293	529	3	1018	603	3	293	529	3	1018	603
4	294	533	4	1018	603	4	293	531	4	1018	604	4	293	531	4	1018	604	4	293	531	4	1018	604
5	292	532	5	1018	602	5	293	531	5	1018	602	5	293	531	5	1018	604	5	293	531	5	1018	604
6	293	533	6	1016	606	6	293	531	6	1016	606	6	293	531	6	1016	606	6	293	531	6	1016	606
7	292	532	7	1019	604	7	292	532	7	1019	604	7	292	532	7	1017	604	7	292	532	7	1017	604
8	292	532	8	1019	605	8	293	531	8	1019	605	8	293	531	8	1019	606	8	293	531	8	1019	606
9	292	531	9	1019	605	9	294	530	9	1019	605	9	294	530	9	1017	606	9	294	530	9	1017	606
10	292	532	10	1016	605	10	293	530	10	1016	605	10	293	530	10	1019	604	10	293	530	10	1019	604
11	292	532	11	1018	603	11	289	531	11	1018	603	11	289	531	11	1017	606	11	289	531	11	1017	606
Total Mittelwert	292.2	531.9	Total Mittelwert	1017.2	603.3	Total Mittelwert	292.5	530.7	Total Mittelwert	1016.7	604.5	Total Mittelwert	292.5	530.7	Total Mittelwert	1016.7	604.5	Total Mittelwert	292.5	530.7	Total Mittelwert	1016.7	604.5
standard deviation	1.6	0.7	standard deviation	2.1	1.8	standard deviation	1.4	0.8	standard deviation	2.3	1.2	standard deviation	1.4	0.8	standard deviation	2.3	1.2	standard deviation	1.4	0.8	standard deviation	2.3	1.2
Position 2		X [Pixel]		Y [Pixel]		Position 4		X [Pixel]		Y [Pixel]		Position 2		U [Pixel]		V [Pixel]		Position 4		U [Pixel]		V [Pixel]	
1	184	535	1	1034	599	1	184	535	1	1034	599	1	184	535	1	1015	487	1	184	535	1	1015	487
2	183	536	2	1038	598	2	185	535	2	1038	598	2	185	535	2	1014	488	2	185	535	2	1014	488
3	189	534	3	1038	601	3	190	535	3	1038	601	3	190	535	3	1015	487	3	190	535	3	1015	487
4	189	534	4	1040	599	4	189	535	4	1040	599	4	189	535	4	1015	487	4	189	535	4	1015	487
5	189	535	5	1039	597	5	189	535	5	1039	597	5	189	535	5	1016	487	5	189	535	5	1016	487
6	188	535	6	1038	600	6	186	533	6	1038	600	6	186	533	6	1015	487	6	186	533	6	1015	487
7	189	535	7	1038	600	7	187	535	7	1038	600	7	187	535	7	1015	487	7	187	535	7	1015	487
8	188	535	8	1038	600	8	188	534	8	1038	600	8	188	534	8	1014	487	8	188	534	8	1014	487
9	188	535	9	1036	600	9	187	534	9	1036	600	9	187	534	9	1014	488	9	187	534	9	1014	488
10	189	536	10	1036	600	10	188	533	10	1036	600	10	188	533	10	1014	488	10	188	533	10	1014	488
11	188	536	11	1037	599	11	186	534	11	1037	599	11	186	534	11	1015	488	11	186	534	11	1015	488
Total Mittelwert	187.6	535.1	Total Mittelwert	1037.5	599.4	Total Mittelwert	187.1	534.4	Total Mittelwert	1037.5	599.4	Total Mittelwert	187.1	534.4	Total Mittelwert	1014.7	487.4	Total Mittelwert	187.1	534.4	Total Mittelwert	1014.7	487.4
standard deviation	2.1	0.7	standard deviation	1.6	1.1	standard deviation	1.8	0.8	standard deviation	1.6	1.1	standard deviation	1.8	0.8	standard deviation	0.6	0.5	standard deviation	1.8	0.8	standard deviation	0.6	0.5

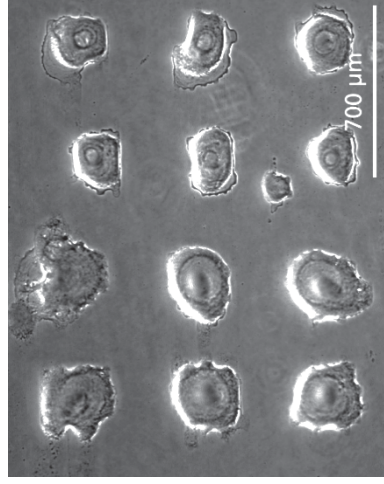
Donor stage

Acceptor stage

=> Scaling factor to pixel : 1µm

Acceptance tests: transfer of hydrogel

- 5 % gelatin transferred onto a receiver (glass) slide by LIFT
- Experimental Setup:**
- 5% gelatin solution (heating up to 60°C)
 - distributed evenly on a Ti 80nm coated slide with a blade coater (~150 μm)
 - grid of droplets: drop to drop distance: 400 μm , 15 μm



Printed onto glass => the droplets are not round shaped.

If the receiver is coated with a different hydrogel (different protein-concentration for microscopy purpose) the droplets within the hydrogel will have a round shape.