AMOLF physics of functional complex matter

Annex

Technical specifications for ultra-stable optical tweezers and microfluidics

Organization	[name]
Function	[function]
Ms./Mr.	[naam]
Contact details	[email]

1. Introduction

This schedule of requirements specifies the instrument and conditions concerning the purchase AMOLF intends to do. Requirements are to be considered as mandatory to comply with.

2. Conformity

We kindly ask you to fill in the table in chapter 3.

3. Requirements

Please state if you comply ("y" or "n") with each of the requirements.

System features

Nr	Requirement	y/n
1.	The system is an optical tweezers instrument, which can be combined with simultaneous confocal microscopy down to single-molecule resolution.	
2.	Capable of manipulating (stretch and relax) individual polymers like DNA, RNA and polypeptides with step sizes of less than 0.2 nm, attached to micron-size beads trapped in laser beams, Using two traps with an very high force (>1000 pN) and stiffness (1.5 pN/nm), thus effectively suppressing thermal fluctuations.	
3.	Measure forces and length change of the polymer with very high resolution (<0.1 pN and <0.3 nm at 100 Hz, while showing very high force stability (<0.3 pN change over 2 minutes).	
4.	The ability to add single-molecule fluorescence detection capabilities through a confocal fluorescence module, which can work together in a tightly integrated manner. This should allow the single-molecule confocal imaging of multiple differently labeled proteins on the polymer with single photon sensitivity, using 2 confocal colors or more, photon time tagging of 10 ns, Dark counts < 0.025 photons per pixel dwell time (0.1 ms), confocal spot positioning accuracy of less than 5 nm, leading to a localization precision of 15 nm with high background rejection, enabling measurements in high concentrations.	
5.	Combining the above measurements simultaneously and in real time, so that detected events can be correlated.	
6.	Directing all key instrument actions using a scripting language. Ability, for instance, to automatically change flow, capture beads, perform bead movements, while measuring forces.	
7.	All above measurements must be combined with an ultra-stable multi-channel micro-fluidics system with automated pressure-driven laminar flow and intuitive software, that enables an extremely constant flow-rate necessary for performing high-resolution single-molecule force-fluorescence measurements and greatly enhanced throughput.	

Optical Tweezers

Nr	Requirement	y/n
8.	Continuous wave laser traps	
9.	Force resolution (x,y) < 0.1 @100 Hz	
10.	Force stability (x,y) < 0.3 pN over 2 minutes	
11.	Trap distance stability (x,y) using active trap stabilization: < 0.5 nm drift over 10 minutes	
12.	Force acquisition rate (x,y) 78 kHz on two traps	
13.	Maximum escape force (x,y) > 1000 pN for 4.5 µm polystyrene beads	
14.	Bead displacement resolution using force signal < 0.3 nm @100 Hz	
15.	Bead displacement resolution using live brightfield bead tracking < 3 nm @100 Hz	

16.	Minimum incremental step size 0.2 nm	
17.	Field of movement (x,y,z) 50 µm x 50 µm x 9 µm	
18.	Number of independent traps 2 or more	
19.	Laser power and power ratio between traps software controlled over full dynamic range from 0-100% with a step size of 0.1% or less	
20.	Axial control (Z-axis) of traps	
21.	Differential detection of two coupled microspheres to limit common mode force noise	
22.	Laser: continuous wave 1064 nm, 20 W power or higher	
23.	Micro-positioning stage (microstage) for switching between flow channels in combination with coarse sample movement.	
24.	Software automated condenser positioning for hands-free operation and alignment	
25.	Data & computation elements all required: HDF5 open data format, ability to perform relax-wait-stretch cycles between changeable force and/or distance setpoints, automatic streaming data storage, point and click data analysis, GPU driven smooth data visualization, automatic scripting with access to all relevant parameters.	

Fluid control:

Nr	Requirement	y/n
26.	Glass microfluidic flow cell, with 5 or more independent fluid channels	
27.	Automatic control of 6 or more microfluidic flow channels using pressure, software controlled	

Warranty and Services

Nr	Requirement	y/n
28.	All equipment should be guaranteed for trouble-free operation and against manufacturing defects for a minimum period of 12 months after the acceptance test at AMOLF. Sufficient numbers of rapidly wearing and consumable parts are to be included with the system to cover the warranty period. The Contracting Authority may demand from the supplier that they replace the products at their expense within the set term, if the products show defects which do not permit normal use in accordance with the terms of the contract, for a period of one year counting from the date of provisional acceptance at the place of delivery.	
29.	The vendor should guarantee the availability of spare parts and service support for at least 10 years.	
30.	Technical help desk support should be available during normal local office working hours.	
31.	The company must have a local (Benelux) service department.	
32.	The language of all support (visits and technical help desk) should be English or Dutch.	
33.	The Vendor should offer software updates for at least 10 years.	

Shipping and delivery

Nr	Requirement	y/n
34.	The system must be packaged for shipment in a way to ensure safe delivery.	
35.	The vendor ensures, under their full responsibility, the transport and installation of all equipment on the site.	
36.	Customs, shipping, transport, transport insurance and taxes are the responsibility of the vendor.	
37.	Delivery of the microscope uses the as-is path to the relevant room within the AMOLF building.	

Documentation

Nr	Requirement	y/n
38.	The following documentation will be provided as electronic pdf files in English: installation Manual, operation Manual and maintenance Manual	
39.	The following details will be provided in the documentation: system footprint, system dimensions and weight, and infrastructure requirements	

Other requirements

Nr	Requirement	y/n
40.	The system can operate in a lab environment compatible with biological samples (ML-I and ML-II).	
41.	The system should be new and not used.	
42.	The vendor should provide all pre-installation requirements.	
43.	The system should comply with all relevant safety regulations.	
44.	Offline software licenses are provided for processing of the acquired images	
45.	On request of AMOLF, the vendor shall demonstrate the capability of the system to comply with the requirements.	