### TABLE OF TECHNICAL PARAMETERS

**„Light-sheet microscope for imaging of large cleared samples“**

**Internal contract registration number: VZ 24/859 ÚMG**

**Description of the subject of performance:**

The subject of performance is the delivery and installation of a new, previously unused, unrestored and fully functional **light microscope** designed and optimized for rapid volumetric imaging of intact cleared specimens (e.g. brain, lung) with subcellular resolution, including all necessary accessories and components, training of the operator and provision of warranty service. The scope of performance shall also include the supply of the necessary quantity of fully compatible material for installation, functional verification and commissioning so that the purchaser can verify the functionality and smooth operation of the delivered equipment upon delivery and after installation. The cost of this material shall be included in the supplier's total tender price.

**The subject of performance is**:

Light-sheet microscope system designed and optimized for rapid volumetric imaging of intact cleared samples (e.g. brain, lungs) with subcellular resolution. System will enable imaging of samples up to 40mm x 70 mm in lateral dimensions and provides 20 Hz or faster full frame capture with homogeneous illumination and includes algorithms for computational image de-striping. Sample illumination system involves the technology of axially swept light-sheet and synchronization with the rolling shutter of the camera to ensure homogeneous light-sheet illumination throughout entire field of view. System will enable whole mouse brain imaging with the voxel size no bigger than 1.8µm x 1.8µm x 1,8µm and the possibility to image the details of the same sample with the voxel size no bigger than 0.7µm x 0.7µm x 0.7µm. All the key microscope features are automated and system enables for smooth protocol operation and provides built in procedures for precise light-sheet alignment and tuning.

Supplier Cairn Research Ltd. hereby solemnly declares that the offered subject of performance has all the technical characteristics and meets all the technical parameters specified in the Purchase Contract and in Article 3 TD of the above-mentioned public contract, specifying in more detail below the characteristics of the subject of performance offered by him:

**Absolute minimum requirements for the subject of performance, i.e. Light-sheet fluorescence microscope for imaging of large cleared samples, and their fulfilment by the supplier:**

**Light-sheet fluorescence microscope for imaging of large cleared samples:**

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| --- | --- |
| **Producer:** | LifeCanvas Technologies |
| **Type:** | SME |

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| --- | --- | --- | --- |
|  | **Required function or parameter:** | **Fulfilling the parameter**  ***the participant leaves one option - either YES or NO*** | **The value of the parameter/feature for the subject of performance offered by the participant:**  ***The participant shall add the value of the offered performance for the items marked***  *[SUPPLEMENTED BY SUPPLIER]* |
| **Sample chamber & sample holders:** | | | |
| 1.1 | Chemically-inert (Water, CUBIC, BABB, DBE, ECi, etc) sample chambers and sample holders | YES |  |
| 1.2 | Various chamber sizes possible for one or multiple samples. System will provide at least two sample chamber sizes:   * + Min. 60 mm x 118 mm x 60 mm (w x l x h)   + Min. 80 mm x 174 mm x 60 mm (w x l x h) | YES | The system will be provided with two sample chambers: Chamber-1   * + Min. 60 mm x 118 mm x 60 mm (w x l x h)   Chamber-2   * + Min. 80 mm x 174 mm x 60 mm (w x l x h)   On request additional sample chambers or custom-size chambers can be designed and made based on the users’ samples. |
| 1.3 | Motorized sample stage with linear encoders equipped with easy to fit sample holder for sample mounting and precise positioning   * + Sample positioning in XYZ directions   + Travel range at least 50 mm x 100 mm x 50 mm (w x l x h)   + Step size max. 10 nm   + Position repeatability max. 200 nm   + Speed at least 1.75 mm/s | YES | The SmartSPIM has been specified with a fully automated XYZ sample stage controlled via joystick or within SmartSPIM acquisition software. The automated XYZ control system has been specified for rapid volumetric sample imaging and sample location automation. The stage is equipped with a standard (1.59mm) lead screw pitch (maximum speed 1.75mm/s) and linear encoders (10nm resolution) for accurate stage positioning and repeatability (200nm). The stage has an XYZ range of travel of 50mm x 100mm x 50mm (w x l x h). |
| 1.4 | Sample mounting holders of flexible design for various sample sizes, different sample orientations, including holders for multiple samples. Custom made sample holders are possible and can be easily implemented. | YES |  |
| 1.5 | Sample imaging area up to 40 mm x 70 mm in lateral dimensions | YES | Samples can be imaged across an area of 40mm x 70mm in the lateral dimension. |
| **Illumination and lasers:** | | | |
| 2.1 | Illumination objectives NA at least 0.125, long working distance that enables imaging in large sample chambers up to 80 mm in width | YES | The illumination optics (NA=0.125) in combination with the time averaging of the illumination beam over the FOV produces a light sheet that is optimised for each magnification |
| 2.2 | Adjustable light-sheet optics to fit FOV of objective used | YES |  |
| 2.3 | Dual sided illumination to minimize shadowing artifacts and provide homogeneous illumination across the whole sample | YES |  |
| 2.4 | System enables optical tuning for immersion refractive index | YES |  |
| 2.5 | Full control over both channel offsets to correct for any chromatic focal shifts or aberrations as well as refractive focal plane offsets to be able to account for any small non-uniformities in refractive index through the depth of the sample. | YES |  |
| 2.6 | Uniform point spread function and reduction of out-of-focus light across a large field of view using axially swept light-sheet technology - rolling shutter of the camera synchronized to the axial scan of a Gaussian beam | YES |  |
| 2.7 | Light-sheet thickness ≤ 2,5 m with objective 9x, ≤ 3.8 m with objective 3.6x and ≤ 8 m with objective 1.6x across the entire FOV of the sample | YES | The light sheet is tuned to provide a light sheet of thickness less than or equal to 8µm with the 1.6x, less than or equal to 3.8µm with the 3.6x and less than or equal 2.5µm with the 9x objective. |
| 2.8 | Flat excitation profile and uniform axial resolution across the entire FOV of the sample | YES |  |
| 2.9 | Possibility to equip the system with up to 6 laser lines. System must be equipped with at least three excitation lasers:   * + 488 nm ± 5 nm, min. 150 mW,   + 561 nm ± 5 nm, min. 150 mW   + 638 nm ± 5 nm, min. 140 mW | YES | A Cairn multiline laser launch system is specified for light sheet with three laser lines: 488nm ± 2 nm (150mW), 561nm ± 2 nm (150mW) and 638nm ± 2 nm (140mW). The laser launch can house upto 6 laser lines. The fibre output ports have individual mechanical shutters in addition to global electronic shuttering of the laser output. The lasers specified for use in this system are Coherent OBIS or Omicron LuxX diode lasers with expected lifetimes of over 10,000 hours and beam quality (M2) < 1.15. The lasers can be fully controlled (intensity and triggering) through SmartSPIM acquisition software, and are hardware synchronised with the camera acquisition period. These MHz diode lasers can be modulated on/off on the microsecond timescale meaning there is no need for AOTFs. There is an input on the laserbank controller to enable synchronisation of illumination with the acquisition system on the microsecond timescale to minimise sample bleaching. Individual laser intensities can be modulated on a similar timescale via independent analogue inputs. The lasers will be supplied in a 6-position Cairn multiline compact laserbank designed to be ‘plug and play’ - and other lasers can be readily added on site upto a total of 6 laser lines. Lasers can be readily aligned on site with a full alignment taking no more than a couple of hours and routine service adjustments in just a few minutes. Laser heads are rated at <0.25% RMS noise, with long term stability (24Hr) <2%. |
| 2.10 | Laser intensity control from software, step size max. 0.1%, | YES | The lasers can be fully controlled (intensity and triggering) through SmartSPIM acquisition software with intensity control with minimum step size of 0.1% |
| 2.11 | Global electronic shuttering of the laser output and the fiber output ports must have in addition individual mechanical shutters | YES |  |
| 2.12 | Hardware controlled triggering, synchronization of illumination with the acquisition system on the microsecond timescale to minimize sample bleaching | YES |  |
| **Objectives and detection:** | | | |
| 3.1 | Infinity corrected dipping objectives designed to work with all the different immersions (Water, CUBIC, BABB, EasyIndex, DBE, ECi, etc) covering the full range of refractive indices (RI = 1.33 – 1.56)   * + 1.6 x or equivalent, min. NA=0.1, min. WD=17,5 mm   + 3.6 x or equivalent, min. NA=0.2, min. WD=17,5 mm   + 9 x or equivalent, min. NA=0.3, min. WD=18 mm | YES | For optimal resolution and FOV capture of large sample we have specified the following infinity corrected dipping objectives:  •1.63x (NA 0.1, WD = 17.5mm)  •3.6x (NA 0.2, WD = 17.5mm)  As an additional option for imaging smaller regions of interest in large samples at high resolution we have specified:  •9x (NA 0.3, WD = 18mm)  The objectives specified are designed to work with all the different immersions (Water, EasyIndex, BABB, DBE, ECi, etc) covering the full range of refractive indices (RI = 1.33 – 1.56). The objectives all offer long working distances with high resolution and image flatness resulting in bright, sharp, high-contrast images for fluorescence imaging. The objectives have high transmission and chromatic aberration correction over a wide-range of wavelengths (400nm - near IR). |
| 3.2 | Chromatic aberration correction over a wide-range of wavelengths (400 nm - near IR) | YES |  |
| 3.3 | Automation of objective focus control, escape and refocus   * + Min. 50 mm objective travel range   + Max. 10nm step size   + Position repeatability max. 200 nm   + Travel speed at least 1.75 mm/s | YES | The system includes automation of objective focus control (10nm resolution, 1.75mm/s max speed, 50mm travel range, 200nm repeatability), escape & refocus, all controlled within SmartSPIM acquisition software. |
| 3.4 | Easy and fast objective exchange without the necessity to remove the sample | YES |  |
| 3.5 | 6-position high-speed filter wheel fully controlled from acquisition software, filter exchange time max. 40ms | YES | The system utilises a 6-position high-speed filter wheel (<40ms between adjacent positions) which is fully controlled in acquisition software. |
| 3.6 | Emission filters for GFP, mCherry and Cy5 (high quality single bandpass filters 525/50, 600/50, 700/75 or equivalent) | YES | All filters specified are high-quality Chroma sputter-coated filters with high transmission in the emission bands alongside high optical density (OD) out of band to block excitation light from reaching the detector. We have provided single-band emission filters to cover fluorophores in the GFP, mCherry and Cy5 range based on excitation at 488, 561 and 638nm, respectively:  GFP – ET525/50m  mCherry – ET600/50m  Cy5 – ET700/75m  Note: Final filter specifications would be decided after consultation with the end user. |
| 3.7 | Image pixel size max. 4 um, FOV min. 8 x 8 mm with x1.6 magnification | YES | For the 1.6x objective the corresponding pixel sizes and FOV’s are the following:  •4.0 µm pixels with x1.65 magnification and a field of view (FOV) of 8 x 8 mm |
| 3.8 | Image pixel size max. 1,8 um, FOV min. 3.6 x 3.6 mm with x3.6 magnification | YES | For the 3.6x objective the corresponding pixel sizes and FOV’s are the following:  •1.8 µm pixels with x3.6 magnification and a field of view (FOV) of 3.6 x 3.6 mm |
| 3.9 | Image pixel size max. 0,7 um, FOV min. 1.4 x 1.4 mm with x9 magnification | YES | For the 9x objective the corresponding pixel sizes and FOV’s are the following:  •0.7 µm pixels with x9 magnification and a field of view (FOV) of 1.4 x 1.4 mm |
| **Camera:** | | | |
| 4.1 | Monochromatic | YES |  |
| 4.2 | Type: sCMOS, rolling shutter | YES |  |
| 4.3 | Chip resolution at least 2300x2300 pixels (5.2 Mpix) | YES | The chip has 2304 (H) x 2304 (V) effective number of pixels (5.2 Mpix). |
| 4.4 | Pixel size at least 6.5 x 6.5 µm | YES | The chip has 6.5 µm (H) x 6.5 µm (V) pixel size. |
| 4.5 | an effective sensor area of at least 14 mm (H) × 14 mm (V) | YES | The chip has an effective sensor area of 14.9 (H) x 14.9 (V) mm |
| 4.6 | Chip cooling by water -8 °C at room temperature 25 °C | YES | Specified with water cooling to provide sensor temperature of -8°C (Water temperature: +25°C) |
| 4.7 | Maximum quantum efficiency (QE) of at least 95 % (using a wavelength of 550 nm) | YES | Maximum quantum efficiency (QE) of 95% at 550nm. |
| 4.8 | Full well capacity of at least 15 000 electrons | YES | Full well capacity of 15,000 electrons. |
| 4.9 | Dynamic range at least: 20 000:1 | YES | Dynamic range at least: 20 000:1 |
| 4.10 | Read noise <0.7 electrons rms | YES | Read noise <0.7 electrons rms |
| 4.11 | Dark current <1.0 electrons/pixel/s at -5°C | YES | Dark current <1.0 electrons/pixel/s at -5°C |
| 4.12 | Exposure times in the range of 17 µs to 10 s | YES | Exposure times in the range of 17 µs to 10 s |
| 4.13 | Frame rate of at least 30 frames/s（16 bit), 40 frames/s（12 bit), 60 frames/s（8 bit) frames per second at full resolution | YES | Frame rate of at least 30 frames/s（16-bit), 40 frames/s（12-bit), 60 frames/s（8-bit) frames per second at full resolution |
| 4.14 | Binning possible: 2x2, 4x4 | YES | Binning possible: 2x2, 4x4 |
| 4.15 | Digital output: 16, 12 and 8 bit | YES | Digital output: 16, 12 and 8-bit |
| 4.16 | USB 3.1 connection to PC | YES | USB 3.1 connection to PC |
| **Acquisition software:** | | | |
| 5.1 | Acquisition software with UI friendly interface for full control of the microscope and the camera | YES |  |
| 5.2 | Built in procedures for precise light-sheet alignment and tuning | YES |  |
| 5.3 | Full sample control, XYZ sample movement, sample location from software | YES |  |
| 5.4 | Multi-dimensional acquisition for z-stacks and multiple channels | YES |  |
| 5.5 | Definition of the imaging area at low magnification and possibility to image specified area with higher resolution by switching objectives without the necessity to move the sample or sample chamber | YES |  |
| 5.6 | Automatic tiling setup for multiple tile imaging | YES |  |
| 5.7 | Automated image acquisition workflows for a wide range of applications | YES |  |
| 5.8 | Enables pre-processing of data on-the-fly during image acquisition (background correction, flat field correction) | YES |  |
| 5.9 | Acquired images saved in format compatible with common commercial software for 3D/4D data reconstruction/visualization/deconvolution | YES |  |
| 5.10 | Software support and updates at least 10 years from the purchase | YES |  |
| **Image processing software:** | | | |
| 6.1 | Separate postprocessing software that can work in parallel with acquisition software | YES |  |
| 6.2 | Includes algorithms for removing or limiting the appearance of shadows ("computational de-striping") | YES |  |
| 6.3 | Automated workflows that include monitored folders for immediate start of the image processing immediately after data acquisition (de-striping and preparation of the data for stitching) | YES |  |
| 6.4 | Includes automated workflows for automatic stitching of large data sets after image acquisition | YES |  |
| 6.5 | Flat field correction | YES |  |
| 6.6 | An additional (off-line) processing license included that can be installed on customers desktop computer or virtual machine for processing of large datasets. | YES |  |
| **The acquisition workstation minimum specifications:** | | | |
| 7.1 | 8 core CPU (Passmark v10 – min. 18000 points) | YES | AMD Ryzen 5 5700G – 8-core, 16 thread CPU (Passmark v10 – min. 18000 points) |
| 7.2 | 64 GB DDR4 M2 Quad Channel Memory | YES | 64 GB DDR4 M2 Quad Channel Memory |
| 7.3 | min. onboard GPU | YES | AMD Radeon 8-Core GPU |
| 7.4 | 1TB Intel M.2 system SSD | YES | 1TB Intel M.2 system SSD |
| 7.5 | 32 TB internal storage | YES | 32 TB internal storage |
| 7.6 | 10GB Network Card | YES | 10GB Network Card |
| 7.7 | Microsoft Windows 10 Professional (64-bit) | YES | Microsoft Windows 10 Professional (64-bit) |
| 7.8 | 34” monitor (3480 x 1440) | YES | 34” monitor (3480 x 1440) |
| **The processing workstation minimum specifications:** | | | |
| 8.1 | 24 Core CPU (Passmark v10 – min. 50 000 points) | YES | AMD Ryzen™ Threadripper 3960X 24-Core CPU (Passmark v10 – min. 50 000 points) |
| 8.2 | 128 GB Quad Channel Memory | YES | 128 GB Quad Channel Memory |
| 8.3 | GPU with at least 2GB VRAM | YES | AMD Radeon® RX 550 2GB VRAM |
| 8.4 | 500GB NVMe M.2 system SSD | YES | 500GB Samsung 970 EVO Plus NVMe M.2 SSD |
| 8.5 | 32TB Raid 0 internal storage HDD | YES | 32TB Raid 0 internal storage HDD |
| 8.6 | 10GB Network Card | YES | 10GB Network Card |
| 8.7 | Microsoft Windows 10 Professional (64-bit) | YES | Microsoft Windows 10 Professional (64-bit) |
| **Additional specifications for tender documentation:** | | | |
| **Installation and training:** | | | |
| 9.1 | Delivery includes on-site installation | YES |  |
| 9.2 | Included 1 day initial expert training for up to 5 people | YES |  |
| 9.3 | Included second training session after the system has been in use for some time. This training should occur no later than 6 months after installation. | YES |  |
| 9.4 | Free additional trainings during warranty period as part of any service visit or on demand | YES |  |
| **Warranty:** | | | |
| 10.1 | Full warranty must be provided on all hardware and electronic parts of the microscope including optics and lasers as well as on the computer and the software for at least 1 year. | YES | Telephone / e-mail support is currently provided free of charge for the life of the system.  Full warranty on all parts and labour are provided for repairs as part of the initial 1-year warranty for new hardware, along with required site visits for faults/repairs. |
| 10.2 | Software updates provided for free | YES |  |
| **Warranty and post-warranty service conditions:** | | | |
| 11.1 | Free Telephone, remote access and e-mail support | YES |  |
| 11.2 | Reaction time: max 24-48 hours | YES |  |
| 11.3 | Service engineer visit: in max 3-5 working days | YES |  |
| 11.4 | Target repair time: max 14 days after the failure was reported | YES |  |
| 11.5 | If faulty hardware cannot be repaired in a reasonable timescale, supplier will provide a temporary replacement part while the repair is being carried out. | YES |  |
| **Post warranty:** | | | |
| 12.1 | Free telephone, e-mail and remote access and support for the life of the system. | YES |  |
| 12.2 | Software updates are provided for 10 years from the receipt of purchase. | YES |  |
| 12.3 | Post-warranty service will be provided for at least 8 years after the warranty ends. | YES |  |

The Contracting Authority draws the attention of the participants to the fact that in case the offered performance does not meet the technical characteristics and parameters specified by the Contracting Authority above (i.e. in case the participant indicates "NO" in the above table in the "YES/NO" answer selection section, or. in the column "Value of the parameter/feature for the subject of performance offered by the tenderer", the tenderer provides data or information that contradicts the requirements of the Contracting Authority or does not meet its binding requirements), the tenderer's offer does not comply with the terms of reference and the requirements of the Contracting Authority and the tenderer who submitted such a tender may be excluded from further participation in the tender procedure.

An incomplete box marked for completion may result in exclusion for failure to comply with the terms of reference.

Completion of the specification table shall be binding on the supplier and the completed Technical Specification Table shall be attached as Annex 1 to the Purchase Contract.

Note: The contracting authority reserves the right to require additional submissions from the supplier:

* Manufacturer's/importer's declaration
* Declaration of conformity
* The actual description of the associated software (demo version if applicable), which must contain all binding and precisely defined technical parameters for the individual functionalities
* etc. documents in order to assess compliance with the technical specification.

**I, the undersigned representative of the tenderer, solemnly declare that the above information is true and that, if successful in the tender, we will deliver the goods exactly according to the technical and commercial conditions in our tender.**

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| --- | --- |
| In Faversham, UK on |  |
|  | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Signature of the supplier |

When submitting the tender electronically, it is sufficient for the contracting authority to sign the Annex 4 of the tender (Annex 1 of the contract) electronically by submitting the tender into the electronic tool <https://www.tenderarena.cz/profil/detail.jsf?identifikator=ustmolgen> under his name and password.