

Technical specification for
Custom confocal microscope for quantum emitter measurements

1. The vendor must quote for a confocal microscopy system with at least one laser excitation (nominally 532 nm) and at least three detection channels- 1) wide-field camera imaging of the sample, 2) single photon-counting (SPC) measurements with two SPC units to enable second order correlation measurements, 3) detection channel should be for performing spectral (Raman and luminescence). It should have imaging capabilities.
2. Appropriate safety measures such as laser interlock and protective housing and/or beam stops should be provided to protect the user of the system from accidental exposure to the laser.
3. While the system should be fully functional capable of being a stand alone, it should be allow integration (without its objective) with the Attocube's AttoDry 800 cryostat (with RT & LT Objective Transmission shroud) to be installed in our lab.
4. The system should allow for laser beam to be coming horizontally or vertically at the end. The vendor must provide is any structural or optical components are needed to allow horizontal and vertical orientation of the laser beam at the appropriate height for the Attocube system.
5. All electronics, drivers, and power supplies (compatible with Indian power supply) should be provided. All necessary cables should also be provided.
6. A Windows based computer with monitor and necessary software for the system should be provided. Software must be provided for control of the laser, Raman measurements, camera, and control of certain optical/optomechanical components (listed in the specifications below). Software should allow data/spectral analysis, spectra image processing & presentation. Software should allow viewing and capturing of images from the camera.
7. The vendor must provide a detailed optical design of the system.
8. The vendor must provide detailed specification sheets for the components. IITM reserves the right to ask for more detailed proof for the quoted specifications.
9. The vendor should have sold at least 5 similar units and should provide 3 contact details of 3 references who have bought the system.
10. The vendor must provide at least one year warranty on all components.
11. The vendor should have technical service professionals available within India.
12. The vendor must transport and install the system at the IITM location. They should also provide training in the use fo the hardware and software at the IITM site.
13. Following criterion will be used for determination of successful installation:
 - Demonstration of successful measurement of Raman spectrum from standard calibration samples such as Si with instrument limited linewidths
 - Imaging of PL from one sample from IIT Madras. We may consider a sample from the vendor if appropriate a sample is not available at IITM.

The key components and their specifications are listed below:

Component	Specifications
Narrow line excitation Laser compatible with Raman spectroscopy	<ul style="list-style-type: none"> • With necessary mechanical components to hold it, and any necessary filters to enable high resolution spectroscopy • Wavelength: 532 ± 1 nm • Power: ≥ 100 mw • Transverse Mode: TEM₀₀ • Power stability: 3% peak-peak over 8 hrs • Linewidth: < 0.005 nm • Noise of amplitude (rms, 1Hz~20MHz): $< 1\%$ • M²: < 1.2 • Beam Divergence: < 1.5 • Polarization Ratio: $> 100:1$
Detector channel 1: Camera for sample imaging	<ul style="list-style-type: none"> • ≥ 2 Megapixel color camera for Sample Viewing and appropriate imaging lens to image the sample • White light LED source should be included
Detection channel 2: Single Photon Counter (2 numbers to enable g2 measurements)	<ul style="list-style-type: none"> • Compatible with Time correlated single photon counting (TCSPC), Fluorescence lifetime measurements and fluorescence lifetime imaging microscopy (FLIM) • Wavelength rage: 400 nm- 1000 nm • Quantum efficiency @650 nm: $> 60\%$ • Dark counts: < 100 cps • Timing resolution < 250 ps • Maximum count rate (linear regime): ≥ 1 Mcps • Maximum count rate: ≥ 10 Mcps • Dead time: < 25 ns • Output pulse amplitude: >2 V
Detection channel 3: Raman and luminescence spectrometer	<ul style="list-style-type: none"> • Fiber coupled spectrometer including the coupling fiber • Optics: Czerny-Turner with aberration corrected imaging mirror with ≥ 150mm focal length • Gratings: 600 gr/mm • Resolution: < 0.2 nm/pixel • Raman Shift: from at least 100 cm^{-1} to 4000 cm^{-1} (3000 cm^{-1} for NIR) or greater • TE Cooled Detector • Cooling: < -10 °C • Dark Current: 0.001 e-/pixel/s • Read Noise: < 1 e- • Quantum efficiency: $\geq 60\%$ @ 600nm
Objective	<ul style="list-style-type: none"> • 20 X, NA > 0.4, long working distance

XYZ stage for sample movement	<ul style="list-style-type: none"> • Closed-loop motorized stages with software control • Travel: X and Y ≥ 75 mm, Z ≥ 40 mm • Resolution: X and Y: ≤ 100 nm, Z: ≤ 25 nm
Other optics and opto-mechanics	<ul style="list-style-type: none"> • Motorized shutter and shutter controller to be provided in software. • At least 5 position ND filter wheel for laser attenuation with absorptive filters covering the range from 100 % to 1 % with safe access to the wheel. • Necessary filters in the detector 2 and 3 paths to filter the laser sufficiently and collect the luminescence • 532nm Narrow notch filter of OD ≥ 5 in front of camera • 532nm Dichroic Mirror in the laser path • 90/10 Beam Splitters for camera and LED light source • USB power meter and sensor compatible with laser power