Supplementary Materials

Photonic Timestamped Confocal Microscopy (PT-Confocal)

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Abstract. This document provides supplementary information of "Photonic Timestamped Confocal Microscopy (PT-Confocal)" .

1 The imaging system setup of PT-confocal.

See Fig. S1.

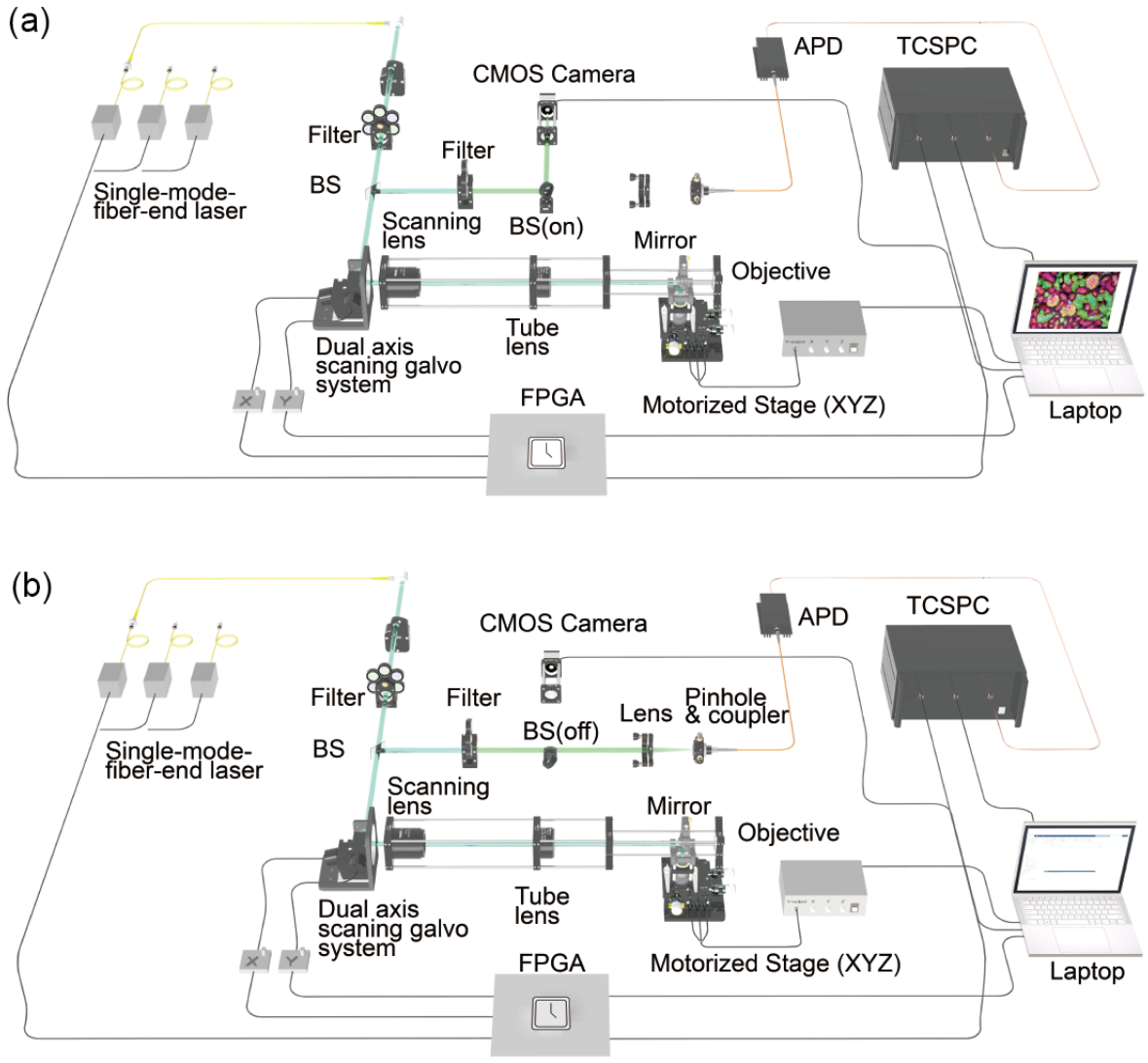

Fig. S1 **Overview of the whole system. (a)** When the BS is in the upright position (labeled "on"), CMOS camera is capturing the real-time wide-field fluorescent imaging to roughly find the position of the focal plane. **(b)** When the BS is in folded (labeled "off"), the APD detector and the TCSPC system is open. And after arriving the accurate position of the focal plane, the controlling and recording system is turned on for acquiring the confocal signal. F: filter, BS: 50:50 beam splitter, SL: scanning lens, TL: tube lens, M: mirror, Obj: objective, AL: achromatic lens, FC: fiber coupler, APD: avalanched photon diode, TCSPC: time-correlated single-photon counting module, Scanning Galvo: dual-axis galvo scan head system.

2 Refactoring results of MLE and MAP.

When processing the timestamp information, we compare the results of maximum likelihood estimation (MLE) and maximum posterior estimation (MAP), See Figure S2. The MAP method is clearer in estimating the details at the edge of the membrane, but the error is larger in areas with dense photon numbers. In terms of overall image quality, MLE's results are better. We ultimately chose MLE as an upfront method for data fitting.

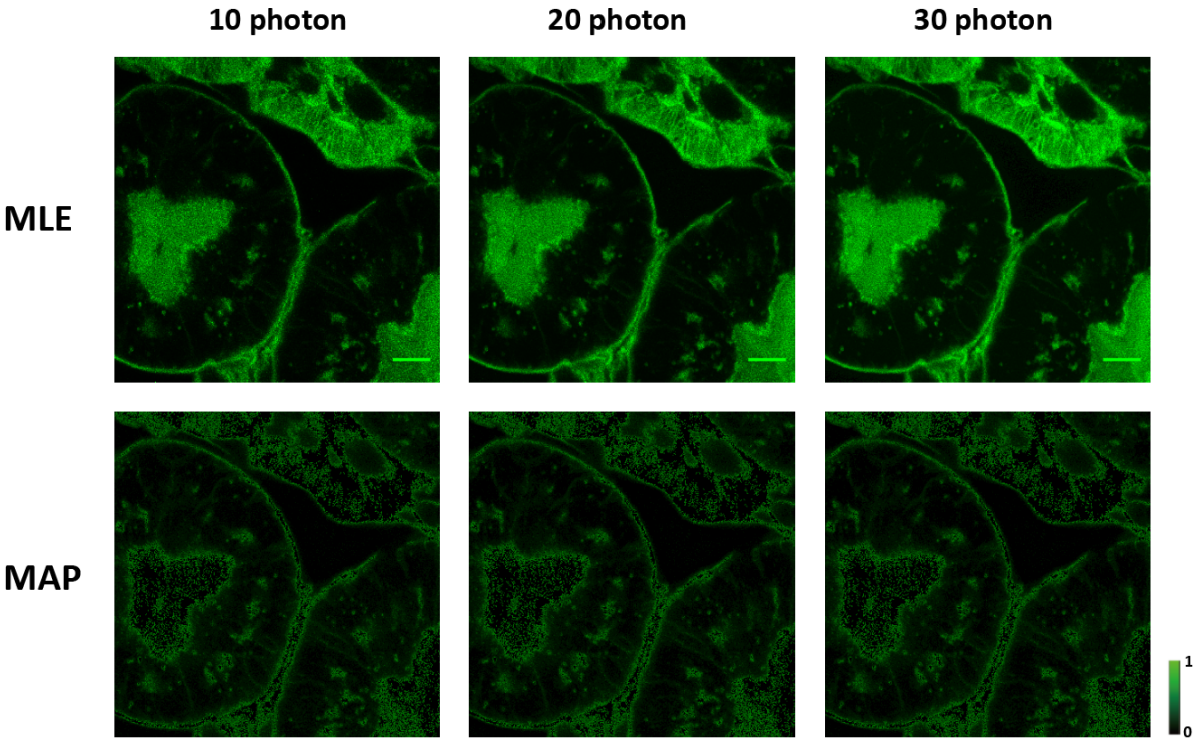

Fig. S2 **Refactoring results of MLE and MAP.** Rows 1 and 2 correspond to the results of MLE and MAP; The first, second, and third columns correspond to the results of the 10, 20, and 30 photon timestamp information.