Amorphous MoSi SNSPDs with a low time jitter and a high detection efficiency

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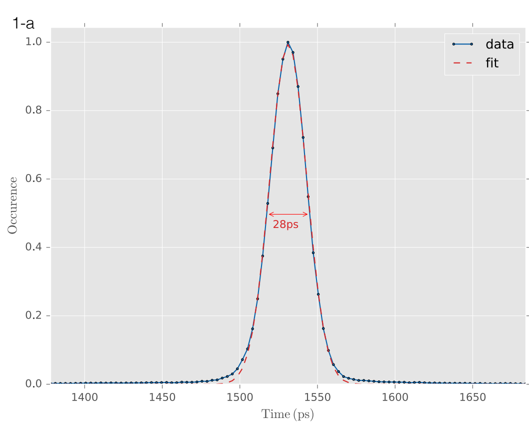
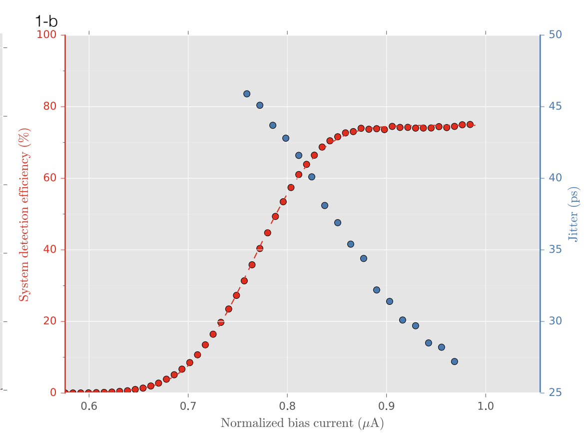
Superconducting nanowire single-photon detectors (SNSPDs) are a key technology for optical quantum information processing [1]. Their low dark count rate, fast response time, small jitter, and high system detection efficiency (SDE) favours their use in various demanding quantum optics applications such as high-speed or long-distance quantum key distribution, quantum networking, device-independent quantum information processing and deep-space optical communication. One recent advance in the SNSPD field has been the introduction of amorphous superconductors such as tungsten silicide (WSi), molybdenum silicide (MoSi) and molybdenum germanium (MoGe). SNSPDs based on these materials currently have the highest reported detection efficiencies (93% with WSi [3]), as well as a high fabrication yield, favouring their use in complex structures such as detectors arrays. One limitation is that they typically operate at lower bias currents, in particular with nanowire geometries that lead to a saturated detection efficiency (a plateau). As a result, high-efficiency amorphous SNSPDs reported so far have a higher detection jitter, because the latter is essentially limited by the electronic noise of the amplification chain. Some previously reported values are 150 ps with 93% detection efficiency with WSi [3], and 76 ps with 87% detection efficiency for MoSi [4].

Obtaining a low jitter and a high detection efficiency requires finding an appropriate nanowire geometry in order to maximise the critical current while keeping a plateau, as well as the use of an optical stack to maximise absorption. In this talk we will report on high-efficiency SNSPDs based on amorphous MoSi exhibiting time jitters lower than 30 ps. For this we fabricated and characterised a series of devices with varying nanowire widths and fill factors. Fig. 1-a shows a jitter histogram for one device having a full-with at half maximum value of 28 ps at a temperature of 0.8 K. The corresponding detection efficiency curve is shown on Fig. 1-b; this device reaches a 75% detection efficiency with a clear detection plateau. Another device with a larger fill factor resulted in a detection efficiency of 85% with a jitter of 40 ps. The influence of the nanowire and meander geometries on the jitter and efficiency will be discussed.





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