1 Explanation of the work carried out

Task number & title *excluding the uptake and exploitation task (JRPs & JNPs only) & management & coordination tasks*	**Task end date in Annex 1**	**Actual task completion date**	**Status:** *inactive, on schedule, delayed to..., or completed*	**Explanation of the work carried out in each task in this reporting period**	
				Summary of the progress towards the aim of each task in this reporting period (max 700 words per task)	**Explain any issues affecting the completion of the tasks (eg describe the cause of delays / deviations etc. and any knock-on effects)** (max 300 words per task)
3.1: Novel quantum sensors in diamond	May 2024		On schedule	**Activity A3.1.1 Activity on schedule**. Temperature dependence of the Mg center in diamond was studied in the 5-300 K range. The centers evidenced a blue shift of the ZPL at decreasing temperature.. **Activity A3.1.2** Not started. **Activity A3.1.3** Not started. **Activity A3.1.4** Activity started ahead of schedule. Preliminary characterization of the first SnV centers in diamond provided by UNITO was performed at PTB. Photoluminescence emission from SnV centers was observed. Characterization of other parameters such as spectrum and g2(0) will be performed next. **Activity A3.1.5** Not started.	
3.2: Novel quantum sensors in non-diamond material	May 2024		On Schedule	**Activity A3.2.1 Completed** The setup to study the optical properties, e.g. spectral characteristic and single-photon emission, of point defects in hexagonal boron nitride (h-BN) materials is completed. The setup consists of a confocal setup in a vertical configuration equipped with an excitation laser with a wavelength of 532 nm. Different air and oil immersion objectives are available for the experiments. **Activity A3.2.2** On schedule. A first h-BN sample with point defects was developed and characterized in terms of its micro-photoluminescence, spectral characteristic, single-photon purity (g2(0)) and saturation curve. Four points defects were characterized in total. All of them present a narrowband spectral zero-photon line emission (FWHM≈30 nm). However, the spectral line for each point defect is different. The single photon purity (g2(0)-value) measured was less than 0.3. The photon flux emission was 1.3 Mphotons/s. The single-photon emission stability remains a challenge. Blinking and bleaching were observed even though the time period of stability differs greatly between different emitters. Next steps will be to improve the stability of the single-photon	

				emission. For this purpose, different annealing methods will be applied, for example heating the sample to 500 °C. In addition, the variation of photoluminescence as a function of an in-plane magnetic field will be characterized. **Activity A3.2.3 Activity has started.** PL investigation of the samples implanted in A1.3.3 confirmed the formation of G- and W- centers in Si, and V_{si} centers in SiC.. **Activity A3.2.4** Not started **Activity A3.2.5** Activity is ongoing. A GaAs/InAS quantum dot single-photon emitter was designed and developed. The emitter consists of an InAs quantum dot embedded in GaAs. Its photon extraction is efficiently maximised by an optical cavity consisting of DBR mirrors in the substrate. The chip dimension is 5 mm x 5 mm. The first characterisation was successfully performed at 1.6K. After M9, the activities on 'photon extraction efficiency' and 'user-friendly high-flux' operation has been continued by further optimising the output grating couplers targeting coupling efficiencies >50% into permanently fixed (glued) single mode fibres. So far up to 35% coupling efficiency has been achieved for test structures. **Activity A3.2.6** Activity started ahead of schedule. Initial investigation of possible detection schemes performed by DFM. A number of schemes that highlight the capability of the Sparrow Quantum single photon source to be used as a quantum probe has been suggested by DFM. DFM will visit SQ in first half of 2023 to determine best implementation plan for proposed schemes. **Activity A3.2.7** Not started.	