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)
4.1: Sensor production methods	March 2024		On Schedule	**Activity A4.1.1** Optical activation of NV centers on a selected set of samples implanted in A1.1.3 in the 300-1200 °C range is under study. **Activity A4.1.2 Completed ahead of schedule**. In situ and laser-induced annealing methods have been explored on a set of implanted diamond Si and SiC samples. In situ annealing in diamond samples enabled to achieve photostable emission higher ensemble densities of NV and MgV centers not accessible with RT implantations due to the material graphitization, PL intensity increased by 14% with respect to conventional RT implantation. **Activity A4.1.3** Not started.	A4.1.1 is partially delayed due to the issues in the delivery of the purchased material (ordered in July 2021) affecting Task T1.1. Expected delay circa 6 months. A4.1.1 on TUBITAK's side, continues with a delay due to issues experienced in acquiring the substrates and later on troubles with the helium ion microscope (flood gun, turbomolecular pump). The activity was resumed after these problems were solved and the first round of annealing is finished. The second and supposedly last round of annealing is planned in the third week of January 2023 and will be followed by the post-anneal characterization. To compensate for this delay, several activities in WP4 started ahead of schedule (A4.1.2, A4.2.2, A4.2.3, A4.3.1, A4.3.2) and A4.1.2 has been completed ahead of schedule.
4.2: Design and modelling of single-atom-like systems	May 2024		On Schedule	**Activity A4.2.1** Activity is **complete**. Recently, the inclusion of atom position and elastic strain using LAMMPS software was perfected. Furthermore, the ETB algorithm was partially rewritten to speed up the calculations considerably and to	

				assure their convergence each time they are run. This activity is fully completed. **Activity A4.2.2** Activity is ongoing. The connection of CI and ETB algorithms was done and tested for ETB with every atom orbital basis. The results reproduce calculations using other methods, like, e.g.,k.p+CI. This activity is, thus, completed. **Activity A4.2.3** Recently, the calculations using sp3d5s* ETB and CI were tested for Ge/Si quantum dots with experimental results, providing very good agreement. Moreover, energies of intersticial atoms in dots were computed as well and compared to available fotoluminescence measurements of Ge/Si QDs. The results of the latter were reasonably good but still need further testing. **Activity A4.2.4** Activity not started	
4.3: Traceability of optical PL detection apparatus	May 2024		On Schedule	**Activity A4.3.1 The activity is completed**. A low photon flux detection system able to operate both in free beam and fibre coupled regimes has been built. The device participated in a campaign in PTB to measure the photon flux of a fibre coupled QuDot based single photon source. The lowest photon flux measured was 400000 photons/s with a noise of about 1 %. A second front end electronics has been designed and built with the purpose to be equipped with a operational amplifier with better noise performance to replace an IC component that has been recently made obsolete. **Activity A4.3.2** The activity progressed and it is on schedule. Aalto, has obtained and used a more sensitive amplifier to account for very low (10 femto A) dark current of the cooled PQED detector in the spectral range of interest (600 nm - 900 nm). This will enable us to achieve lower uncertainties in responsivity at lower photon flux of 1-100 million photons per second traceable to a cooled PQED detector with an uncertainty of < 1 % both in the free-beam and in the fibre-coupled (multi-mode) configurations. **Activity A4.3.3** Not started **Activity A4.3.4** Not started **Activity A4.3.5 Activity started ahead of schedule** Equivalent system under final test for 1550 nm calibration. The 940 nm system design will be finalized based on lessons learned. **Activity A4.3.6** Activity not started	