Supplementary information

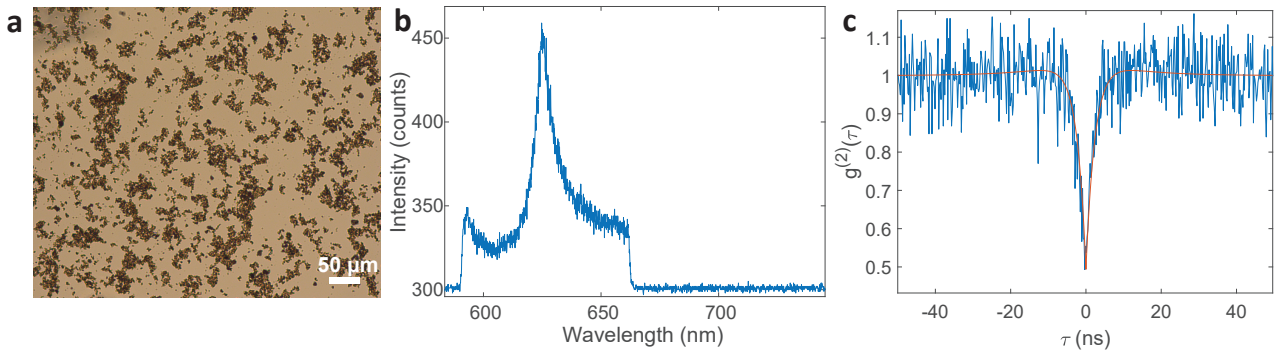

Figure 1: Color centers in hBN nanoparticles exfoliated in IPA and dropcasted on a glass slide. **a)** bright field image of exfoliated nanoparticles on a glass substrate. **b)** ZPL spectrum of a characteristic color center. **c)** Corresponding $g^{(2)}$ function proving the single photon nature of the emission. The measurement is slightly less noisy then in the case of cells, as the sample is fixed and longer acquisitions can be taken.

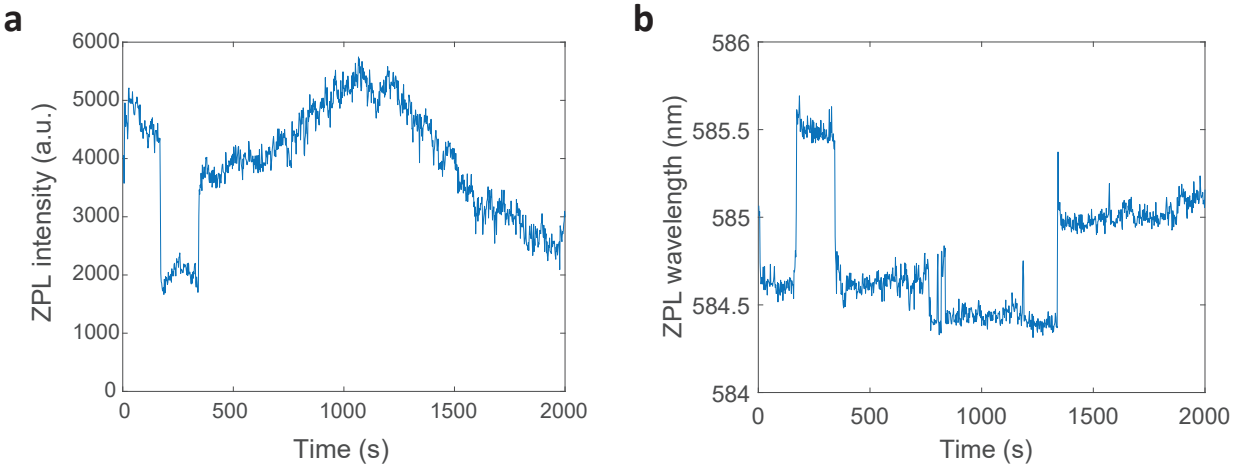

Figure 2: Typical temporal behavior of the color centers. In general, they show fairly steady behavior, with some discrete jumps, both in intensity and emission wavelength. **a)** Intensity changes over long time can be considered reasonably stable. Blinking was observed only in $\approx 5\%$ of investigated color centers. **b)** Emission wavelength is also very stable. Some discrete changes, that are usually accompanied with simultaneous intensity changes, are small and their discrete nature again points towards quantum nature of the sources. No difference regarding this type of behavior for hBN nanoparticles dropcasted on a glass slide and those internalized by cells was observed. This type of behavior does not present any significant drawbacks to our method. For barcoding, the intensity variations do not present a problem since the ZPLs are very prominent and the intensity remains high even if blinking occurs while wavelength variations are small ($< 1\,\mathrm{nm}$) in comparison with typical ZPL width (median $3.59\,\mathrm{nm}$).

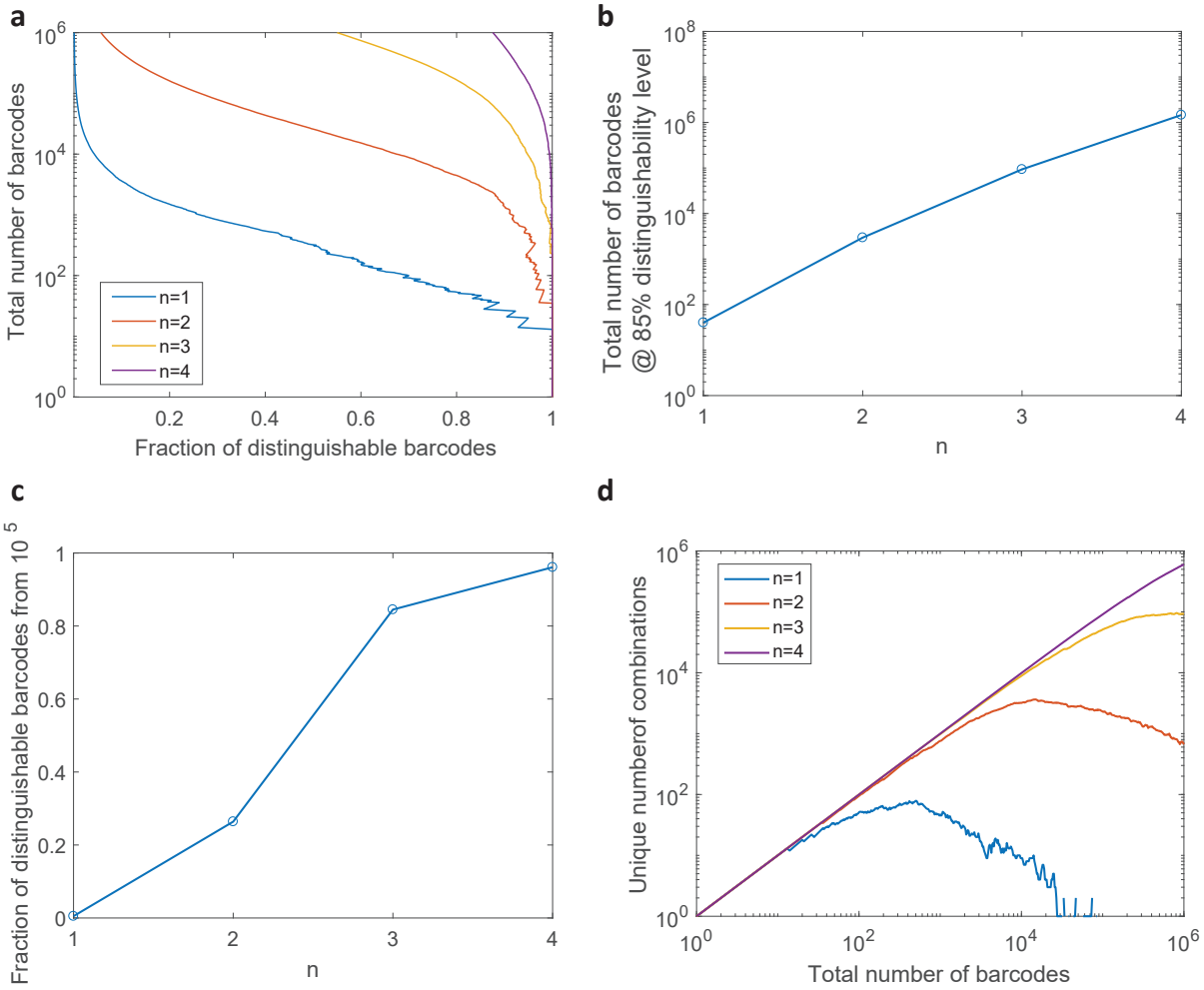

Figure 3: Monte Carlo calculation of spectral barcodes with different color centers inside each cell. **a)** Calculation of how large is the barcode sample size at a given distinguishability percentage. This would in practice correspond to how many cells we can have in the sample so that a given percentage of them will be distinguished. **b)** Total number of barcodes at 85% distinguishability level for different n, denoting number of spectral peaks in each barcode, i.e. number of color centers per cell. This relates to the sample size where 85% of the cells are distinguishable. It can be seen that the value is increasing approximately exponentially when increasing n. **c)** Alternatively, we can look at a sample of given size, in this case 10^5, and determine how the fraction of distinguishable barcodes changes with increasing n. Values of n above 4 would only be needed when one would want to realize well above 10^5 distinguishable barcodes. **d)** Another useful information is how many unique barcodes we can get, meaning that not only are they distinguishable but they also do not have duplicates. Already for $n = 4$ and for practically useful numbers of barcodes up to 10^6 the number of unique and distinguishable barcodes are almost the same.