Supplementary Figure 1 | Numerical fits of experimental and theoretical results of ^{nat}**Si:P electron spin decoherence by exponential functions** $\exp\left[-T/\tau_{ID}-\left(T/\tau_{SD}\right)^{\lambda}\right]$. **(a,c)** Experimental or **(b,d)** theoretical (solid lines) and fitted (dashed lines) coherence of the P-donor electron spin in the natural ^{29}Si nuclear spin bath under **(a,b)** CPMG or **(c,d)** UDD control. Here the same value of $\tau_{ID}=10$ ms was used in all the fits. We attribute the deviation seen at ~1 ms for CPMG-6 to an overlap with uncorrected stimulated/unwanted echoes. The magnetic field was $B=0.3$ T applied along the [110] lattice direction.
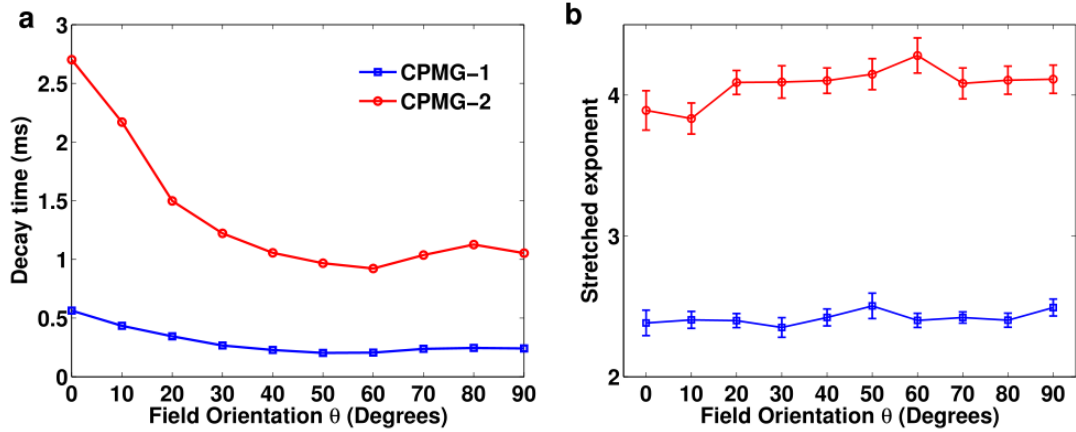
Supplementary Figure 2 | Theoretical angular dependence of the decay time and stretching factor of central spin decoherence under dynamical decoupling. (a) the decay time τ_{SD} depends strongly on the field orientation. **(b)** the oscillations of the stretching factor λ with different field orientations are very small compared to the pulse number-parity oscillations. This implies that the pulse number-parity effect can be observed for any field direction. The crystal orientation is done in the [001]-[110] plane with the relations: [001] ($\theta = 0°$), [111] ($\theta = 54.73°$) and [110] ($\theta = 90°$). The error bars correspond to the systematic errors of the stretched exponential fitting of the time-domain spin decoherence.