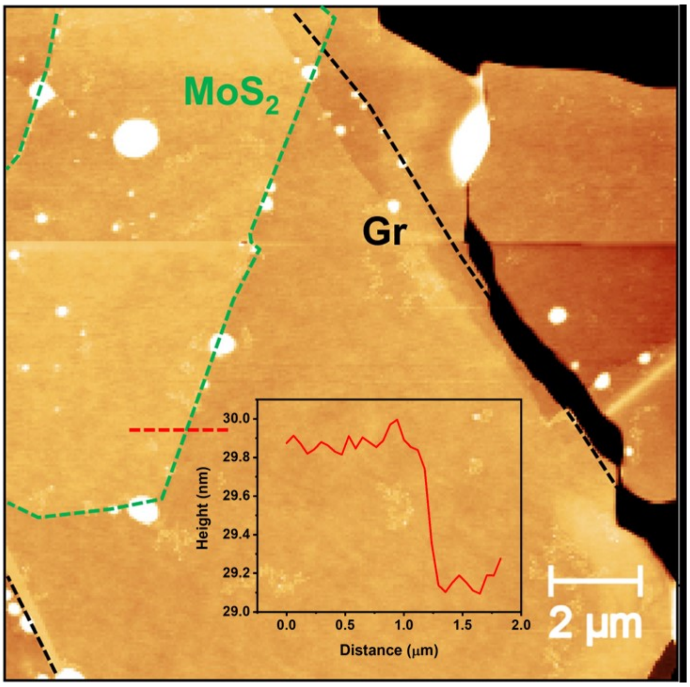
Supplementary figures:

S0:AFM image of SL MoS_2 flake

Atomic force micrscope image shown below confirms the single layer MoS_2 in our device. This is further confirmed by PL measurements shown in Figure 1D in the main text.



S1:Mobility calculation

We can estimate electron mobility in our device from the I_d-V_{bg} trace shown below (same as in Figure 1I of the main text). The transconductance trace can be split into three regions. Below $V_{bg} < 6V$, the device is in the OFF state. Between 6V to 7V, I_d increases linearly and above $V_{bg} > 7V$, the I_d starts to saturate where the I_d is limited by the contact resistance of the device. To calculate the mobility, we use the relation:

$$\mu = \frac{dG \quad L \quad 1}{dV_{bg} W C_g} \quad \ldots \ (1)$$

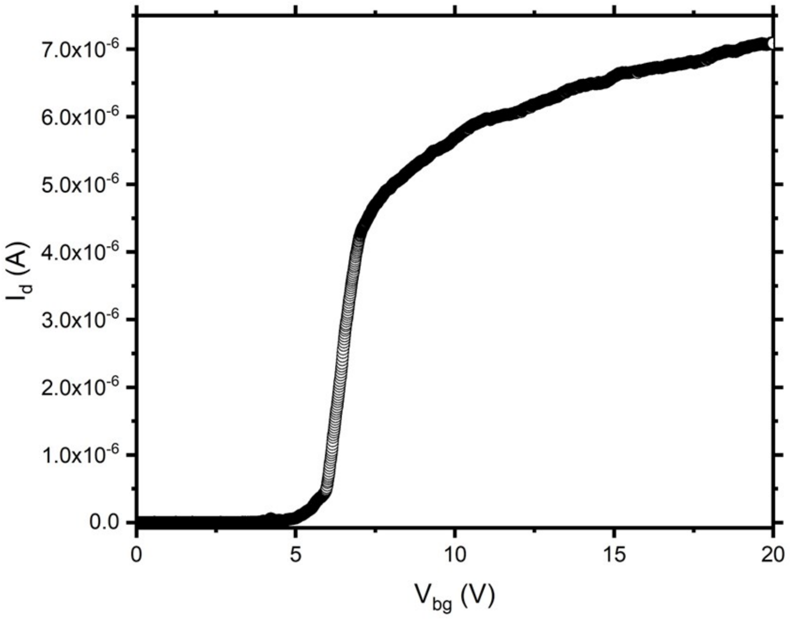
Where dG/dV_{bg} is the rate of change of conductnace as a funtion of backgate votlage, L = length of the channel (10.25 μm), W = width of the channel (8 μm), $G = I_d/V$ and C_g is the gate capacitance. The gate capacitance can be calculated by considering the dielectric environment between MoS_2 and the backgate. In our case, the gate dielectric comprise of 285 nm of SiO_2 and 30 nm of hBN. Therefore the gate capacitance C_g is given by:

$$C_g = \epsilon_0 \frac{\epsilon_{SiO2}\epsilon_{hBN}}{\epsilon_{hBN} t_{SiO2} + \epsilon_{SiO2} t_{hBN}}$$

$$C_g = \epsilon_0 \frac{(4)(4)}{4(285 \times 10^{-9}) + 4(30 \times 10^{-9})}$$

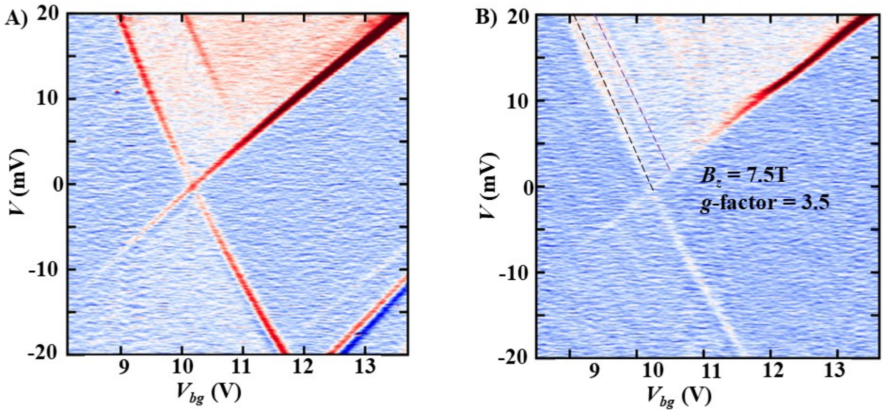
$$C_g = 1.12 \times 10^{-4} F/m^2 \quad \dots (2)$$

Using eq.1, we fit the higher backgate voltage range to estimate a mobility of ~27,000 cm²/V.s. However, we emphasize that it is difficult to extract the gate-channel capacitance accurately in dual gated device geometry using parallel plate capacitor model in two-terminal measurement configuration. Moreover, gate voltage dependent contact resistance needs to be taken into account to extract the exact mobiltiy. Hence, the actual mobility in our device can be upto one order of magnitude lower than the extracted value (i.e. few thousands cm²/V.s.).



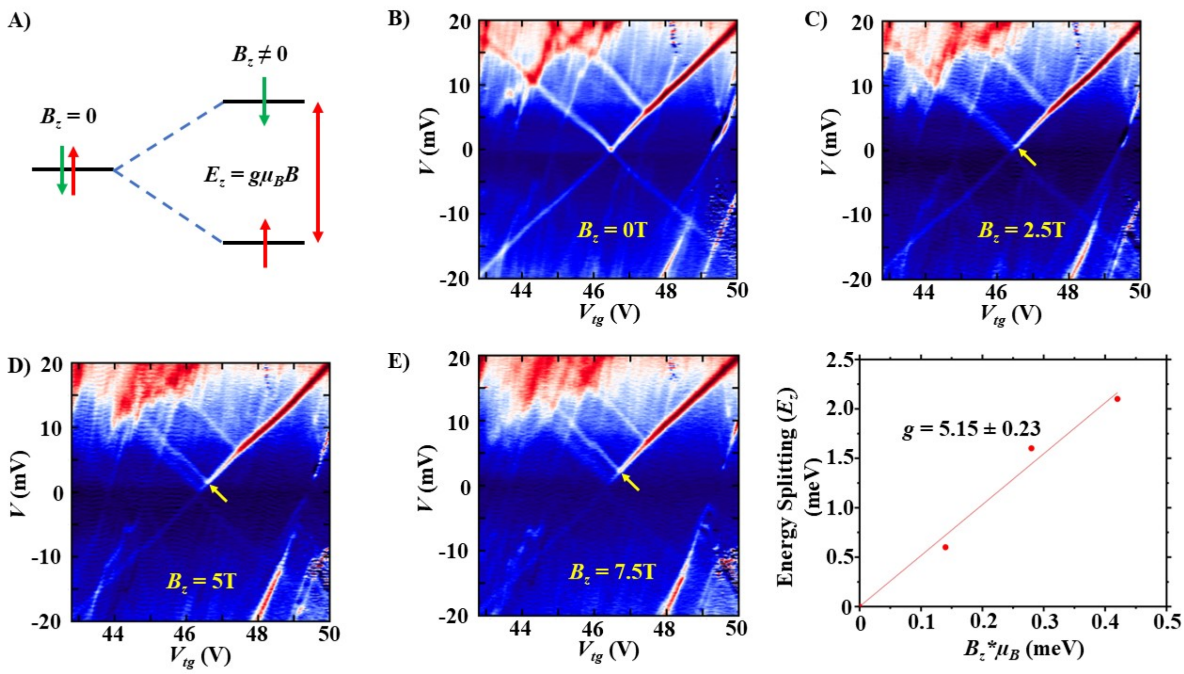
S2: Zeeman splitting of crossing A shown in main text figure 2B

Evolution of CB diamond A shown in main text Figure 2B under perpendicular magnetic field. The figure below shows CB diamond A measured at B_z = 0T (Figure S2A) and B_z = 7.5T (Figure S2B). We see a spliting of ground state at higher magnetic field. From the splitting we extract a *g*-factor of 3.5 which is lower than the value observed for CB diamond B and C but still higher than the previous reports. The spin filling order in CB diamond A is consistent with that of CB diamond B shown in the main text.



S3: Zeeman splitting of crossing C shown in main text figure 2B

We measure the g-factor for CB diamond C as well. We compare the same CB diamond under different magnetic field to measure Zeeman splitting. Figure below B-E shows CB diamond B measured for B_z = 0T, 2.5T, 5T and 7.5T. We observe Zeeman splitting of the ground state due to lifting of spin degeneracy (marked by yellow arrow in Figure S3 C-E below) which increases with increasing B_z. From the evolution of the Zeeman splitting as a function of the magnetic field, we can extract the electron g-factor for CB diamond C. In Figure F below we plot the extracted Zeeman energy as a function of the B_z and we extract a g-factor of 5.20 ± 0.17. The spin filling order in CB diamond C is consistent with that of CB diamond B shown in the main text.



S4: Dependence of quantum dot energy level on back gate and top gate

To examine the coupling of the top gate to the QDs, we measure the CB peaks as a function of V_{bg} and V_{tg} at $V = 5$mV. For a QD equally coupled to both the gates, we expect a slope of -1 in the V_{bg}-V_{tg} space. In our device, V_{tg} is much closer to the MoS_2 channel (~ 10nm thick hBN dielectric) than V_{bg} and hence an asymmetric coupling is expected. We look at the CB peak (Figure 5A) which corresponds to single charge transition and use the relation $Q = CV$ where Q =1e and C corresponds to capacitive coupling and V is the gate voltage. Since we are looking at single charge transition dependence as a function of V_{tg} and V_{bg}, we can equate $V_{tg}/V_{bg} = C_{bg}/C_{tg}$.

where C_{tg} is top gate capacitance coupling to QD and C_{bg} is the back gate capacitance coupling to the QD. From the slope of the first charge transition in the figure below, we get a $C_{tg} = 69 * C_{bg}$ supporting our claims that the QDs are strongly coupled and located below the top gate.