in *I***G A**

$$
\begin{array}{ccccccccccc}\n. & B & \mathbf{\hat{g}}_{1} & \mathbf{r}_{1}^{1} & D. & \mathbf{r}_{1} & \mathbf{r}_{2}^{2} & \mathbf{r}_{1} & \mathbf{r}_{2} & \mathbf{r}_{1} & \mathbf{r}_{2}^{1} & \mathbf{r}_{2} & \mathbf{r}_{1} & \mathbf{r}_{2}^{2} & \mathbf{r}_{1} & \mathbf{r}_{2}^{2} & \mathbf{r}_{1} & \mathbf{r}_{2}^{2} & \mathbf{r}_{1} & \mathbf{r}_{2} & \mathbf{r}_{1} & \math
$$

We present experimental magnetotunneling results and atomistic pseudopotential calculations of quasiparti-measurements of the *energies* of characteristic processes \vec{s} as the form \mathfrak{t} and \vec{s} and charging of excitons.

> the t \mathbb{Z}_2 of \mathbb{Z}_2 of \mathbb{Z}_2 \mathbb{Z}_2 of \mathbb{Z}_2 o $-f_{U}$ is the set of \mathbb{Z} of \mathbb{Z} and \mathbb{Z} of f_{U} is the set of \mathbb{Z} is the set of \mathbb \overline{g} .

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 \vec{s} \vec{s} \vec{r} \vec{s} \vec t um $t\bar{s}$, r the t transferred method.^{1[,16](#page-6-6)} Γ are investigated by capacitance-voltage Γ $\begin{array}{ccccc}\n & \text{if} &$ $r \overline{s}$ ft to $r \overline{s}$ tt contacts respect to a carrier respect to a carrier respect to $r \overline{s}$ and $r \overline{s}$ $\mathfrak{p} = 1$ by \mathfrak{p} . Characteristic maxima in the capacitety \mathfrak{p} tance appear time and time $t=1, 1, 1, 1, \text{tr}$ and $(\text{tr} \cdot \mathbf{1})$ $\left(\frac{1}{2} \right)$

 \vec{s} u $\overline{\text{A}}$ u \vec{s} f capacitance maximum is a measure of tunneling \mathbf{m} $t = t$ and the back contact.

 $\frac{19}{11}$ $\frac{19}{11}$ $\frac{19}{11}$ $\frac{1}{31}$ $\frac{1}{11}$ $\frac{1}{3}$ $\frac{1}{1}$ $\frac{1}{1}$ $\frac{1}{3}$ turn, \vec{s} is the proportional to the probability density density of the probability density of the \vec{s} particle wave function in space. $\frac{5,6,20}{\text{g}}$ $\frac{5,6,20}{\text{g}}$ $\frac{5,6,20}{\text{g}}$ $\frac{5,6,20}{\text{g}}$ expansion in space. principal out the \mathfrak{g}_1 of \mathfrak{g}_2 or \mathfrak{g}_3 or \mathfrak{g}_4 or \mathfrak{g}_5 or \mathfrak{g}_7 or \mathfrak{g}_8 or \mathfrak{g}_7 or \mathfrak{g}_8 or \mathfrak{g}_7 or \mathfrak{g}_8 or \mathfrak{g}_9 or \mathfrak{g}_9 or \mathfrak{g}_9 or $\mathfrak{g$ m_1 m_2 and m_3 as a function of the in-plane magnetic field for f fferent met ler tte \vec{z} .

 \vec{s} **t**, **i** \vec{s} m **i** \vec{s} **c** \vec{a} **c** $A\vec{s}$ (Al_x \vec{a} *x*As) \mathbb{S} , \mathbb{S} , \mathbb{S} , \mathbb{S} by molecular beam epitation by molecular beam epitation by molecular beam expansion of \mathbb{S} . bedded Indian Indian \mathbb{S} -doped hole-domena (1) \mathbb{S} m 1 \mathbb{S} prepared as described in Ref. [12,](#page-6-2) however, with a slightly \mathbb{R} of \mathbb{R} slightly \mathbb{R} $t = r\mathbf{t}$. $1/\sqrt{r}$ n r f 19 nm to facilitation $f = f(\cdot, t)$. m density. The 1 and $f \overline{g}$ is defined the *n*-doped sample f and f and f $\frac{1}{x}$ found in Terms can be found in $\frac{7}{x}$ $\frac{7}{x}$ $\frac{7}{x}$ \mathfrak{g} or \mathfrak{g} and \mathfrak{g} are prepared by all \mathfrak{g} and \vec{g}_{1} , C_{1} -Au $_{1}$, $_{1}$ \vec{g} (300 300 m²) . The *C*-

[1–](#page-5-0)[4](#page-5-1)

 $\mathbf{g} = \mathbf{t} \cup \mathbf{t}$ of $\mathbf{r} = \mathbf{l} \cup \mathbf{f} \cup \mathbf{t}$ and $\mathbf{r} = \mathbf{t} \cup \mathbf{t}$ through engineering of the *wave functions* themselves through manipulation of their degree of localization, spatial \mathbf{r} and \mathbb{R} transferred removements or angular-momentum character. The first crucial called at c_1 and c_2 allows the design of a device on the devi fundamental level of its f is \mathcal{F} of \mathcal{F} is a vector is \mathcal{F} is \mathcal{F} is a vector is wave-function contribution \mathcal{F} is a vector is defined as \mathcal{F} is a vector \mathcal{F} is a vector \mathcal{F} is a function monitoring along with an understanding \mathfrak{g}_1 and \mathfrak{g}_2 and \mathfrak{g}_3 and \mathfrak{g}_4 and \mathfrak{g}_5 trolling physical parameters. However, \mathbb{F}_p and \mathbb{F}_p is the experimental parameters. imaging $\frac{5}{10}$ and the many-particle calculations of the many-particle many-particle many-particle wave functions of dots present a formidable challenge. From the theoretical point of view, the tradition $\mathbb{Z}[\mathbf{r}_1]$ and \mathbf{r}_2 is largely been to the top \mathbf{r}_1 f mas_x r levels by a few paramthe confining potential potential potential p and p and p and p and p r , 1. If $r = m$ is m is, r r n n n n energy-related quantities e.g., the molecules or \mathbb{F} or \mathbb{F} in the molecules or \mathbb{F} or $\frac{1}{\sqrt{2}}$ fine-structure splittings-controlling physical reality on the state \mathbb{Z} on the state than the state of \mathbb{Z} . \mathfrak{g} theoretical determination of wave functions is is m ore challenging than $m=1$ and f the corresponding of the corresponding of the corresponding α e^+e^- ies because of their high sensitivity to subtlementary to subtlementary to subtlementary to subtlementary \mathbb{R}^2 \vec{s} if if is reflected to the instance terms of piezoelectric terms or particleparticle correlations of r is $r \sin \theta$ if $r \sin \theta$ is the energy θ is $r \sin \theta$ y_{max} affect $-\frac{f_{\text{max}}}{s}$ shapes rather clearly. In this shapes rather clearly. In this shape $\frac{f_{\text{max}}}{s}$ paper, we present a combination of experimental magnetothus the technique and a prediction technique theoretical modeling of $\mathbf r$ f_{1} wave \overline{g} that g is an unprecedent into \overline{g} into \overline{g} into \overline{g} the physics of carriers in confined geometries. The physics of com- \mathbf{r} bined approximate a direct and physical p cal problems such as the such as the hole filling sequence $\frac{12,13}{1}$ $\frac{12,13}{1}$ $\frac{12,13}{1}$ that violates the Aufbau principle, the method of the atomistic of the atomi symmetry, correlations, and piezoelectricity and $\frac{1}{2}$ and $\frac{$ the decade-old \mathfrak{g}_1 \mathfrak{g}_2 in \mathfrak{g}_3 where \mathfrak{g}_4 in \mathfrak{g}_5 in \mathfrak{g}_7 the setting of self-assemble \mathfrak{g}^{15} setting by shapes in the shape shapes of setting \mathfrak{g} and $\overline{\mathbf{s}}$ tr (1.43) r 1.tr 1.3. 1.

 $\bf E$ imaging and atomistic modeling of electron and hole quasiparticle wave functions $\bf E$

spectroscopy was carried out using a standard *LCR* meter $(A_1 \t1.1 \t42.4A)$ $1 \t m.11$. f $= 10 \text{ m}.$ f_{r} , $\sqrt{3}$ r r t 1 $\sqrt{3}$. $\left(\begin{matrix} 0 & 40 \end{matrix} \right)$ $\left[\begin{matrix} 0 & 1 & 1 \end{matrix} \right]$ to the capacitance and r if $\left[\begin{matrix} 0 & 1 \end{matrix} \right]$ tunneling rate. 7.19 To determine the tunneling probability as a 1 to $\bar s$ is function of \mathfrak{g} and the map out the \mathfrak{g} and 1 function in momentum space, $C-\vec{s}$ in for $i=1,\ldots,1$ space up to $B=26$ and for angles in the form $f(x)$ and \therefore r ll 1 t [011] r 3t 1 r t . $i-1$ $i-1$ mm ψ m $\Vert f \Vert$ $\Vert f$ from $\Vert f \Vert$ $\Vert f$ *C*- amplitudes of the different charging peaks 0–6 carriers \mathbf{r} (**b**) \mathbf{r} [1](#page-1-0) **u** \mathbf{r} **f** \mathbf{r} **i f** \mathbf{r} **i f i i f i f i i f i f i i f i f i f i f i f i f i f i f i f i f i f i f i**

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A full theory of magnetotunity of late \mathbb{Z}/\mathbb{Z} of $\$ consistent consistent calculation of the transport properties of the full \mathbb{Z} of the full \mathbb{Z} \sqrt{s} stem \sqrt{r} to \sqrt{r} is a and \sqrt{r} is still problem at an analysis \sqrt{r} $\mathbf{u} \mathbf{m} \mathbf{g}$ 1 1 f $\mathbf{r} \mathbf{g}$ 1 $\mathbf{v} \mathbf{g} \mathbf{g}$ $\mathbf{m} \mathbf{g} (=10^6 \mathbf{u} \mathbf{m} \mathbf{g})$. \mathbf{g} , \sqrt{s} simplified transmission theory, which is stated to $\sin \theta$ nonlinear field and device structure effects of each \mathbb{R} and \mathbb{Z} as measures the emitted tunneling tunneling states are stated to examine the emitter states are states are stated to examine the emitted states are stated to examine the examine of \mathbb{Z} are stated to \mathbb \mathbf{v} . See that they are in \mathbf{v} $q \equiv \frac{1}{2}$ dot state $\frac{1}{2}$ to state calculated the trans- \sqrt{s} to rate of an electron contribution or $\sin t$ and $\sin t$ in state to $\sin t$

a quantum dot containing particles following particles for f Barden.²¹ In this approximation, the transition rate is given by ,

 $\big)$

 r tion, where r is $1 \nvert \vec{z}$ in the $2 \nvert \vec{z}$ in the r Aufbau principles and right partition of r at 1 $r \overline{\ast} 1$ result where $1 \overline{\ast} 1$ results in $D \overline{\ast} 1$ results in $D \overline{\ast} 1$ figures being very different, we conclude that \vec{s} and \vec{s} and \vec{s} \mathbb{R} strong indicated, independent that, independent is filled before it finishes of \mathbb{R} or \mathbb{R} is finishes of $t = 2$ state. This is one of our main findings. Recent theoretical calculations \mathbb{R}^{25} showed that even for a showed that \mathbb{R} is a showed that even for a showed that

conventional filling of the shells, following the Aufbau printciple, the magnetic field dependent charging may depend charging may describe $f(x)$ the experimental results of r in r . $\frac{12}{3}$ $\frac{12}{3}$ $\frac{12}{3}$ therefore challenging the interpretation of an unusual shell fill filling. We believe $\mathbb{E}[Y]$ that our magnetotunneling spectroscopy results give a $\frac{1}{3}$ and $t = 1$ and $t = \frac{1}{2}$ $\frac{13}{15}$ $\frac{13}{15}$ $\frac{13}{15}$ $\frac{13}{15}$ of a violation of the Auf_{bau} principle.

For $\frac{1}{2}$ the $1, 5 \rightarrow 6$ regains some anisotropic charat r different maxima along the 110 directions. final state is still mainly given by holes in *D* states, ⁰ 2 1 2 3 2 , but now \mathfrak{g} multiple percentage of 77% . The m and r 23% are configurations that include 2 state that m may $1 \cdot t$ [110] $r \cdot t$. This is \mathbb{Z} ff e of f or e in the tentant form in terminor inportant for f

122 (2000). $\frac{6}{7}$ A. **p** ., **g** . B **65**, 16530. (2002).