SINGLE- PARTICLE VS.
COLLECTIVE

1) 2 CLASSICAL MAGNETIC MOMENTS
\[ \uparrow \downarrow \uparrow \downarrow \text{ etc. } \text{LOCALIZED} \]

2) CHAIN OF MAGNETIC MOMENTS:
MAGNONS (SPIN WAVES)

\[ \uparrow \quad \text{VIEW FROM THE TOP: } \mu_x = \mu_0 \sin(kx-\omega t) \]
\[ \mu_y = \mu_0 \cos(kx-\omega t) \]

\[ \uparrow \quad \text{etc. } \text{COLLECTIVE EXCITATIONS: } \text{DELOCALIZED} \]

NANO: DISCRETE MAGNONS
MAGNETIC MOLECULES: Fe_{10} FERRIC WHEEL