

# PROBABILITIES

Physical world	Mathematical model
outcomes of an experiment $\odot$ event $\heartsuit$ frequency (of the event's occurrence if I repeat the experiment) $f = \frac{\# \text{ times event occurred}}{\# \text{ times exp. repeated}}$	set $S \uparrow$ subset $E \subset S$ probability (of $E$ ) $\ast$ $p = \frac{\# E}{\# S}$
throwing $\odot$ 2 dice (@ the same time) on same table event: sum is 7 $f \sim \frac{1}{6}$	$S = \{11, 12, \dots, 66\} = \left\{ \begin{matrix} 11, \dots, 16 \\ 21, 22, \dots, 26 \\ \dots, 66 \end{matrix} \right\}$ $E = \{16, 25, 34, 43, 52, 61\}$ $p = \frac{6}{36} = \frac{1}{6} \quad \ast\ast$
"throwing" 2 bosons $\odot\odot$ (@ same place & time) event: sum is 7 $f \sim \frac{1}{7}$	$S = \left\{ \begin{matrix} 11, 12, \dots, 16 \\ 22, \dots, 26 \\ \dots \\ 66 \end{matrix} \right\}, E = \{16, 25, 34\}$ $p = \frac{3}{21} = \frac{1}{7} \quad \ast\ast\ast$
"throwing" 2 bosons in 2 diff places event: sum is 7, $f \sim \frac{1}{6}$	like for 2 dice (question: how close should 2 bosons be in order for them to lose their identity?)
"throwing" 2 fermions $\odot\odot$ (@ same place & time) event: sum is 7 $f \sim \frac{1}{5}$	$S = \left\{ \begin{matrix} 12, 13, \dots, 16 \\ 23, \dots, 26 \\ \dots \\ 56 \end{matrix} \right\}, E = \{16, 25, 34\}$ $p = \frac{3}{15} = \frac{1}{5} \quad \ast\ast\ast$
"thr" 2 fermions in 2 diff places $f \sim \frac{1}{6}$	like for dice
$\odot\odot$ eg H atoms (id. looking); say they have 6 poss states & identically looking or differently looking $\heartsuit$ may or may not occur in each experiment $\odot$ that allows repetition (e.g. ... not "my death") $\ast$ math model correct if $f \sim p$ as $\# \text{ exp} \rightarrow \infty$ .	$\ast\ast\ast$ (& fermions) bosons act as if they are identical so dice model incorrect (i.e. oct as if) $\ast\ast$ identically dice "know they are distinct" (looking) distinct, ord irrelevant $\uparrow$ Cantor's definition $S = \{a, b, c, \dots\}$
$\odot\odot\odot$ e.g. electrons (Pauli exclusion principle); say 6 poss states	