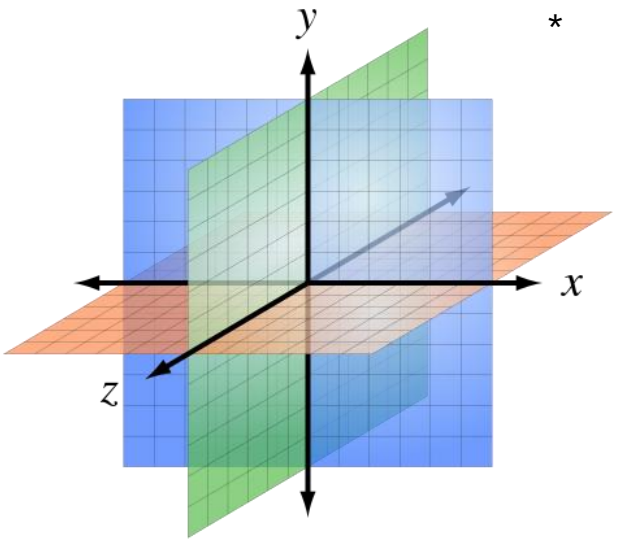
Degrees of freedom

- The maximum number of logically independent values, which are values that have the freedom to vary, in the data sample.
- In CT we want to describe the state of a system
- The DoF are the number of independent variables that are needed to fully describe the state of the system
- E.g. ideal gas:
  - We have 4 variables, p, V, T and n
  - But they are not all independent
  - We have the constraint that $pV=nRT$
  - Hence, if we know 3 of the variables the 4^{th} is fixed
  - So, 3 DoF

Example from Properties of Matter

- Translational degrees of freedom = 3 (e.g. *x*, *y*, *z*)
- So, sideways, up/down or straight at you/away from you
- What about diagonally?
- Diagonally is just a (weighted) sum of the cartesian coordinates = constraint) – so not independent



*

Set of linear equations

- Can only be solved when the number of independent variables equals the number of independent equations (constraints)
- In this case there are no degrees of freedom
- $x + y = 5$
- $x - y = 3$
- Two variables + 2 equations (constraints)

- $x + y + z = 5$
- $x + 2y - z = 3$
- Three variables + 2 equations (costraints) $\Rightarrow$ 1 DoF
- Can choose 1 variable freely, but then the other two will be fixed.