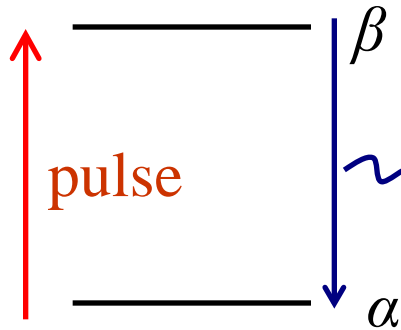


# NOE in detail

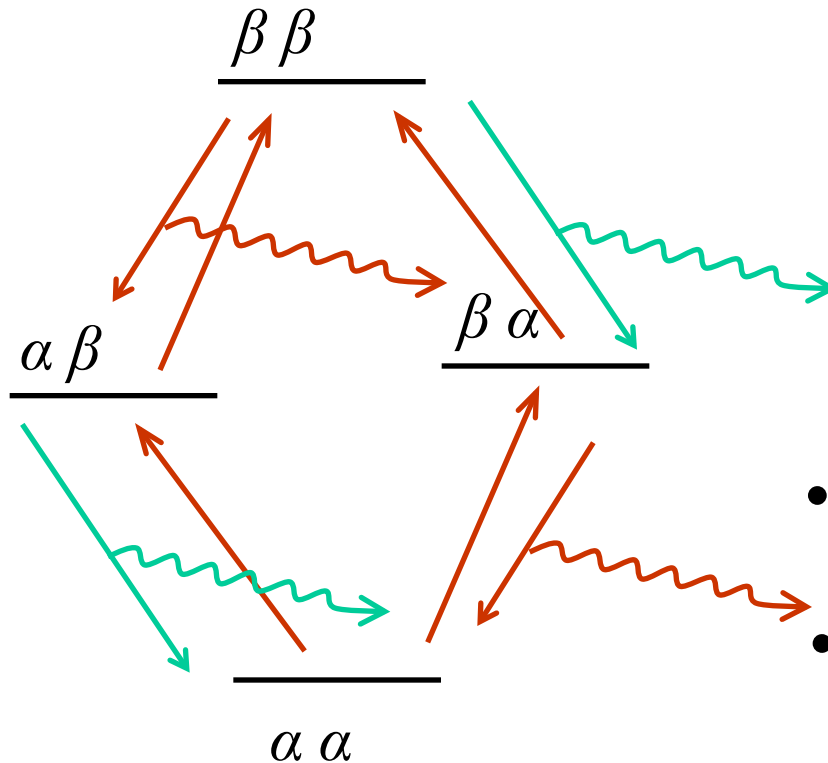
- If I have one spin, there are two energy states



- If I have one spin, there are two energy states
- I see a signal if I
  - pulse and send spins from  $\alpha$  to  $\beta$
  - record the jump from  $\beta$  to  $\alpha$

# two spins

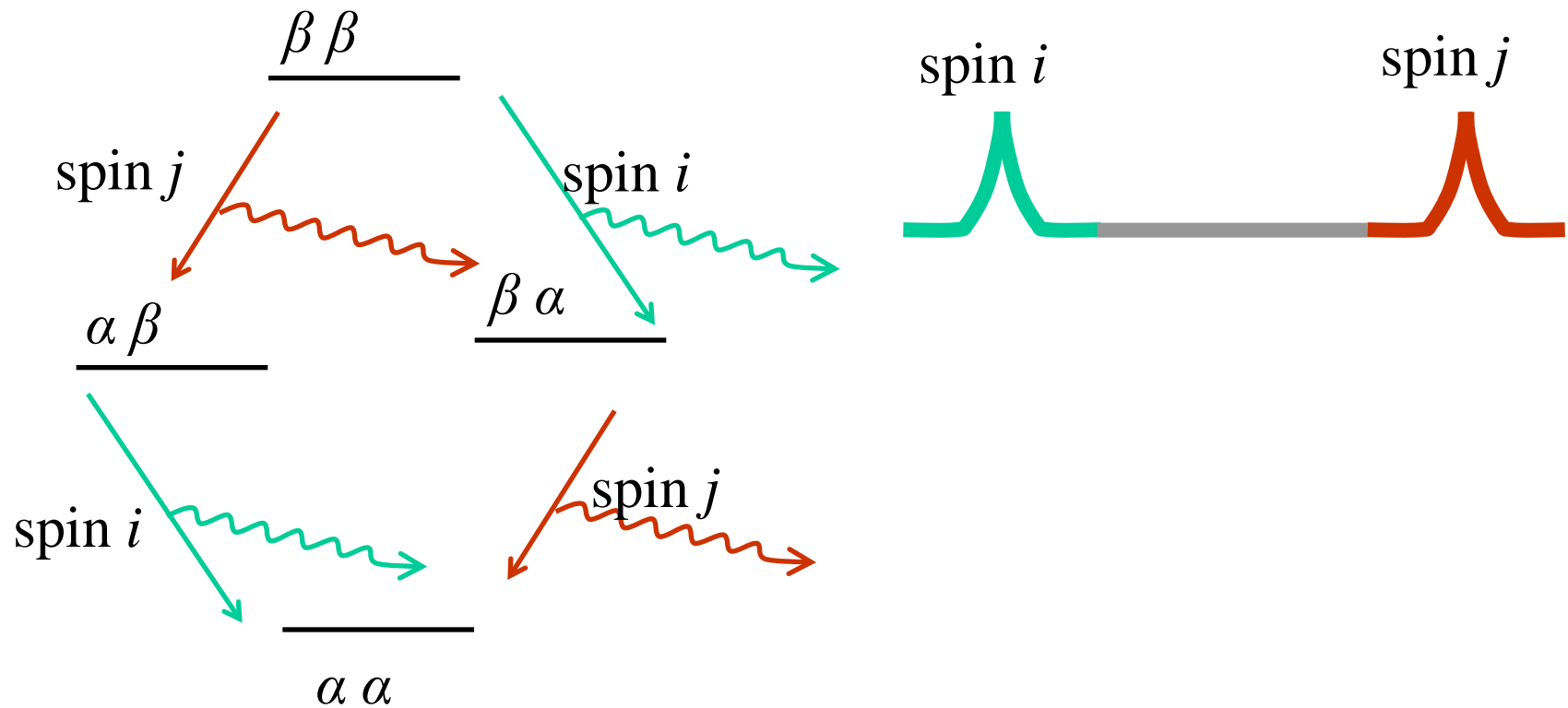
- dipolar coupling, through space



- pulse affects all transitions
- we record the relaxation
  - blue spin
  - red spin

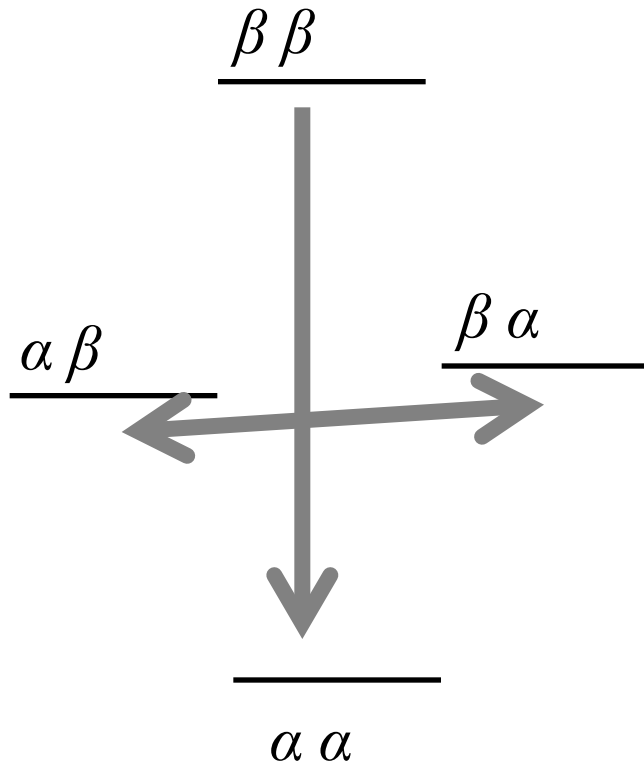
# allowed transitions

- the energy differences are all observable (one quantum)



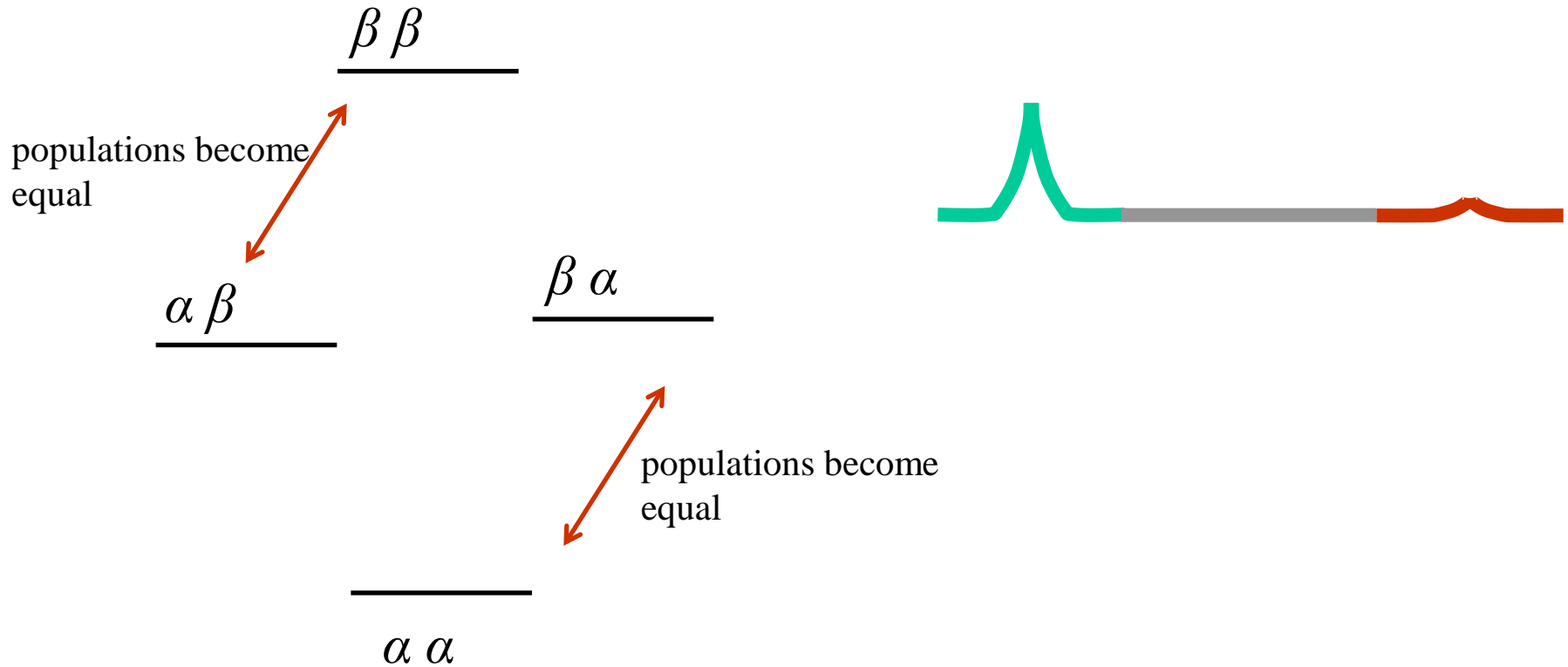
# forbidden transitions

- double quantum
- zero quantum



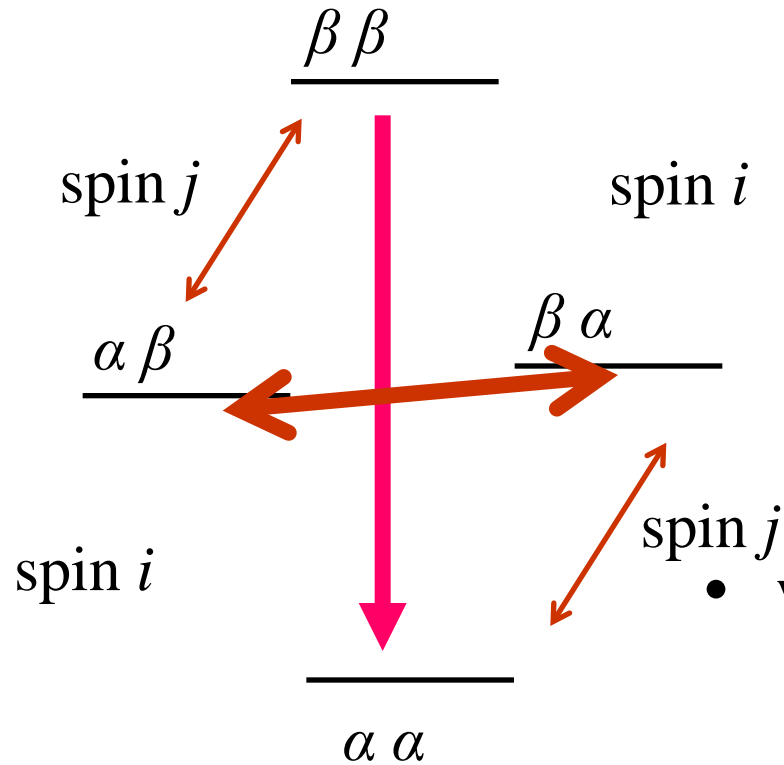
# saturating a spin

- pour in energy at frequency of red spin (spin  $j$ )



# saturating a spin

- pour in energy at frequency of red spin

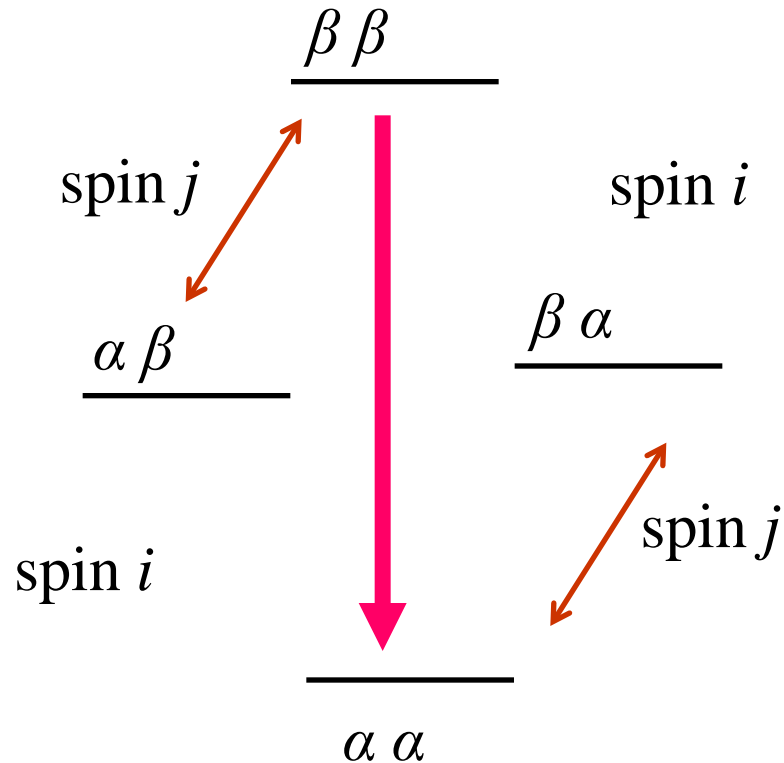


- we get relaxation via the

- double quantum path
- zero quantum path

# saturating a spin

- pour in energy at frequency of red spin



- we are putting energy into  $j$
- every double transition
  - $\beta \beta \rightarrow \alpha \alpha$
  - $i$  population changes

# what has been happening

- we radiate one spin ( $j$ )
- the population levels of a neighbour spin change ( $i$ )
- we record a different intensity for  $I$
- how strong is the effect ?
  - depends on coupling of  $i$  and  $j$
  - depends on distance in space
    - this is not an effect through bonds