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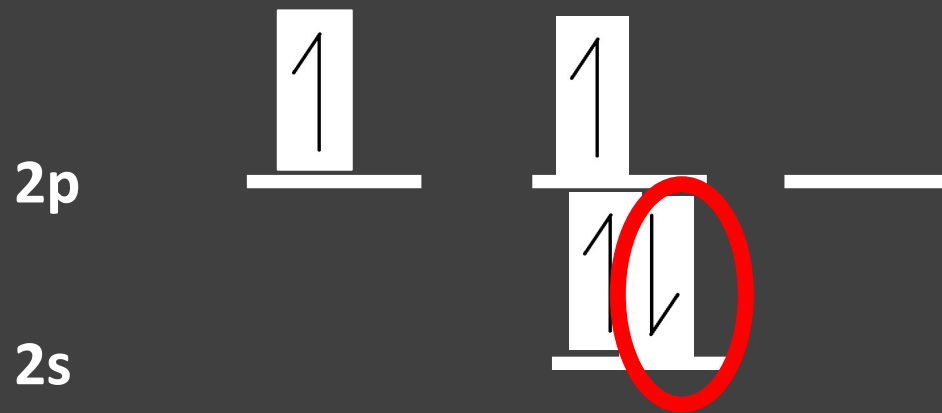
Dr Simon Orchard

Hybridisation of Atomic Orbitals Part 3 - sp hybrids

These slides may be downloaded at <https://www.chemistrytuition.net/>

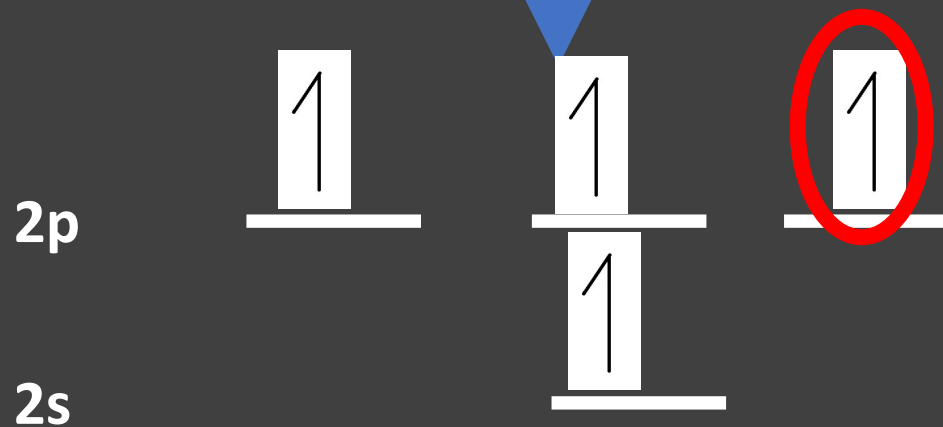
Recap:

Hybridisation
of Orbitals



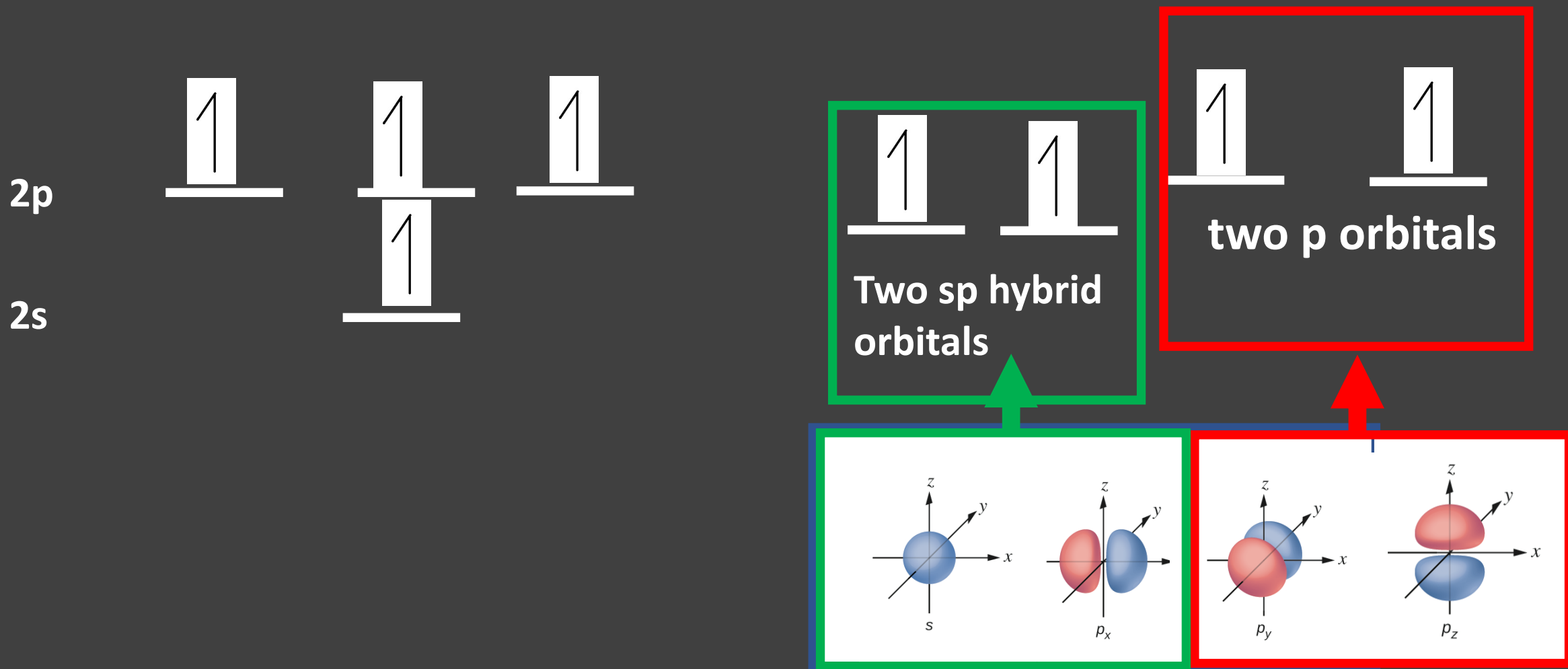
Carbon's electronic structure is $1s^2 2s^2 2p^2$

An electron in 2s is promoted to the empty 2p orbital

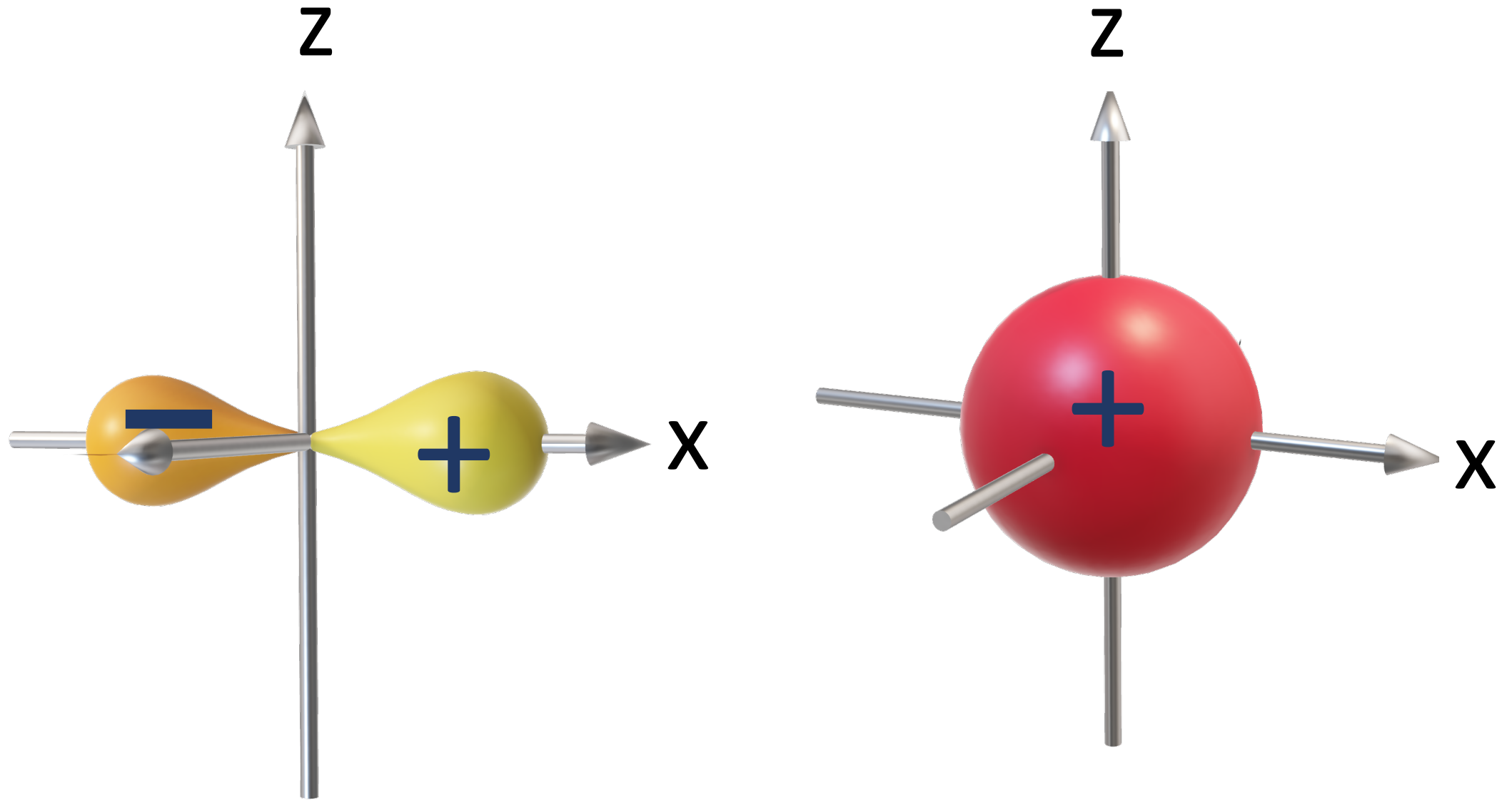


How does carbon form triple bonds e.g. in ethyne $\text{H-C}\equiv\text{C-H}$?

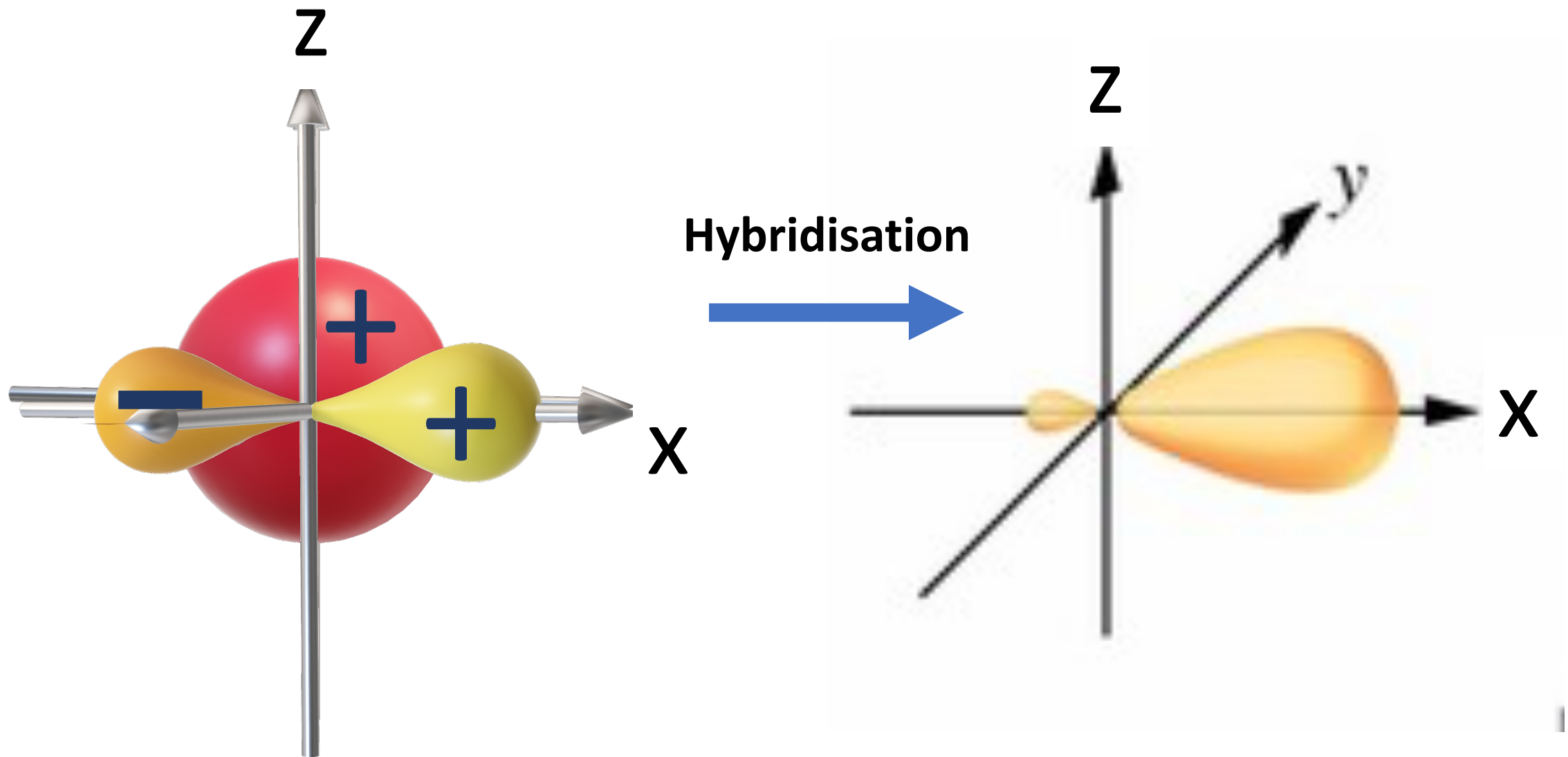
Formation of sp hybrid orbitals



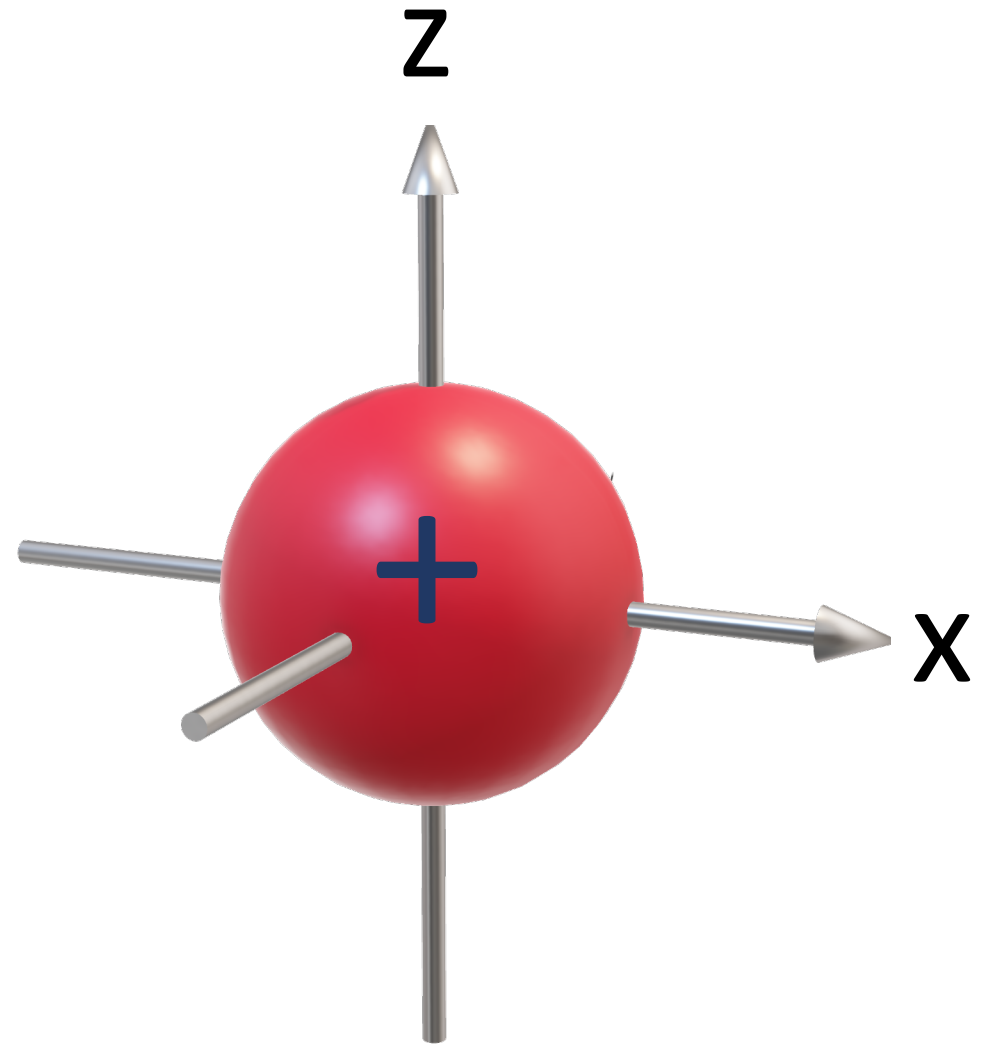
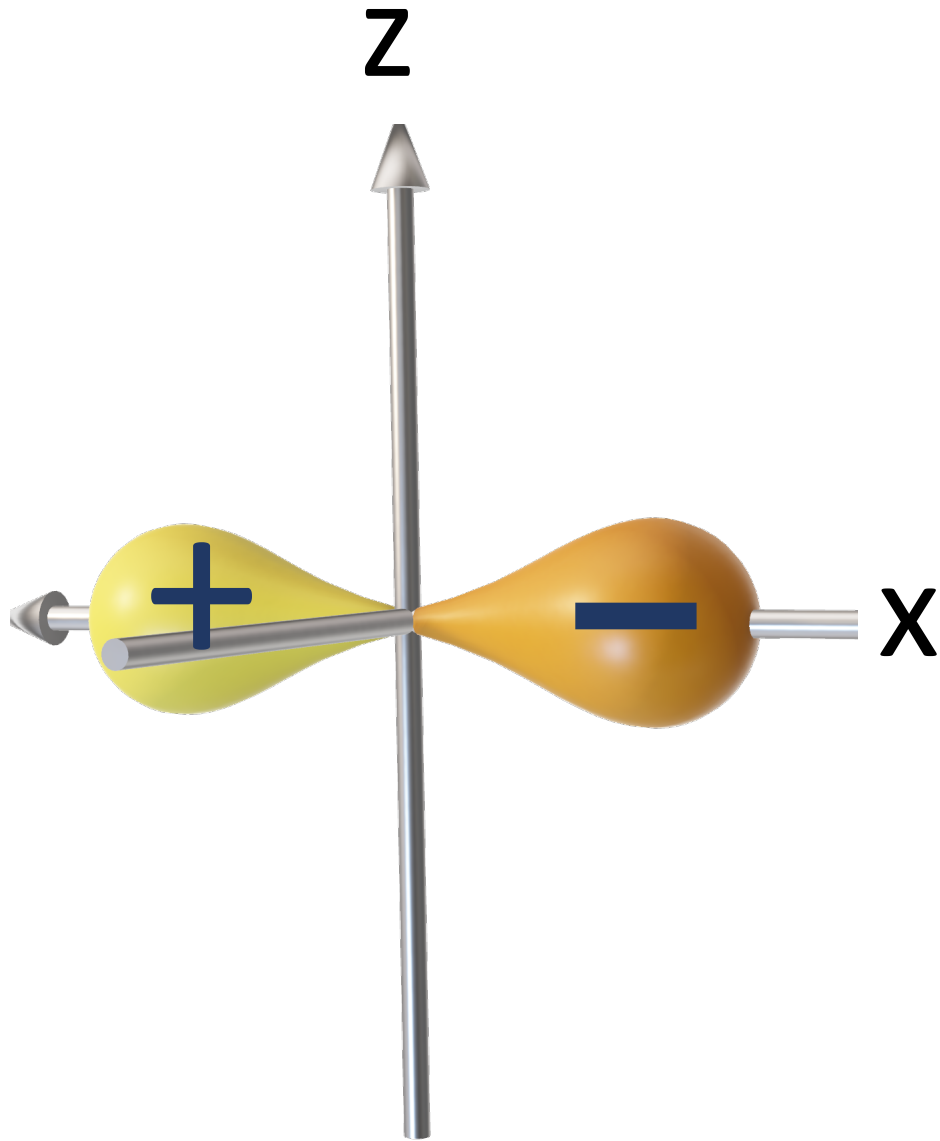
Formation of sp hybrid orbitals



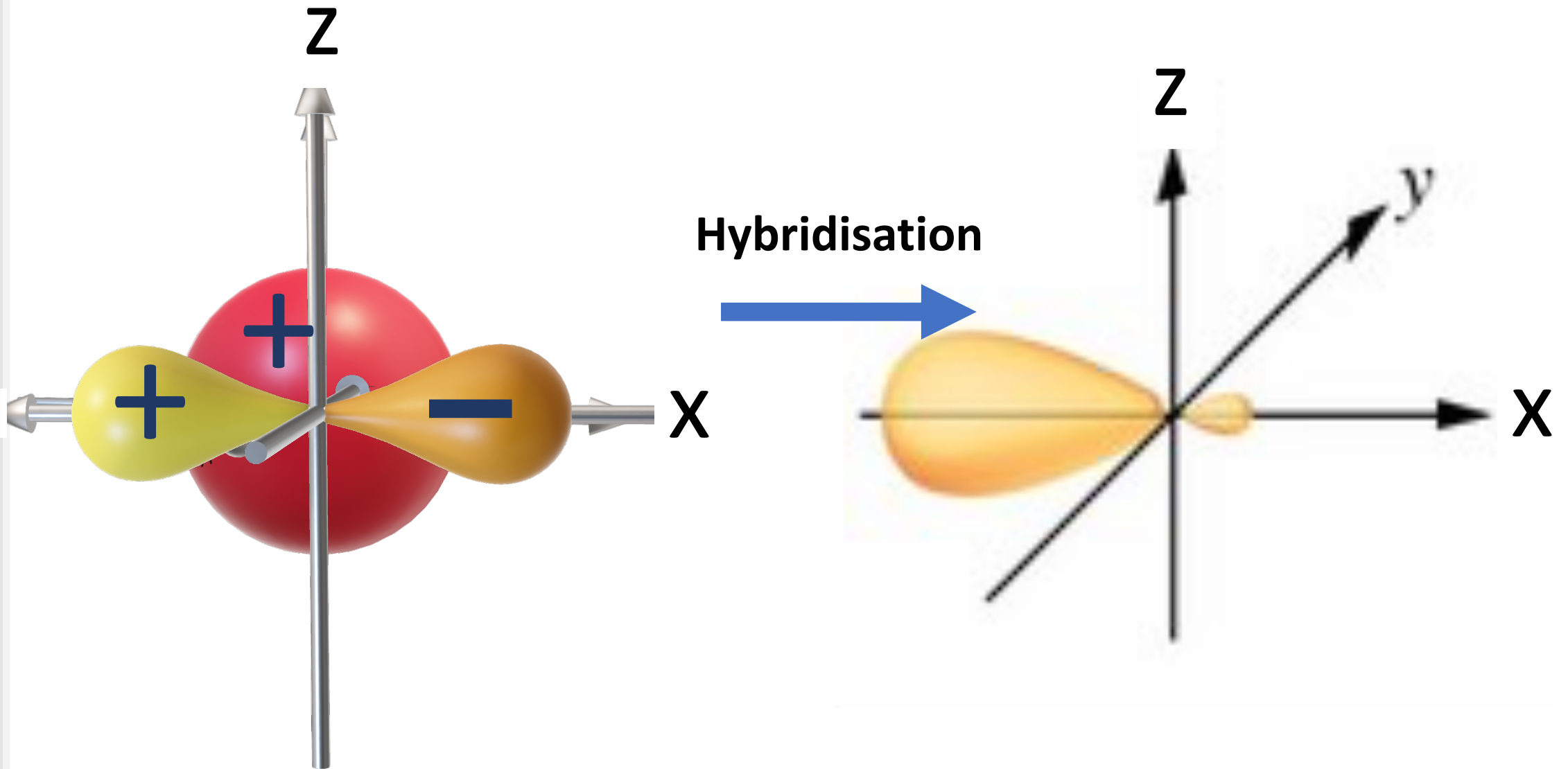
Formation of sp hybrid orbitals



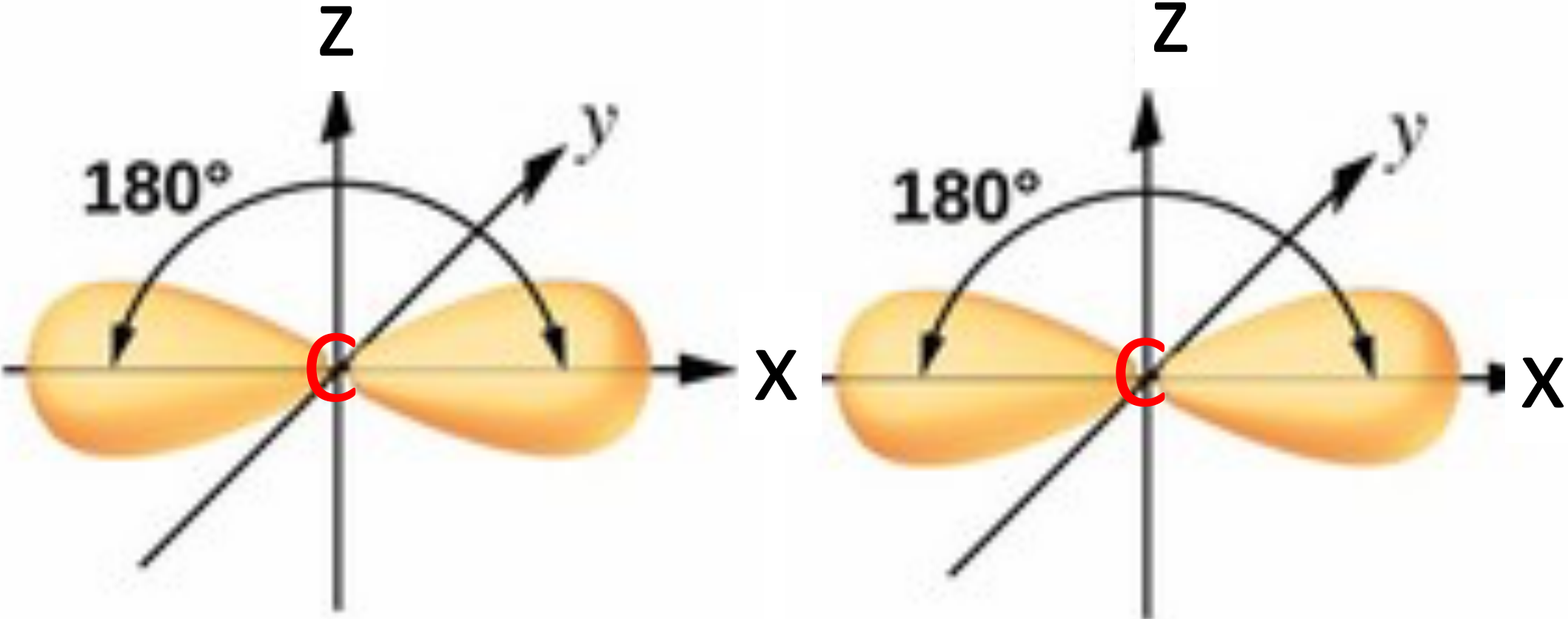
Formation of sp hybrid orbitals to form single bonds



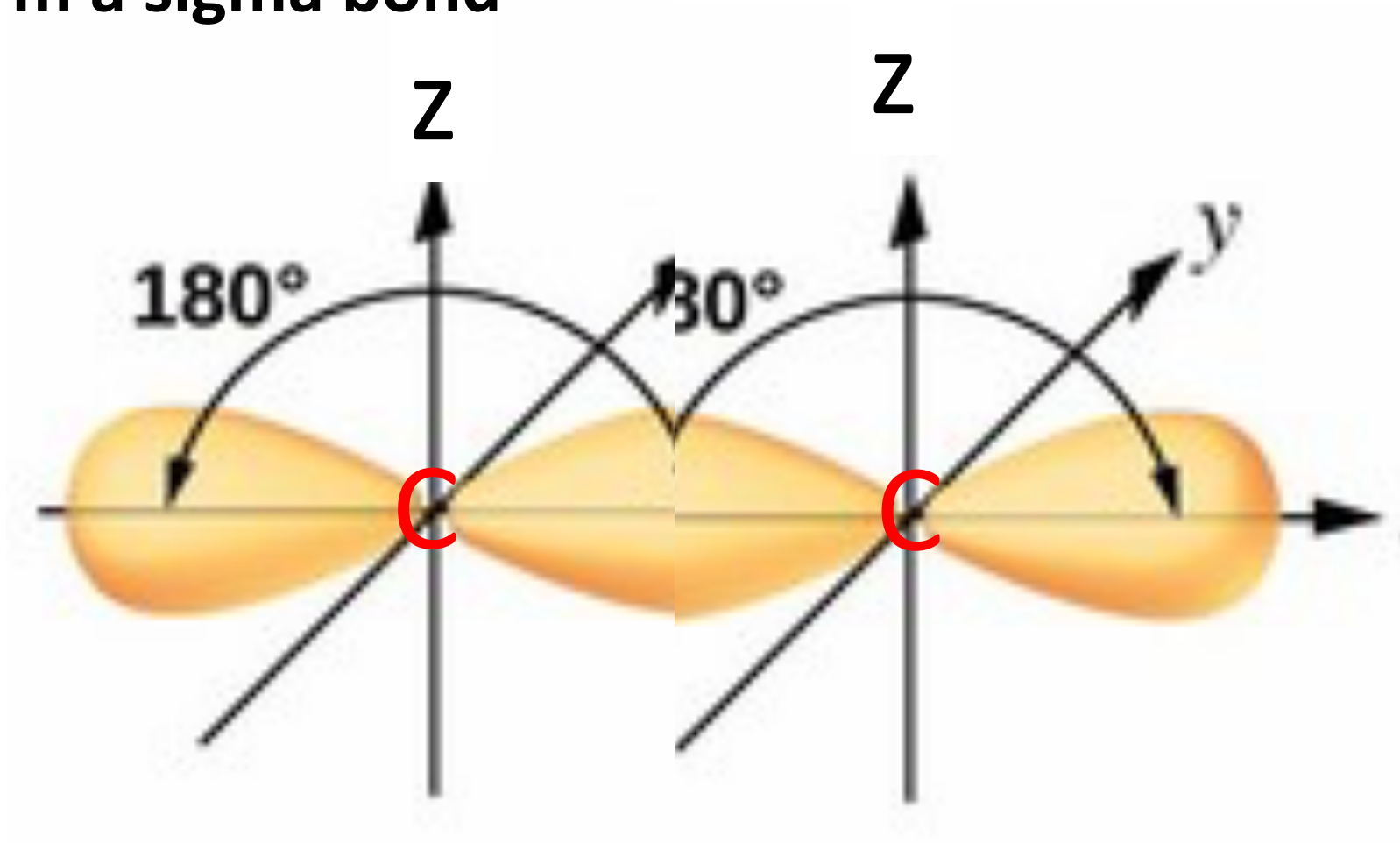
Formation of sp hybrid orbitals



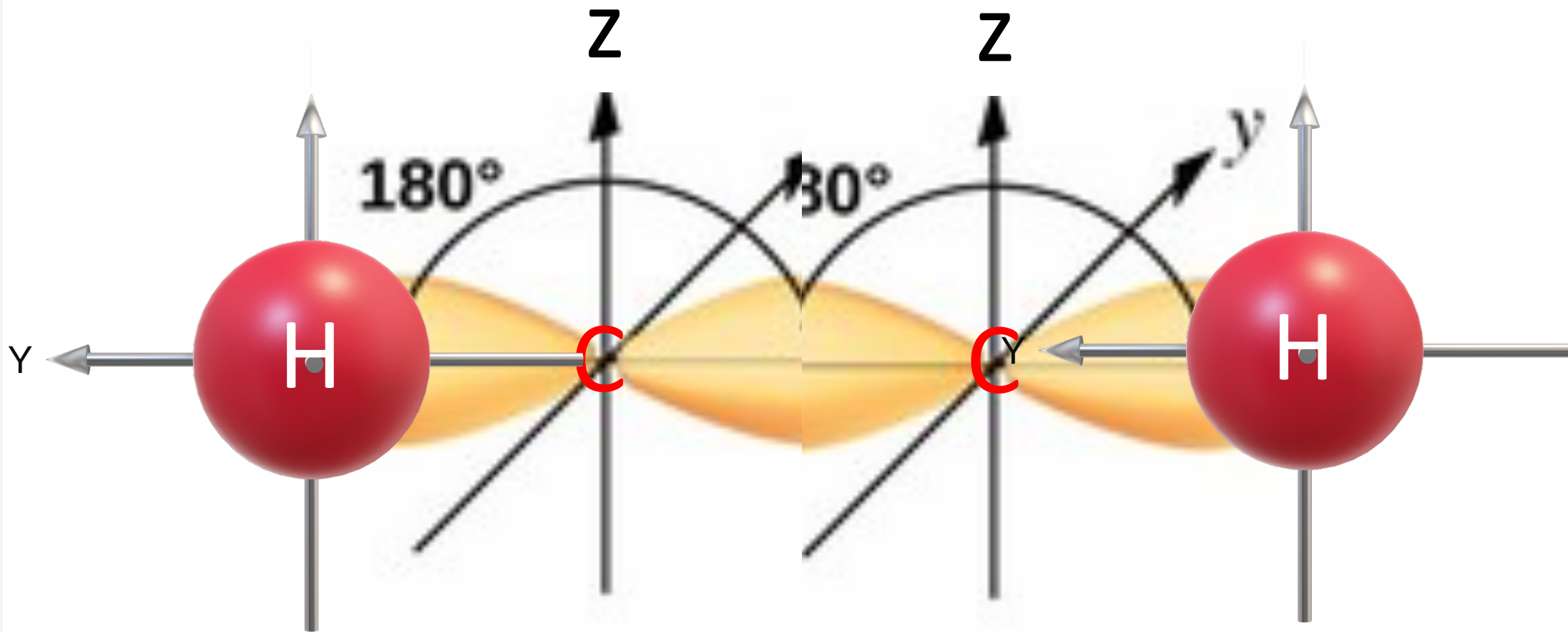
Both carbon atoms have two sp hybrid orbitals



One sp hybrid orbital on each carbon overlap to form a sigma bond

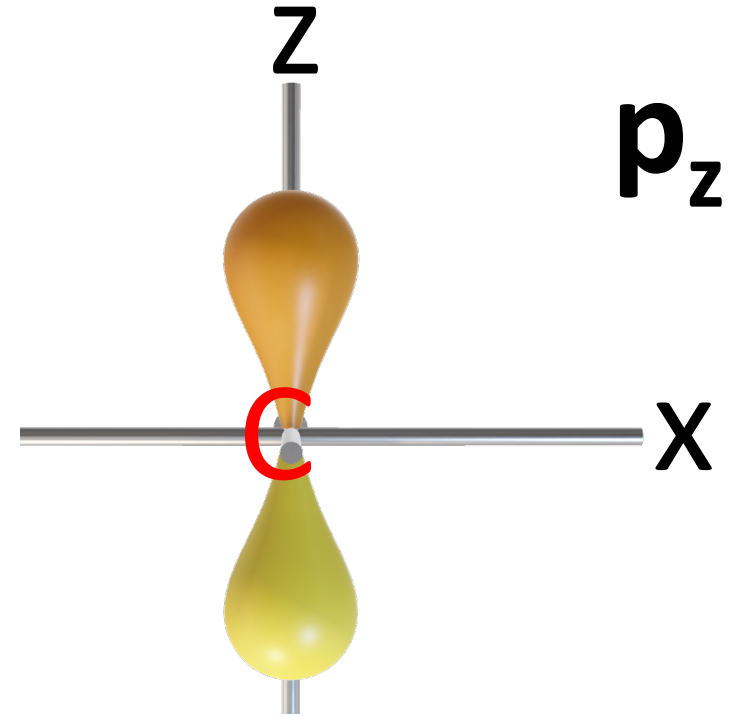
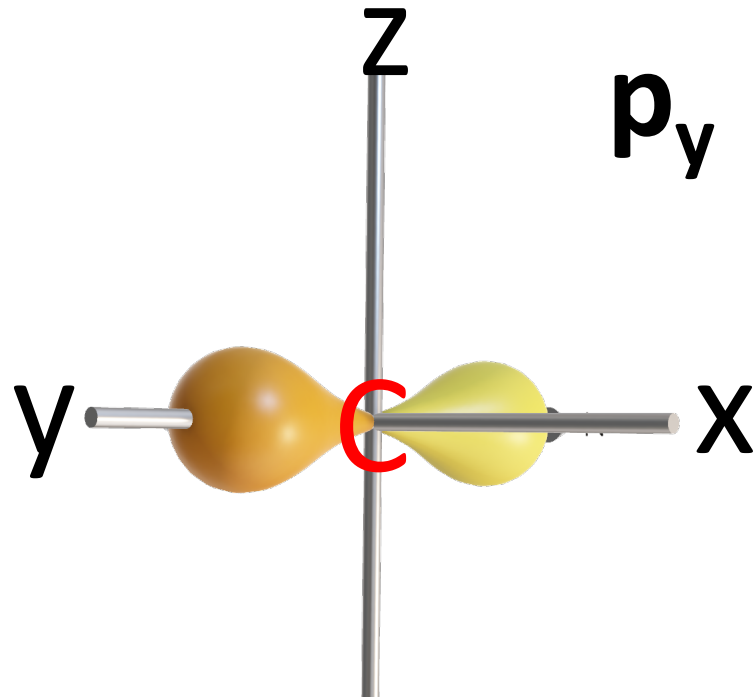


The other sp hybrid orbital on each carbon overlaps with a 1s orbital on the H atom to form another sigma bond

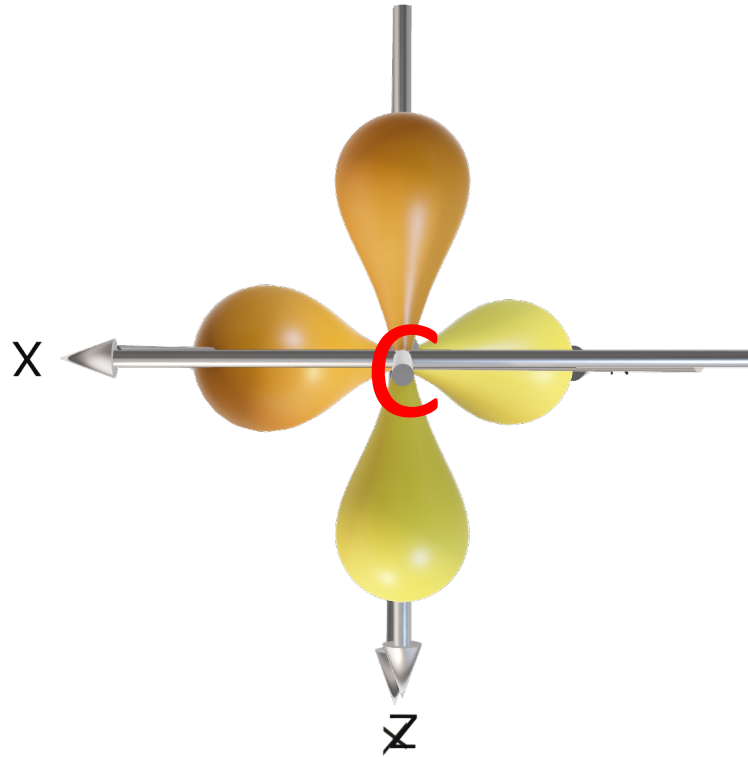


This completes the sigma framework.

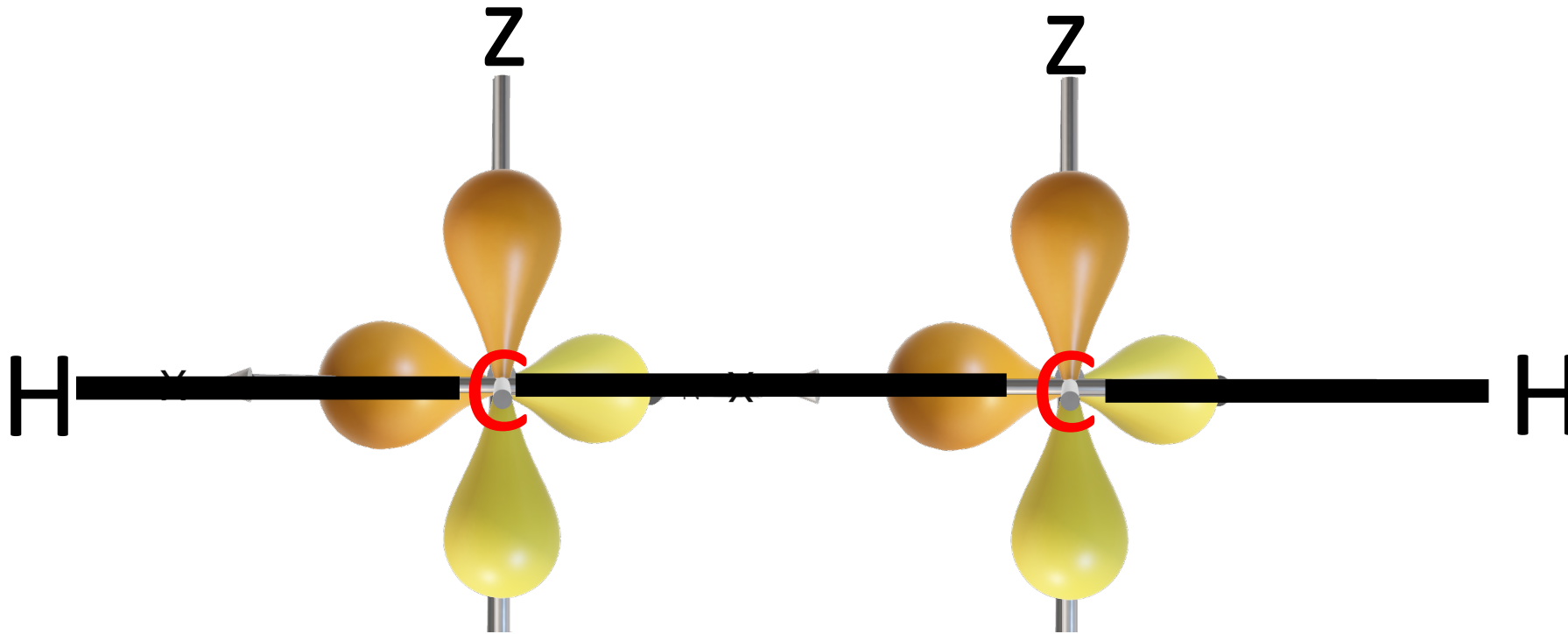
However, the p_z and p_y orbitals remain unbonded.



However, the p_z and p_y orbitals remain unbonded.

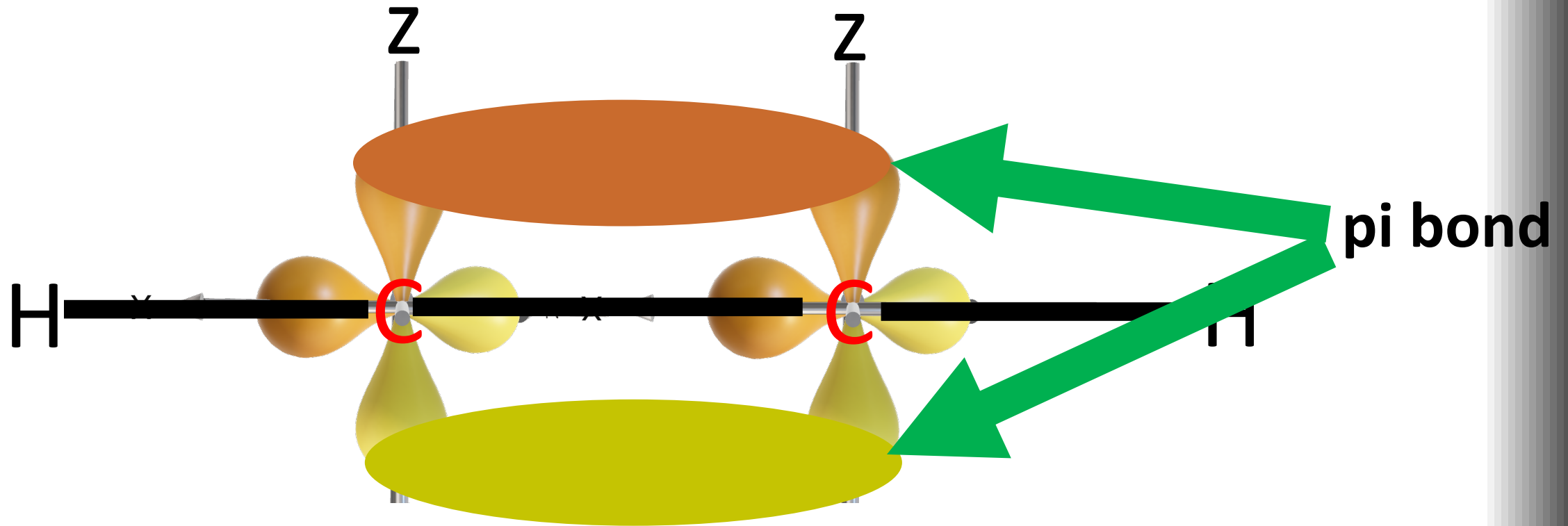


The two p_y orbitals can overlap to form a pi bond.

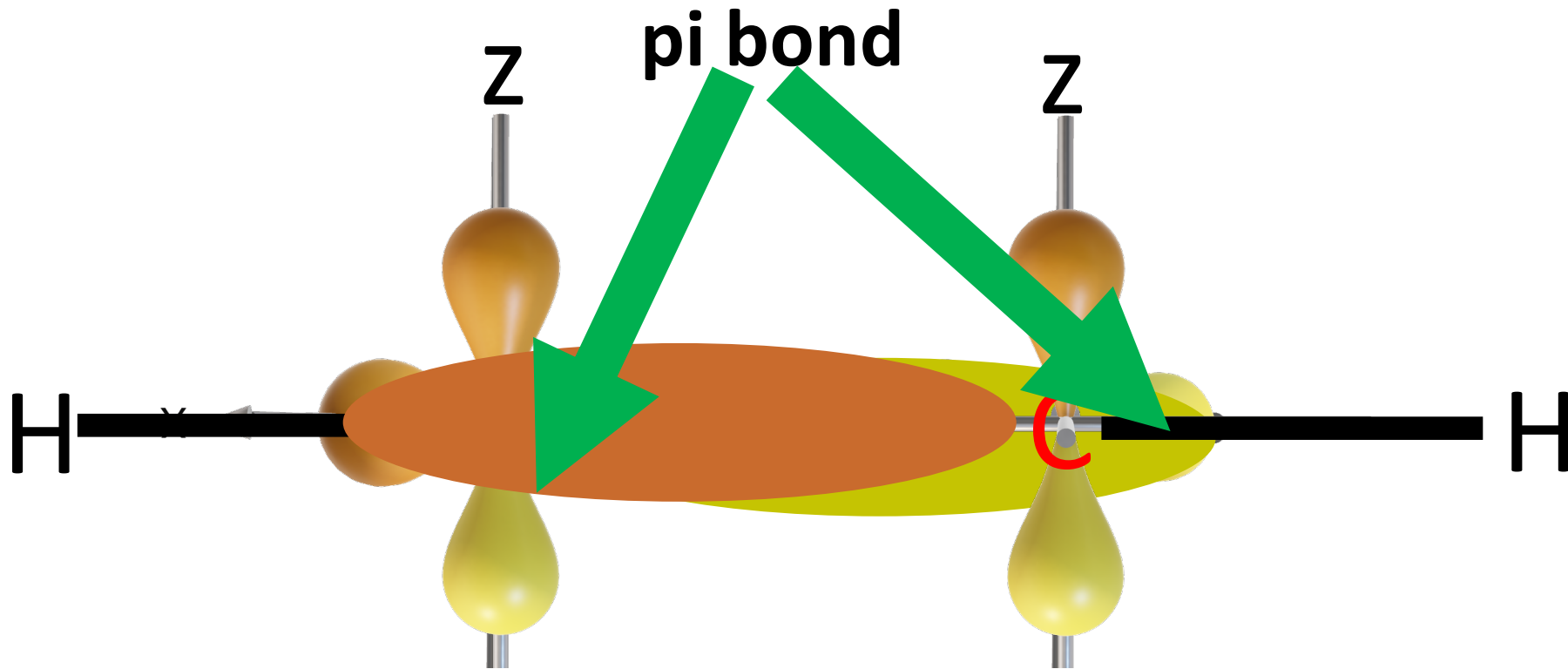


And the two p_z orbitals can overlap to form a pi bond.

p_z orbitals overlapping to form a pi bond.



p_y orbitals overlapping to form a pi bond.



This explains the linear geometry around each carbon atom and how the $C\equiv C$ triple bond is formed.

A ball-and-stick molecular model is shown in the background, rendered in a dark, semi-transparent style. It features a central blue sphere, several black spheres, and several white spheres connected by grey rods. The model is positioned behind the text, which is overlaid on a dark grey background.

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