Orbitals...

Electrons are part of what makes an atom an atom

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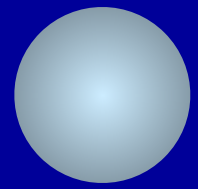


But where exactly are the electrons inside an atom?

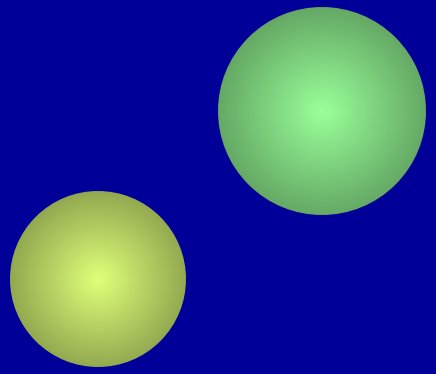
Orbitals

are areas within atoms where there is a high probablility of finding electrons.

Knowing how electrons are arranged in an atom is

important

because that governs how atoms interact with each other



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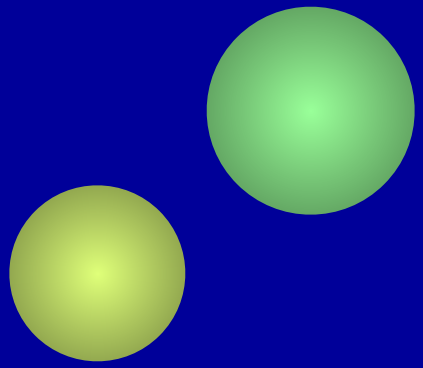

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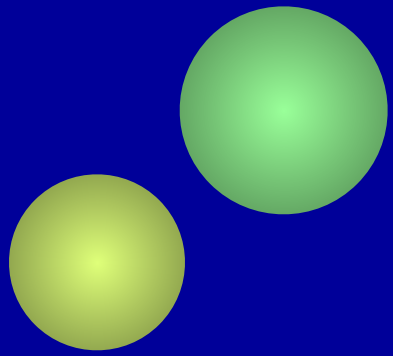

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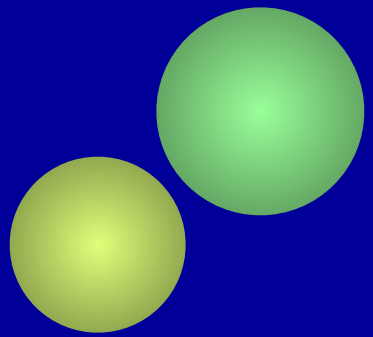

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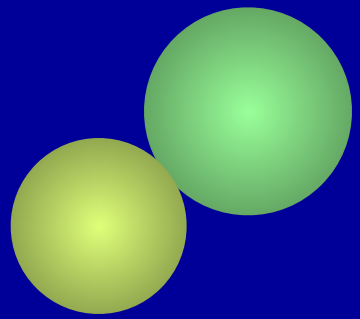

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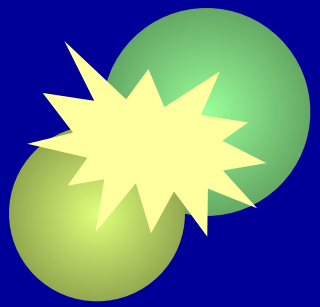

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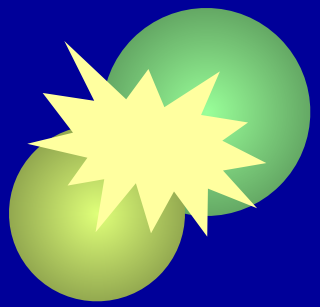
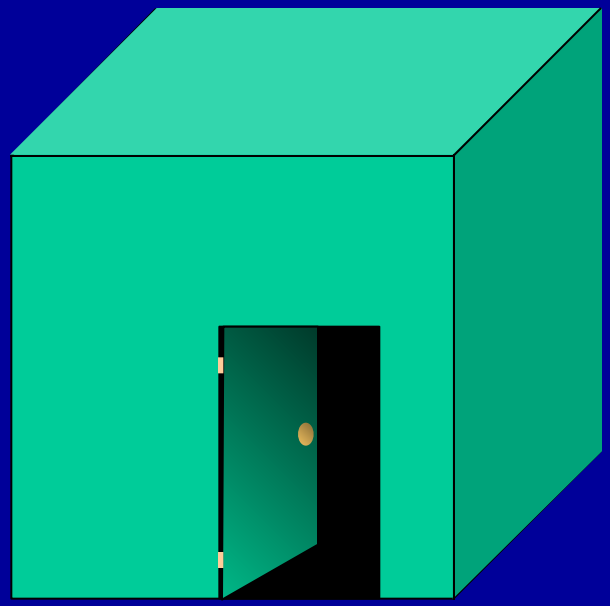
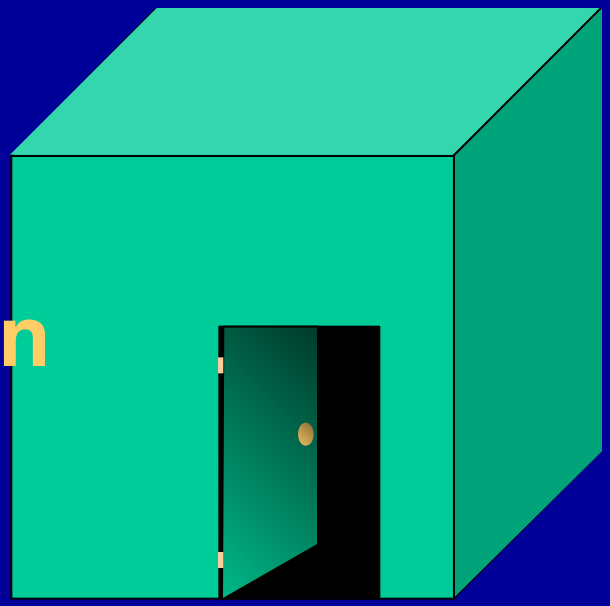


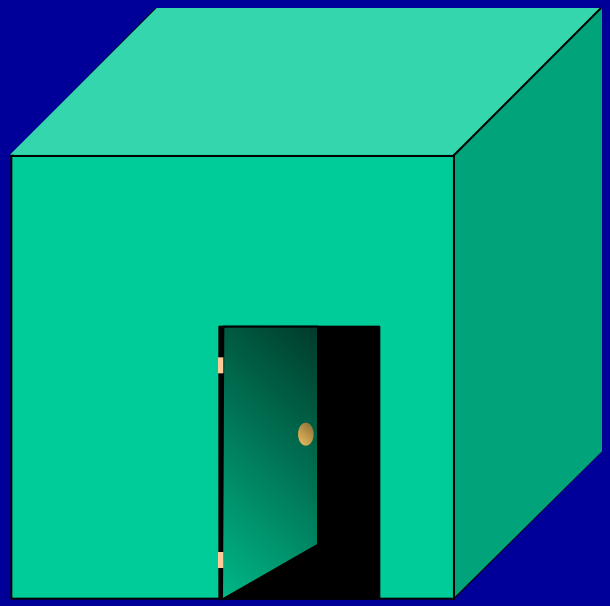
Let’s say you have a room with flies flying around in it



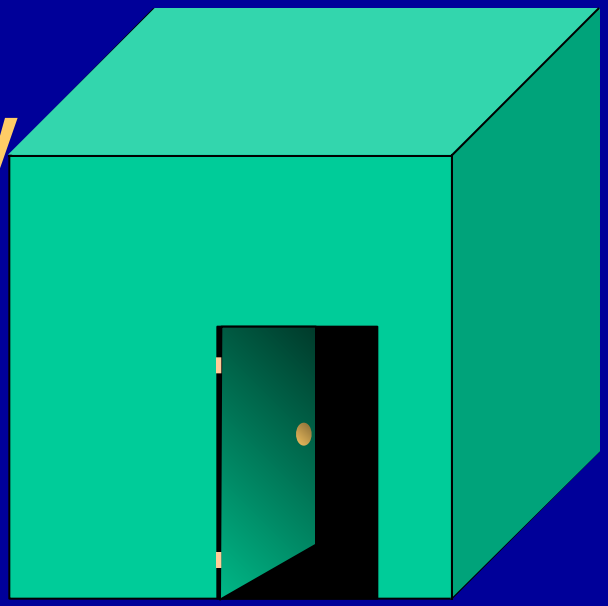
The flies are not just anywhere in the room. They are inside boxes in the room.



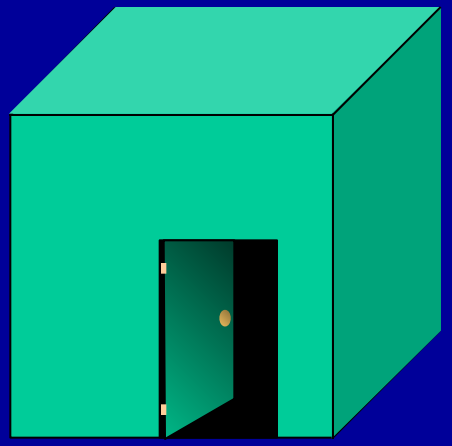
You know where the boxes are, and you know the flies are inside the boxes, but…



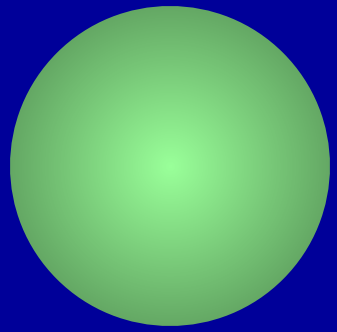
you don’t know exactly where the flies are inside the boxes



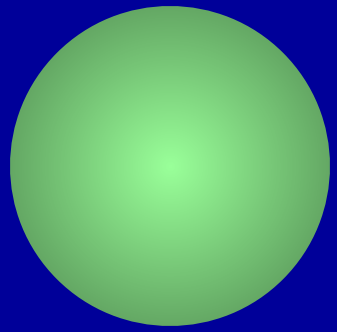
The room is an atom
The flies are electrons
The boxes are orbitals



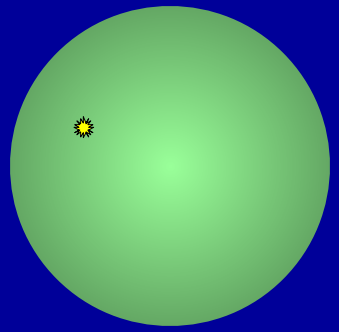
The room is an atom
The flies are electrons
The boxes are orbitals

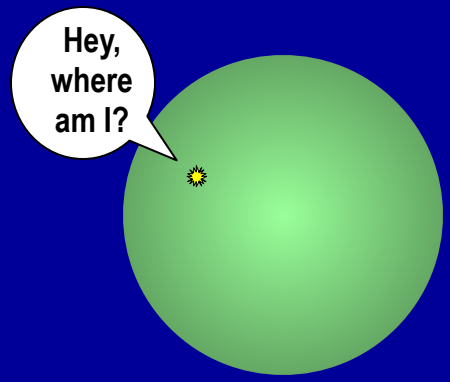


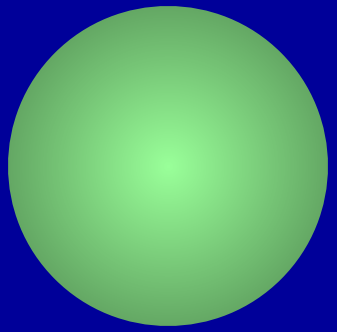
The room is an atom
The marbles are electrons
The boxes are orbitals



Science has determined where the orbitals are inside an atom, but it is never known precisely where the electrons are inside the orbitals

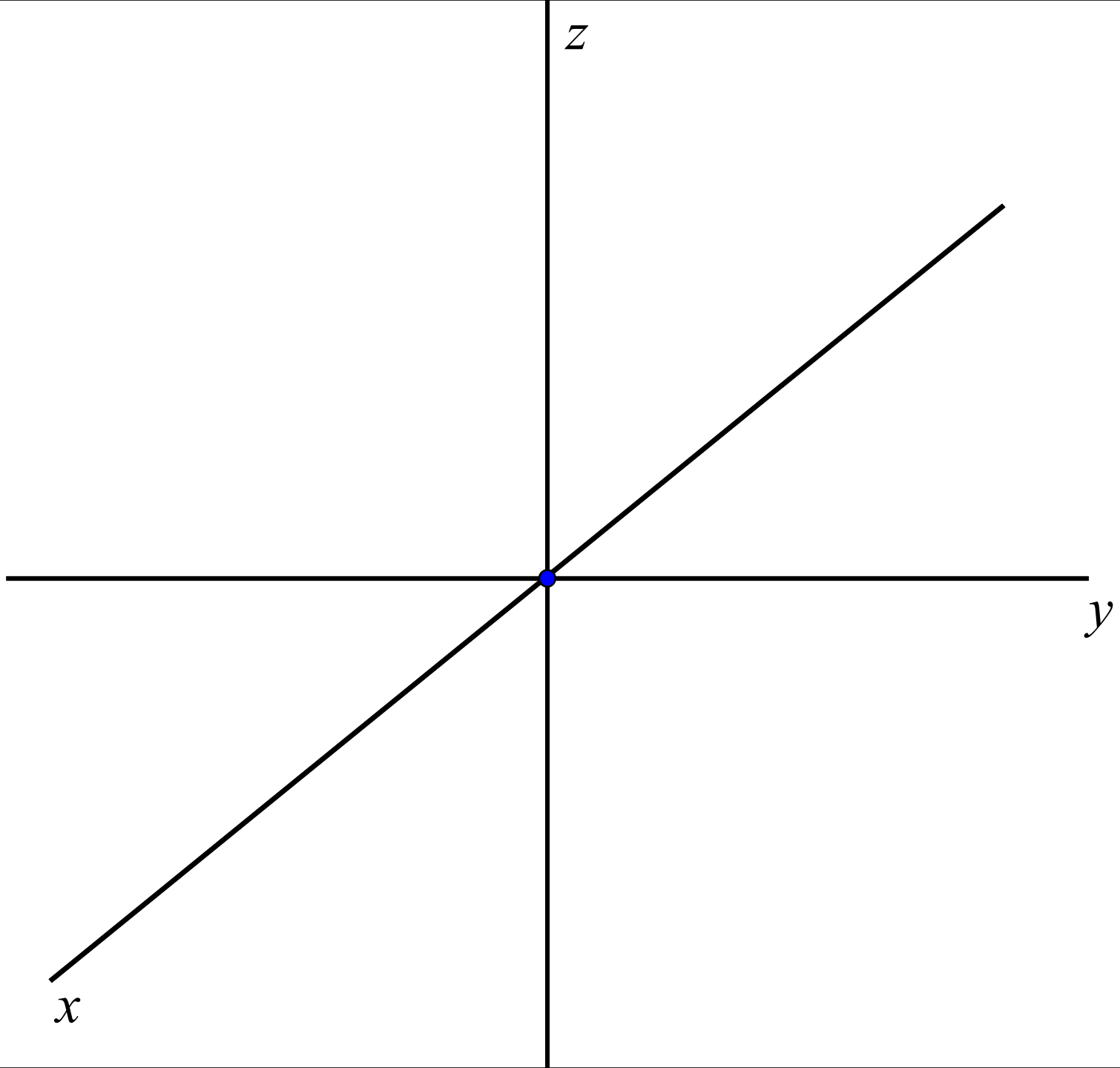


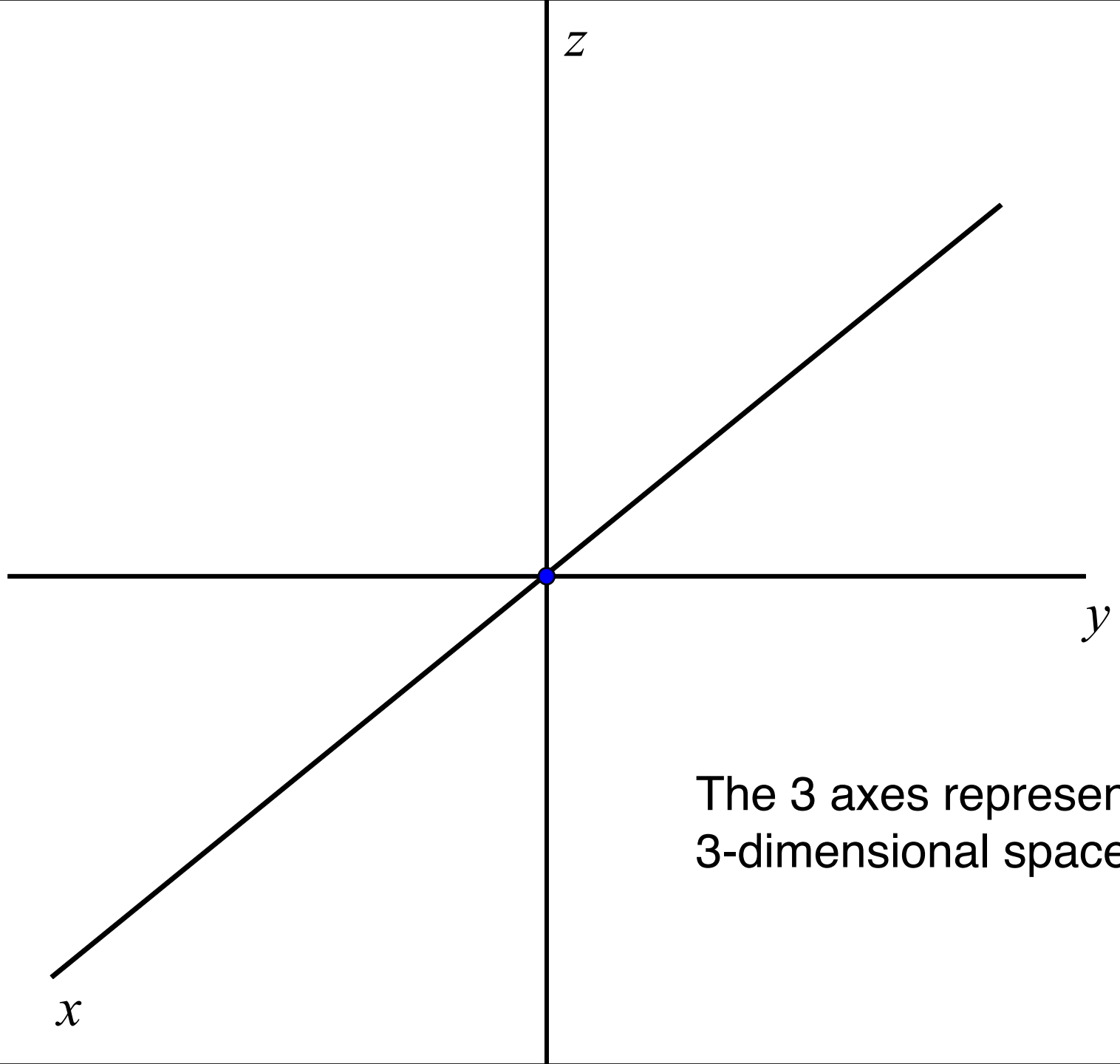

Hey,
where
am I?



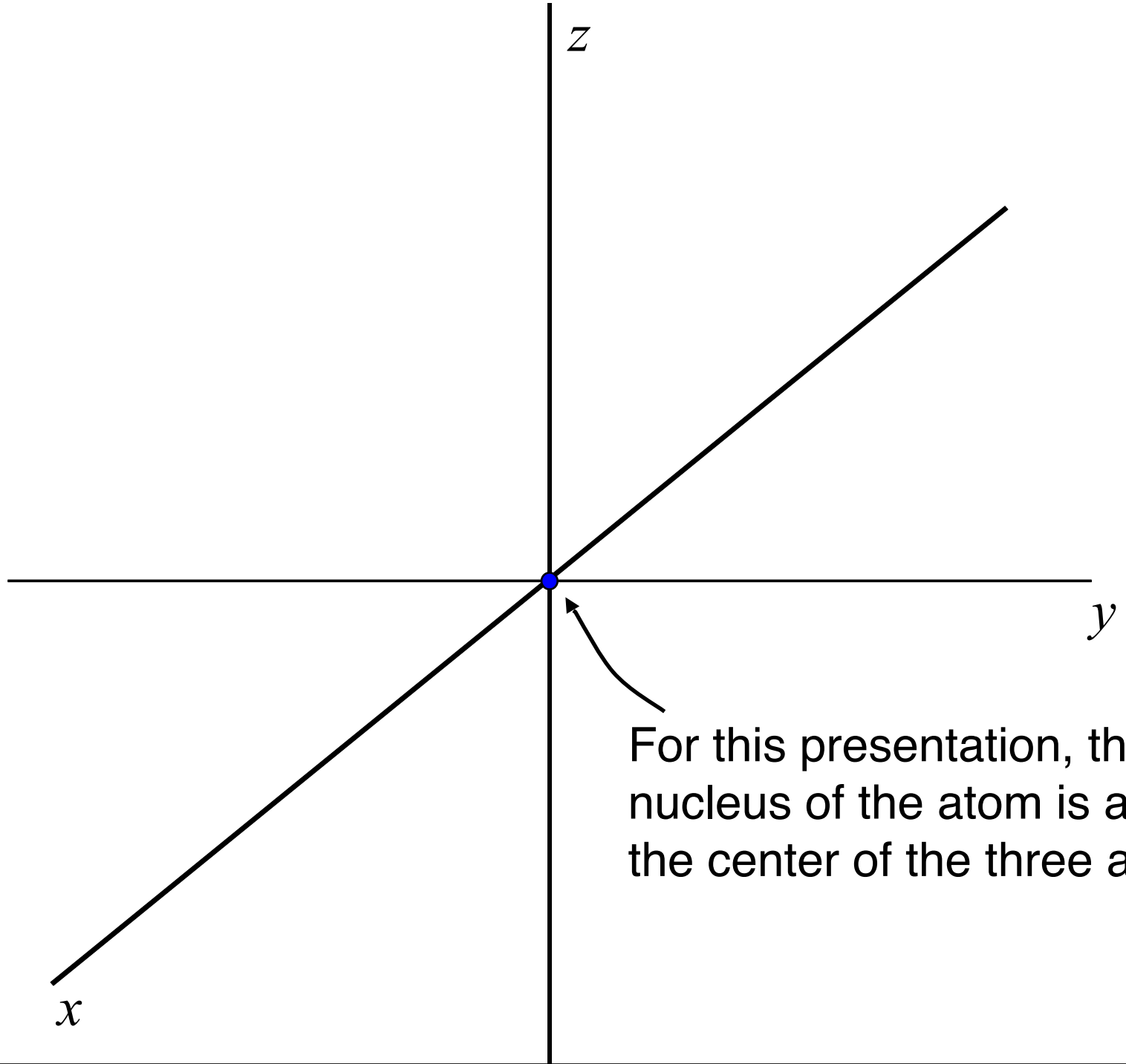
So what are the sizes and shapes of orbitals?

The *area* where an electron can be found,
the orbital,
is defined mathematically,
but we can see it as a specific *shape*
in 3-dimensional space…

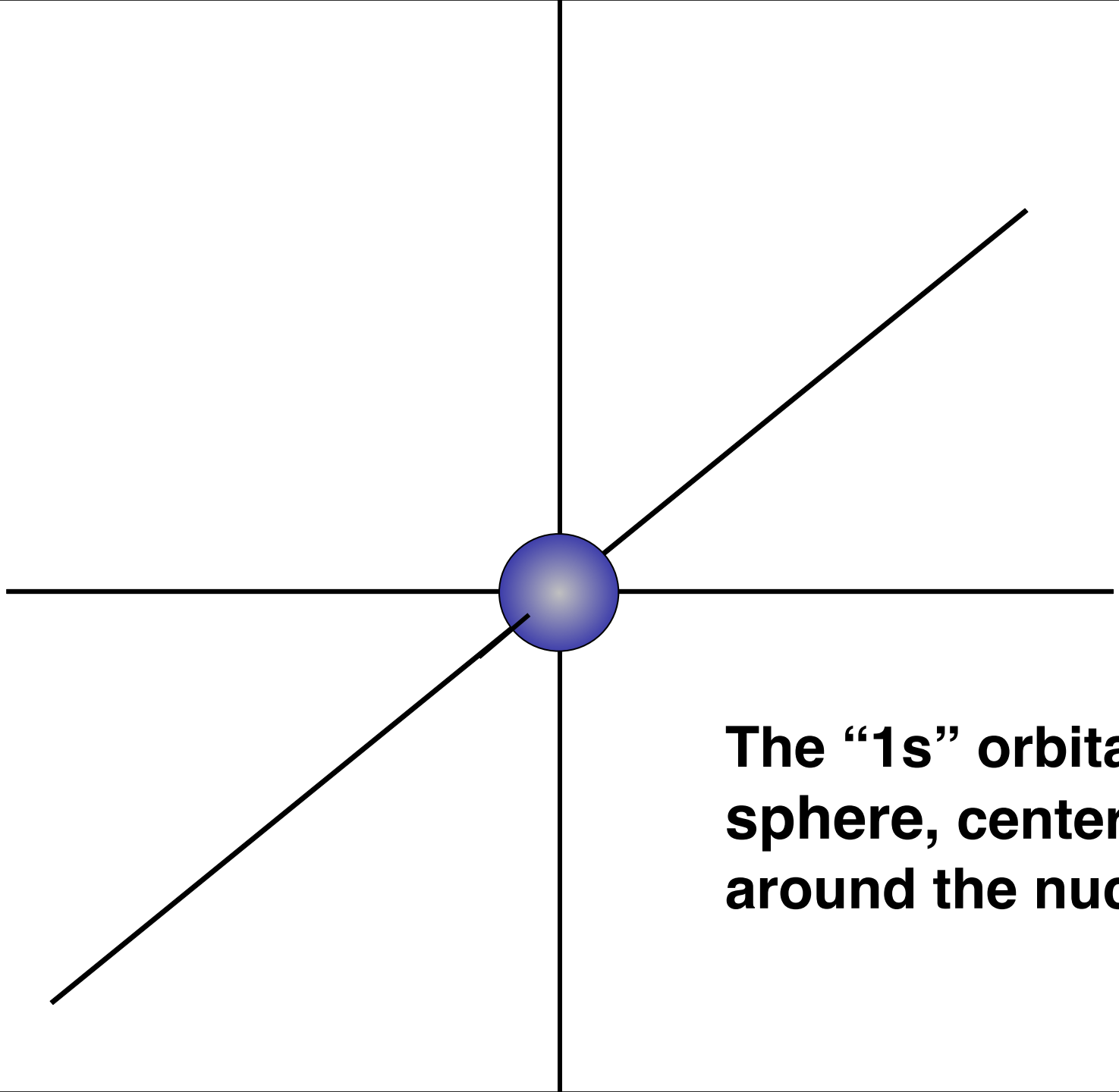

z
y
x



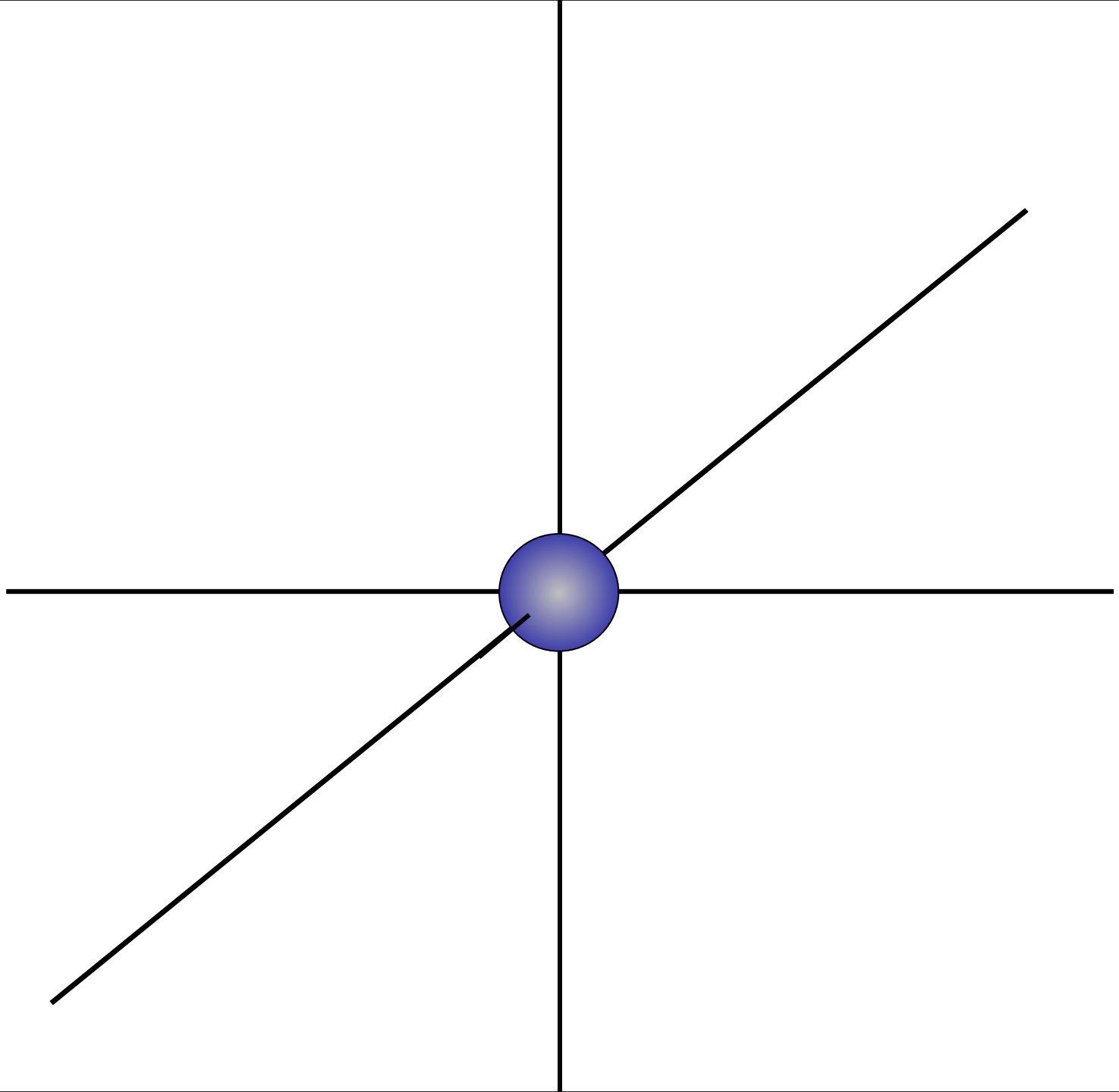
The 3 axes represent
3-dimensional space

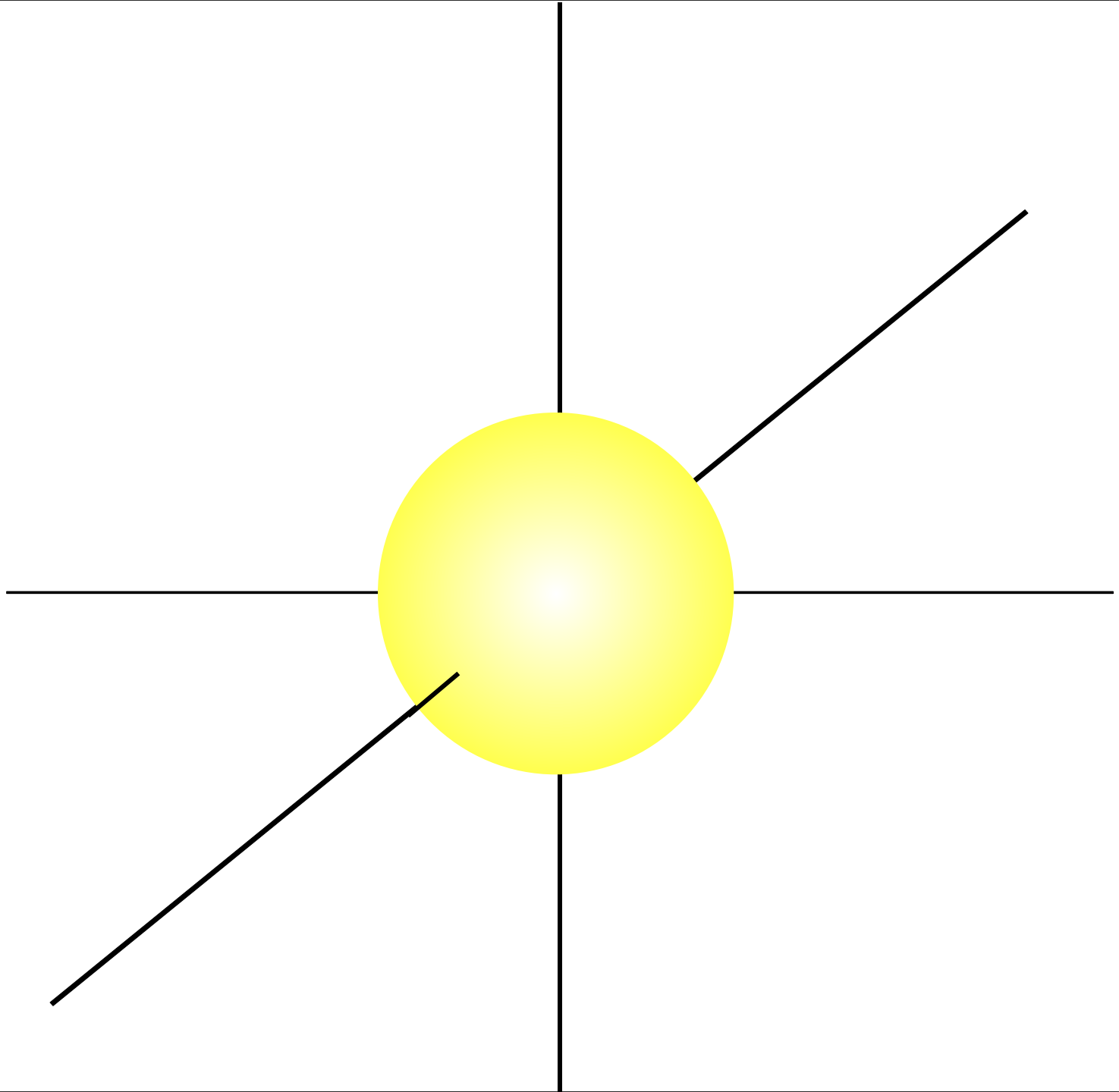


For this presentation, the nucleus of the atom is at the center of the three axes.

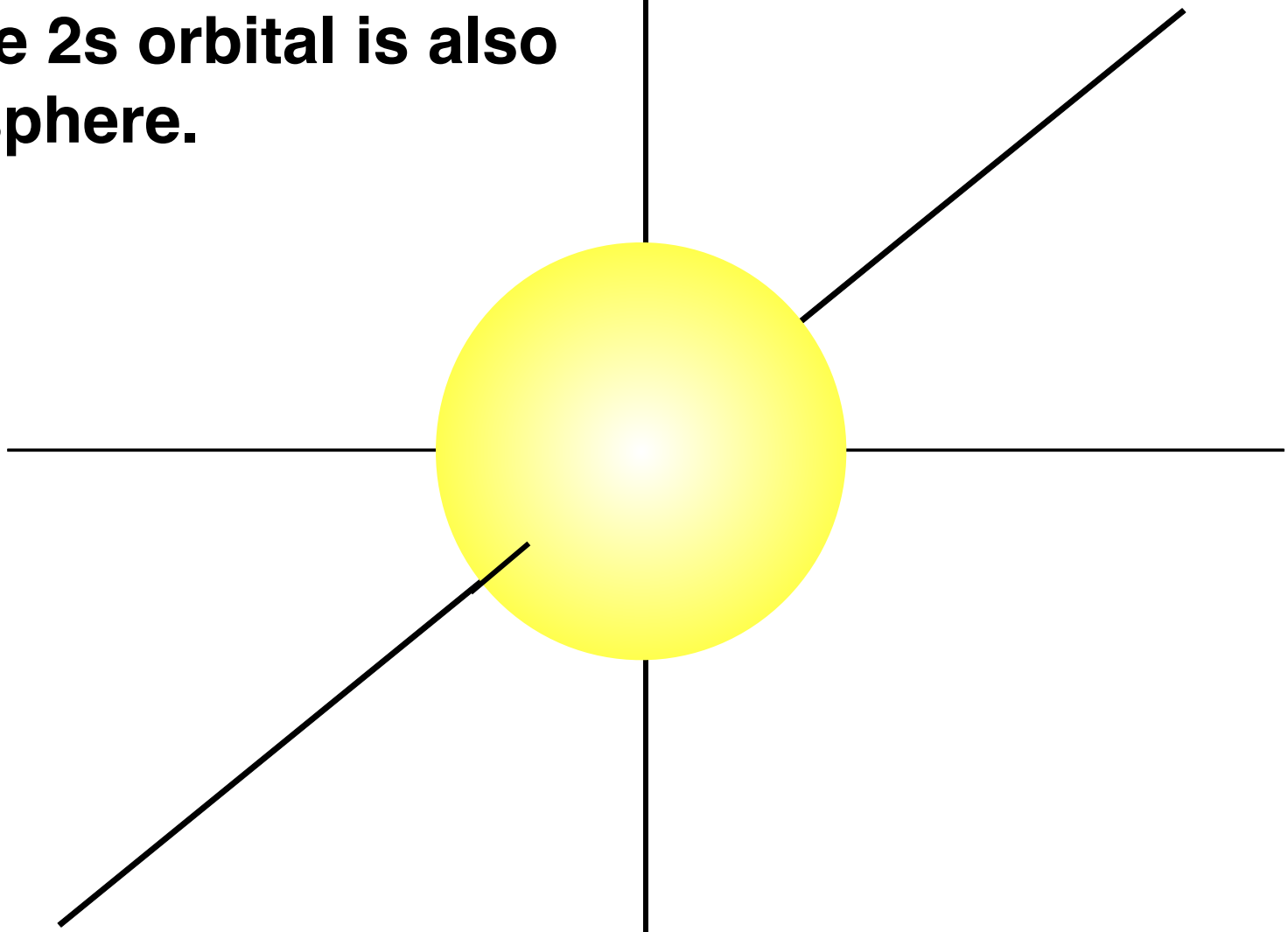


The “1s” orbital is a sphere, centered around the nucleus

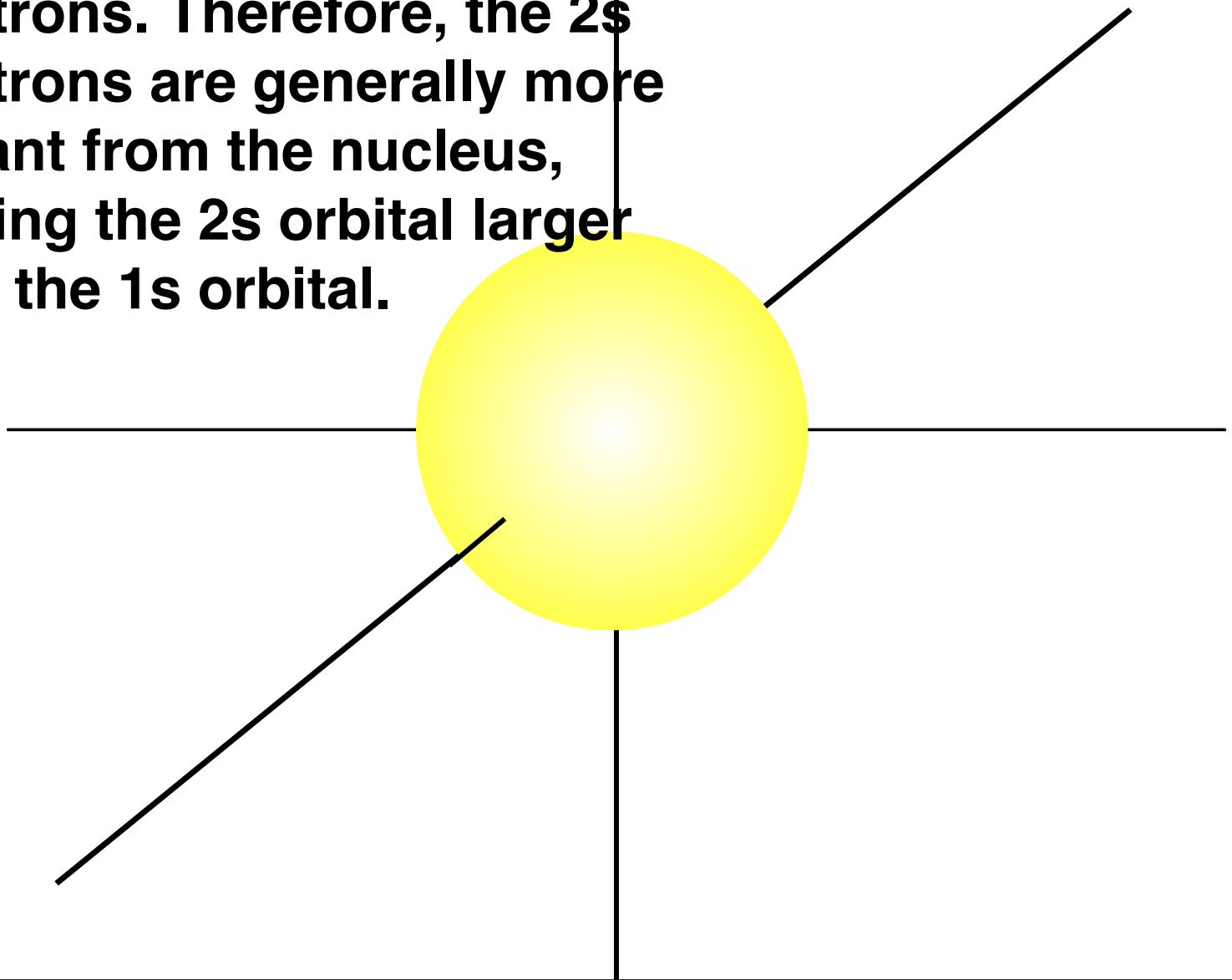




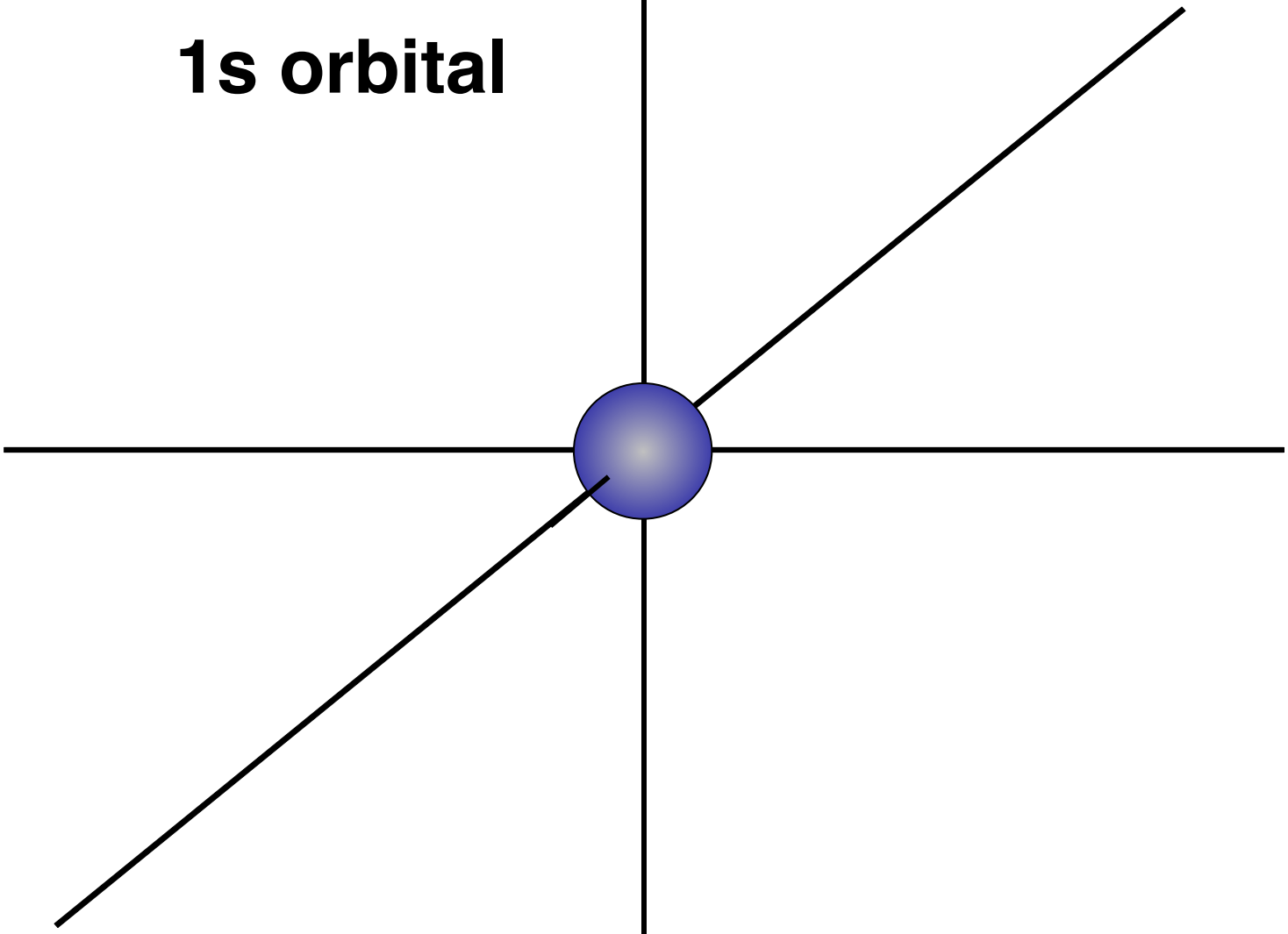
The 2s orbital is also a sphere.



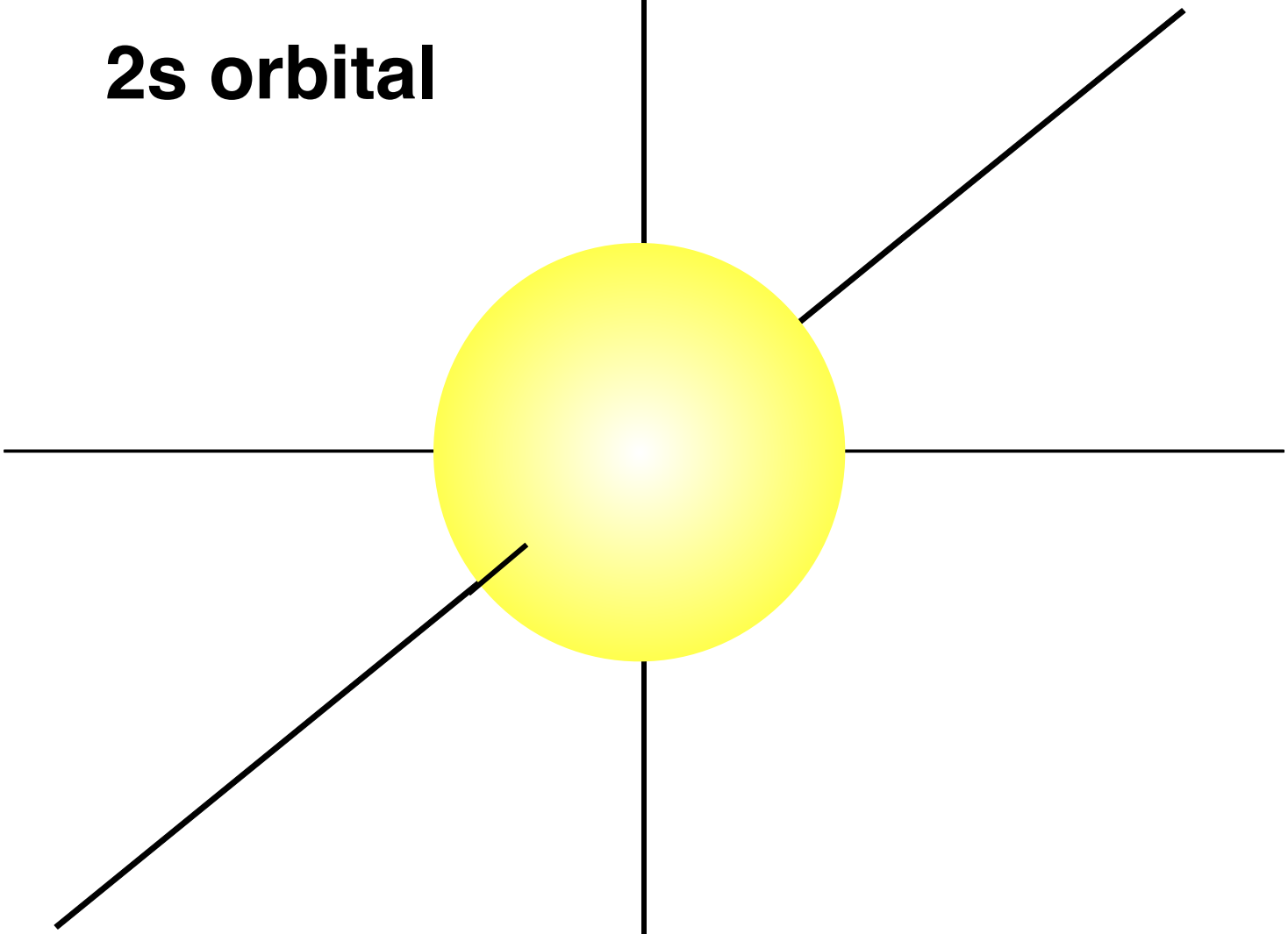
The 2s electrons have a higher energy than the 1s electrons. Therefore, the 2s electrons are generally more distant from the nucleus, making the 2s orbital larger than the 1s orbital.



1s orbital



2s orbital



Don’t forget:
an orbital is the shape of the space where there is a high probability of finding electrons

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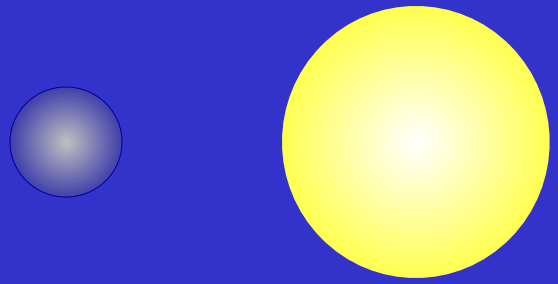
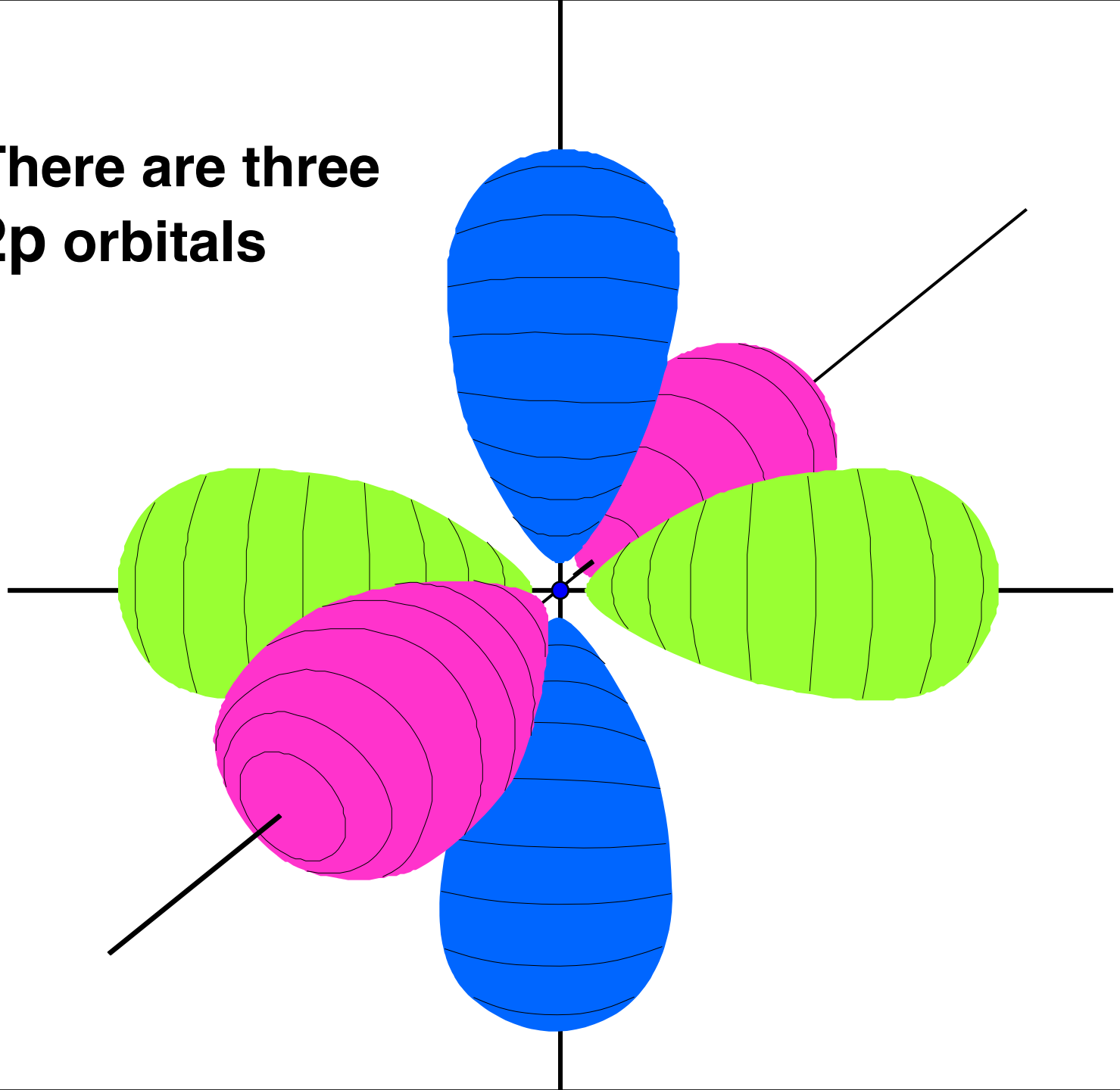
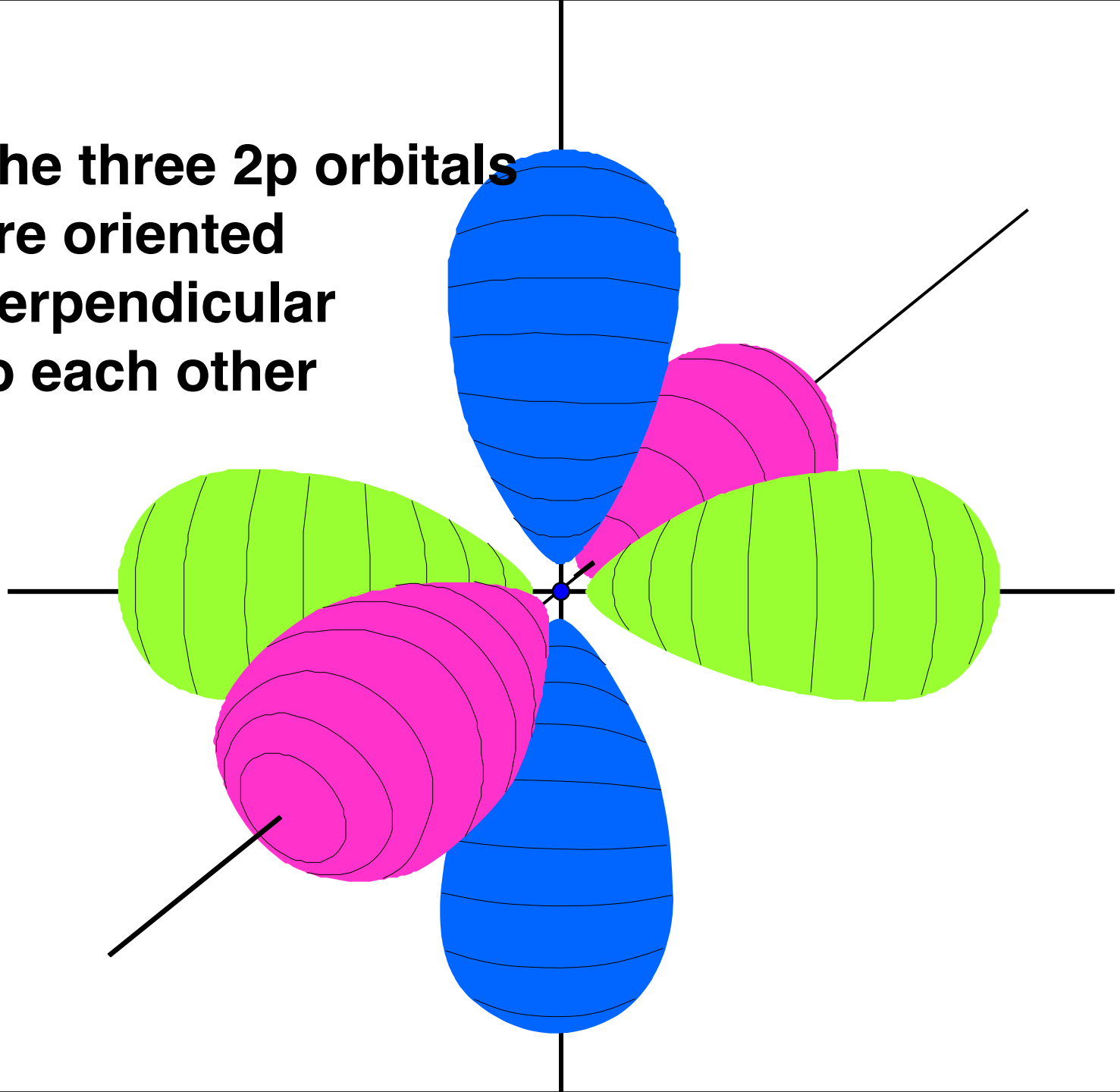


The s orbitals are spheres

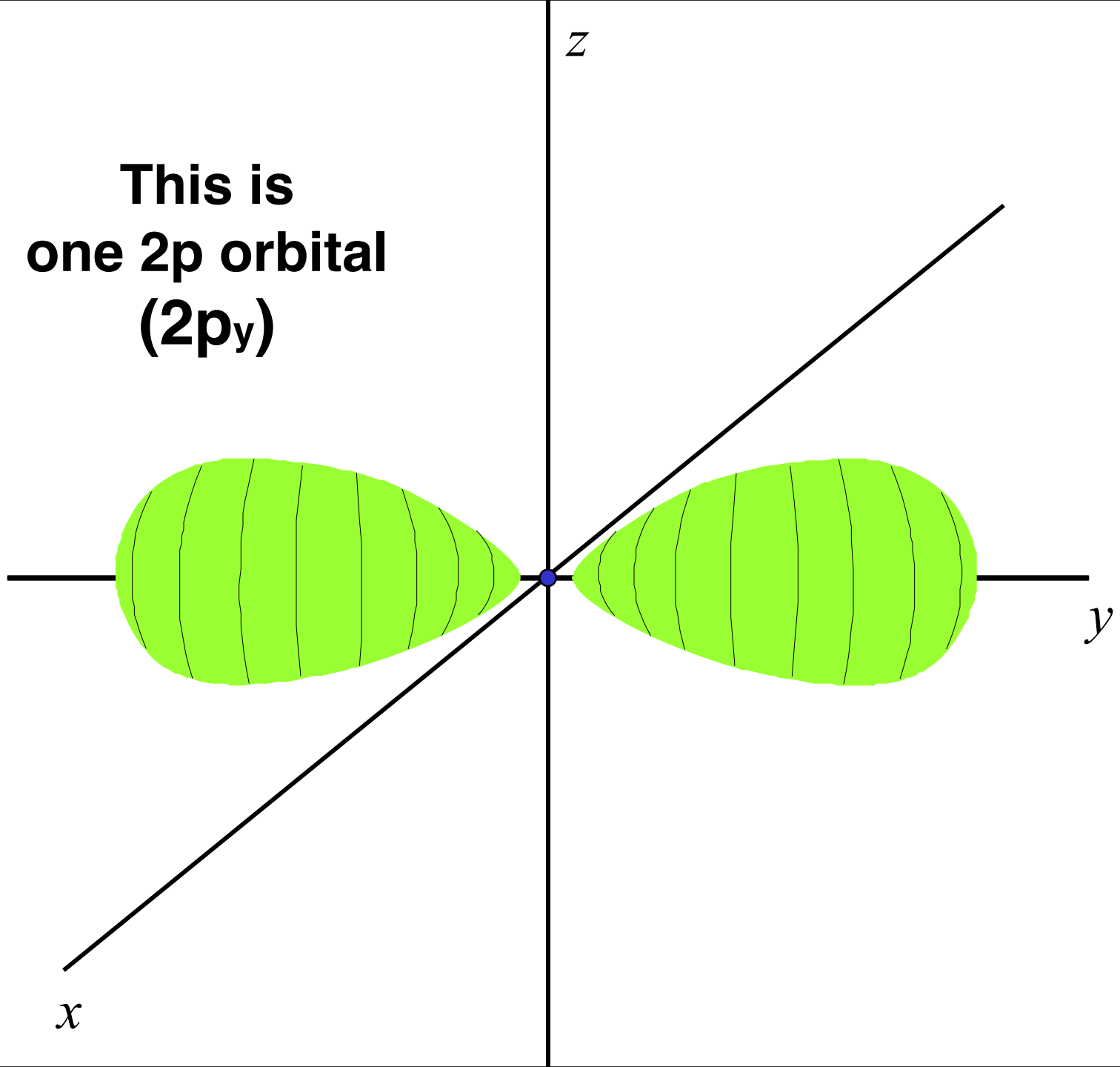
There are three
2p orbitals



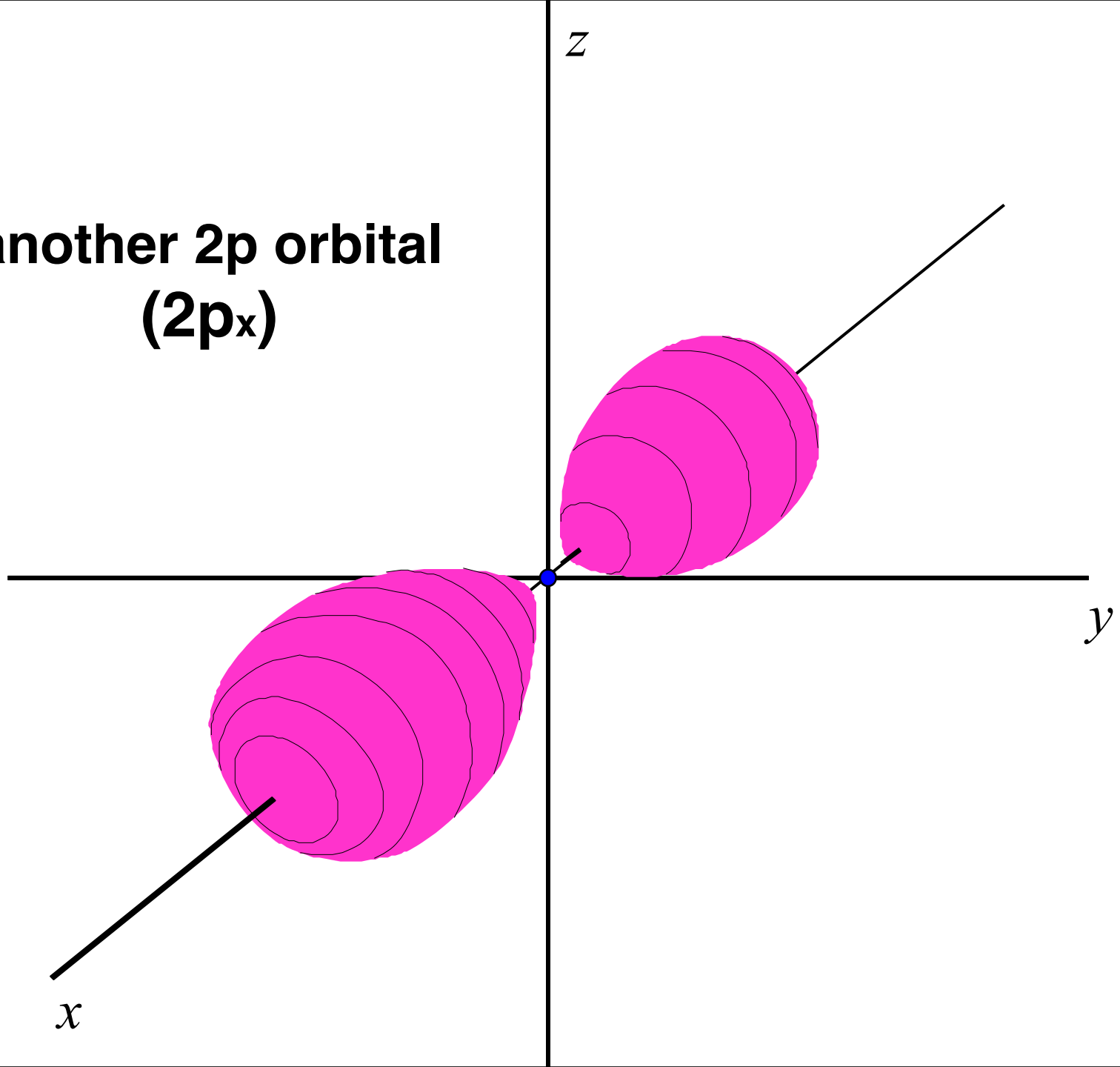
The three 2p orbitals are oriented perpendicular to each other

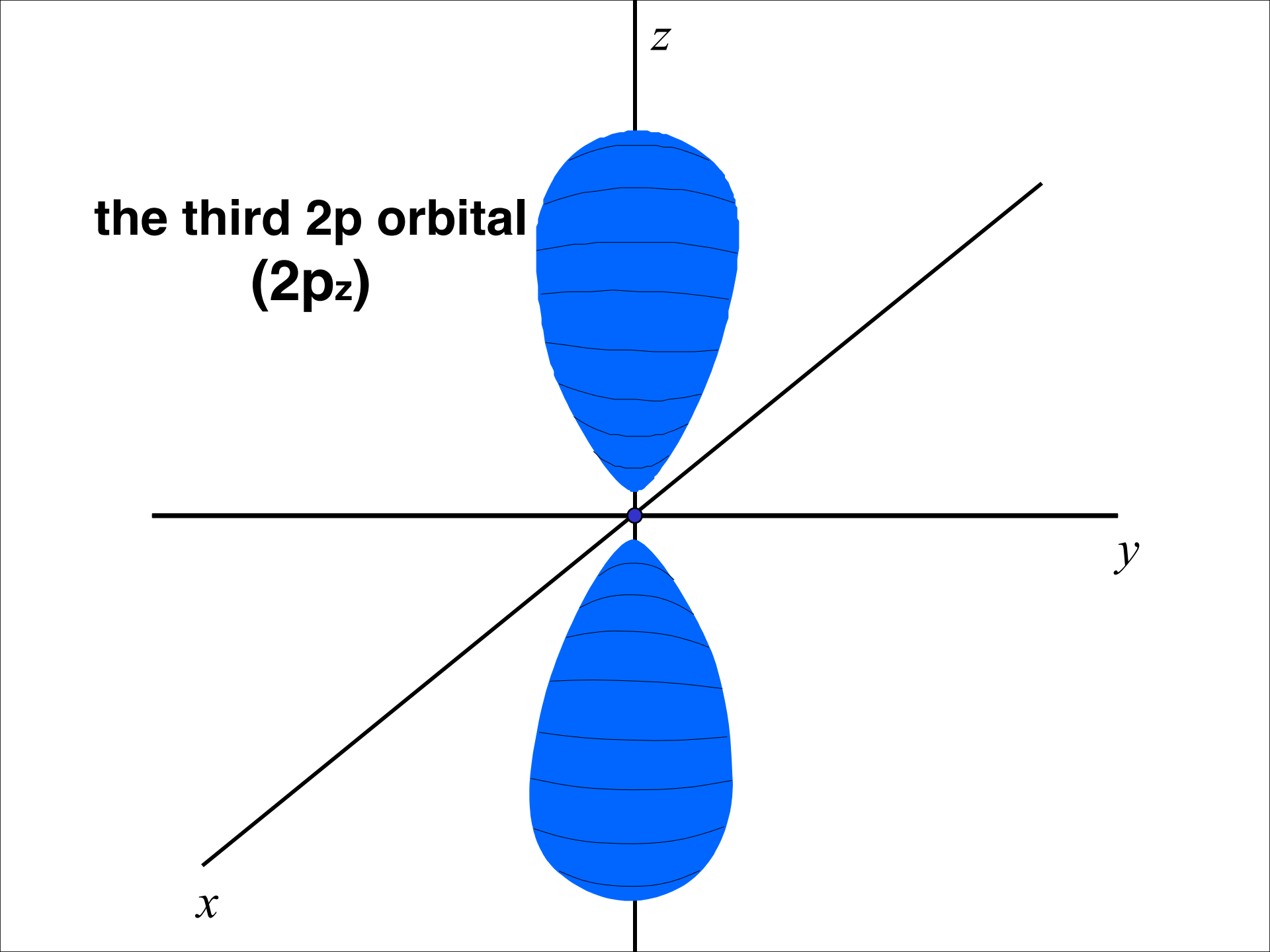


This is
one 2p orbital
($2p_y$)



another 2p orbital ($2p_x$)




the third 2p orbital
(2pz)
z
y
x

Don’t forget:
an orbital is the shape of the space where there is a high probability of finding electrons

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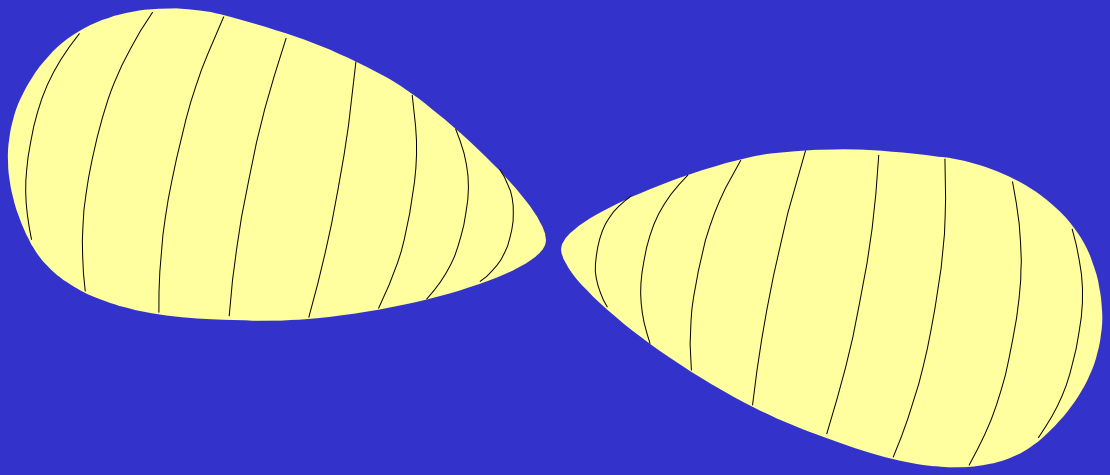
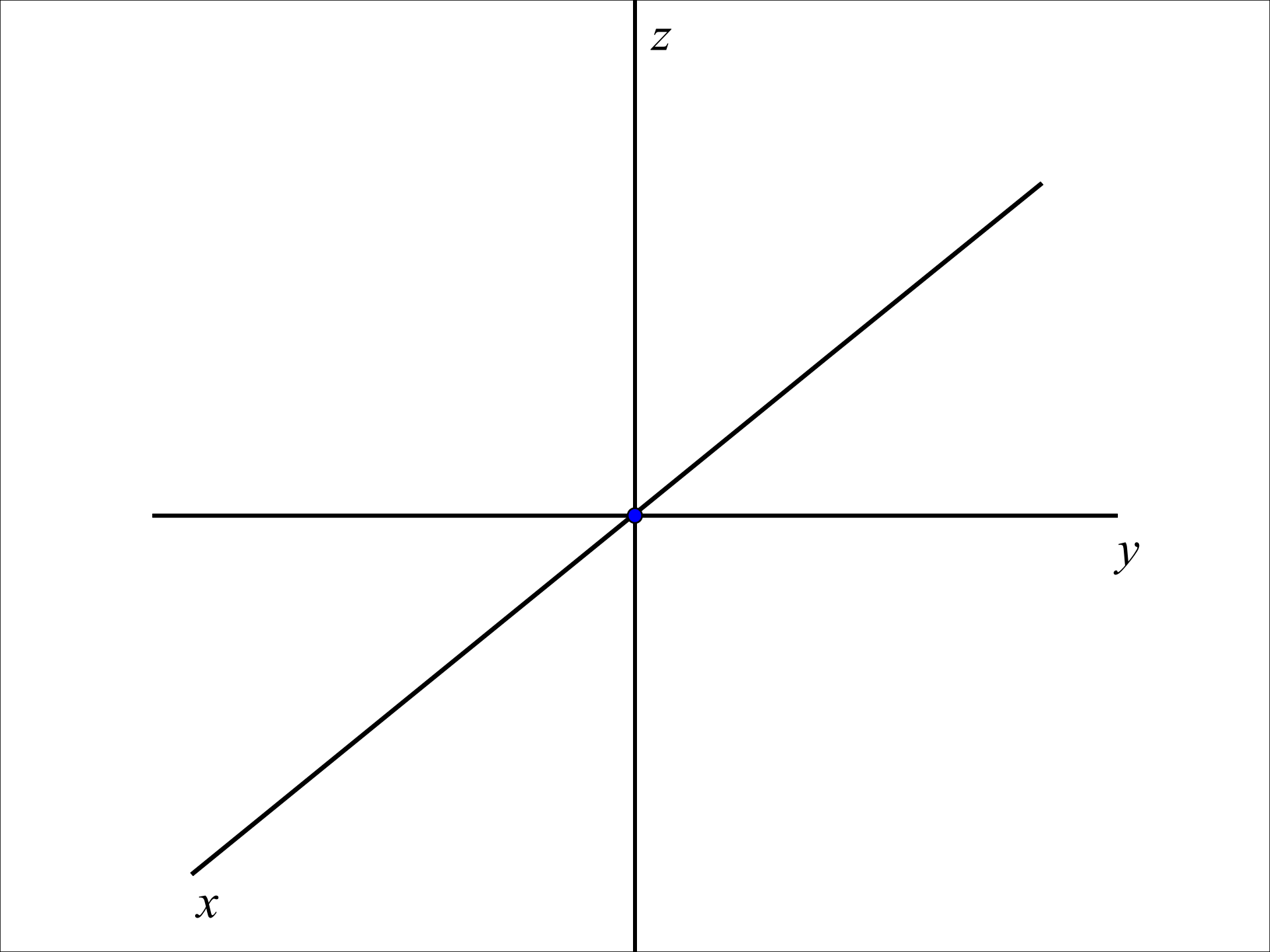
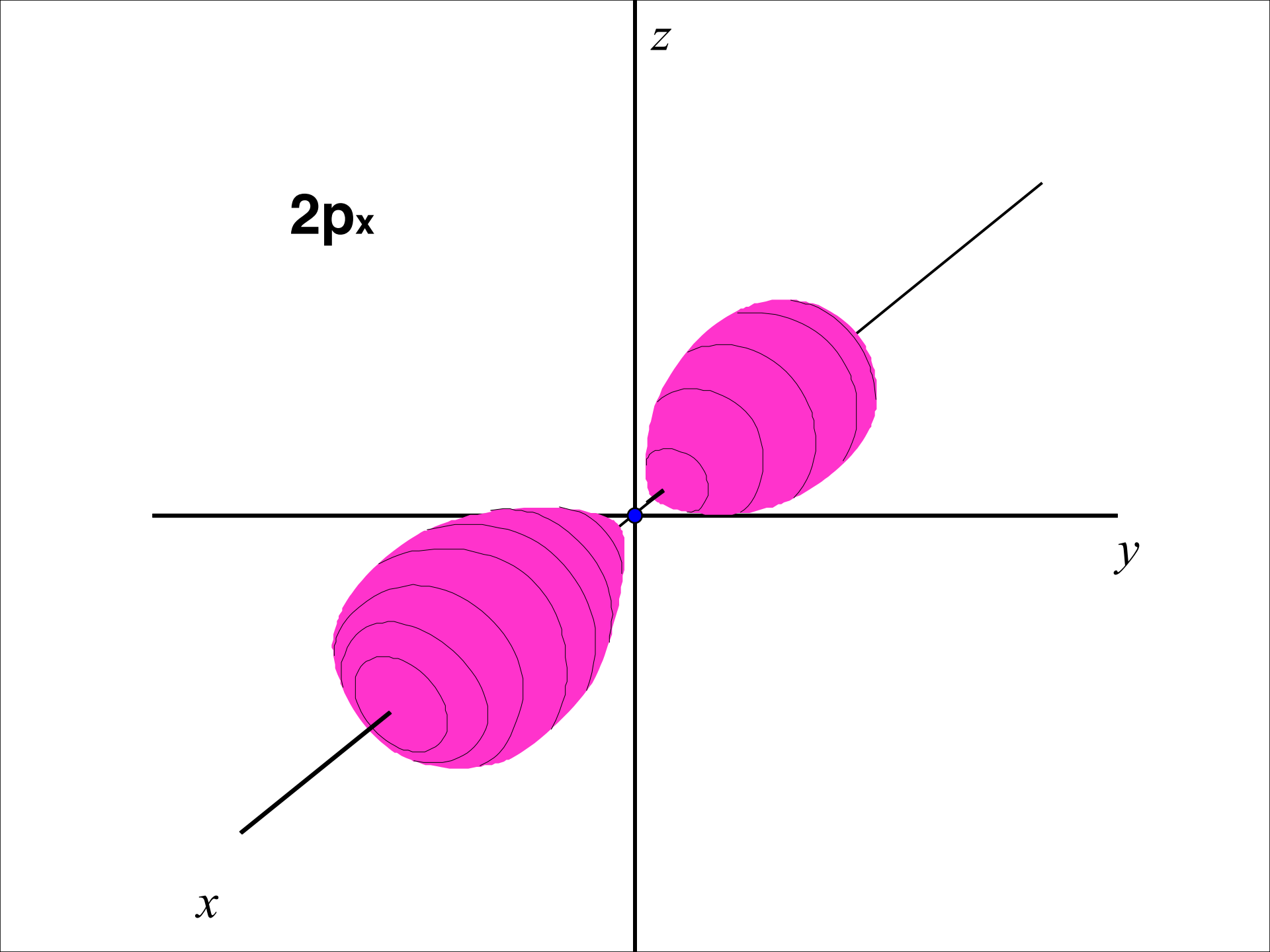
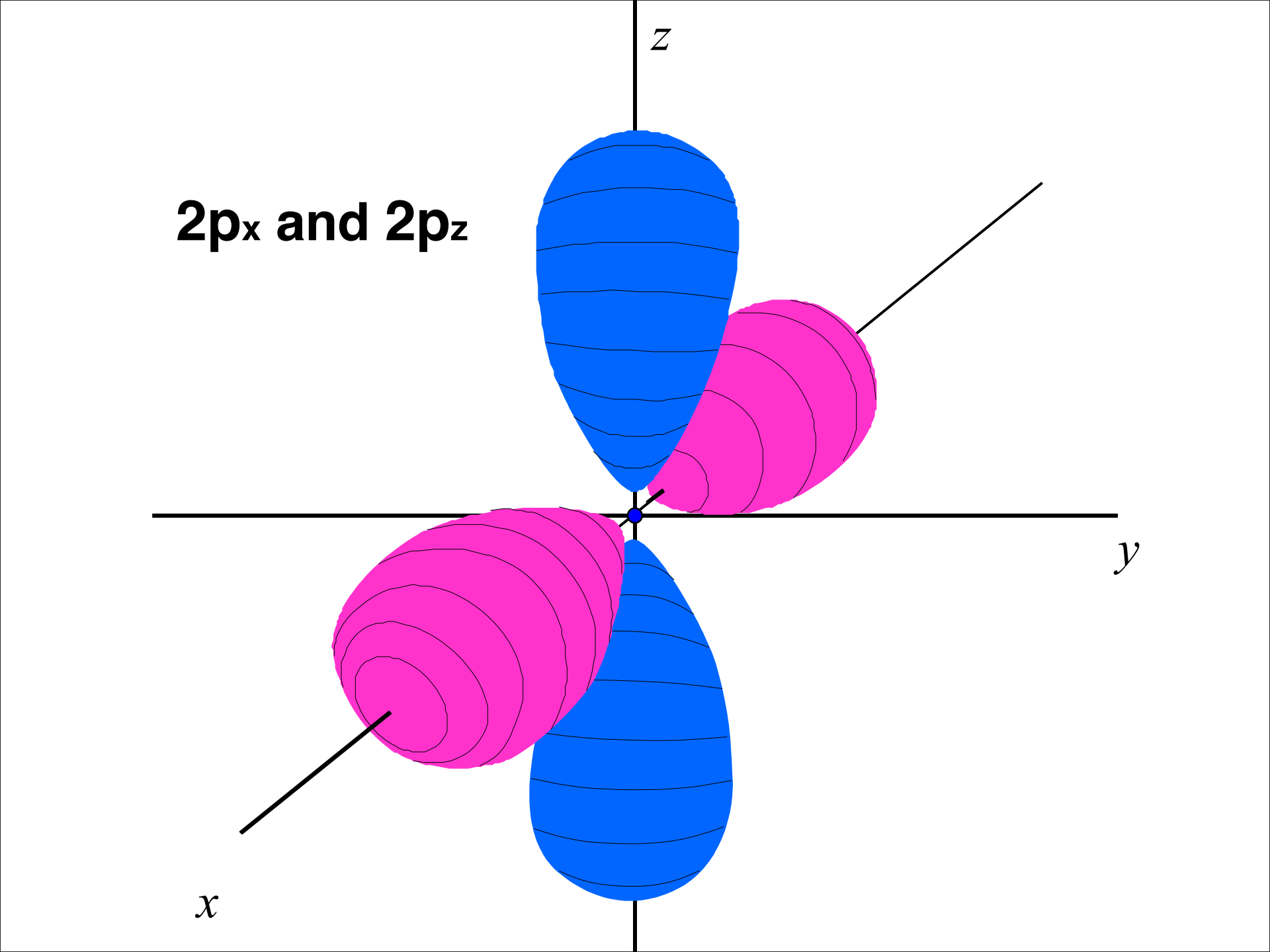
an orbital is the shape of the space where there is a high probability of finding electrons



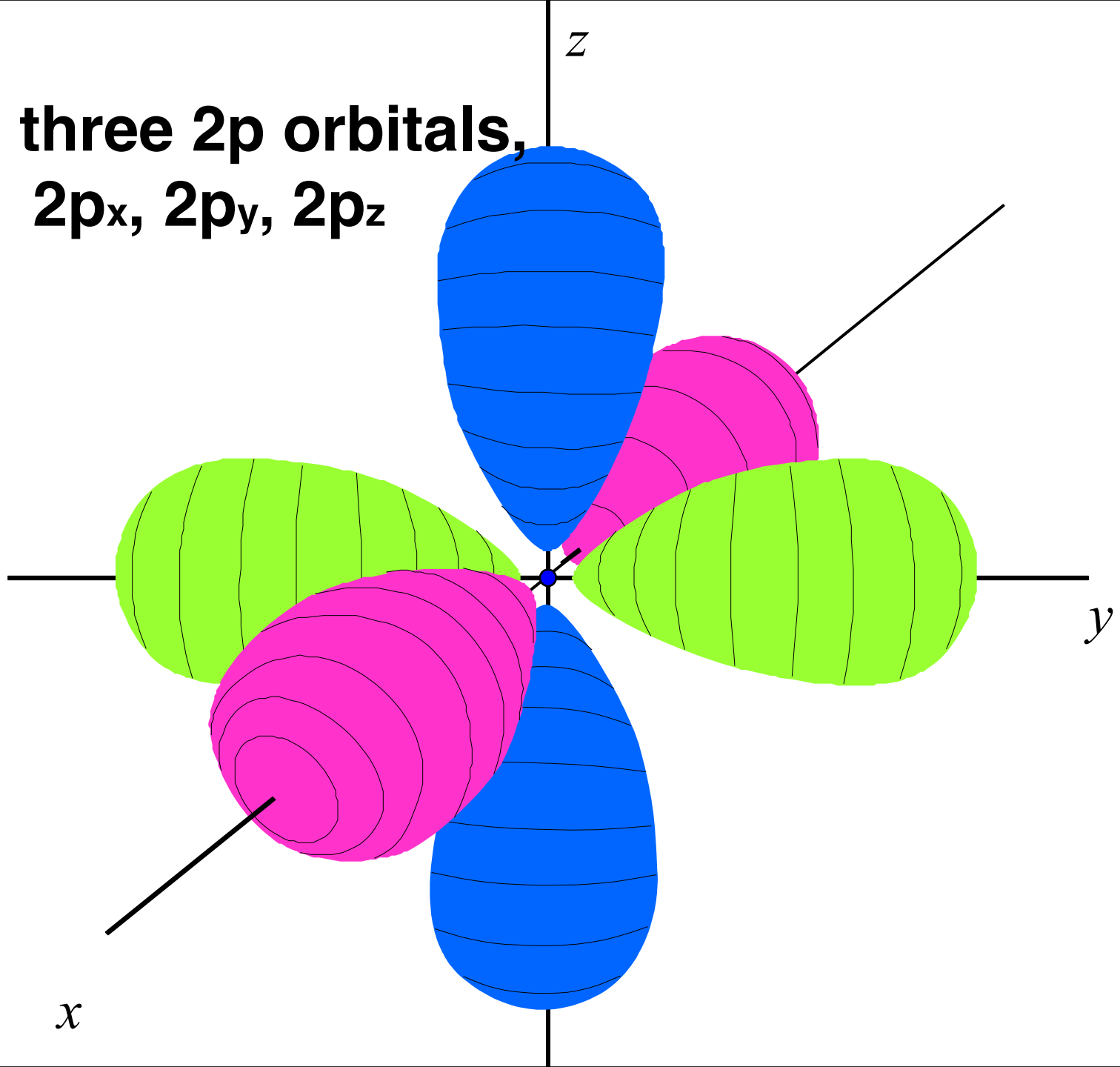
This is the shape of p orbitals


z
y
x

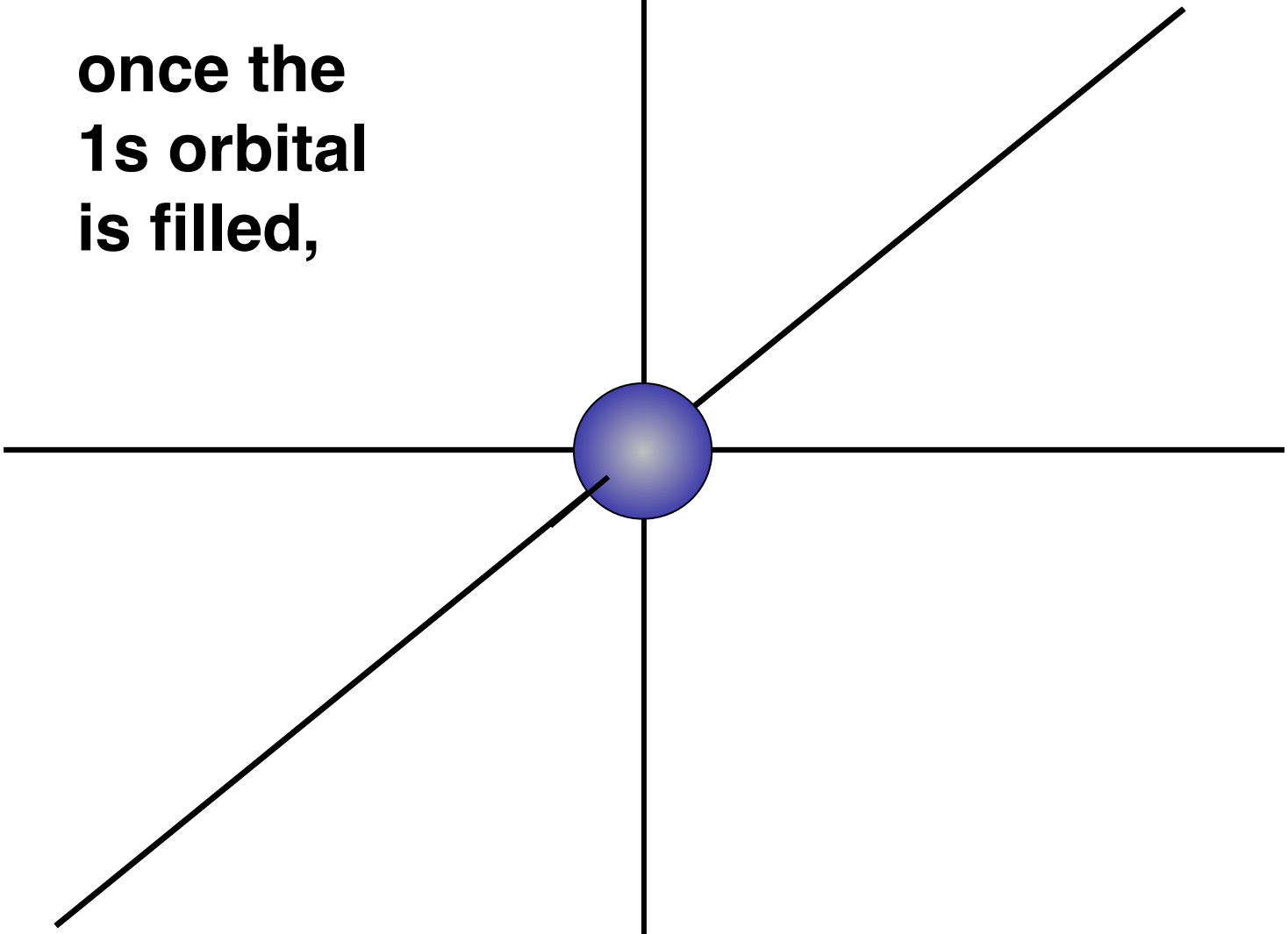

2px
z
y
x


2px and 2pz
z
y
x

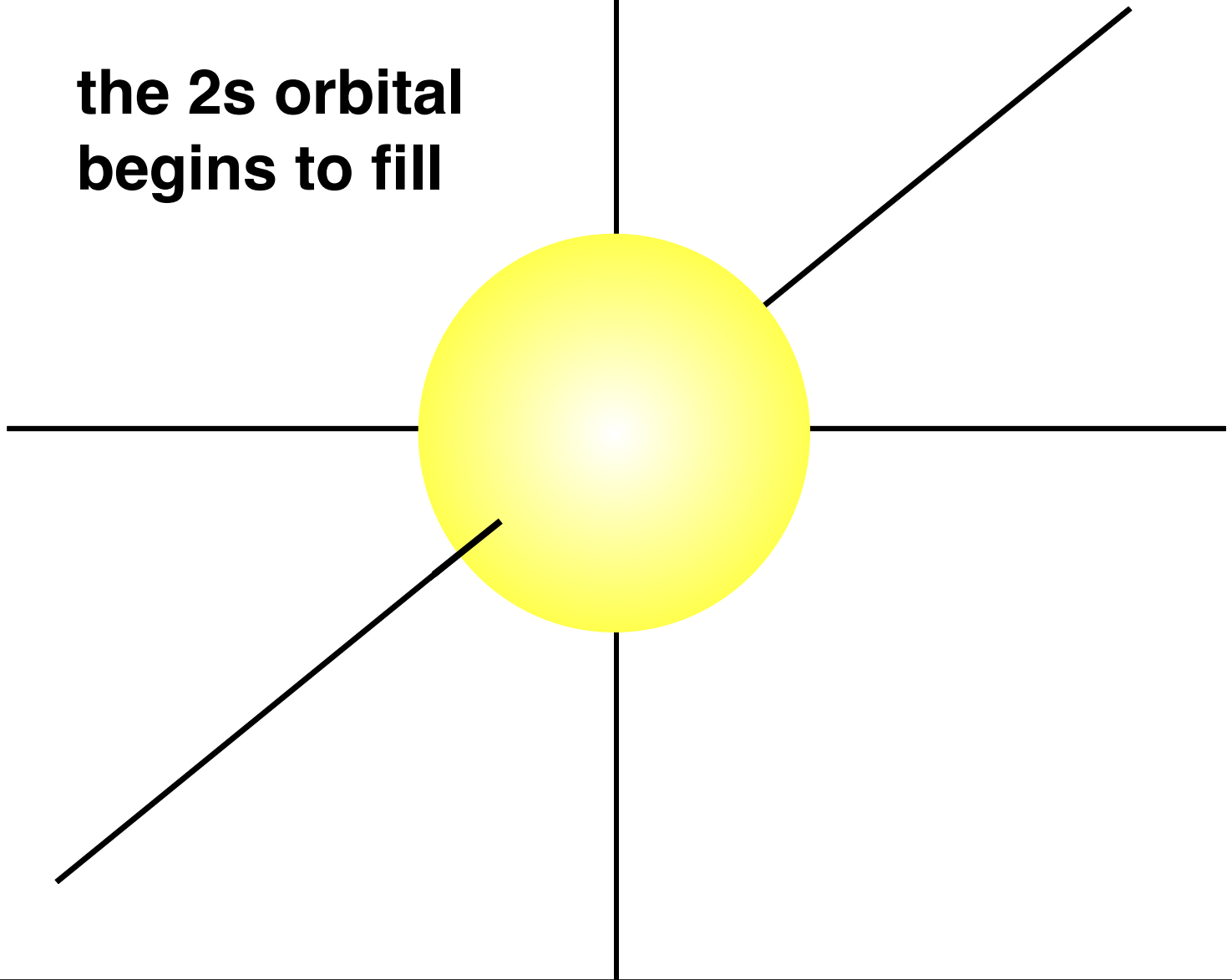
The three 2p orbitals, $2p_x$, $2p_y$, $2p_z$



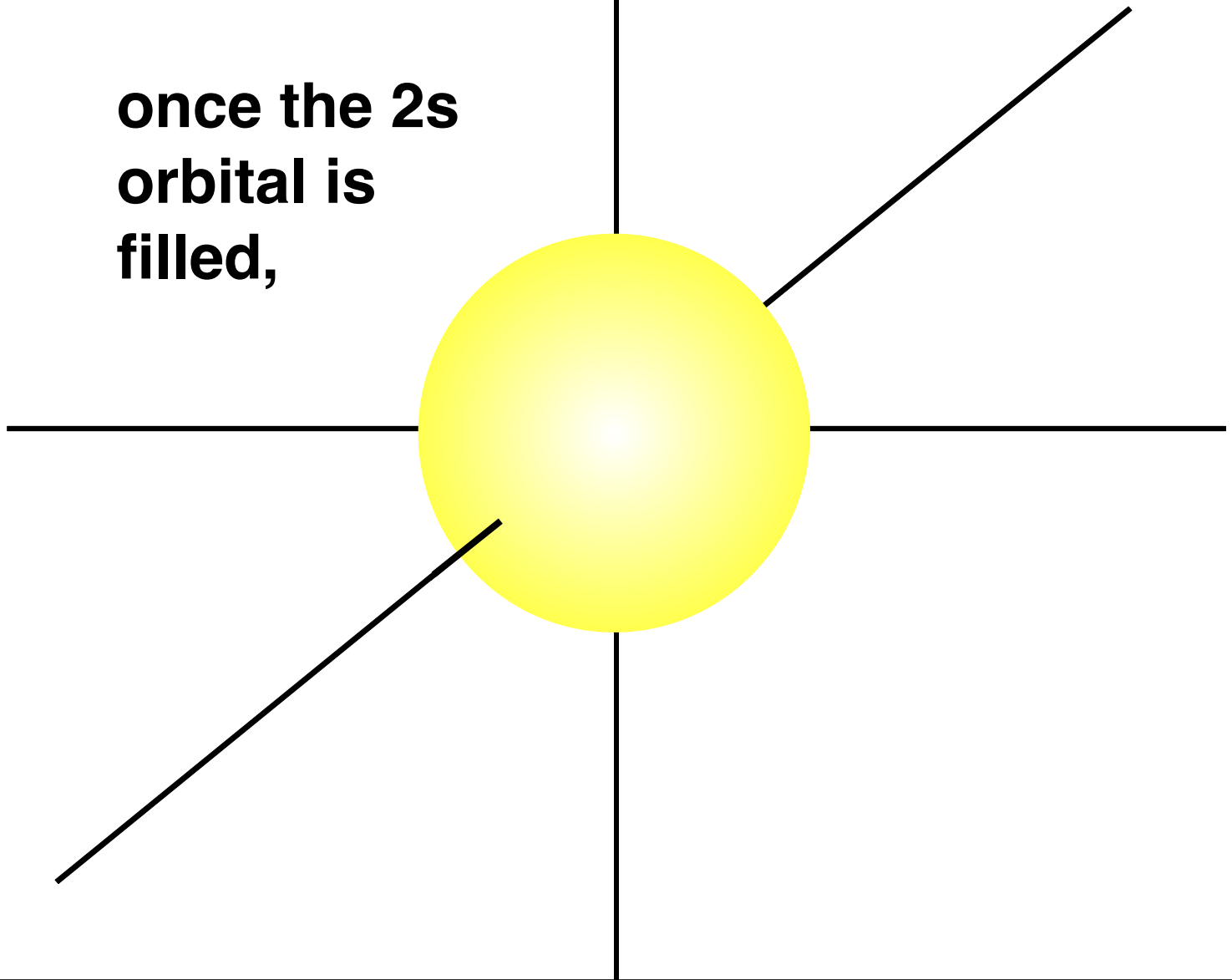
once the
1s orbital
is filled,



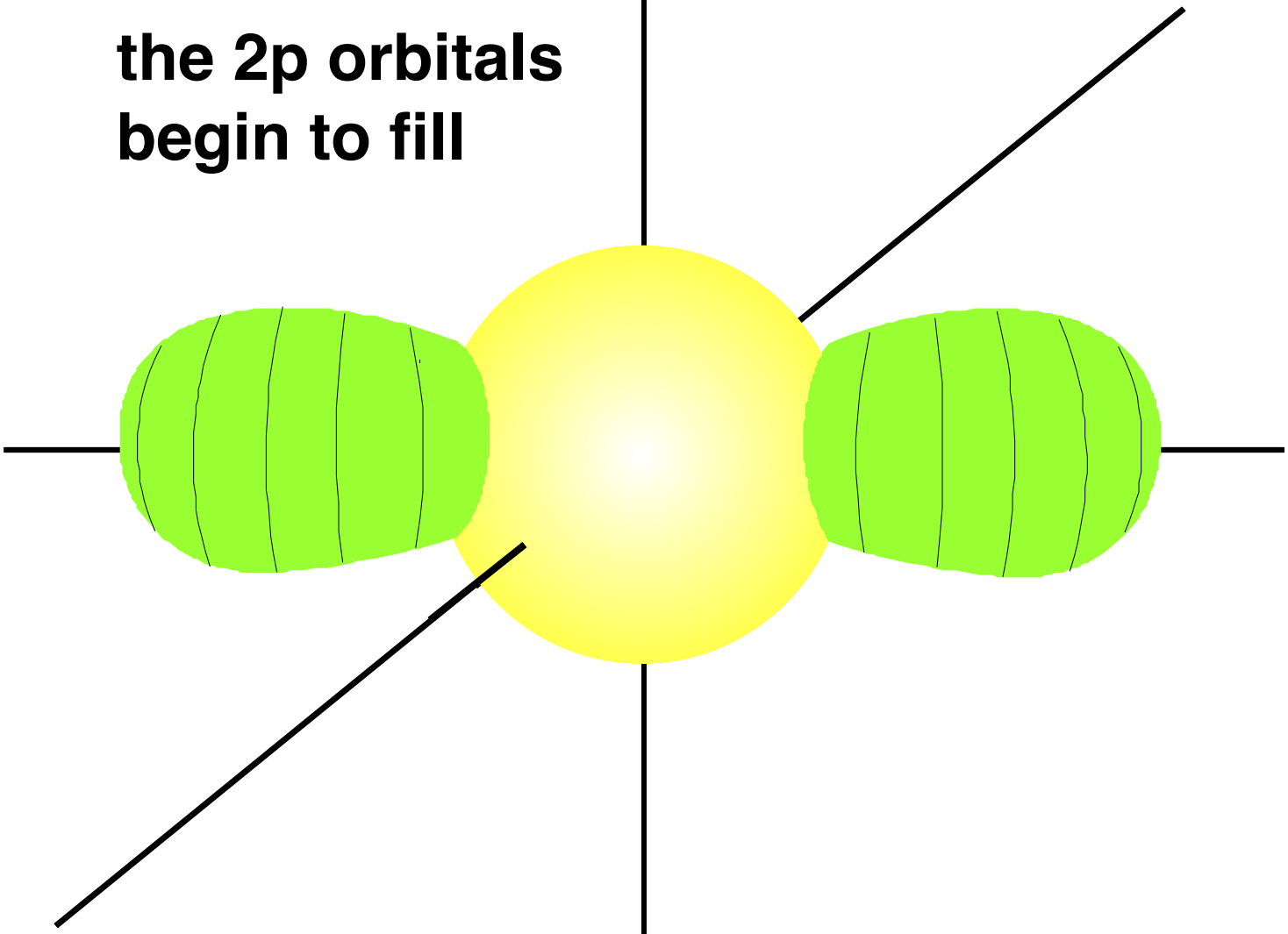
the 2s orbital
begins to fill



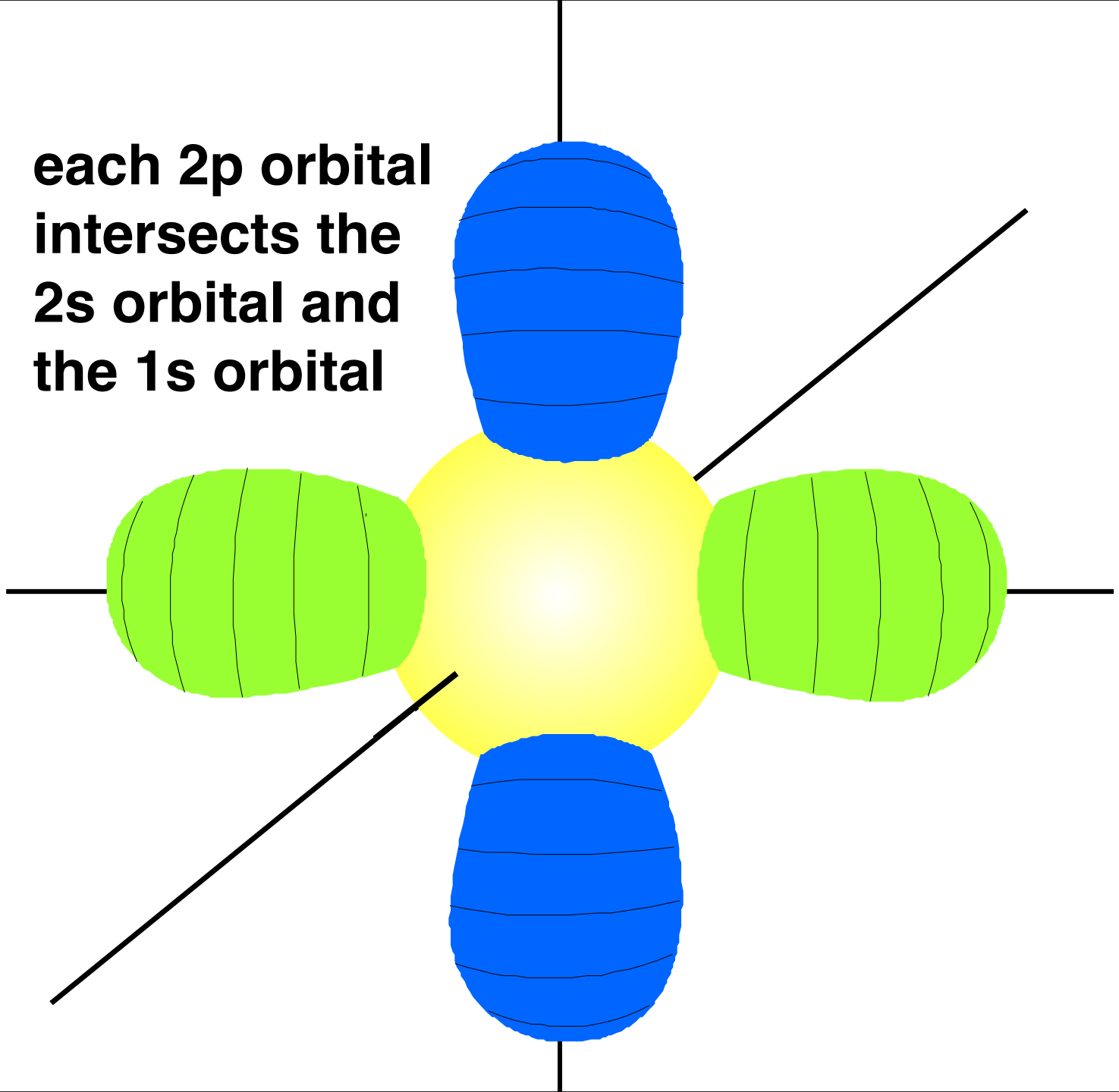
once the 2s orbital is filled,



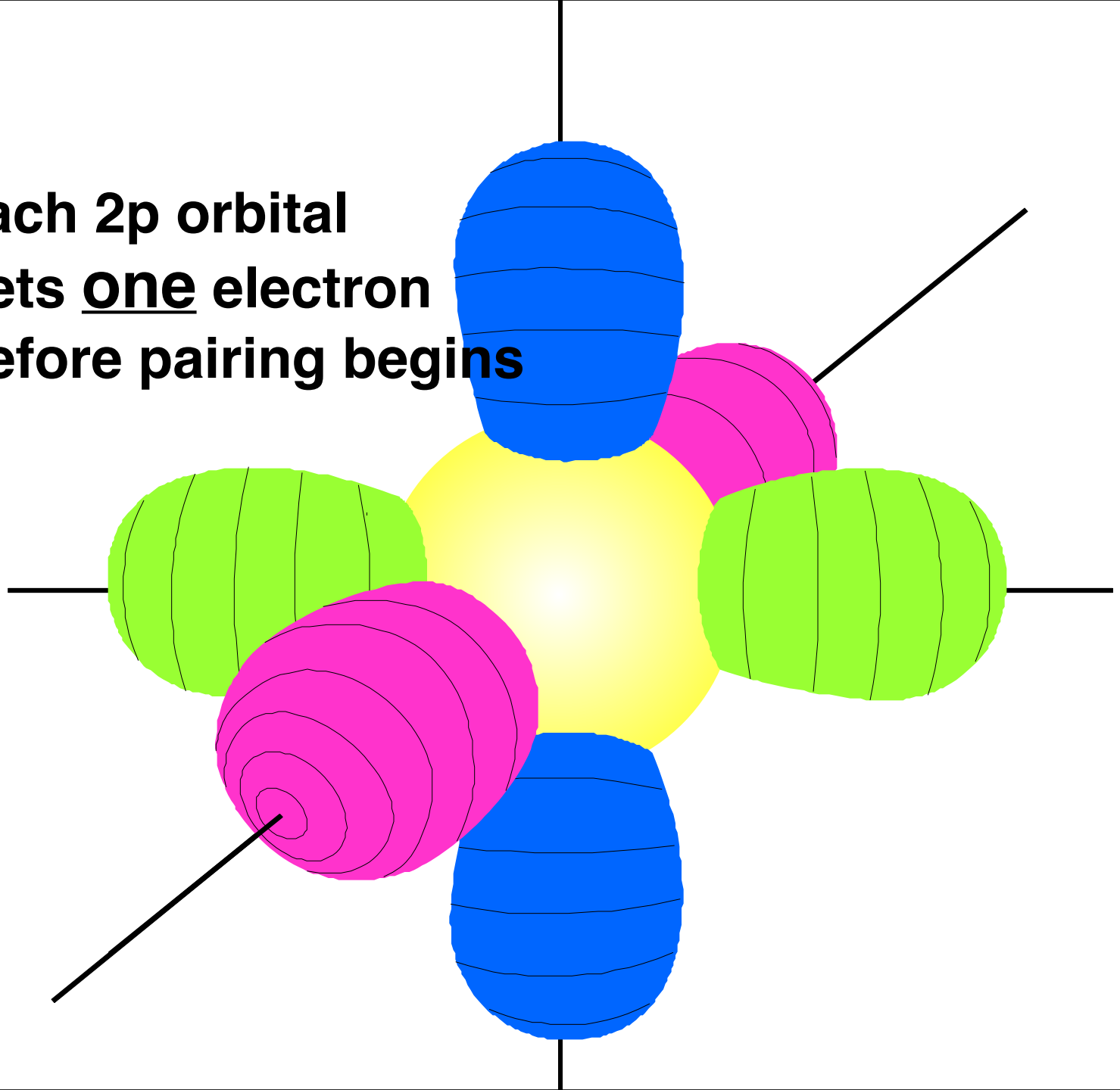
the 2p orbitals
begin to fill



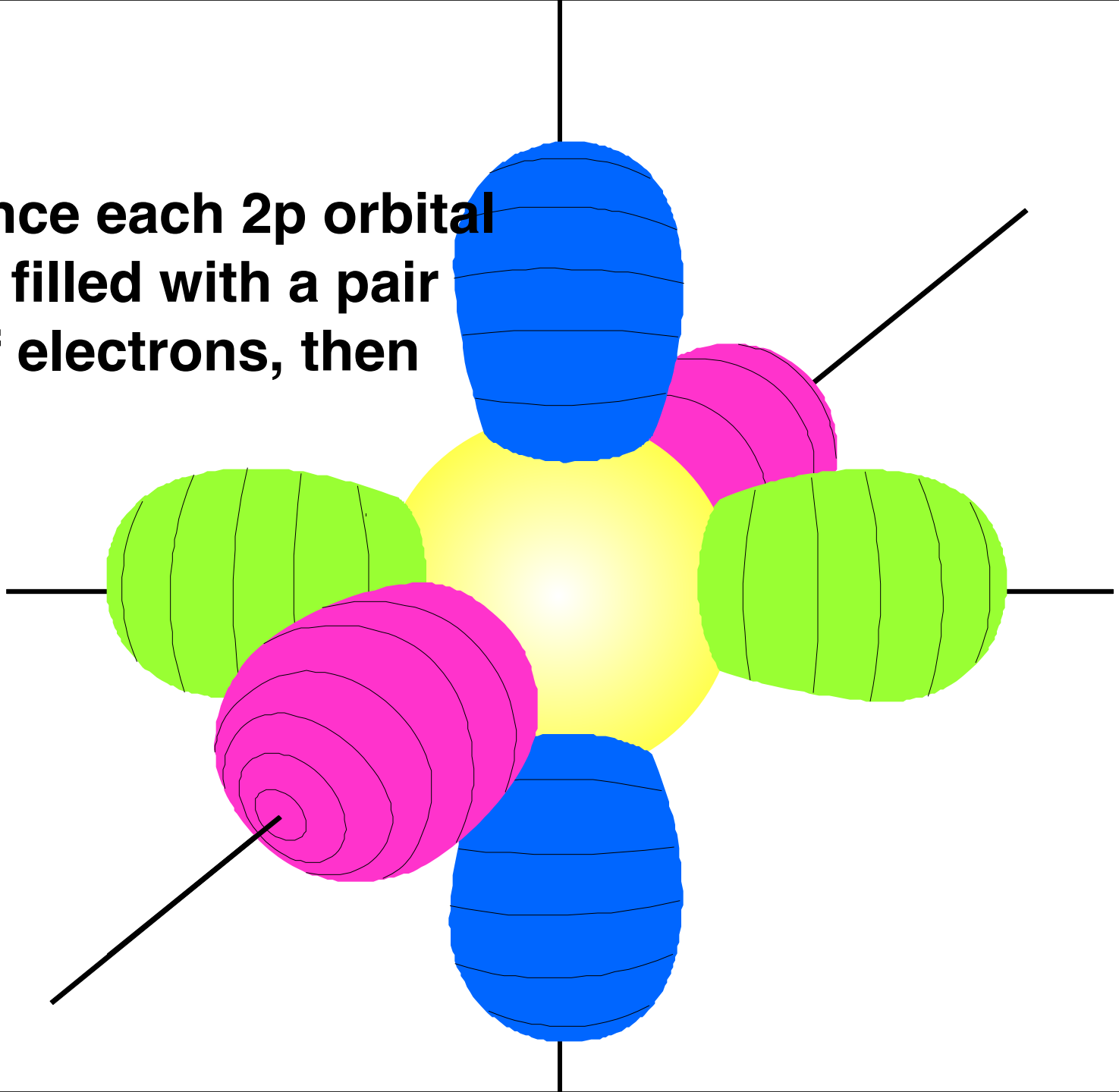
each 2p orbital intersects the 2s orbital and the 1s orbital



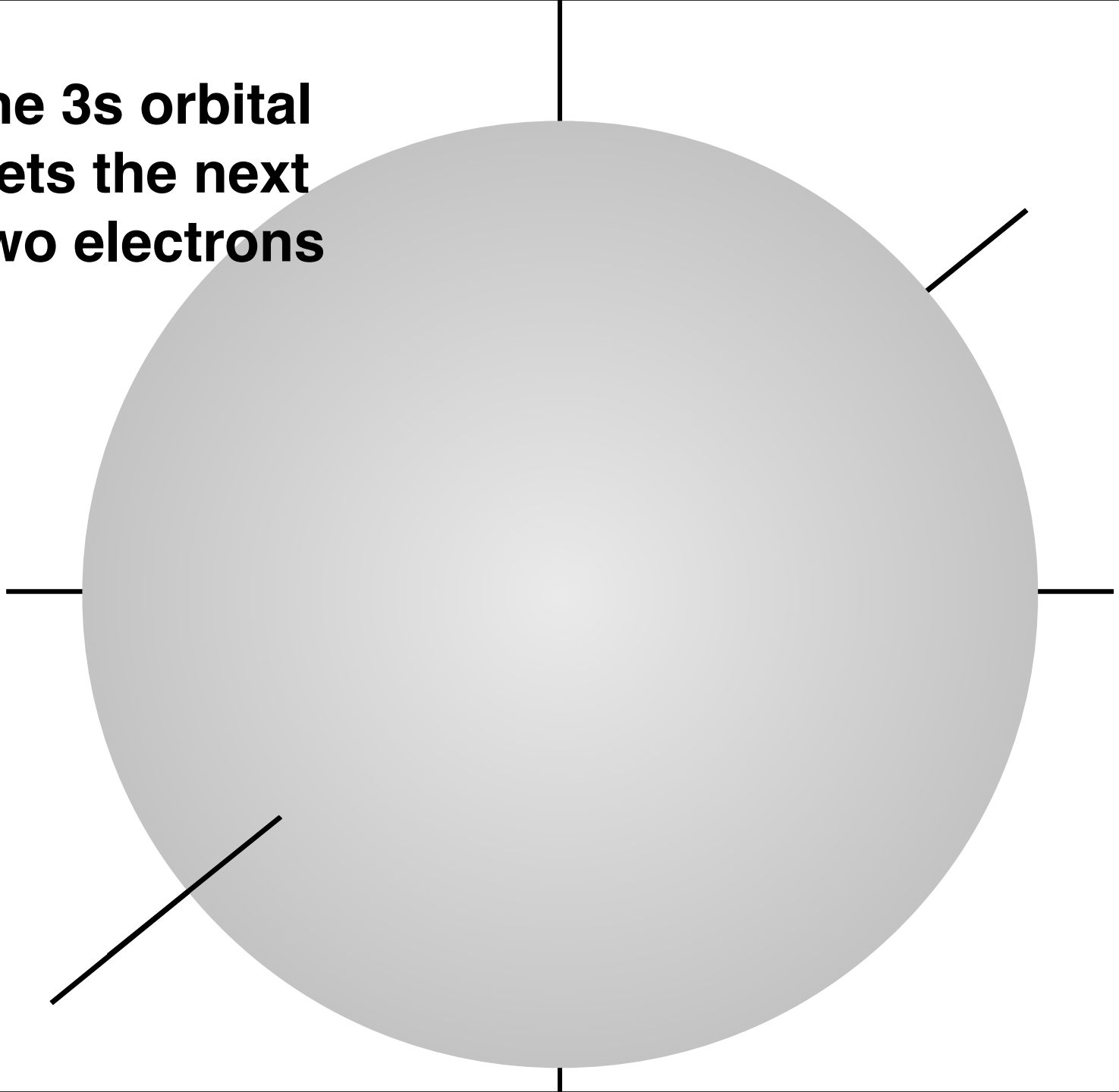
each 2p orbital
gets one electron
before pairing begins



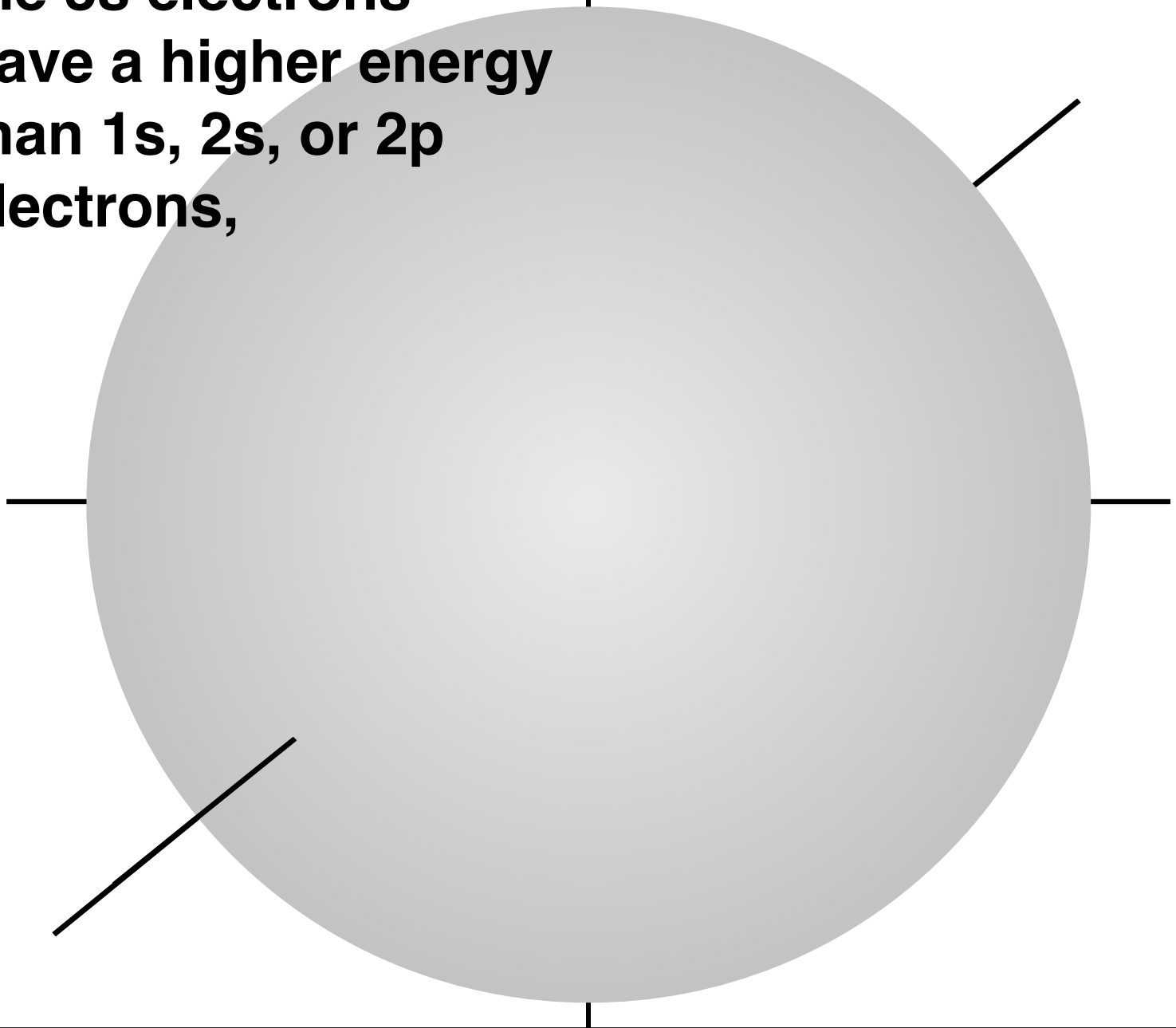
once each 2p orbital is filled with a pair of electrons, then



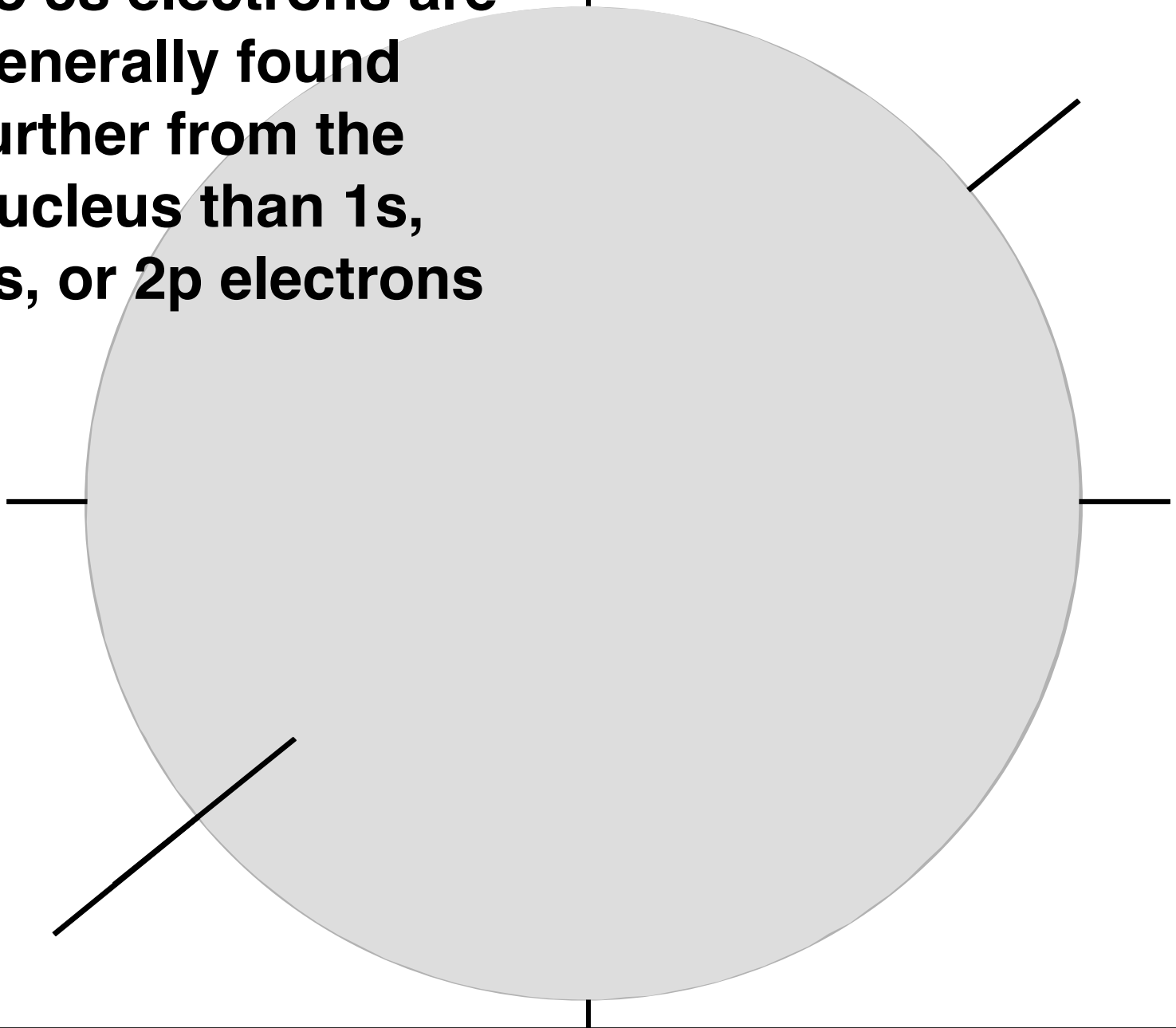
the 3s orbital gets the next two electrons



the 3s electrons have a higher energy than 1s, 2s, or 2p electrons,



so 3s electrons are generally found further from the nucleus than 1s, 2s, or 2p electrons



What does that have to

the billions of interactions of atoms constantly going on around you depend on how the electrons are arranged in each atom

the billions of interactions of atoms
constantly going on around you
depend on how the electrons
are arranged in each atom

the arrangement of an atom's electrons
(its orbitals)
govern how that atom will interact
with other atoms

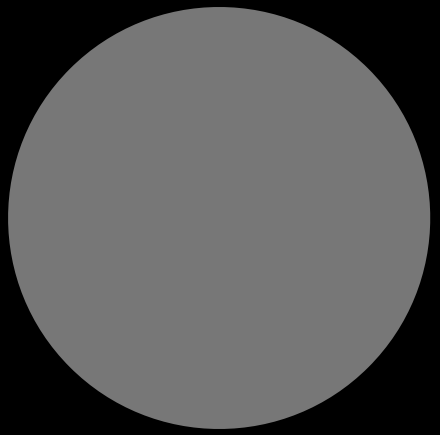
the billions of interactions of atoms
constantly going on around you
depend on how the electrons
are arranged in each atom

the arrangement of an atom's electrons
(its orbitals)
govern how that atom will interact
with other atoms

If atoms did not interact with each other,
you would not be sitting here reading this

An interesting place where electrons have a specific organization within atoms, allowing for intersting atom interactions

An interesting place
where electrons have
a specific organization
within atoms,
allowing for intersting
atom interactions



Not an interesting place,
where electrons have
no specific organization
within atoms,
where atoms wander
aimlessly about

(does not actually exist)