Now okay.

So now I'm going to get to the why this matters.

So there's two different sources, two different targets.

Remember, we can call them sources or targets.

And notice they both have this continuous radiation.

And I will talk about that.

The [INAUDIBLE] will end with a discussion a little bit on what you can do with that.

But for now, let's keep focused on these lines, these discrete characteristic lines.

So there's the k alpha from molybdenum.

There's the k alpha for copper.

OK, now Moseley, Henry Moseley, was a brilliant scientist.

And he was working with Rutherford and others.

And he was really interested in looking at the trends.

So he took all of these elements.

So from calcium all the way to zinc.

20 to 30.

And he said I want to look at the k alpha lines of all of these.

I want to look at the K alpha lines of all of these.

And what he found was extraordinary.

He did more.

38 in total.

But I'm just going to show you his data for these.

OK?

And what he did was absolutely profound because what he noticed-- there are the lines.

These are actually his measurements.

OK?

These are his k alpha lines.

And what he noticed in going from calcium down to-- ohh-- brass?

OK, we'll talk about that in a minute.

It's supposed to be zinc, isn't it?

Why is it zinc?

Well, why is it not zinc?

Let's think about that later.

For now he noticed that this has a square root relationship to the energy.

So Moseley came up with-- he was working on this in 1912.

OK?

You got to remember 1913.

1912 was when Rutherford did the gold foil experiments.

It had been 44 years since Mendeleev put his periodic table to paper and published that.

So for 44 years, we had a periodic table.

But see, the thing is, there was a huge problem with the periodic table because Mendeleev had this, sort of, brilliant realization that periodicity-- periodicity-- was related to, both, the atomic mass-- and remember, we talked about this-- and the properties, the chemical properties.

That chemical properties.

That allowed him to create in ordering of the elements.

In ordering of the elements.

That is still the ordering, essentially, that we have today.

But the problem is why did they have that ordering?

I didn't really tell you why, sometimes, he was like, well, the properties win.

OK, maybe the mass-- no, no.

Properties win.

Properties need to be aligned in this column, so I'm I'm going to move those over.

Like, that's what he did.

But he didn't know why, except that it made sense to him.

Moseley's experiments told us.

They gave us the why.

Aw, it was so important.

And Moseley's law-- Moseley's law-- was, essentially, him thinking about the Bohr model for these characteristic x-rays.

So he said that h nu-- so that's the frequency for some k alpha line-- is equal to 13.6 ev.

All that looks familiar.

Times z minus 1 squared.

And then, he did the difference in energy, just like we've done now a number of times in this class.

That's what he did.

And this is 3/4.

Why this?

Well, let's talk about that in a second.

So 13.6 ev times 3/4 times z minus 1 squared.

Two things about this, right?

One is why is it 1 over 1 squared minus 1 over 2 squared?

Well that's because they knew, or at least they were pretty confident, that you had this positive charge in the middle here.

That's the protons and the nucleus.

And then, you had these electrons.

Right?

So you had, like, the 1s electrons.

And then, you had another shell out here.

And so they knew, OK, 2s.

Maybe that's combined with 2p, so it goes on.

So what happens in the x-ray experiment?

Well what happens is you shoot an electron in.

Rank and just crank the voltage up so high that an electron could come and knock that out.

Right?

And so that's what did it.

And so now one of these can cascade down there and give off a k alpha photon.

Right?

This is nothing new.

We've talked about this.

But you see it here in the equation.

You see it in two ways.

First, we're going from 2 to 1.

1 squared minus 1/2 squared.

3/4.

Right?

But second-- and this was critical-- the z minus.

The z minus told us that all these positive charges in here, all these positive charges, are screened perfectly by one electron, this one that was left.

And it works.

He assumed perfect [INAUDIBLE].

So what do all these see?

They see z minus 1.

They see z minus 1 if z is related to the atomic number.

Now here's where this was so powerful because when you-- and if you can't read this, don't worry about that.

I just want to show you that it is a perfectly straight line.

When you plot the K alpha transitions, these are different elements.

These are his different elements.

And if you plot the square root of the frequency versus element, it is a perfect line that holds.

And so what Moseley wrote in the paper is we have your proof in 1930 that there is, in the atom, a fundamental quantity.

A fundamental quantity, which increases by regular steps as one passes from one element to the next.

This quantity can only be-- only be-- the charge on the central positive nucleus, of the existence of which we already have definite proof.

Now we know about that.

We know from experiments that Rutherford did that that nucleus had the positive charge.

But they didn't know that it was connected to the position in the periodic table.

In fact, years later, people talking about those experiences-- I mean, people didn't even take Rutherford's experiments as seriously until Moseley's work came along.

44 years had come since Mendeleev.

But Moseley gave it the foundation that it needed.

Periodicity is because of atomic number.

Periodicity is atomic number.

That was not known.

That z gives you the periodicity.

Right?

And that gives you, also, the number of protons.

This was a time when they didn't know what was going on.

Why did the mass change so much the neutron wasn't discovered till 1932, 20 years later?

But this gave the grounding that was needed to the chemistry of the periodic table.

It was a very important discovery.

Very, very important discovery.

So that's my why this matters.

And it's really tragic because he died, tragically, in World War I at age 27.

And the Nobel Prize was not given in 1916 for either physics or chemistry.

He died in 1915.

And most people, at the time, believe that he would have won it at age 28.

That's how important that discovery was.