Fragmentation Box

Demo instructions

Don't worry about having to talk with people about the lab... you know more about it that they do!

Stick to the positive messages NSCL wants to convey:

- *We do world-class research (top 3 for rare isotope)*
- *We educate new nuclear scientists (#1 grad program in US)*
- *Our safety record is excellent*
- *We are good for Michigan: high-tech jobs and federal funding*
- *We are awesome*
- *If you're not sure of an answer, it's OK to say "I don't know"*

Thanks for volunteering! This demo (courtesy of JINA) is a pretty simple way to show people what we do at NSCL, and what FRIB will do even better. You'll need some or all of the following equipment (provided by Zach Constan, outreach coordinator):

- Fragmentation box (contains accelerator stand, target suspension)
- Demo case (contains several marble nuclei, dry-erase markers/eraser, Zach's card, repair equipment)
- Glued target (optional)
- Marble Nuclei postcard
- Other NSCL freebies?
- Easel, Chart Nuclides poster
- NSCL Banner
- Printer labels & sharpies (opt)

Figure 1. Your marble accelerator.

Before the demo

If you expect to have a large volume of visitors, it makes sense to use a target that's glued together so you don't have to reconstruct it every time you do the demo!

They may notice that the target doesn't fragment - it's OK to admit that you're "cheating" a bit. After all, it's a model, not a fully-accurate nucleus!

Build a carbon-12 beam nucleus (6 yellow protons, 6 green neutrons). Set up a carbon-12 target nucleus by hanging it from the nail in the box. Beryllium is typically the element we use for the target foil, but carbon-12 works better for this demo.

Figure 2. The "target" nucleus attached to a nail hanging from gutter guard that spans the plastic box, beam tube on left.

Don't be shy about inviting people to try it. Emphasize that they get to "smash stuff and get free stuff." The parts in italics below are the kind of things you could say, but do what's comfortable, especially considering the audience you have.

During the demo

If there are lots of visitors, you can give each a nucleus and do the introduction for all at once, then have them smash one at a time, going back to the chart of the nuclides after they collect their beam and the other fragments from the box.

Everything is made of tiny particles called atoms (you, me, the floor, the air...), and the nucleus of the atom is incredibly small, so you can't see it. So we use marbles as a "model", to imagine what it looks like and how it acts.

Show them the model!

In the National Superconducting Cyclotron Laboratory at MSU, we do world-leading research on the nucleus.

Let them hold the model, have them count protons (*This is a carbon nucleus*) and neutrons (*Six plus six is? This is a carbon-12, a very common and stable nucleus*).

At NSCL we study rare isotopes, which are very unusual versions of the elements and not found on earth, so we have to make them before we can study them. Thus, we take a common, stable isotope like this one, make it go fast using an accelerator like the cyclotrons at NSCL, then smash it. With this model nucleus, we can do the same with an accelerator tube.

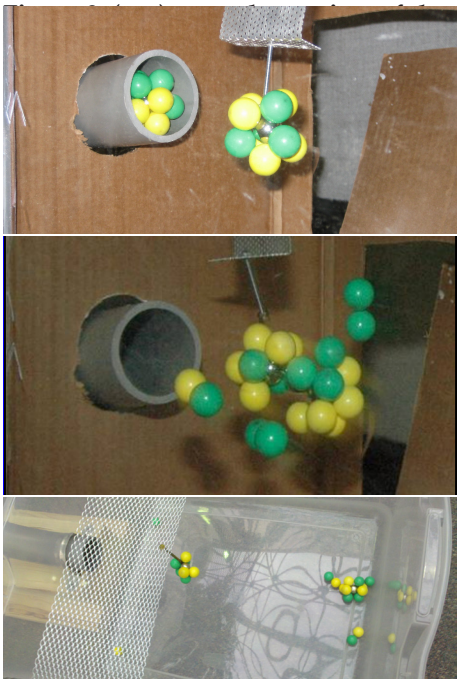

Figure 3. Before, during, and after fragmentation. The new isotope is on the floor of the box (bottom right).

During the demo con't

Show them where the beam goes in, and parts of the demo.

What will happen when you drop it in? Where do you want to drop it? Why? You need a lot of energy (go fast) to break a nucleus. What happens to your "beam" when it hits the "target" nucleus in the box? Try it. Were you right?

You can call the fragmentation box a "cheap Home Depot accelerator that uses gravity" - adults really love that one.

Pull out the new isotope (remains of the beam on box floor), removing any marbles that aren't **directly** touching the silver magnet in the middle.

What isotope is the beam nucleus now? Mark it with your initials on the chart of the nuclides.

You have lots of flexibility in positioning the target nucleus for optimal fragmentation! Move it around if necessary, especially to prevent too much fusion.

Have them mark it in a color of their choice - the more colors you have, the more interesting it looks! Talk to them about their isotope - if it's stable, explain why it's hard to make unstable isotopes. If unstable, make them feel like they produced something interesting. If it doesn't appear on the chart, make a big deal about how they just "discovered" it!

(Optional) Make a label for visitor to wear that says "I made <isotope>".

Your "beam" started as (what?) a stable nucleus… is your final isotope stable? This is like what NSCL can do now, smashing nuclei at up to half the speed of light to produce nuclei that you won't find on Earth.

We can do pretty good experiments right now, but we could make even stranger isotopes is we smashed harder and smashed more. What if we could make this accelerator tube twice as tall and hundreds of times as wide? We'll soon begin construction on the Facility for Rare Isotope Beams, a $730 million project that will create and study more nuclei than ever before!

Much of this is optional, beyond the "fragmentation makes rare nuclei for science, and we're really good at it!" message. Tell the story in the way you are most comfortable doing!

Want to know more? Have a postcard, and some NSCL freebies!

If a kid wants to do it again, and there's a line, just send them to the back. They're usually more than happy to!

(Optional) Give postcards to anyone, but freebies only to kids who actually do the demo.

Feel free to point out the applications of nuclear science and the economic impact on Michigan. Suggest they can take Zach's card if they want more information, and should email him or check out our website (on the postcard) to find NSCL tours and summer programs.

If you are getting lots of questions and have more people waiting, encourage them to take Zach's card and send email!