# Air Track Accelerator
Demo instructions

Be confident when talking about the lab - you know more than 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*
- *If you're not sure of an answer, it's OK to say "I don't know"*

Thanks for volunteering! This demo is a pretty simple way to show people how a linear accelerator works. You'll need some or all of the following equipment (provided by Zach Constan, outreach coordinator):

- 2-meter Air Track
- Air Supply with hose & power
- Air track car
- Two neodymium magnets
- Putty or other sticky material
- Two electromagnetic coils (large enough to go around the air track)
- Power supply
- 4 pair cables with banana plugs
- Two switch boxes labeled "Attract" and "Repel"
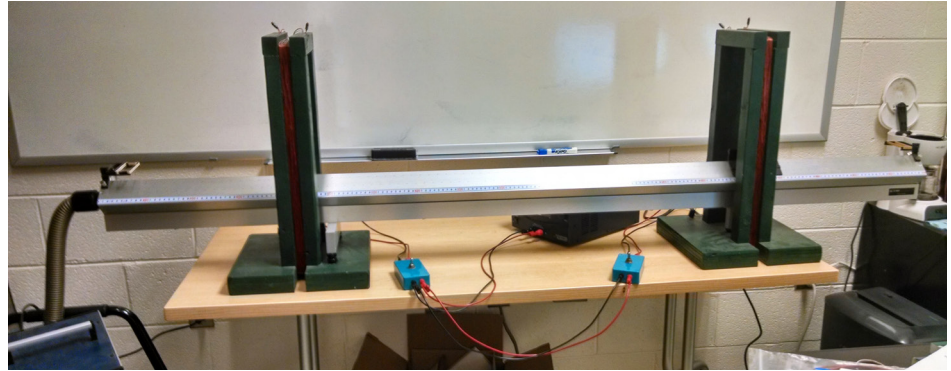
Before the demo

- Connect the air supply to the air track with the hose, plug it in and power on. Check that the air track car moves freely on the track.
- Make sure the neodymium magnets (poles in the same direction) are attached on either side of the air track car. CAUTION: STRONG!
- Put the large electromagnetic coils around the track as shown.
- Connect the power supply to the red/black inputs on one switch box, keeping red/black polarity consistent.
- Connect the red/black inputs of both switch boxes, again keeping red/black polarity consistent.
- Connect the green inputs of each switch box to the inputs on each electromagnet. Polarity is not important at this stage.
- Switch on the power supply. Keep voltage below 5V, amps below 20 (15A should be enough).
- Check that the air track car is attracted or repelled from each electromagnet. If the car is attracted/repelled opposite of what you would expect from the switch setting, turn off the power supply and reverse the banana plug connections on that electromagnet.
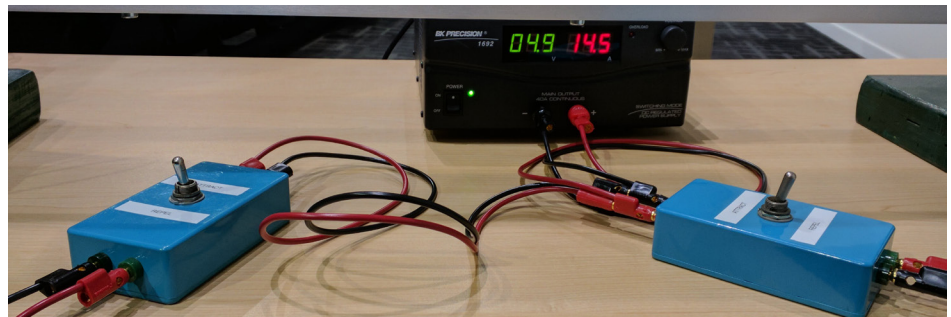
Particle accelerators are machines that make particles (such as nuclei) all travel very fast in one direction. These have many uses! At NSCL, we currently use cyclotrons (circular accelerators) to crash stable nuclei into a target, which lets us learn more about how nuclei behave. FRIB will have a new, more powerful accelerator. This is your chance to run an accelerator yourself!
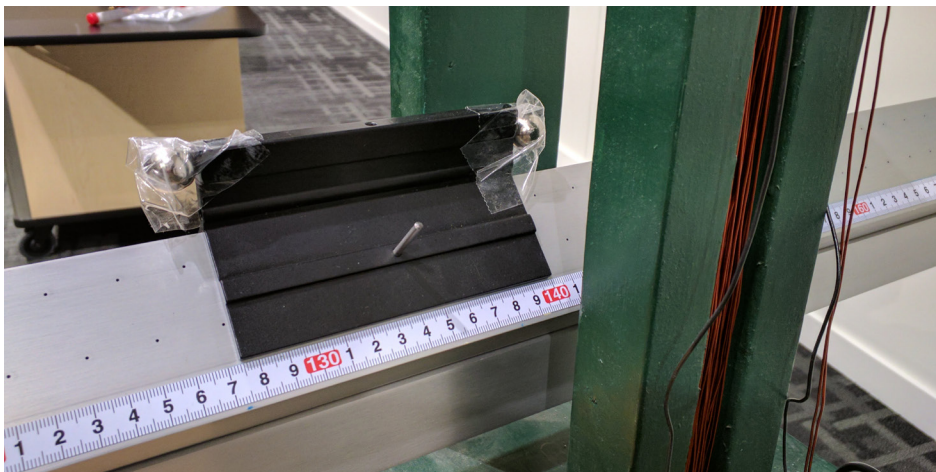
(show the visitor the different parts of the demo) *Imagine the air track car is a particle (nucleus?) you want to accelerate. As it travels along the air track, you can push or pull it with the green electromagnets. The force between the electromagnets and the magnets on the car can either speed up the car or slow it down.*

You have a switch that lets you control the electromagnets - they're set up to either attract (pull) or repel (push). If you switch to attract, you can pull the car towards the electromagnet. As it passes by, you can switch to repel to push it away - you've accelerated it twice!

Let the visitor experiment with it! Some tips:
- Make sure they start with the cart at zero velocity, the effect is much more striking
- Working with a partner so each is only operating one switchbox is easier
- They can try both accelerating and decelerating
- Don't let them pick up or get close to the neodymium magnets

By switching both magnets, you can bring the car up to pretty high speed! (encourage visitors to work with a partner) *Once a particle accelerator does that with nuclei, they're ready to collide with a target.* (direct them to the marble nuclei fragmentation demo)

You can imagine more and stronger electromagnets on a longer track - the more you could place in the path of the car, the faster you could get it going! That's the future of the FRIB "driver", which will accelrate hundreds of times as many nuclei to twice the energy we can today...

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

Turn off the power supply and air supply. Unplug everything, secure the air car with neodymium magnets in the plastic box.