Tour group types and messaging priorities

| Messaging | Young Students | HS/College science | General Public |
| --- | --- | --- | --- |
| Applications | x | x | x |
| Careers | x | x |  |
| Discovery | x | x |  |
| Education | x | x |  |
| Fiscal Responsibility |  |  | x |
| Impressive scale | x | x | x |
| Intro to Nuclei | x | x | x |
| Rare Isotope Production |  | x |  |
| Safety | x |  | x |
| Technical Details |  |  |  |
| World Class | x | x | x |

On a tour, remember to:

* *IN SLIDES: Collect minor form, offer Restroom visit on arrival! Offer group photo*
* *Ask them to ask questions, it’s OK to be overwhelmed*
* Include MORE animations in slides
* Include MORE demos/engagement, ask for volunteers

Talking points by messages

Each message has **animation/demo/engagement**, check demo master list in outreach/events/demo instructions

* + Fiscal Responsibility
		- Reliability/Uptime (**juggling 1, 2, 3 things… 90% of time for 24 hours/day most of the year**)
		- Industry Certifications: environmental quality, operational quality, information security, safety
		- Management/oversight: internal and external reviews of technical advancements, operation, etc. Regular and exhaustive reporting to funding agencies
		- Economic impact (Anderson group estimates): $1B during construction, $1B during first 10 yrs operation
	+ Safety
		- Dosimeters – same exposure as background radiation outside
		- Security – IF they ask: as required by law, we have security measures in place, along with the MSU Police. We can’t give details.
		- Relative danger of radiation
	+ Risks associated with radiation are less of a concern than risks due to electricity or other industrial hazards.
	+ Our most recent NRC inspection showed no violations
	+ ALARA: minimize exposure by reducing time, increasing distance, controlling access
	+ We all have radiation safety Training, plus many other training to avoid hazards (ladders)
	+ **Blocking radiation with material**
		- ZERO Lost-time accidents in 2017, lowest accident rate in last 5 years
		- Our recordable injury rate is lower than university avg, way lower than MI industry
		- Table Est Loss of Life Expectancy NRC regulatory
			* 1 rem/y through working life: 51 days
			* Avg Alcohol consumption: 1 yr
	+ Applications
		- Medical
	+ **Killing cancer cells with accelerators**
	+ Accelerators -> 20 million med procedures/yr
	+ **Who’s had an MRI, x-ray, CAT scan, PET scan?**
	+ production of medical isotopes
	+ sterilizing bandages & medical equipment
		- Geophysics/archaeology
		- Purifying Food & sealing food packaging
		- Careful measurements for quality assurance
		- Power (nuclear plants and deep-space probes)
		- C-14 dating **(dead student)**
		- Smoke detectors
		- Smartphones
		- Save lives and change the world
	+ Careers
		- Our research requires a big team! 800+
		- Backgrounds of people at NSCL
	+ Psychology, farming, physics, engineering, chemistry, manufacturing
		- Many different skill sets come together to achieve things never done before, and none could do alone
		- If it’s STEM-related, we do it. Also skilled trades (machining, welding, plumbing), business support, education, communications
		- Training in-house
	+ World-class
		- Our lab’s major achievements
	+ First single-turn extraction cyclotron
	+ First superconducting cyclotron
	+ World’s highest-energy cyclotron
	+ First new-design SRF linear accelerator
	+ Cyclotron gas stopper
		- Highest-power heavy-ion beam in the world
		- #1 rare-isotope production in the world
		- #1 nuclear science school in US
		- Serve 1500+ scientists in 50 countries
	+ Impressive Scale
		- 300-ton S800
		- Research space 1.5 football fields
		- FRIB linac 3 football fields long, 35 feet down
		- Building >500,000 square feet
		- Power 15-18 MW for FRIB, >$10M/yr
		- Accelerate to 0.5c, four times around Earth/second
		- 3000 gallons of LN/week
		- Tanks for 18000 liters of LHe
		- One room at FRIB has >500 miles of cable
		- FRIB linac 300 cavities at $100K apiece
		- 15 additions since original bldg in 1964
		- Control room reading out thousands of sensors
		- Average Experiment generates 1 TB of data
		- Power/cooling/many complex systems **LN**
		- Different kinds of work/skills needed
		- Exotic environments: equipment at 2K or 4K (-450 F), beamline at 10-6 Torr (billion times less pressure than atmosphere), magnetic fields 100,000x the Earth’s, millions of volts
		- **If wall was the size of the atom, the nucleus would be the width of the crack.**
		- **Marble nucleus football field vote**
		- Other big numbers?
	+ Discovery
		- How Detectors measure invisible & short-lived
		- **What could you measure about marble nucleus?**
		- **Put MN inside box - how measure it now?** (scientists can’t just look at and handle the nucleus!)
		- **Weight - interacts with gravity**
		- **Shadow - interacts with light**
		- **Sound - interacts with box**
		- **Can’t see air, but can see wind**
		- **Shape of an invisible object by bouncing off**
		- **Geiger counter, scintillator paddle**
		- Star material (kilonova!)
		- Discovery of isotopes over time
	+ Discovered 60 isotopes
	+ Discovered bubble nucleus Si-34
	+ Discovered di-neutron decay O-26 Be-16
	+ Measured mass of a Cu-56 in less than 0.1s
	+ Rare isotope production
		- Superconducting magnets **wire sample**
		- how to build an accelerator
		- Fragmentation **frag box**
		- Fragment separation
		- Linear accelerator vs. cyclotron **air track accelerator**
	+ Education/Outreach
		- Camps/other
		- #1 nuclear science school in the US
		- 10% of nuclear PhDs in the country
		- Research jobs at NSCL
		- Science Festival
	+ Introducing the nucleus
		- Nuclear is one of many sciences
	+ **Volunteer – what are you made of?**
		- Energy release from splitting nuclei
		- Parts of an atom
		- Relative size of a nucleus
		- Comparison to LHC?
	+ Technical details
		- Beam energy/current
		- Resolution
		- Techniques