

Superconducting Magnets at RHIC

By Ryan Adkins

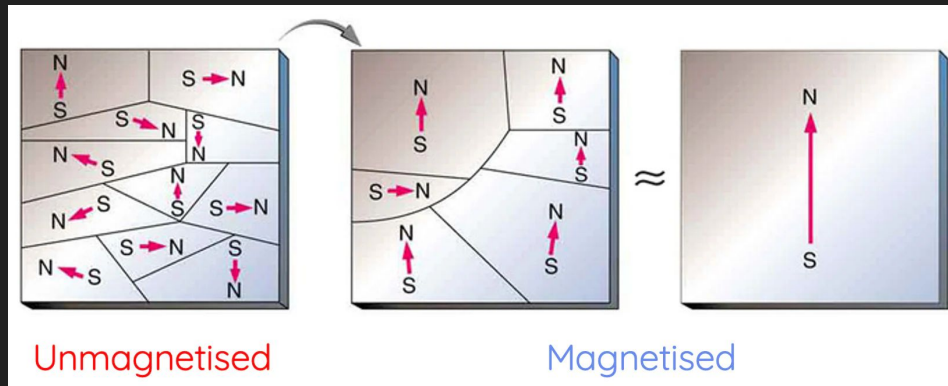
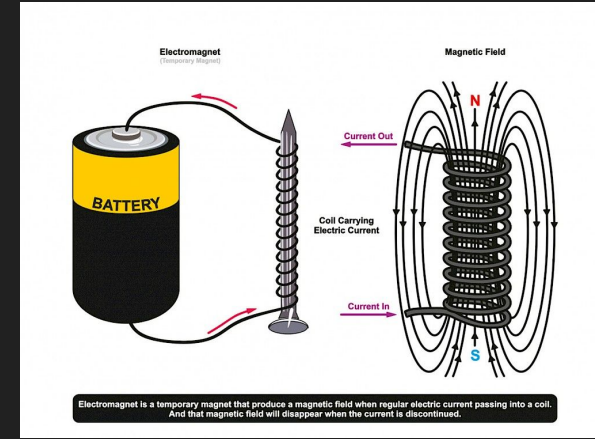
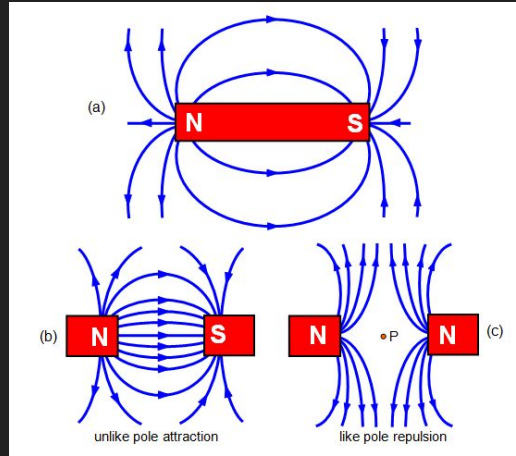
What are magnets

Magnetism is what happens when the spin of unpaired electrons in a material align

This creates magnetic domains in the material

When enough magnetic domains are pointing the same way a magnetic field will form

A magnetic field can be induced by a current carrying wire



History of superconductivity

Discovered by Heike Kamerlingh Onnes in 1911

1933 the meissner effect was discovered

BCS theory is discovered in 1957 by Bardeen, Cooper, and Schrieffer they received the nobel prize in 1972

Superconductors are now used everywhere from mri machines(1986) to particle accelerators(tevetron 1983)

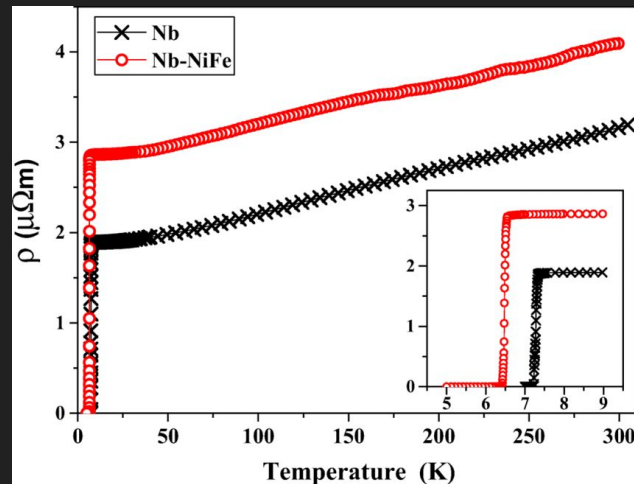
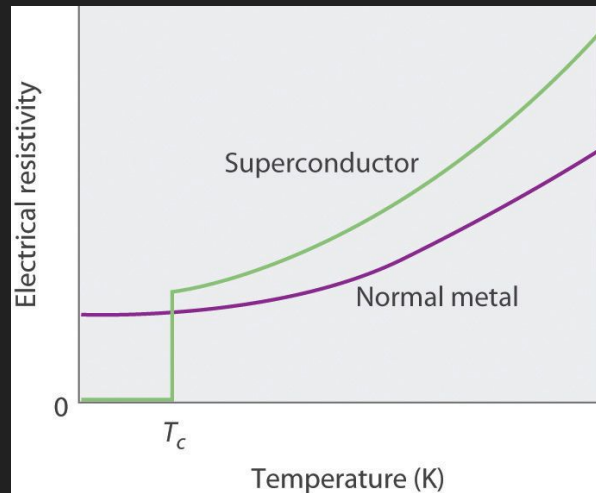
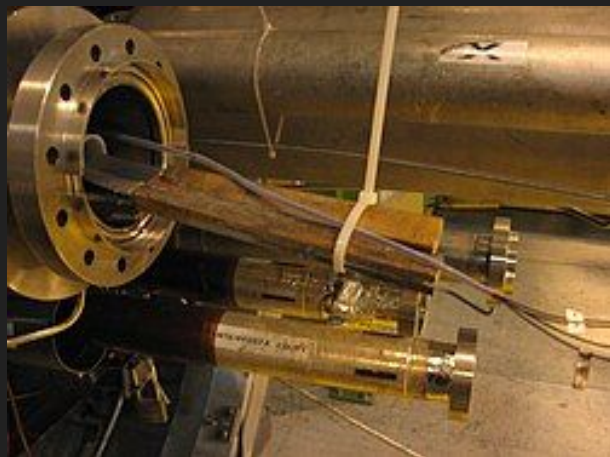


Superconductivity

Certain materials when brought to very low temperatures begin to exhibit the properties of superconductivity

The material Niobium-Titanium is the most widely used

They also have a critical point where too much magnetic flux causes them to stop functioning



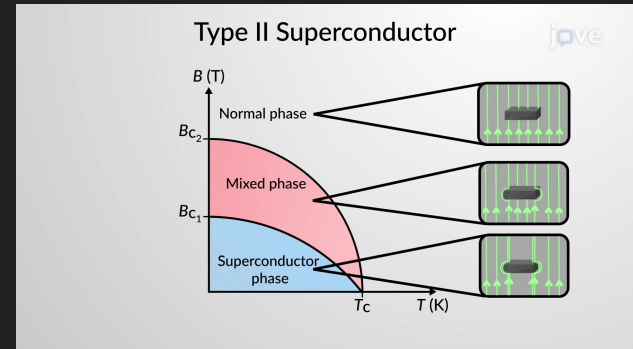
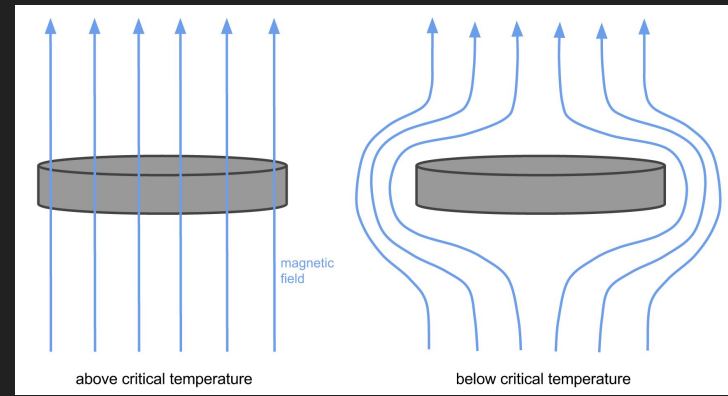
Superconductivity

A superconductor has several properties

It has zero resistance (perfect conductor)

It is a perfect diamagnet (no internal magnetic field)

creates very powerful electromagnets

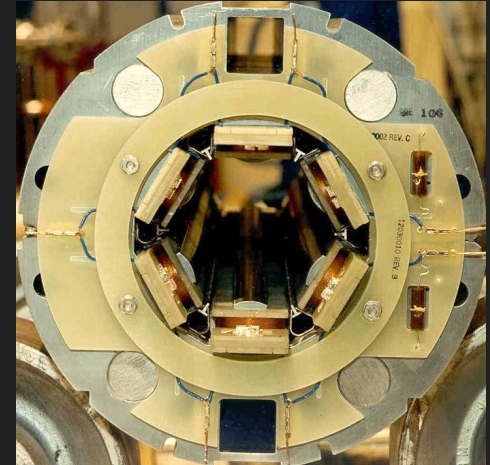
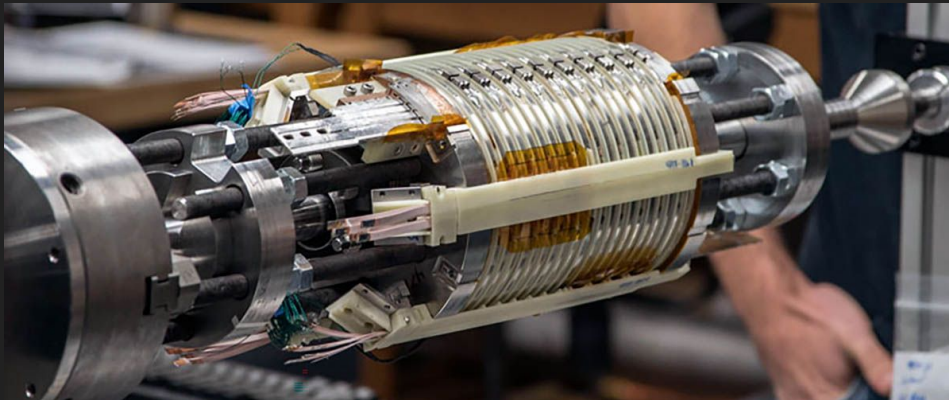
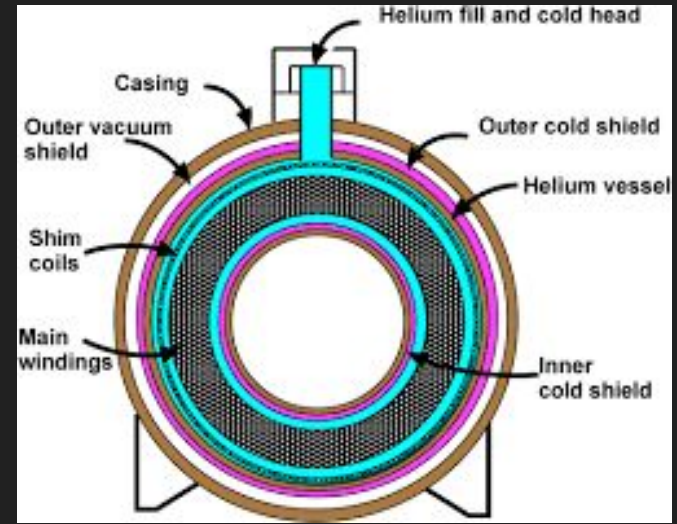


Superconducting magnets

When we make a superconducting wire and put current through it we get a superconducting magnet

Are able to produce extremely powerful magnetic fields due to the extremely high currents

magnetic fields are much stronger than the electromagnet counterparts and due to the superconducting nature have very low energy consumption

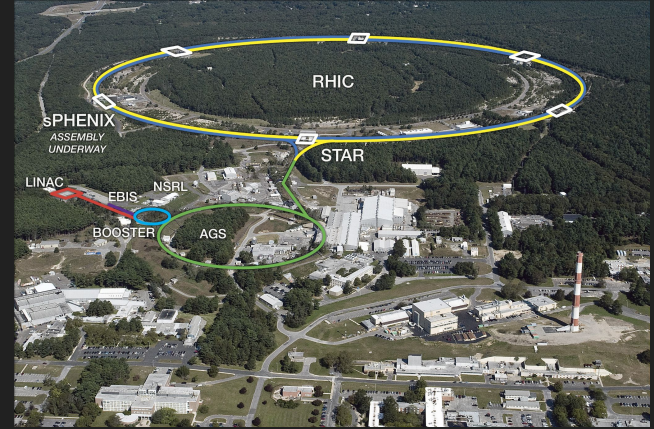
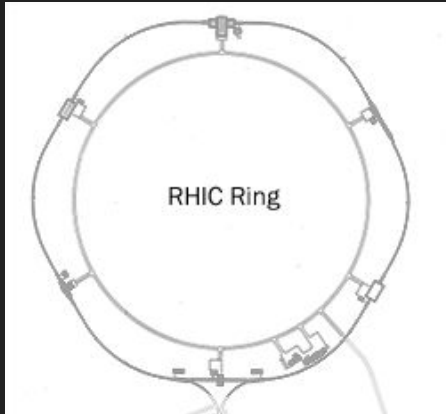


Rhic

1740 superconducting magnets in the ring

Three main kinds dipole quadrupole and sextapole

These three different kinds allow the beamline to move around at speeds near the speed of light (99.995%)



Magnets

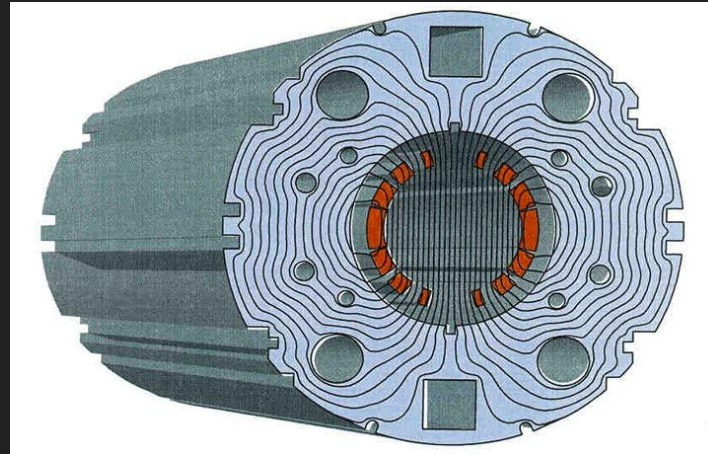
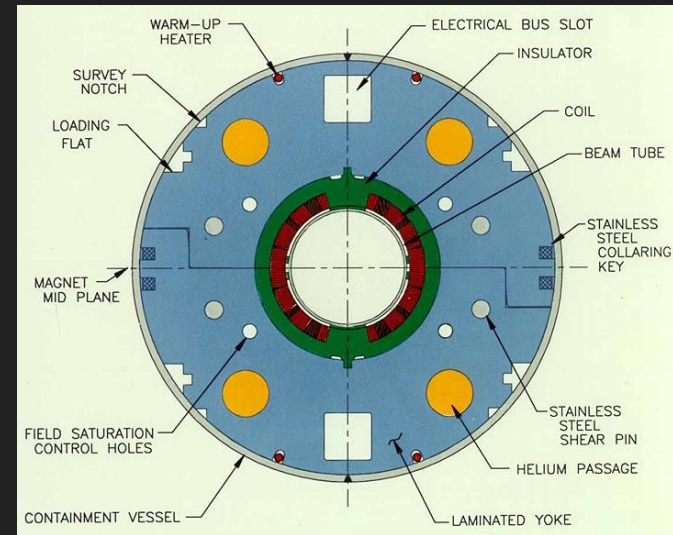
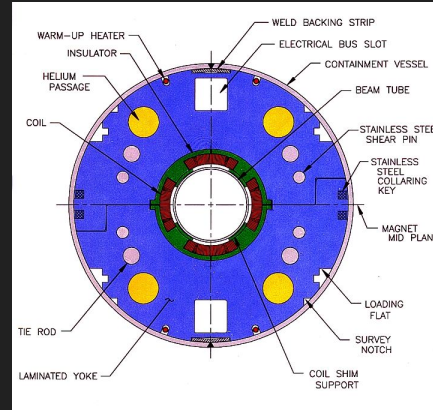
Dipole magnets- bend the beam mainly along the arc

quadrupole - refocuses the beam that naturally is spreading out

Sextapole - fine tune the correction of the other magnets

All are constructed with a core surrounded by a steel casing

That is then surrounded by the cryostat system to reduce the



Questions

Cryostat

The magnetic cores have to be kept around 4.4 k in order to be superconducting