# High Energy Particle Accelerators

## - *why, what and how?*

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FERMILAB

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НГУ

# Items

- AA Batteries
- Impregnated W cathode
- RF cavity copper (warm)
- RF cavity Nb (cold)
- RF tube
- Flat plane/board and tennis ball
- Magnet permanent SmCo
- Magnet superconducting NbTi
- Vacuum pipe

# We will build an accelerator

People

Vacuum

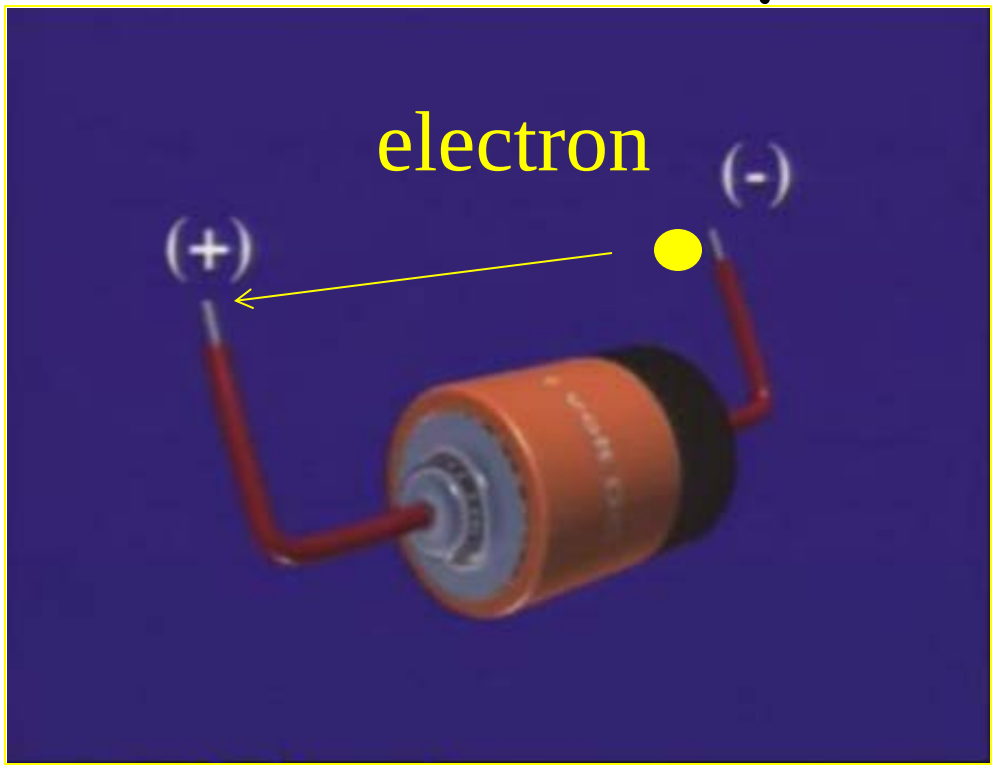
Magnets

Accelerating structures

Sources of particles

# Accelerating elements

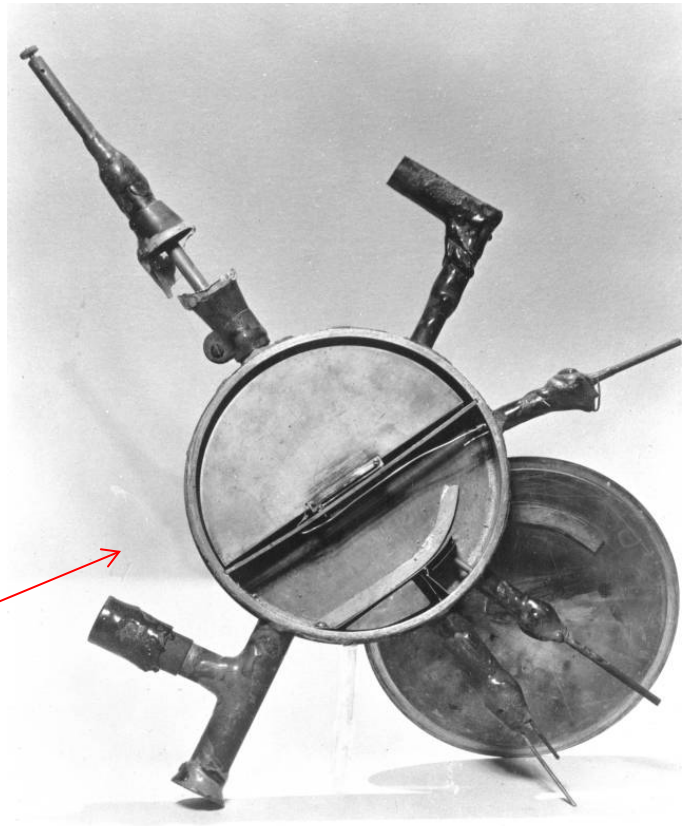
## AA Battery



1 electron x 1 Volt

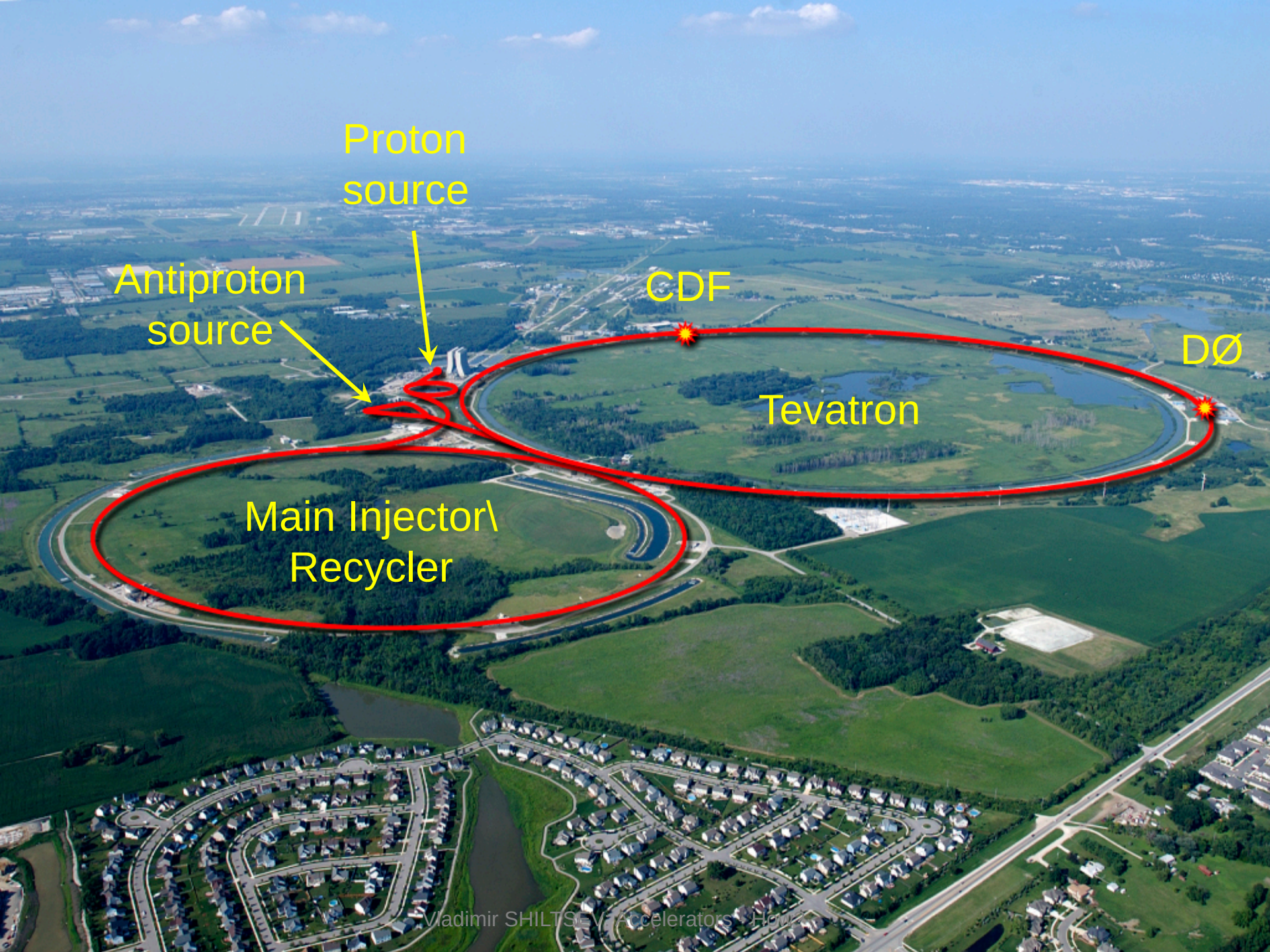
=1 electron Volt

# The First Moder Accelerators



Cyclotron 25$

80,000 Volts


Proton source
Antiproton source
CDF
DØ
Tevatron
Main Injector\ Recycler

# Main Components of A Modern Accelerator

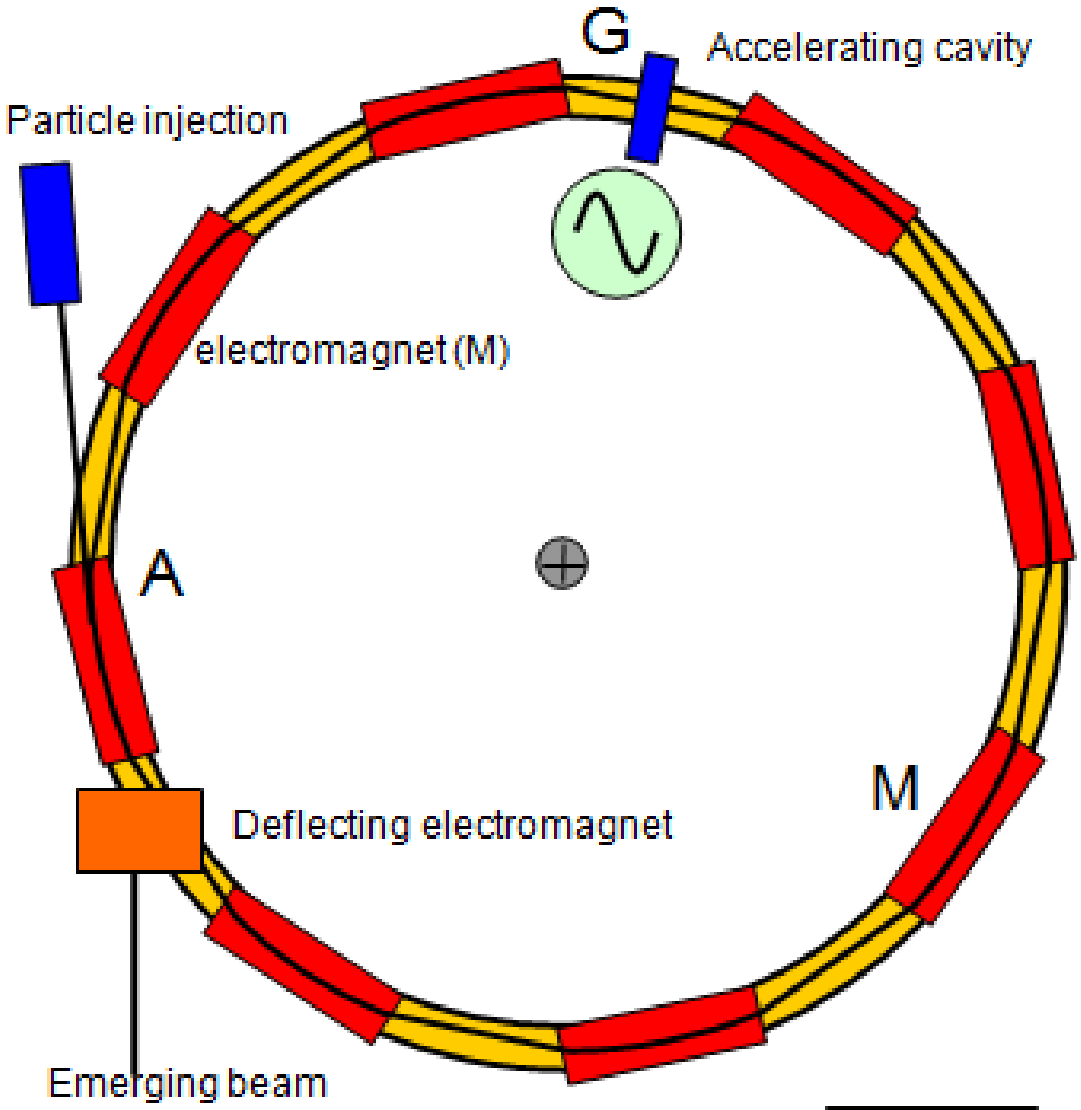
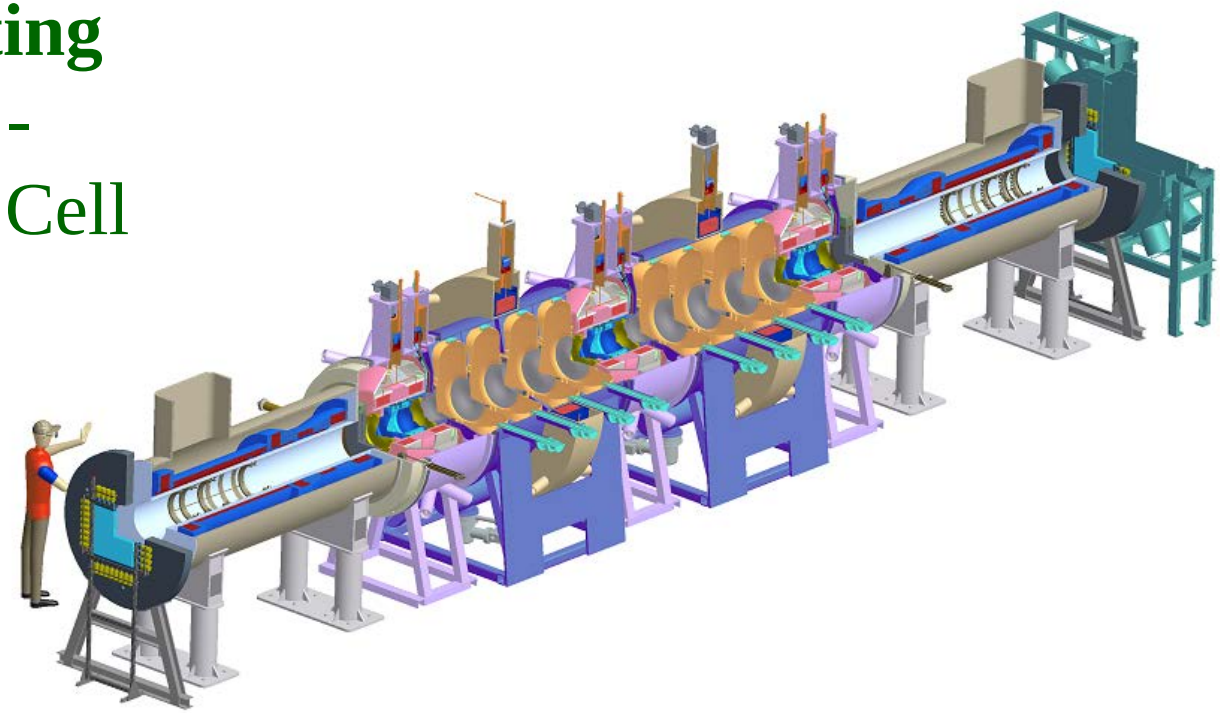
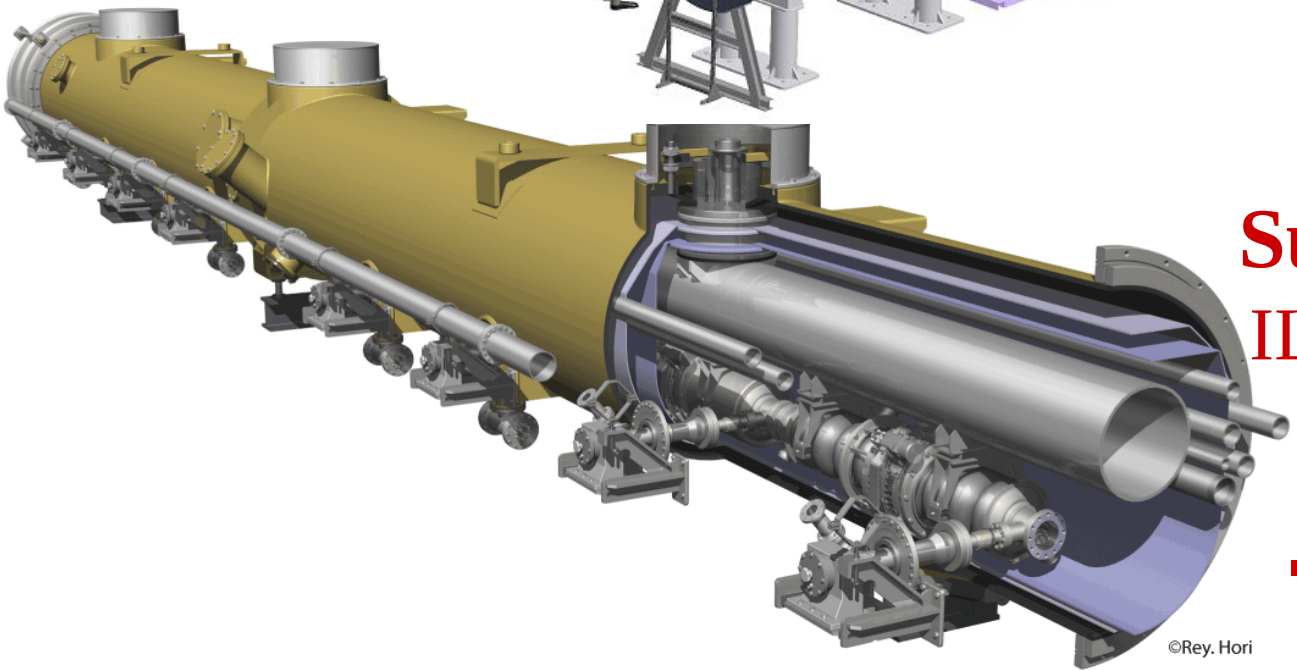



Figure 1

# Radio Frequency Accelerating Cavities

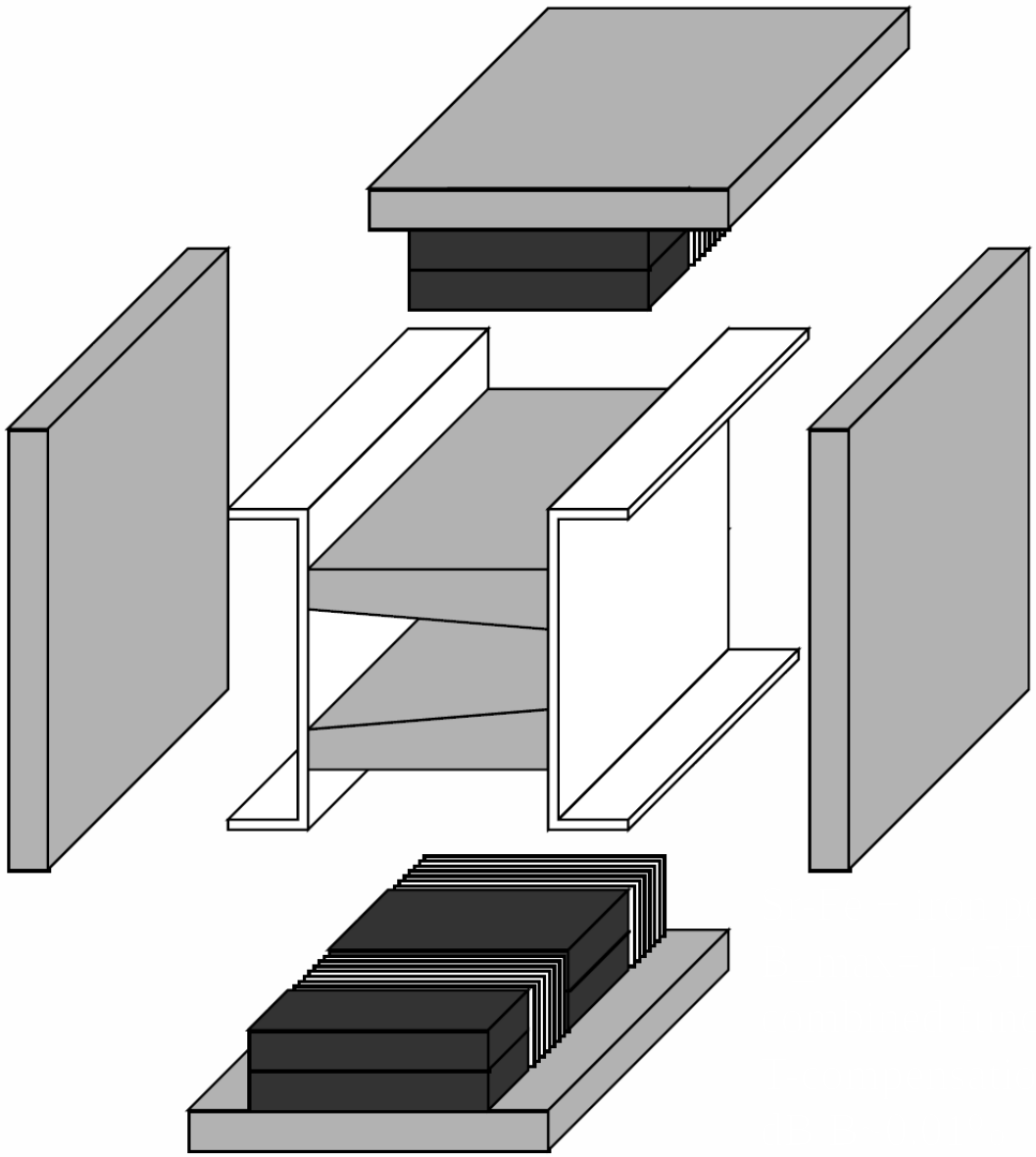
**Normal Conducting**
**("Warm RF") -**
Muon Cooling RF Cell

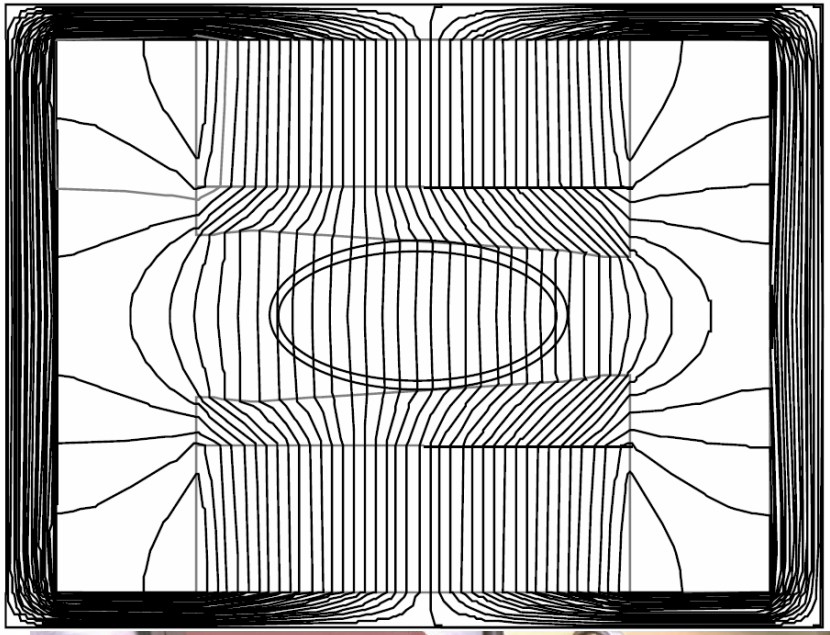





**SuperConducting**
ILC RF Cryomodule

# Accelerator Technology: Permanent Magnets

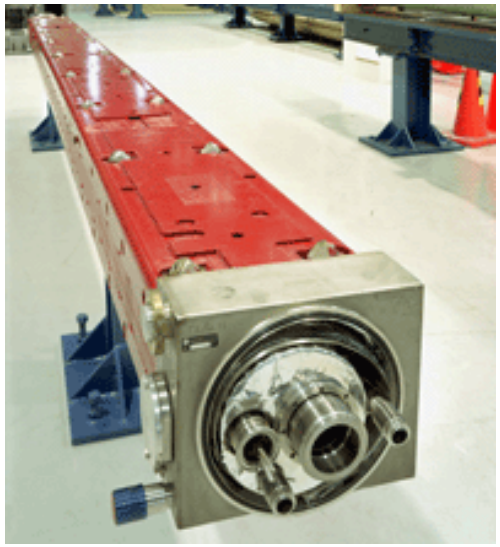




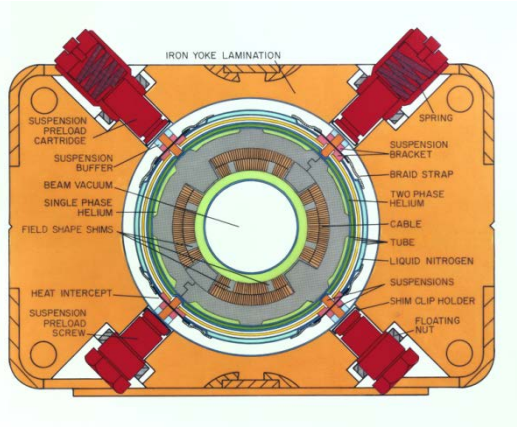
# Recycler Ring

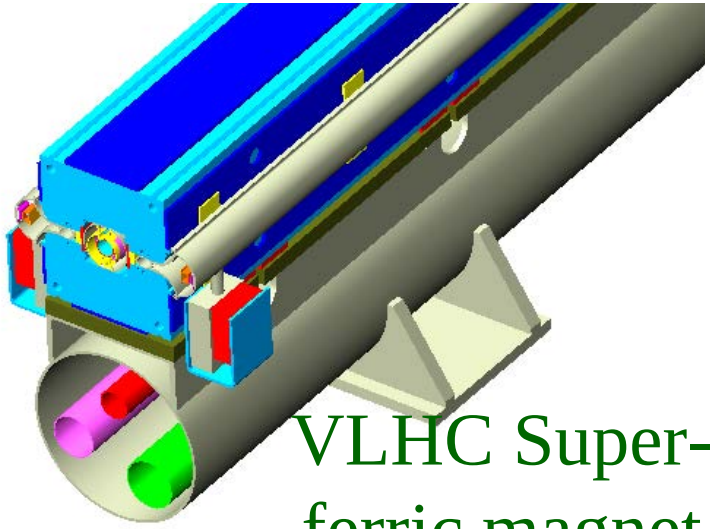
- **Build by the US Congressman**

# Accelerator Elements : Present



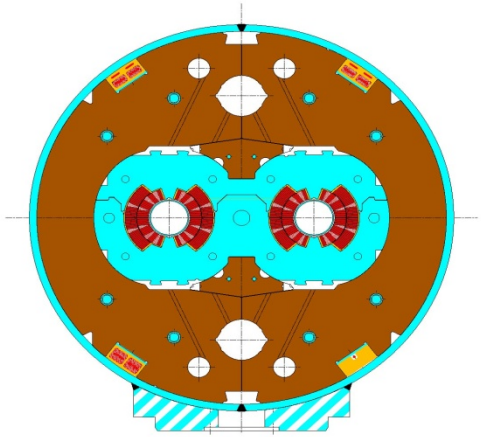
Tevatron
SC magnet

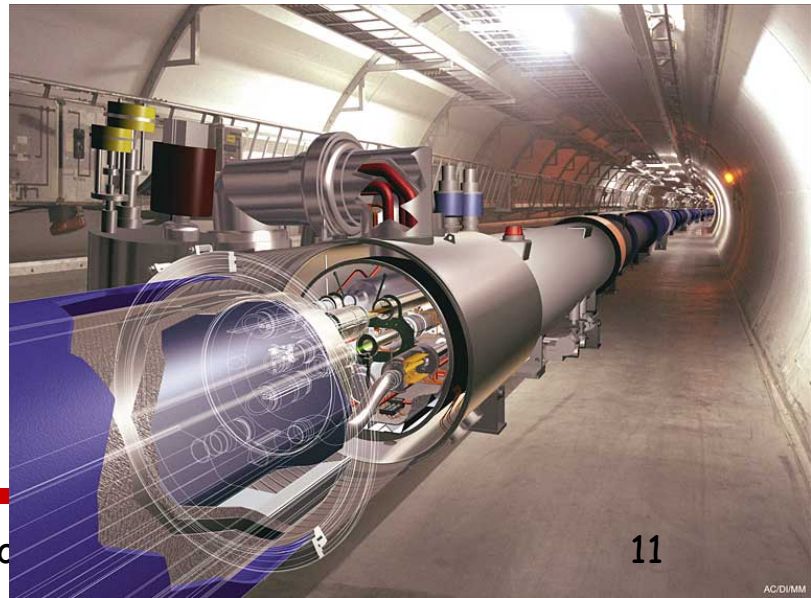


VLHC Super-
ferric magnet

LHC SC magnets

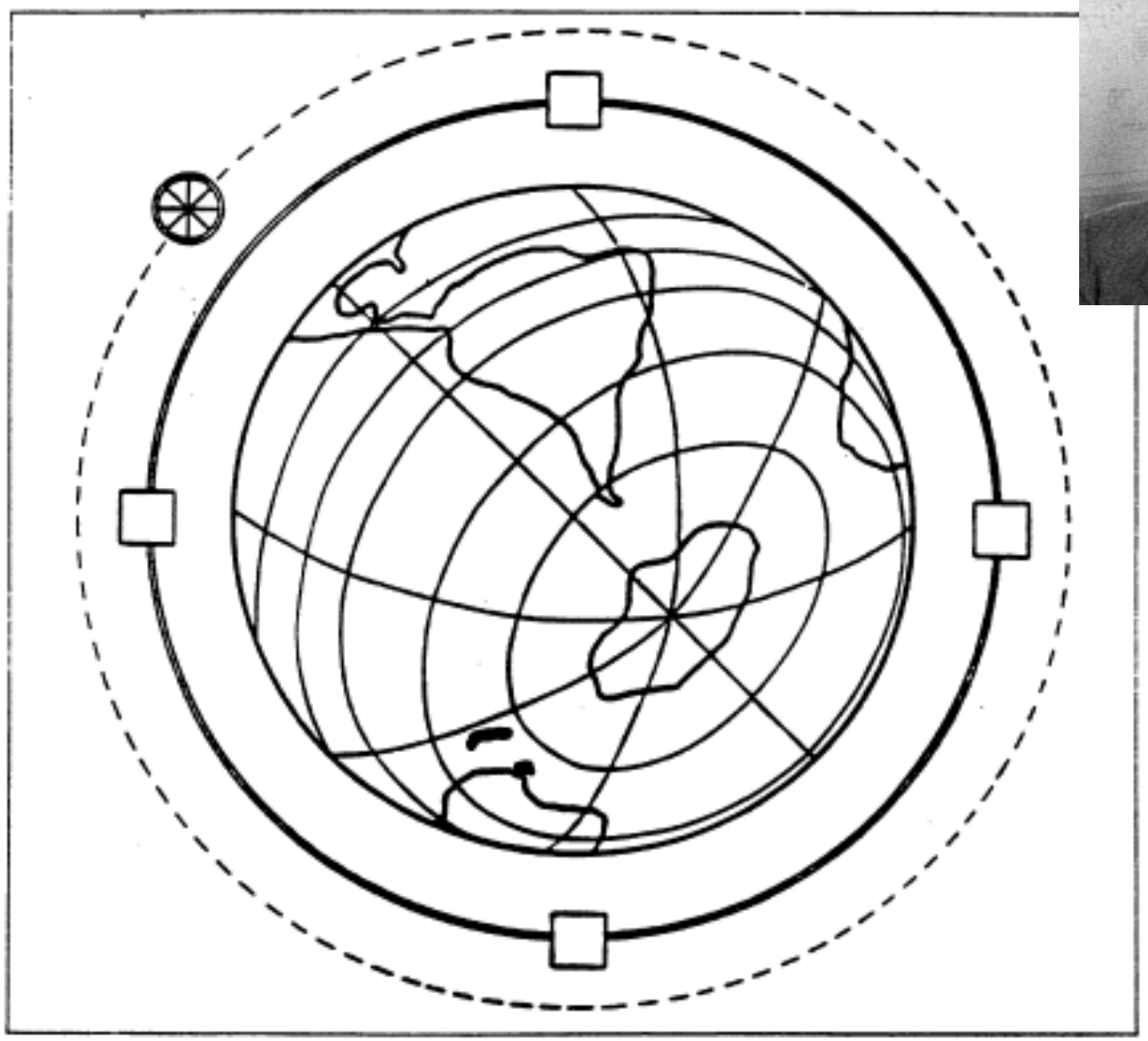




# Magnets in the Tevatron Tunnel

C=6.28km, ~800 SC magnets (4d+q) @ 4.2 K,
E_max/inj=980/150GeV, small size, quench protection

# "GlobeTron" Enrico Fermi (50 yrs ago)



From a 1954 Slide by Enrico Fermi, University of Chicago Special Collections.

# Fermilab's Tevatron – 6km

**1,000,000,000,000 (12 zeroes!) Volt**

# LHC Large Hadron Collider 27км

# LHC = big and long tank

# Quench : MRI magnet*

№1 how LHC was fixed
№2 LHC vacuum chamber

***pulled off the web. We recover our Helium.**

# People

## Scientists, Engineers, Technicians, Operators

# Thank you for your attention!