ELENA ring and antimatter studies

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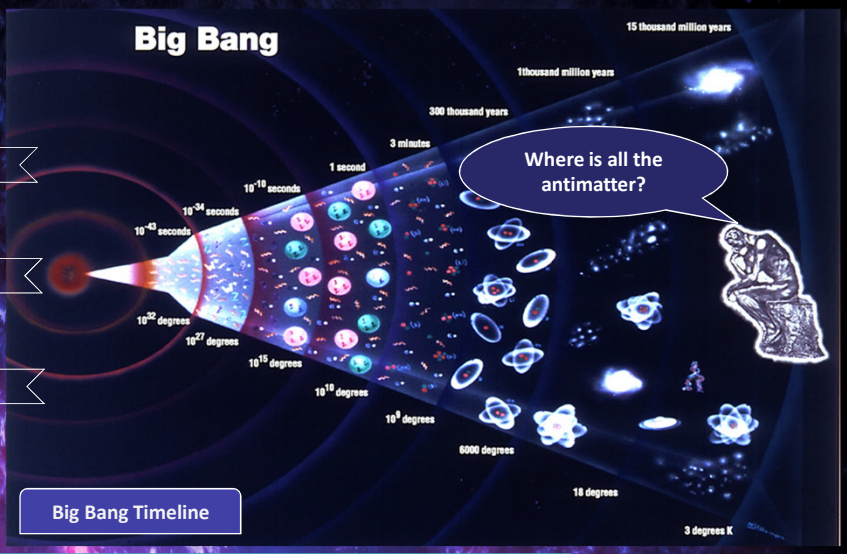
Antimatter problem

We suppose that the Universe began with an explosion of pure energy known as the Big Bang. From the pure energy, matter particles were created alongside so-called antimatter particles.

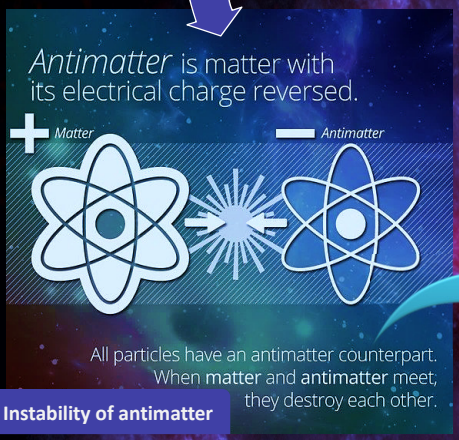
But the universe we observe is only made of matter, and… here's the best part… we have no idea why. Why didn't the matter and antimatter completely annihilate each other? How come we ended up with a little more matter? This delightful mystery is known as baryon asymmetry.

Antimatter, however, seems to only be created where there is lots of energy, for example in particle physics experiments or at the edges of black holes. Particles and their anti-particles are total opposites of each other in every way.

A new promising project ELENA can help shed light on this puzzle.



Big Bang Timeline



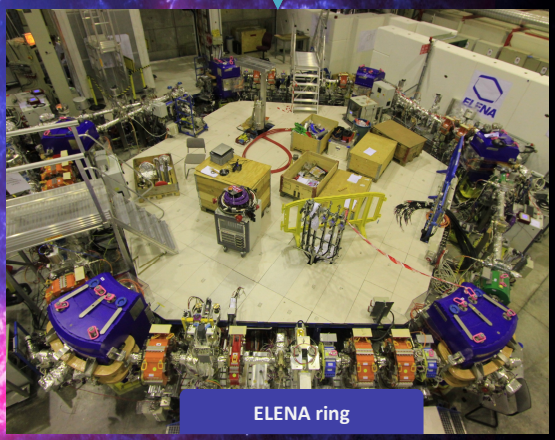
Instability of antimatter

How do we study it?

Try to make a good photo of something when you inside the car that moves at 300 000 km/s. This is impossible. Same story with very fast antiprotons at LHC.

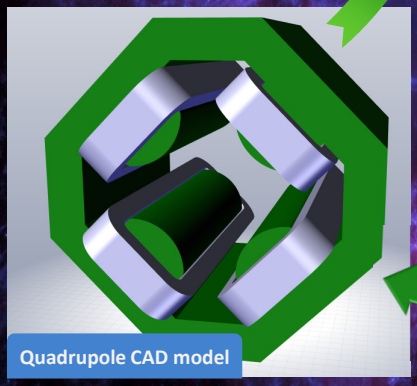
Thus:

- We need to slow down (**cooling process**) our antiparticles using available techniques.
- We minimize interaction of the beam of antiparticles with the matter during cooling by applying EM fields.

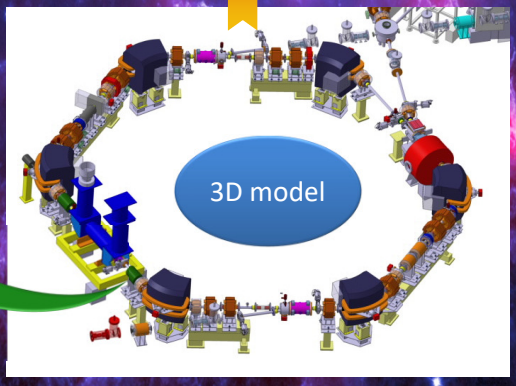


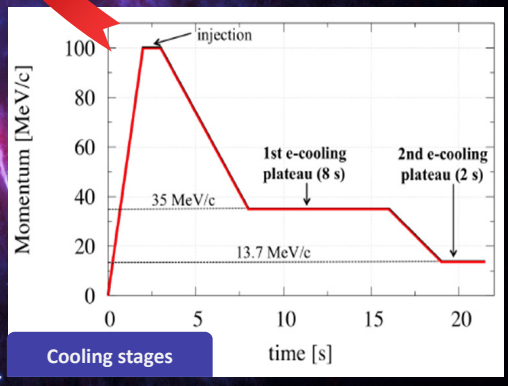
ELENA ring

Fastidious task requires comprehensive studies

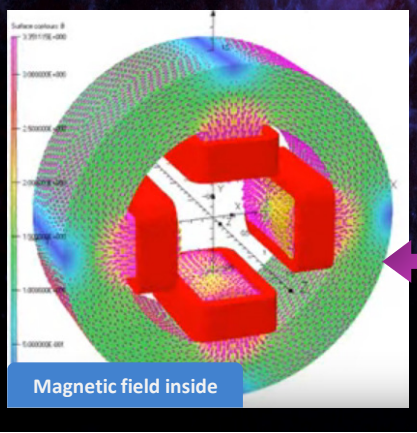


Quadrupole CAD model





Cooling stages



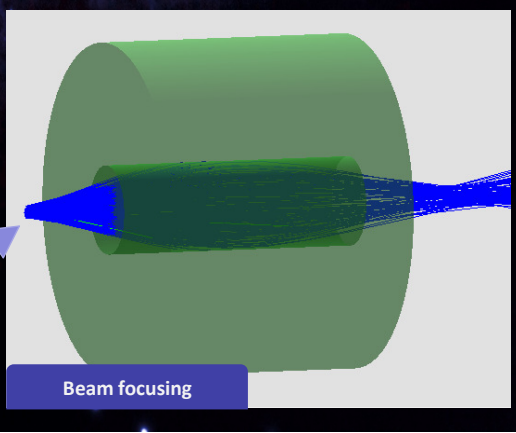
Magnetic field inside

Simulations

A various number of different simulations are very important in predicting and investigating of complex effects.

ELENA ring studies include full 3D modeling of following effects:

- Magnetic and electrostatic fields.
- Beam transport inside based on investigations of electromagnetic 3D fields.
- Beam cooling.



Beam focusing