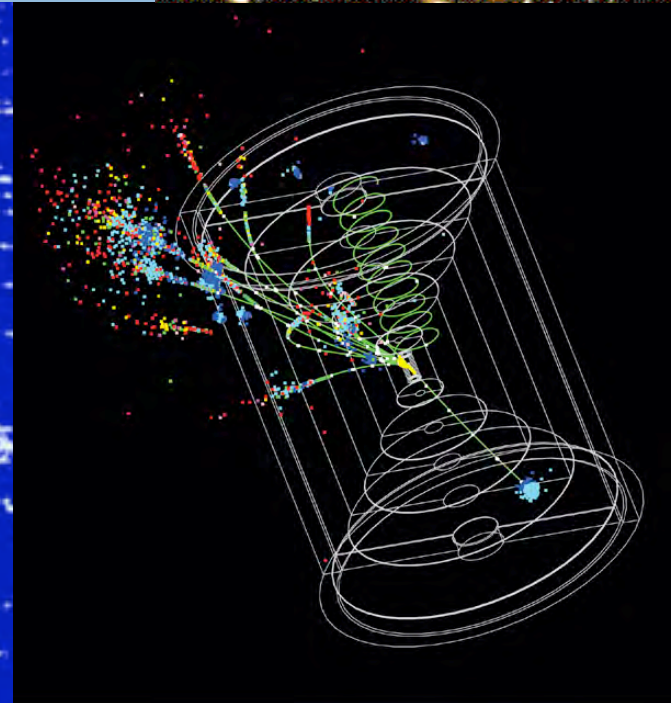
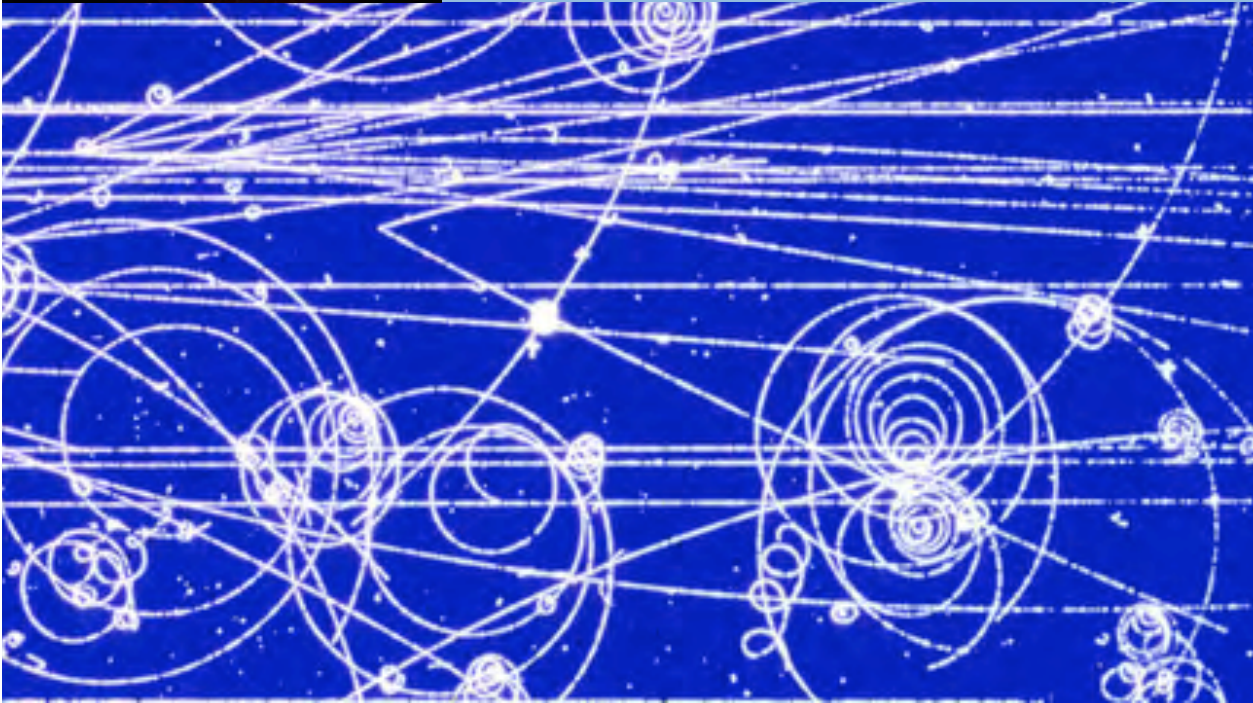




# Particles, Energy, and Cosmology



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# The End of Physics

"The more important fundamental laws and facts of physical science have all been discovered,

and these are now so firmly established that the possibility of their ever being supplanted in consequence of new discoveries is exceedingly remote."

# The End of Physics - 1894



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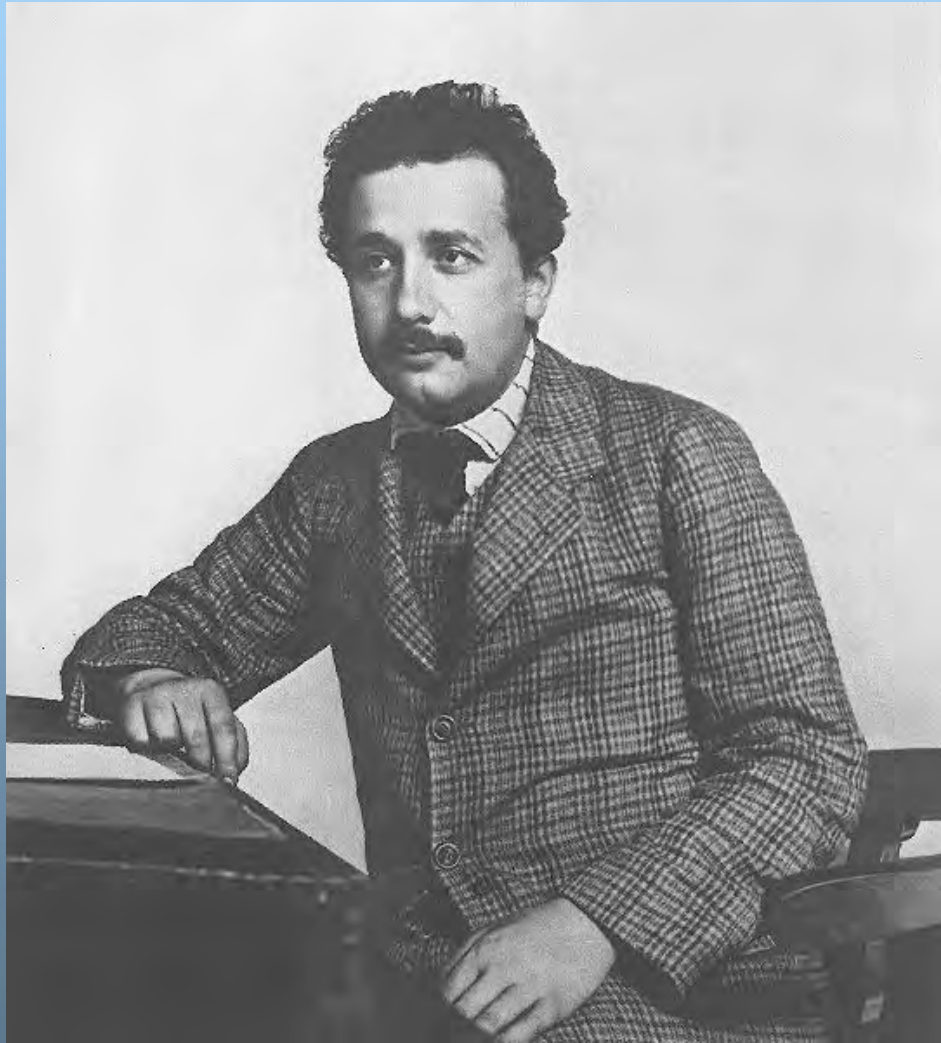
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# The Miracle Year - 1905



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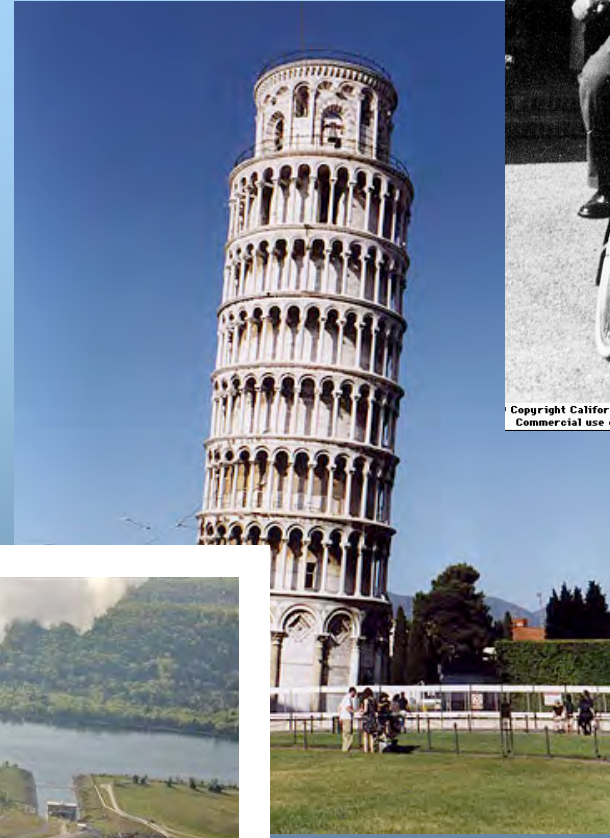
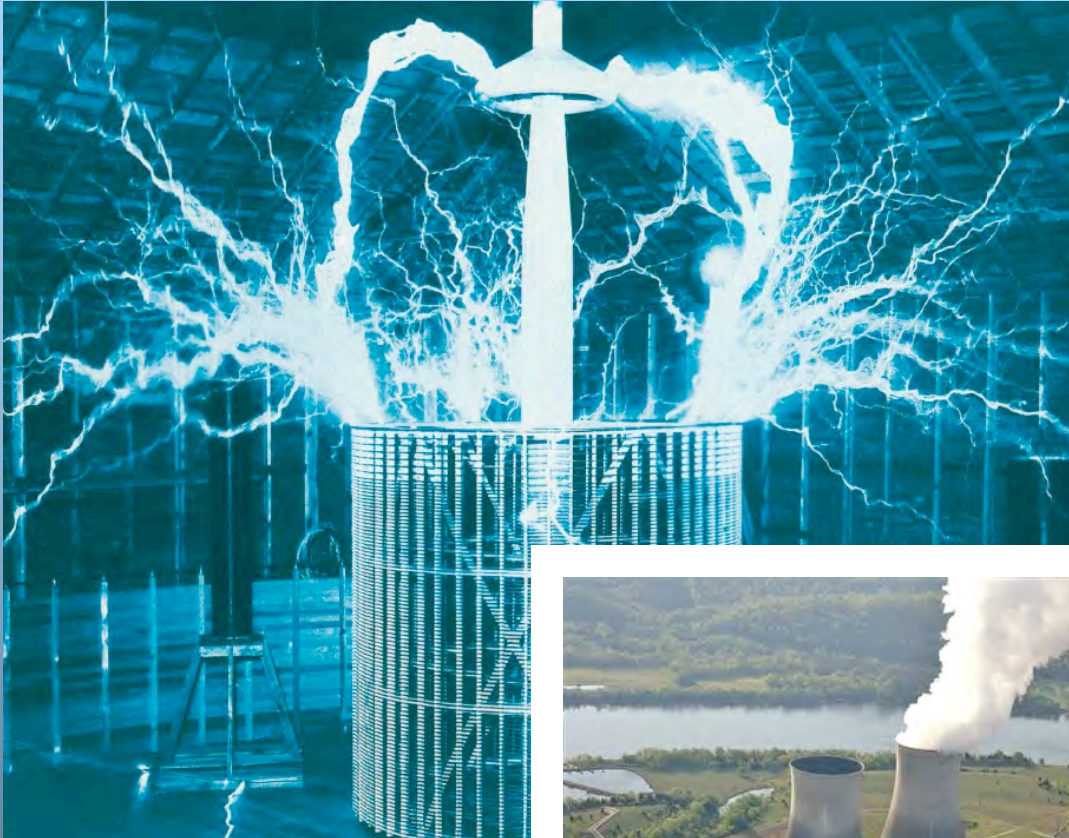
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# Relativity

- When a man sits with a pretty girl for an hour, it seems like a minute.
- But let him sit on a hot stove for a minute—and it's longer than any hour.
- That's relativity.



# Unification of Forces



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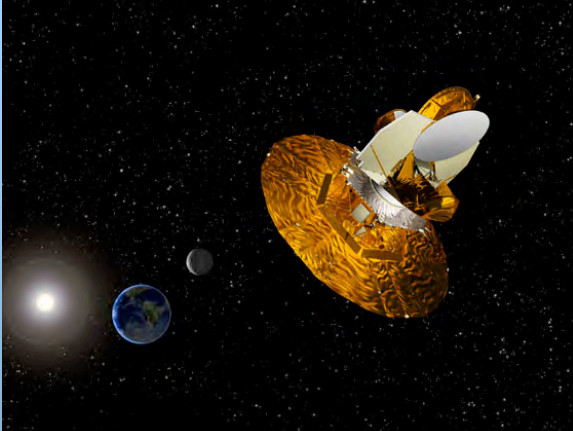
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# Modern scientific instruments



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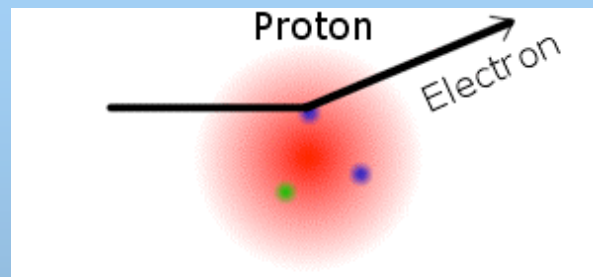
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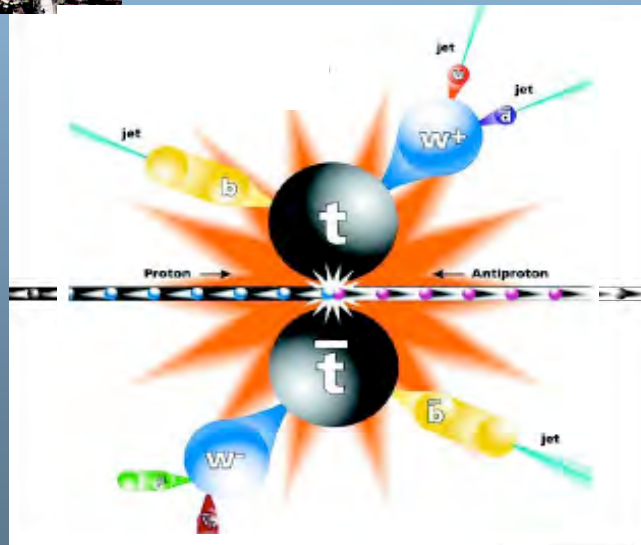


# Particle Accelerators and Colliders

## 1. Super-microscope



## 2. Creation of massive matter ( $E=mc^2$ )



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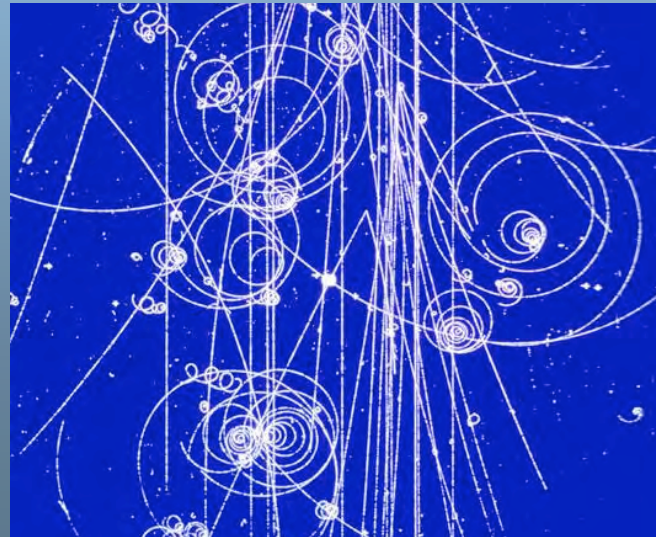
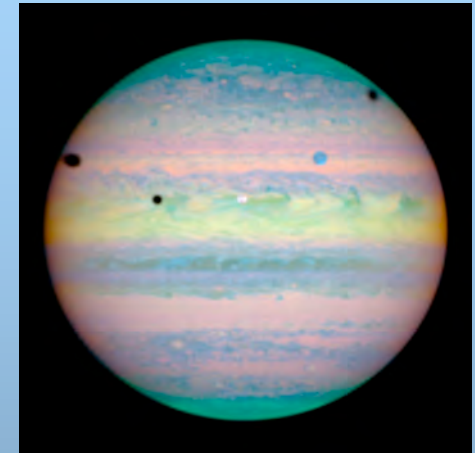
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8



# What is matter?



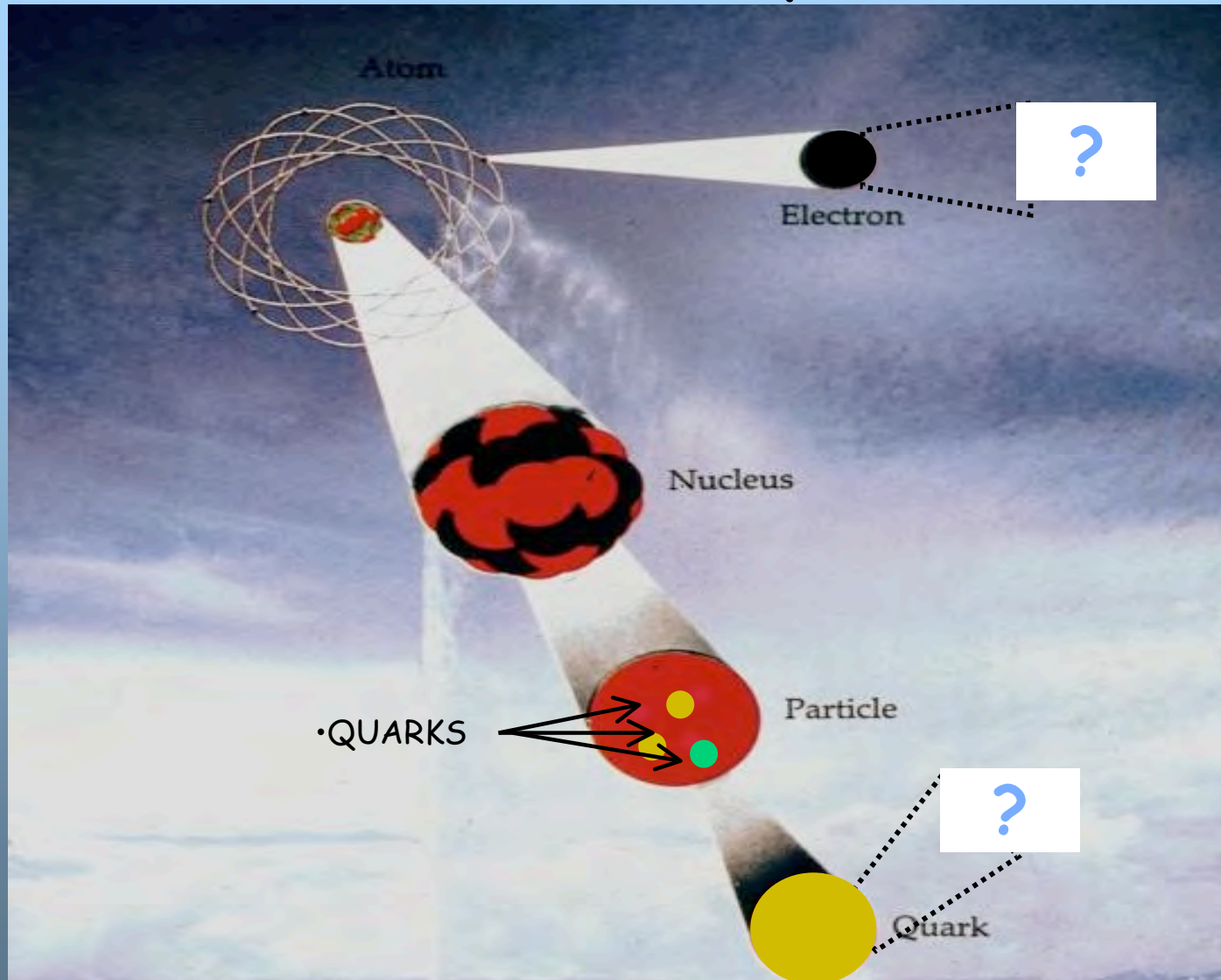
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# The Structure of Matter

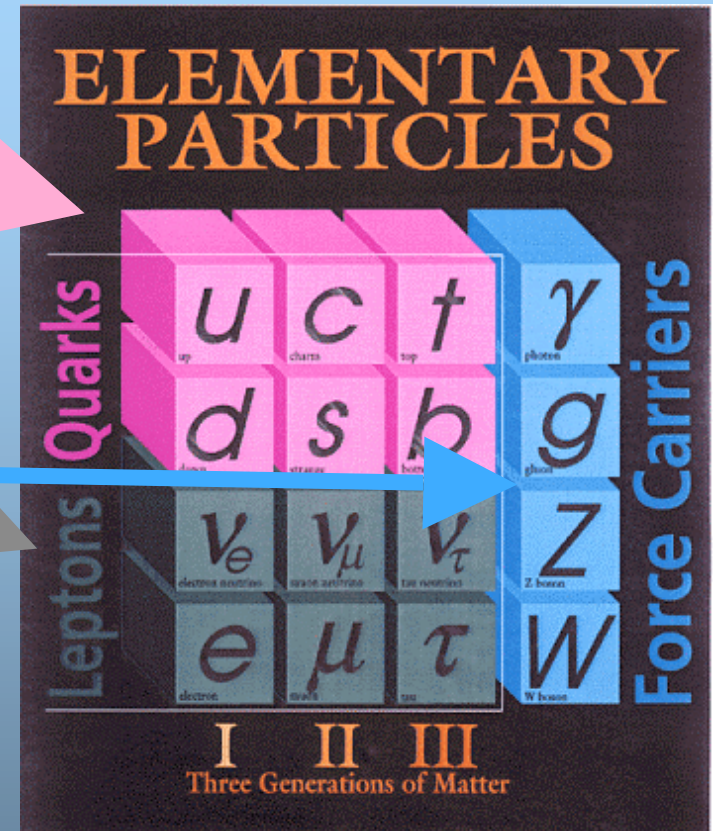


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# What is matter?

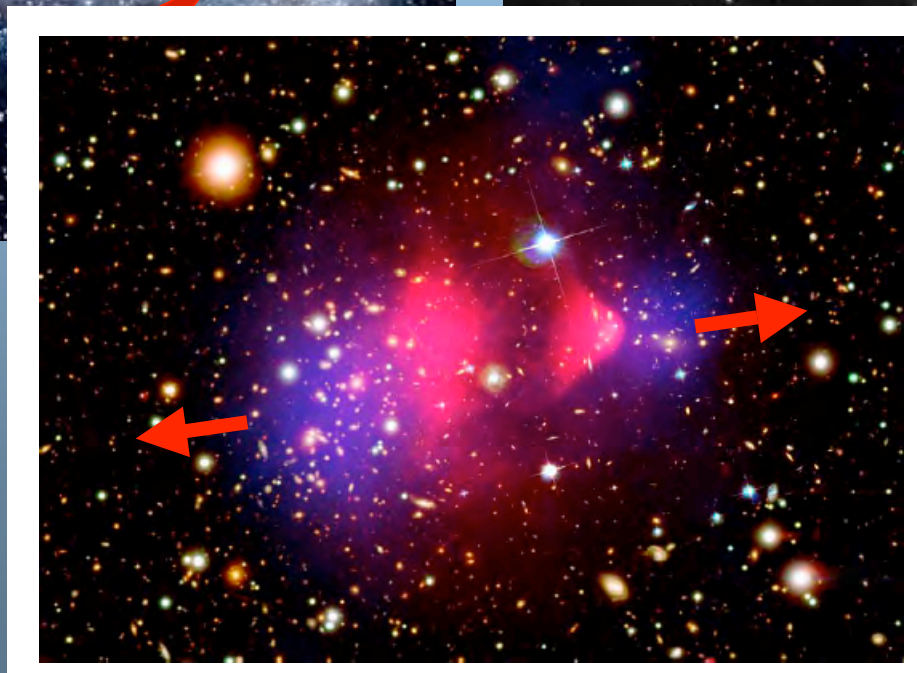
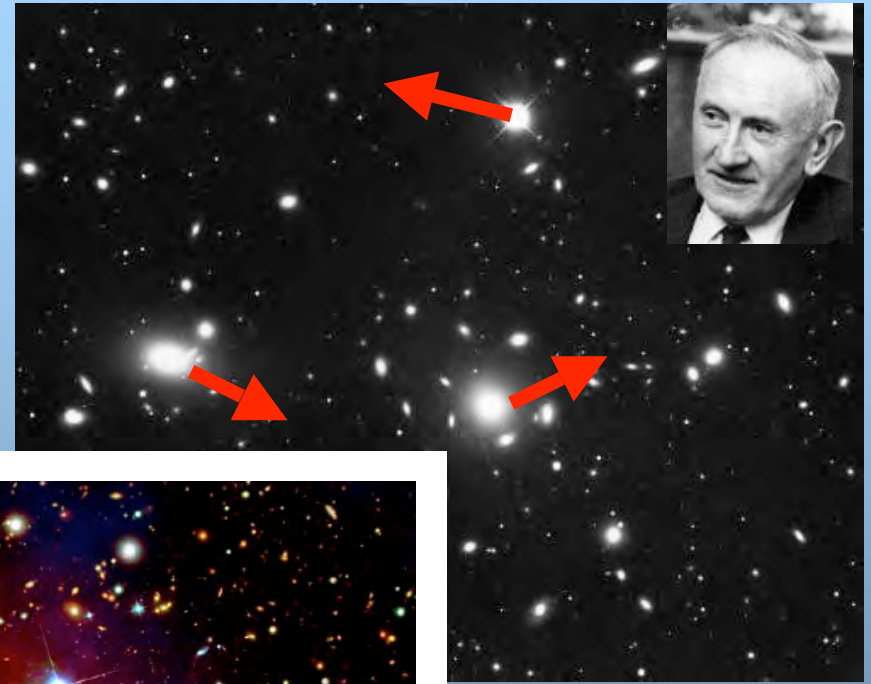
- **Quarks**
  - combine to make protons and neutrons
- **Leptons**
  - eg. electron, neutrino
- **Force Carriers**
  - defines behavior of matter



We have a precise understanding of matter and its behavior

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# Dark Matter



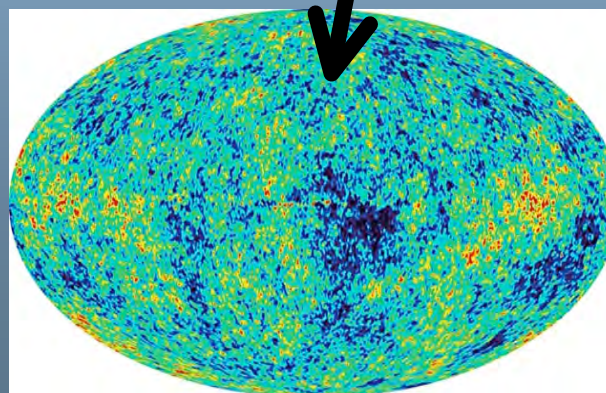
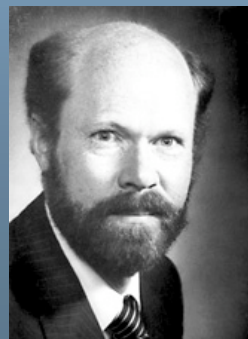
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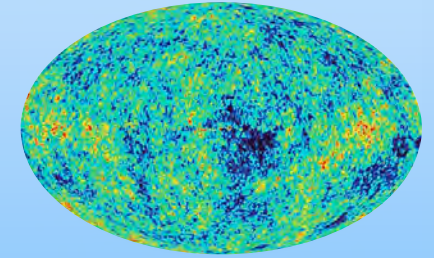
# The Cosmic Fireball

- Visible remnant of the Big Bang

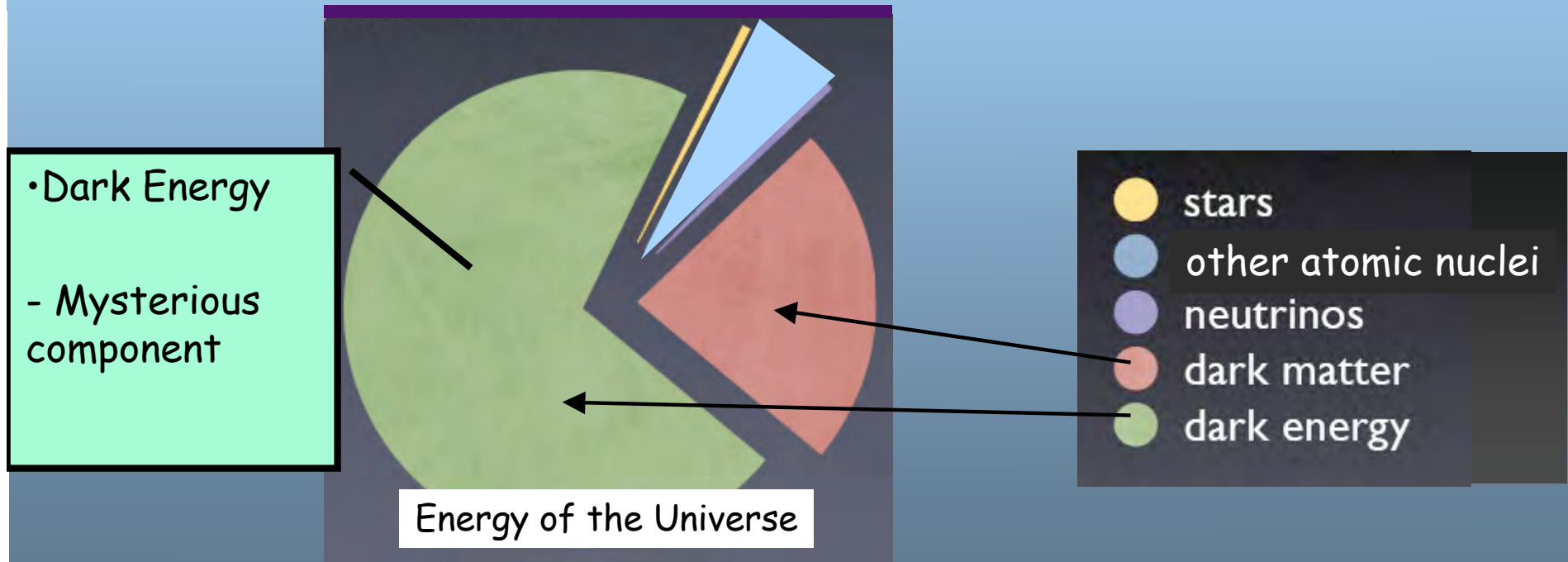


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# Make-up of the Universe



- Dominately dark matter and dark energy
  - Very little anti-matter





# The Dark Side Controls the Universe

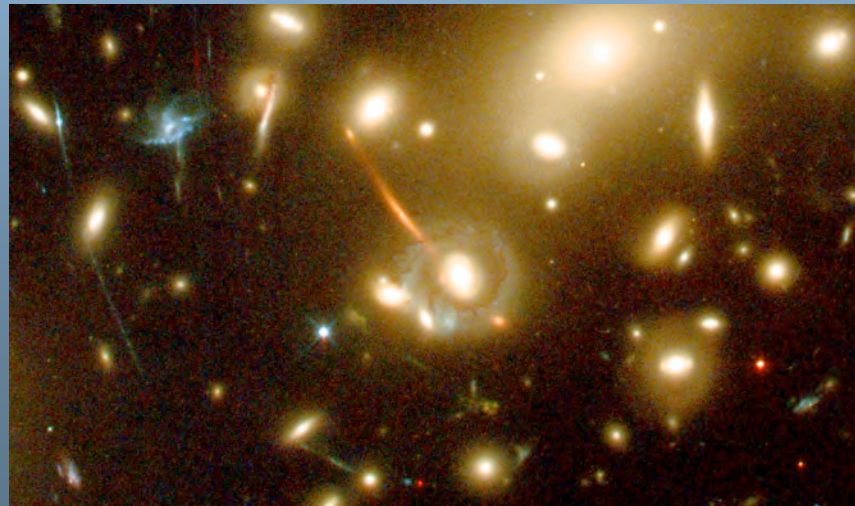


Dark Matter

HOLDS IT TOGETHER

Dark Energy

DETERMINES ITS DESTINY



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# What is the Dark Matter?

POPOULAR HYPOTHESIS

## SuperString Theory



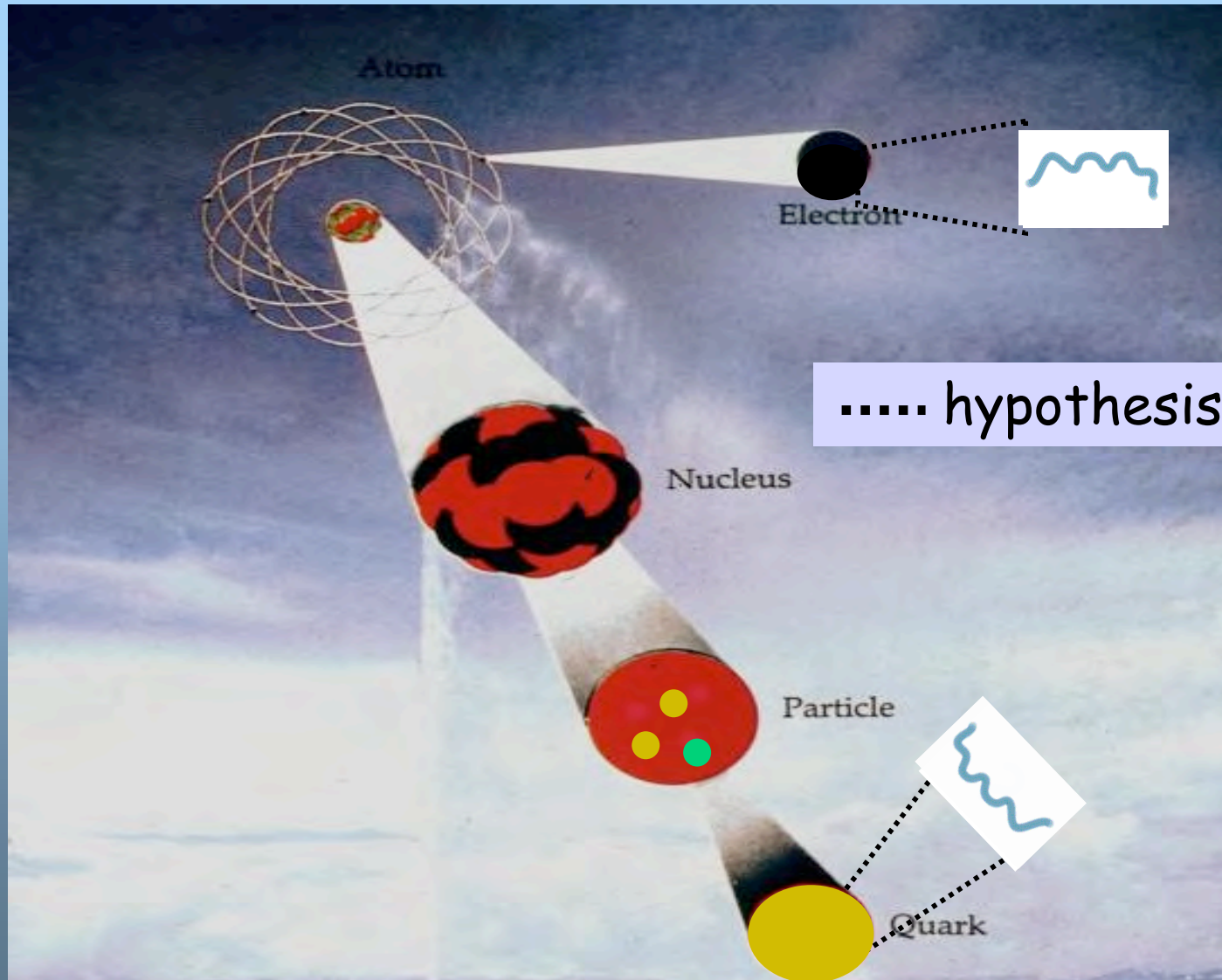
- All fundamental particles are vibrating strings
- Theory unifies all particles and all forces
  - gravity with quantum mechanics
  - String is miniscule
    - 10,000,000,000,000,000,000,000,000 x smaller than atom
  - Space is ten-dimensional (not 3D!)
  - A new set of particles are predicted
    - the super-partners of ordinary particles  $\Rightarrow$  Dark Matter ?



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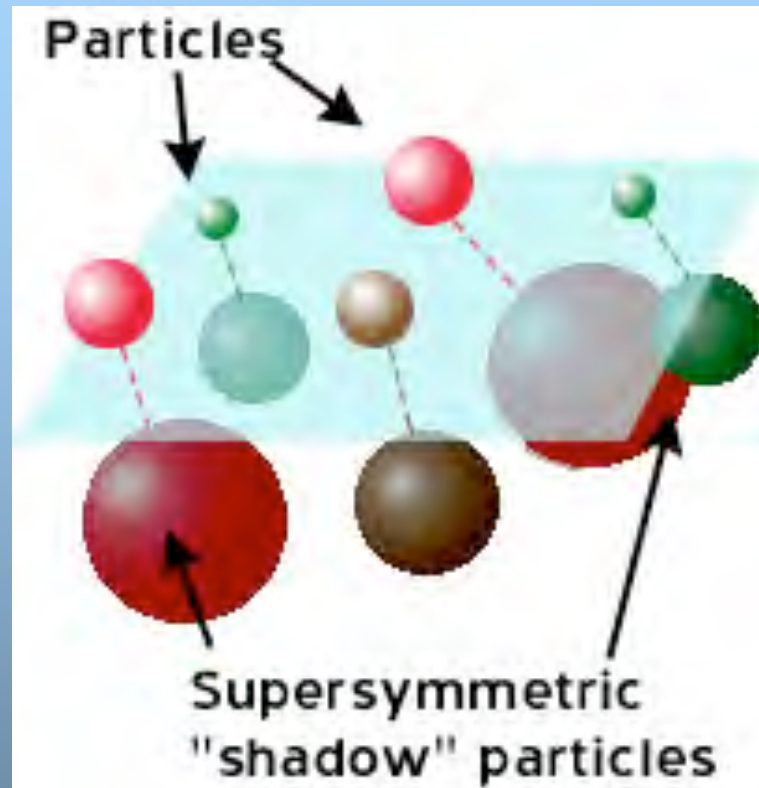


# The Structure of Matter



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# Supersymmetry and Strings



- The supersymmetric particles have just the properties expected of Dark Matter

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# Large Hadron Collider (LHC) Geneva, Switzerland

PLAY ▶



Nearing  
Completion  
Begins operation  
this year

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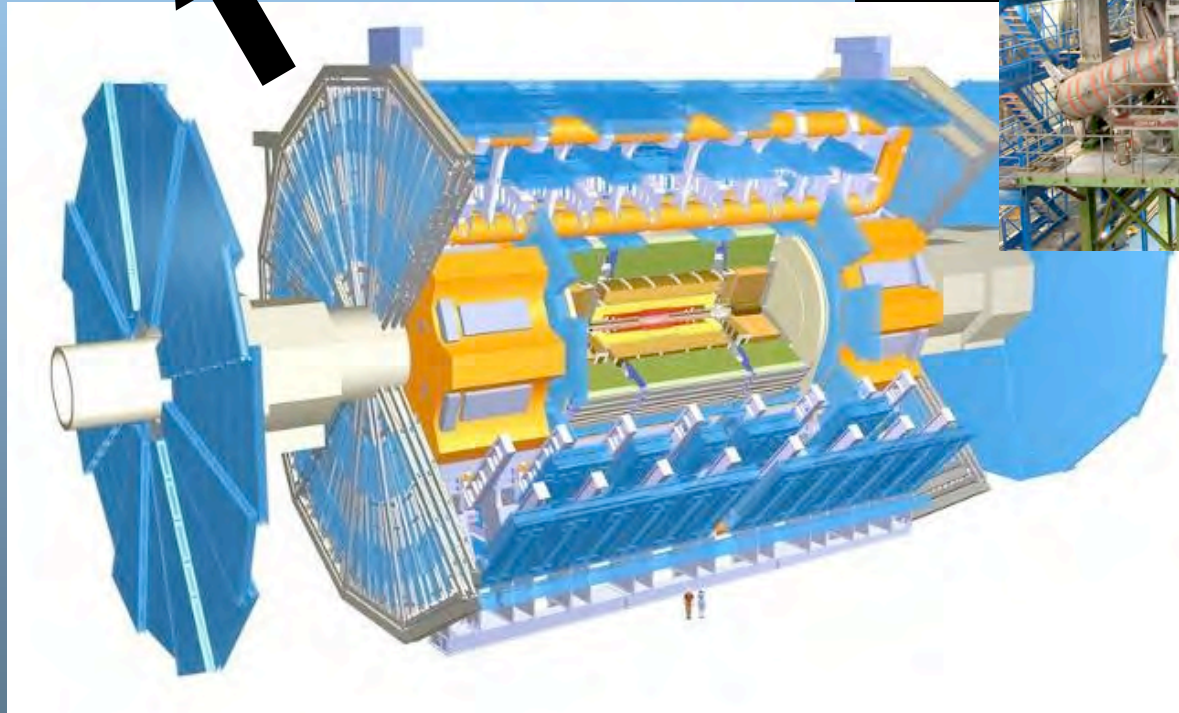
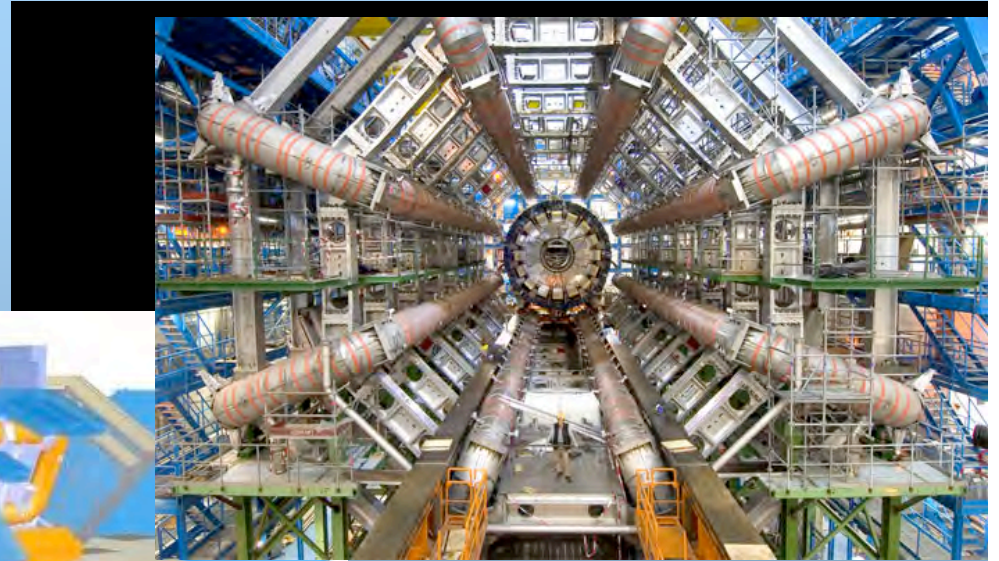
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# LHC Detector - ATLAS



U. Oregon is member  
institution of  
ATLAS Collaboration



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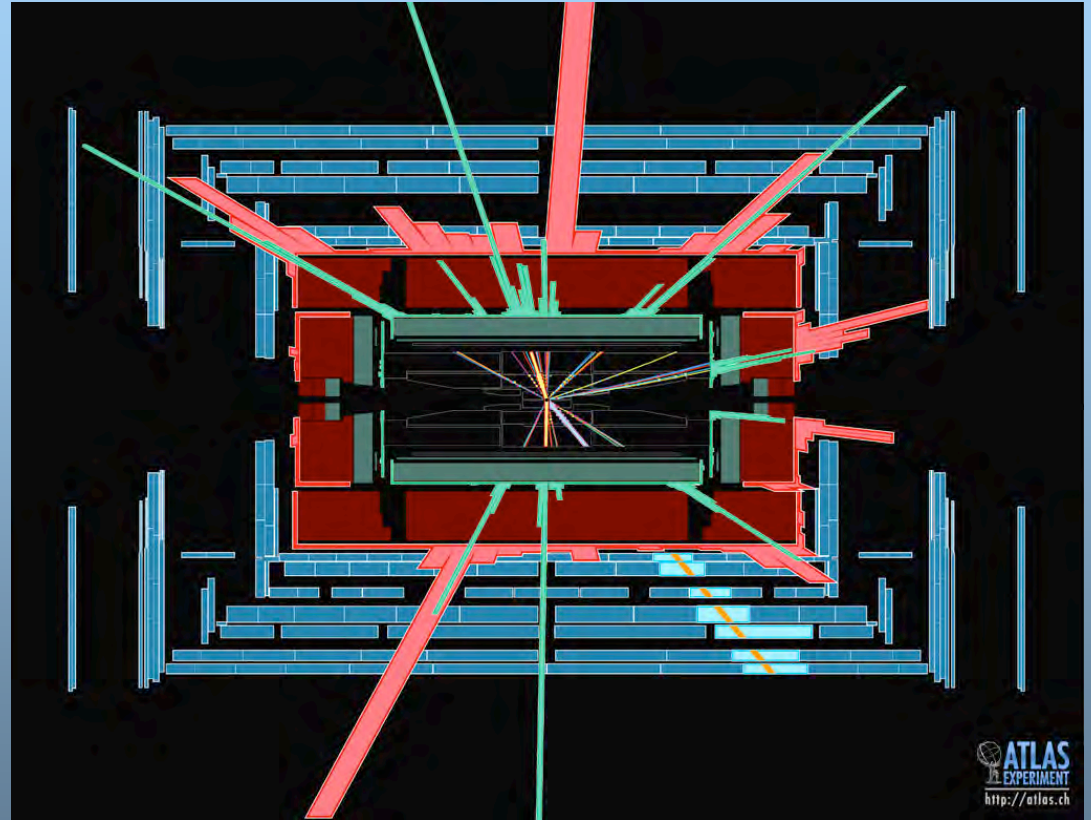
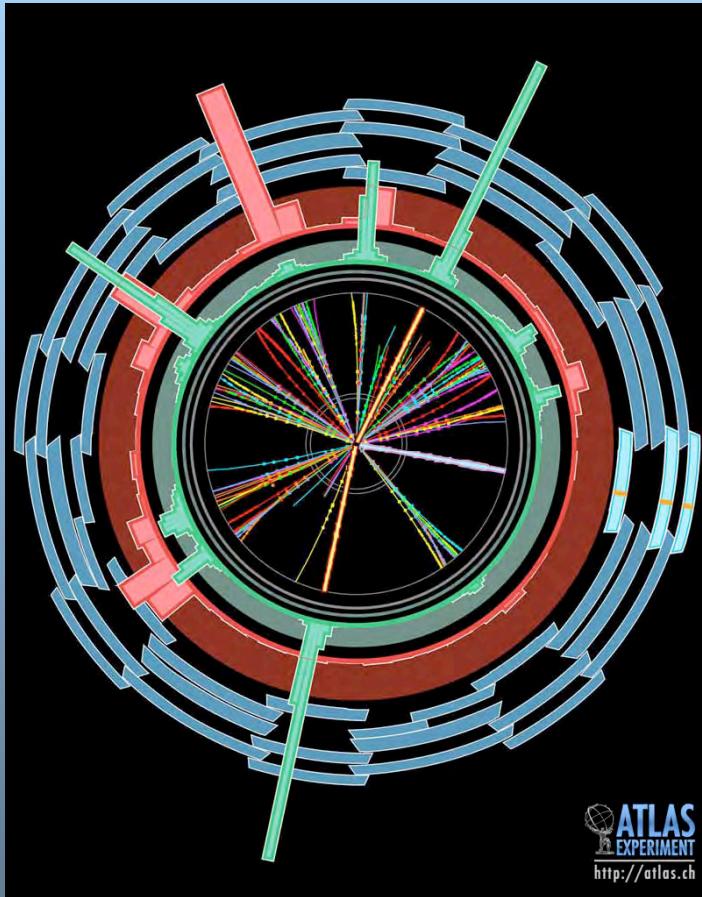
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20



# Collision in ATLAS



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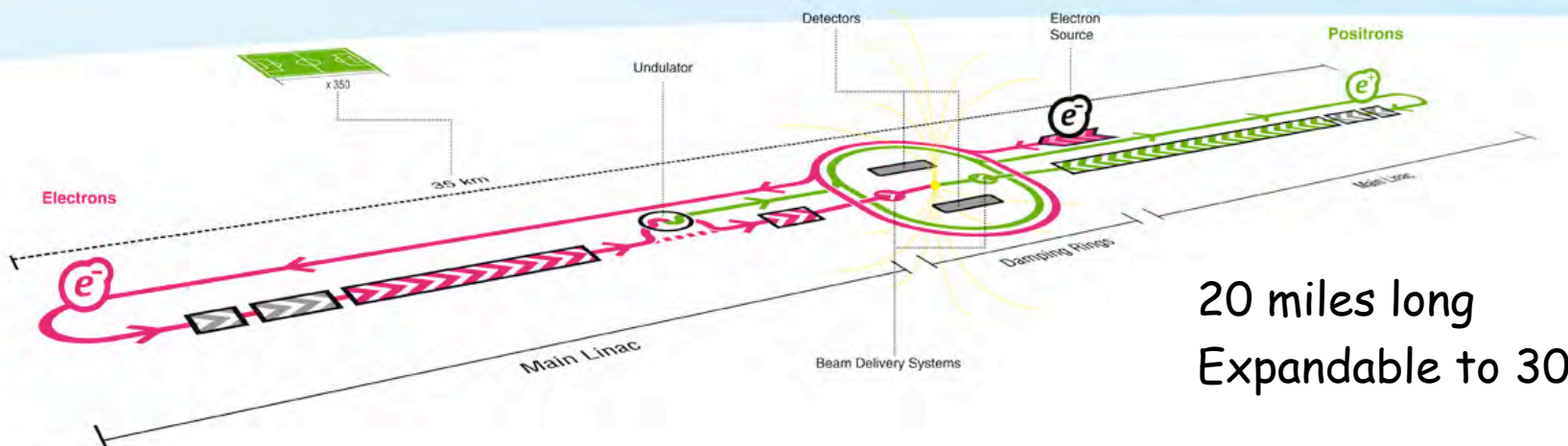
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21

# International Linear Collider (ILC)

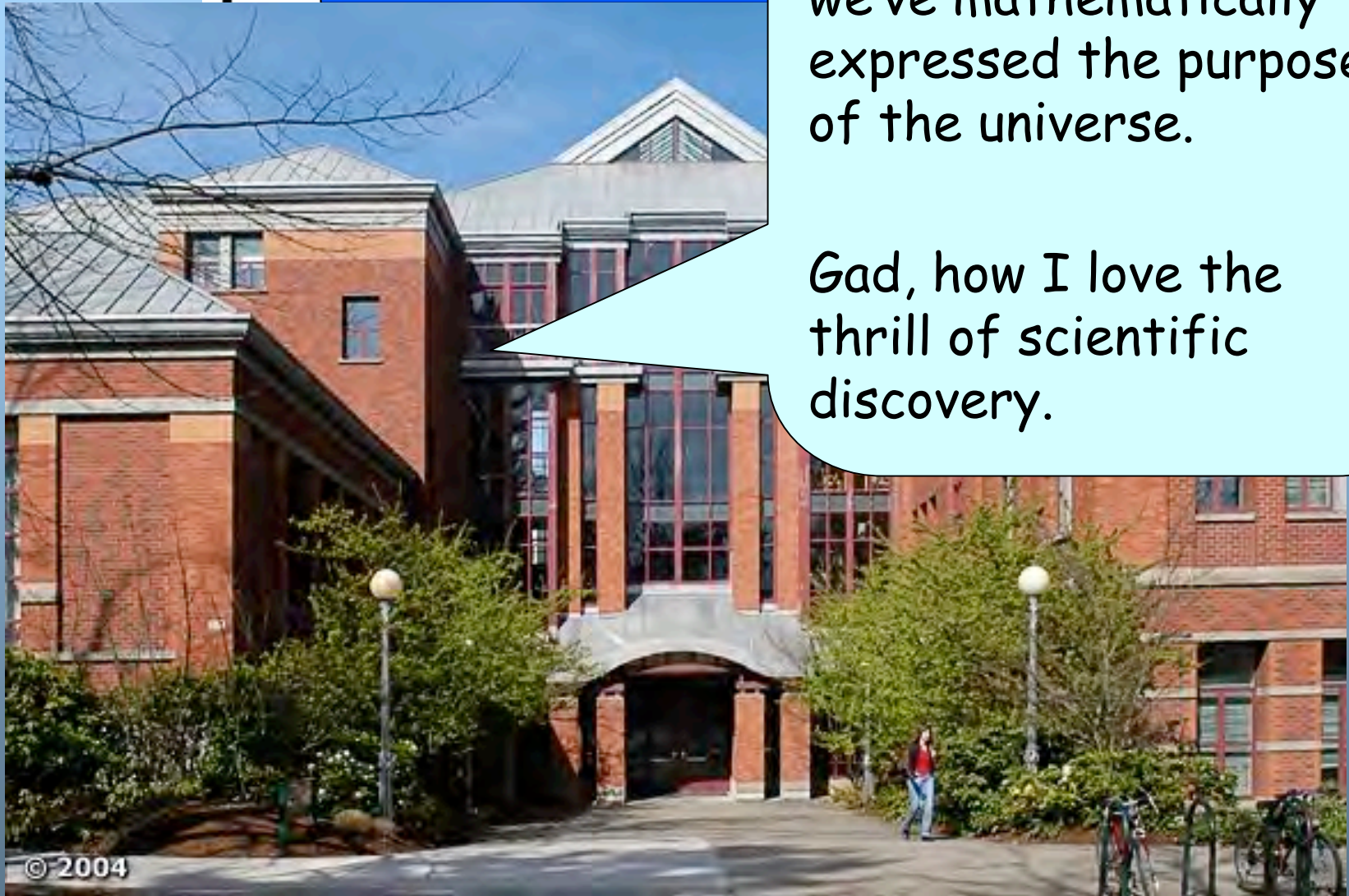


Under development  
by global collaboration  
including U. Oregon

Aim to start  
construction within  
several years



WILLAMETTE



No doubt about it AI -  
we've mathematically  
expressed the purpose  
of the universe.

Gad, how I love the  
thrill of scientific  
discovery.

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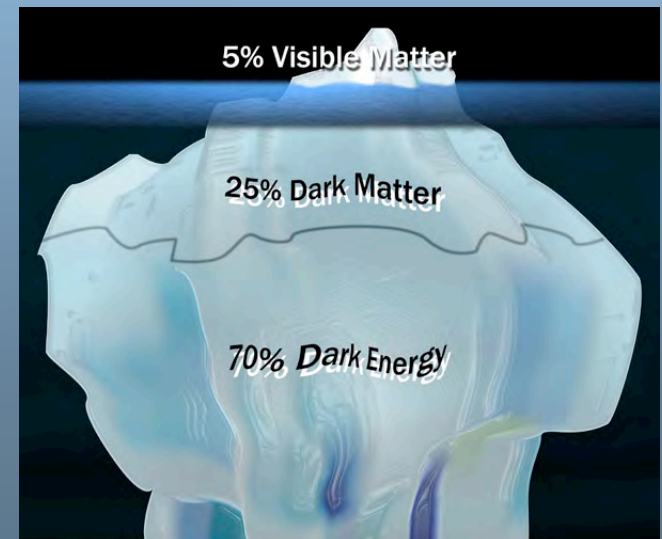
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23

# Our Mysterious Universe

- We are on the eve of a revolution in physics
  - Many mysteries
  - Solutions appear near
  - Deeper understanding of the universe itself
- Dark Matter particles - may appear soon in particle collider experiments
- Also
  - Gravity waves
  - Higgs Boson
  - Extra Dimensions
  - Other AMAZING Things
  - The Unexpected!



# Acknowledgements

RESEARCH SUPPORTED BY

Department of Energy  
OFFICE OF SCIENCE



NATIONAL SCIENCE FOUNDATION



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25