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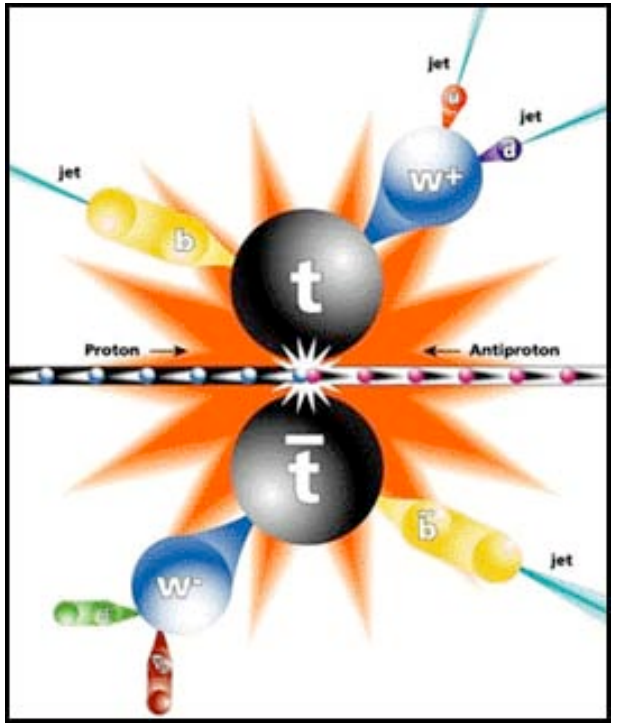
DOE High Energy Physics Program Update



- High Energy Physics Program

Study of Fundamental Nature of Matter, Energy, Space & Time.

Major Goals:
Ultimate Unification & Extra Dimensions
Cosmic Connections

Tools:
- Accelerator experiments + non-accelerator astrophysics, cosmology & neutrino experiments
- Also theory & computing play large role

GLAST User's Committee Meeting
August 9, 2004

Kathy Turner. Office of High Energy Physics

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High Energy Physics Program

➢ Goal: Cosmic Connections

Operating:

Sloan Digital Sky Survey (w/NASA, NSF, foreign)	dark matter, dark energy
Supernova Cosmology Project, Nearby Supernova Factory	dark energy

Approved/Construction:

***Cryogenic Dark Matter Search, CDMS-II** (underground, w/NSF)	dark matter in cosmic rays
Large Area Telescope (LAT) – GLAST, 2007 (w/NASA, foreign)	gamma rays, dark matter
***Pierre Auger** – ground array in Argentina (w/NSF, foreign)	high energy cosmic rays
AMS – Alpha Magnetic Spectrometer – ISS (w/NASA, foreign)	cosmic antimatter
VERITAS – telescope in Arizona (w/NSF, SAO)	high energy gamma rays
AXION-II	dark matter search

Proposed or Possible Future:

JDEM	dark energy
Ground telescopes/cameras	dark energy/matter

* Partial operations at current time

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GLAST Large Area Telescope

Launch: Feb. 2007

- DOE/NASA partner on the primary instrument: Large Area Telescope (LAT) – managed at SLAC
- DOE participation split into 2 parts: construction project & I&T/operations phase
  - DOE funding for construction project: $42M
  - Contributing ~ same for science team and operations, including I&T period.
- **Project is progressing & is sound technically**
- **DOE concerns: cost & schedule contingency almost used up for LAT project – watching this closely with NASA.**

Very excited about this mission and our continued participation in operations & science.

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NSTC's Interagency Working Group on Physics of the Universe

Report released April 2004 -- Recommendations (pertaining to DOE-HEP)

Ready for Immediate Investment & Direction Known

Dark Energy

NASA and DOE will develop JDEM

NSF and DOE will begin technology development of LSST leading to possible construction

Dark matter, neutrinos, proton decay

NSF and DOE will work together to develop a core suite of physics experiments

Gravity

NSF, NASA and DOE will strengthen numerical relativity research to simulate sources of gravity waves

Next Steps for Future Investments

Birth of the Universe Using CMB

The 3 agencies will work together to develop a roadmap for decisive measurements of both types of CMB polarization.

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Interagency Panels & News

Scientific Assessment Group on Experiments in Non-Accelerator Physics (SAGENAP)

- Met in April ’04
- Reports to HEPAP (High Energy Physics Advisory Panel) in Sept.

Task Force on CMB Research (TFCR) joint subpanel

- reports to HEPAP and AAAC (Astronomy & Astrophysics Advisory Comm.)

The AAAC will start reporting to DOE as well as to NSF and NASA

NASA/DOE Joint Dark Energy Mission (JDEM) Science Definition Team (SDT)

- Purpose: lay out level 1 science requirements
- Call for proposals to join the team was released early June
- working on setting it up now - First meeting ~ Fall

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DOE Future Planning

DOE Office of Science Facilities for the Future of Science – a 20 Year Outlook

and **Office of Science Strategic plan** → Released early 2004

5 HEP *facilities for the future* listed:

- JDEM (tied for 3rd priority out of 28)
- BTeV
- Linear Collider
- Double Beta Decay Underground Detector
- Super Neutrino Beam

FY 2005 House Appropriations Committee Report: DOE Office of Science -- June '04

HIGH ENERGY PHYSICS: …."The Committee supports the Department's collaboration with the National Aeronautics and Space Administration (NASA) on the Gamma-ray Large Area Space Telescope (GLAST), the Alpha Magnetic Spectrometer (AMS), and the Joint Dark Energy Mission (JDEM), and encourages NASA to maintain the planned schedule for these missions"…

We are continuing to fund R&D for a JDEM concept. We hope that NASA will be able to start supporting JDEM soon.

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Summary

DOE & NASA partnership working well at all levels!

Backup Slides

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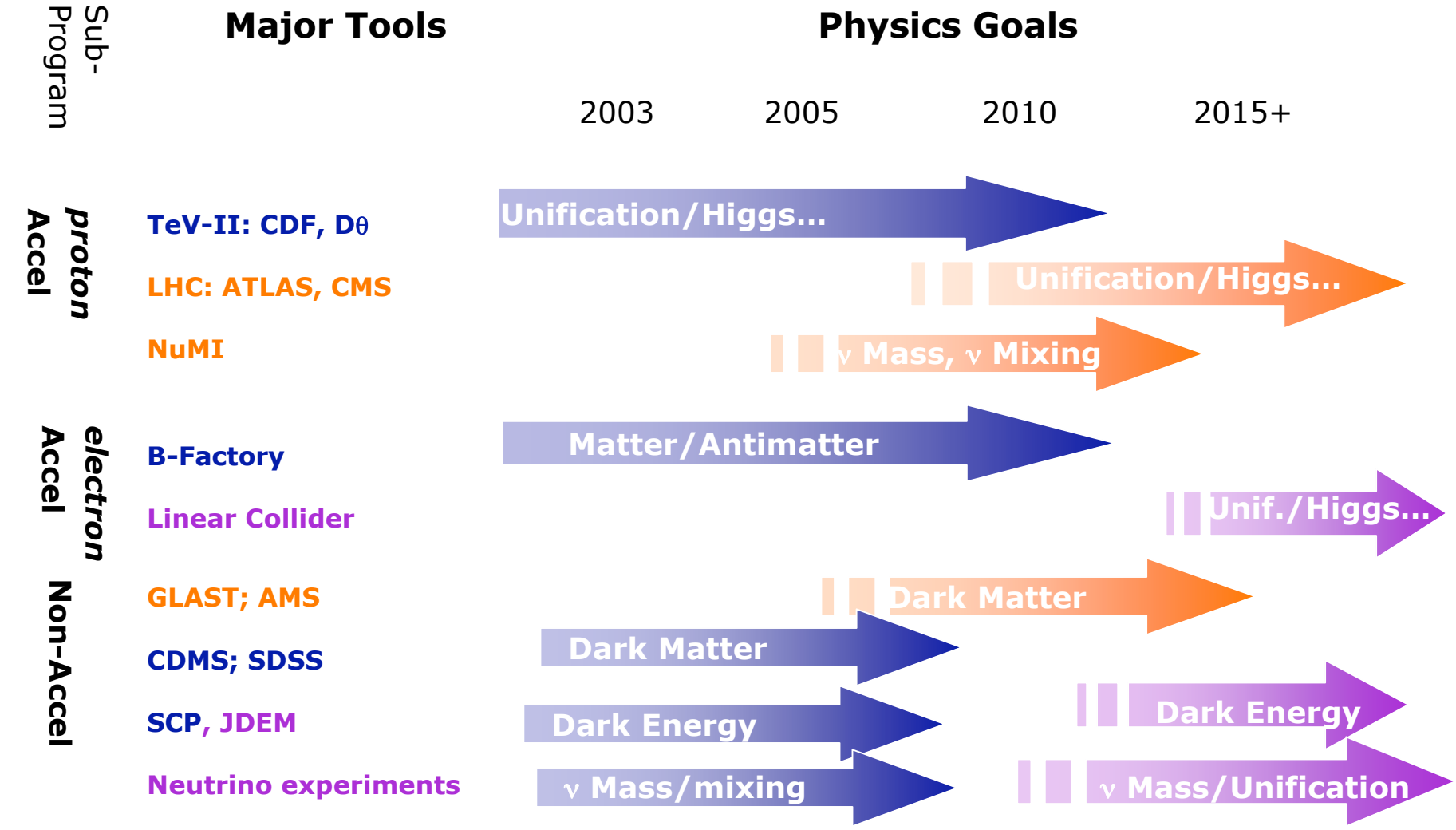
Major Program Thrusts



Blue = In operation Orange = Approved Purple = Proposed

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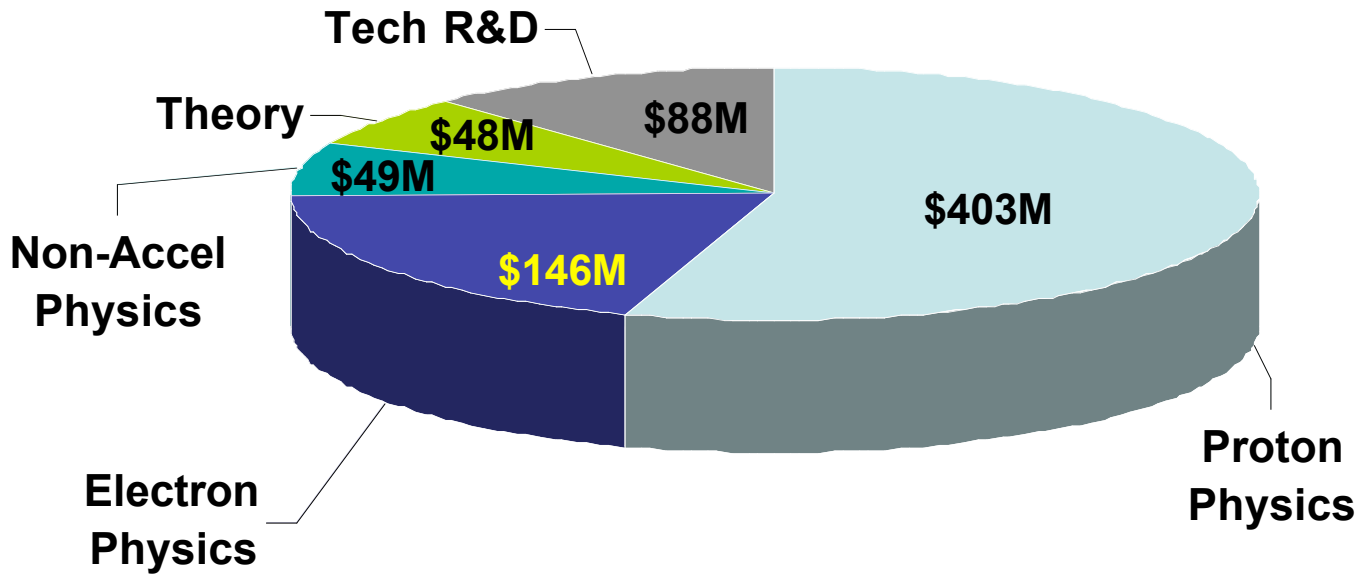
FY 2004 Funding Allocation

- Accelerator based physics (proton & electron) ~75%
- Non-Accelerator physics ~7%
- Theory ~7%
- Technology R&D ~12%



Dark Energy

- causing the acceleration of the expansion of the universe to accelerate
  –- of central importance to HEP program

Current work:

- **Supernova Cosmology Project (SCP) –** continuing ground and HST measurements to collect statistics over redshift range with Dark Energy effects
- **SNFactory** – large sample of nearby supernovae to study properties in detail

Future

- **Next Step**: precision measurements in space over full redshift range to determine nature of dark energy and history of accelerations and decelerations of the universe

- **Developed DOE/NASA Joint Dark Energy Mission (JDEM) plan**
  - strawman plan released Nov. 2003
  - Science Definition Team being formed (proposals due 7/04)

- DOE is continuing its R&D activities for SNAP (using supernova and weak lensing measurements) — a concept for JDEM

- Several other concepts for measurements of dark energy are being investigated by scientists – letter of intent by DESTINY to SAGENAP

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Sloan Digital Sky Survey

2003 – first public data release included data from start of operations in 1998 thru mid-2001

March 2004 – 2nd public data release included data from mid-2001 thru mid-2003 - data for 88 million objects, large fraction of Northern sky

Data taking continues thru summer 2005.

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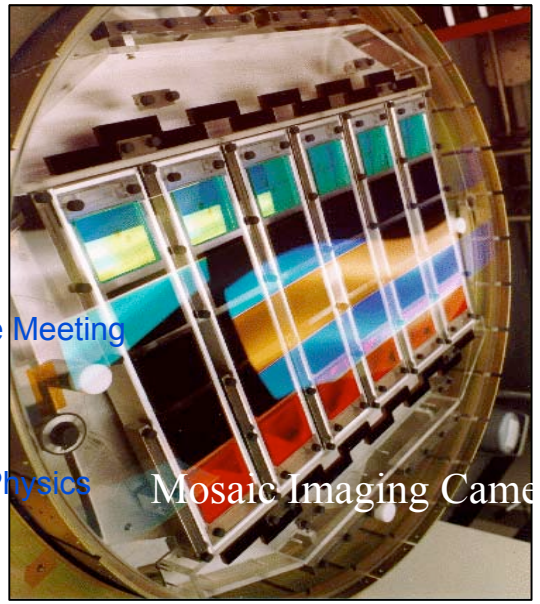

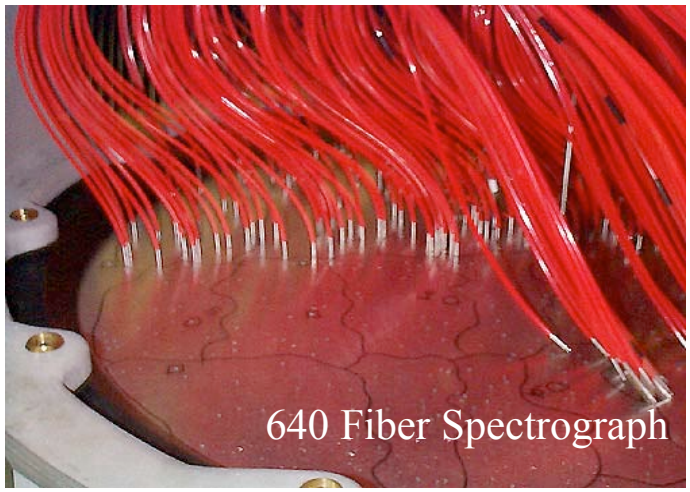

"Photometric" telescope in New Mexico

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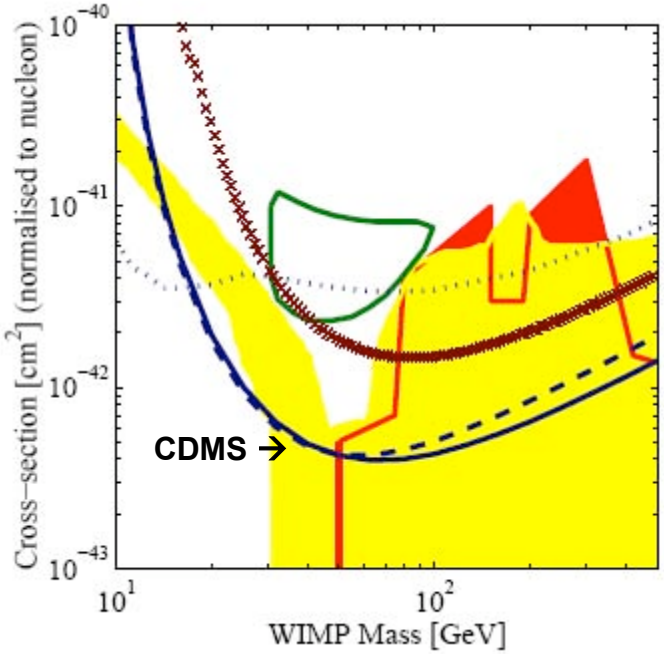
Cryogenic Dark Matter Search

- search for direct detection of WIMPS

Location - Soudan Mine in Minnesota

Data-taking: Started in 2003 with full ops starting early 2005.

Detector measures the recoil energy imparted to detector nuclei through neutralino-nucleon collisions by employing sensitive phonon detection equipment coupled to arrays of cryogenic germanium and silicon crystals.



First results released May'04:

…data set the world's lowest exclusion limits on the coherent WIMP-nucleon scalar cross-section for all WIMP masses above 15 GeV, ruling out a significant range of neutralino supersymmetric models. The minimum of the limit curve at the 90% C.L. is 4 x 10^{-43} cm^2 at a WIMP mass of 60 GeV.

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Very Energetic Radiation Imaging Telescope Array System - VERITAS

- Study of celestial sources of very high energy gamma-rays in the energy range of 50GeV-50TeV -- study extreme acceleration mechanisms
  - Location: Kitt Peak
  - 4 telescope array started construction Oct. '03
- Partnership of DOE, NSF with contributions from SAO + foreign

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Pierre Auger

Pierre Auger high energy cosmic ray detector array – over 3000 km^2 site in Argentina

As of Fall 2003, it's the largest air-shower detector in the world

Partial operations have started & full ops will start in 2005 upon completion of the full array.

<u>Currently installed:</u>
- 2 (out of 4) fluorescence stations w/6 telescopes each
- 395 (out of 1600) surface Cherekov detectors

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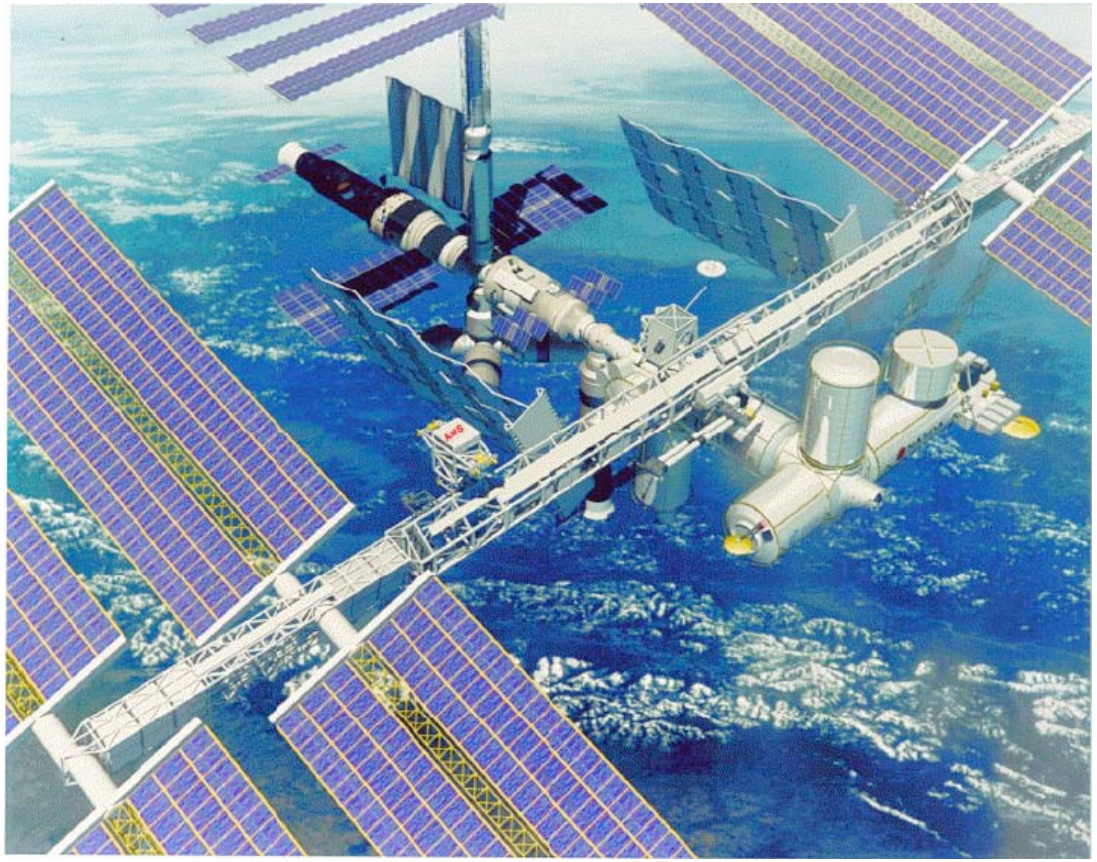
AMS - Alpha Magnetic Spectrometer



- An experiment (magnetic spectrometer in space) to search in space for dark matter, missing matter & antimatter on the International Space Station
- Prototype (AMS-01) took data on STS-91 in 1998
- AMS-02 fabrication complete in 2005
- Launch and deployment on ISS currently planned for 2008.

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➢ Goals: Ultimate Unification & Extra Dimensions

Operating:

CDF and DZero	Fermilab Tevatron (protons)	Top quark, Higgs, SUSY, extra dimensions
MiniBooNE	Fermilab Main Injector (protons)	Neutrino mixing
BaBar	SLAC B-factory (electrons)	Matter-antimatter, b quark, CP violation
Super-K	Japan (cosmic, solar neutrinos)	Proton decay, neutrino mixing
K2K	Japan (accelerator neutrinos)	Neutrino mixing
KamLAND	Japan (reactor neutrinos)	Neutrino mixing

Approved/Construction:

ATLAS & CMS	CERN LHC (protons)	Higgs, SUSY, extra dimensions
NUMI/MINOS	Fermilab MI (protons)	Neutrino mixing (long baseline)

Proposed or Possible Future:

BTeV	Fermilab Tevatron	Matter-antimatter, b quark, CP violation
Linear Collider	International (electrons)	Higgs, SUSY, extra dimensions
Enriched Xenon Observatory (EXO)		neutrino mass