# A Roadmap for High Energy Physics: Objectives and Performance Targets

2006 | 2008 | 2010 | 2012 | 2014 | 2016

## Explore Unification

- Use results from Tevatron Run 2 for Higgs boson, supersymmetric particles, and extra dimensions **(2008)** INTL, NSF
- Measure W boson mass with high precision to understand relationship with top quark and Higgs boson **(2010)** INTL, NSF
- ⬡ Demonstrate progress in measuring the properties and interactions of the heaviest known particle (the top quark), relative to its role in the Standard Model **(2015)**
- Measure properties and interactions of top quark to understand role in Standard Model **(2007)** INTL, NSF
- ⬡ Discover or rule out the Standard Model Higgs particle, thought to be responsible for generating mass of elementary particles **(2015)**
- Use computer simulations to calculate with high precision strong interactions between particles **(2009)**
- Determine pattern of neutrino masses and details of neutrino mixing parameters **(2011)** NP
- ⬡ Demonstrate progress in determining the pattern of the neutrino masses and mixing parameters **(2015)**
- ⬡ Demonstrate progress in confirming the existence of new supersymmetric (SUSY) particles, or ruling out the minimal SUSY "Standard Model" of new physics **(2015)**
- Begin studies of neutrino mass differences and flavor mixing with NuMI/MINOS to clarify role in Standard Model **(2005)** INTL, NSF
- ⬢ **The Large Hadron Collider, the ATLAS and CMS detectors**, all international projects that include the Department, are kept on schedule, within budget, and become operational **(2008)** INTL, NSF
- ⬢ Experiments begin to determine which proposed unified theories describe nature at the smallest scale **(2010)** NSF
- **LHC:** operations begin and research commences, guided by Tevatron results **(2008)** INTL, NSF
- Use early results from Large Hadron Collider to define initial physics objectives of Linear Collider **(2012)** INTL, NSF

## Understand the Cosmos

- Begin using full array of detectors in Pierre Auger Observatory in Argentina to study origins of extremely high-energy cosmic rays **(2005)** INTL, NSF
- Complete initial survey with Gamma-ray Large Area Space Telescope and use results to study high-energy gamma ray sources and astrophysical acceleration mechanisms **(2009)** INTL, NASA
- ⬡ Demonstrate progress in measuring the matter-antimatter asymmetry in many particle decay modes with high precision **(2015)**
- ⬡ Demonstrate progress in directly discovering, or ruling out the existence of, new particles which could explain the cosmological "dark matter" **(2015)**
- Measure matter/ antimatter asymmetry in quark sector with high precision **(2013)** INTL, NSF

## Develop Enabling Technologies (Future Facilities)

- Begin R&D on ground-based detection technologies that can provide complementary information about the nature of dark energy, in parallel with JDEM R&D. **(2006)** INTL, NSF
- Begin R&D aimed at developing next-generation neutrino accelerator and detector technologies that can significantly advance our knowledge of neutrino properties. **(2006)** INTL, NP, NSF
- **JDEM:** construction begins on space-based probe, developed in partnership with NASA, designed to help understand the recently discovered mysterious dark energy that makes up more than 70% of the universe **(2011)** NASA
- **Linear Collider (LC):** construction begins of an electron-positron linear collider built by an international collaboration, designed to complement the LHC as a tool for studying unification **(timing approximate – dependent on international negotiations)** INTL, NSF

## Interdependencies: (Descriptions)

*Broadly with **ASCR** on computational developments, both hardware and software, affecting all facets of basic research and advanced instrumentation.*

*Broadly across HEP objectives and corresponding elements*

NASA = *with NASA*

INTL = *with international community*

NSF = *with NSF*

NP = *with NP*

⬢ =Key Intermediate Objective from DOE Strategic Plan
⬡ =Long Term Success Measure from PART

This timeline is for planning purposes only and does not constitute financial or contractual commitments by the Federal Government.