

The DØ Experiment

Dmitri Denisov

Fermilab

DOE Site Visit

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Tevatron Physics Goals

Precision tests of the Standard Model

- Weak bosons, top quark, QCD, B-physics...

Search for particles and forces beyond those currently observed

- Higgs, supersymmetry, extra dimensions...

Driven by these goals
the experiment
emphasizes

Electron, muon and
tau identification

Jets and missing
transverse energy

Flavor tagging through
displaced vertices

Addressing fundamental
physics questions

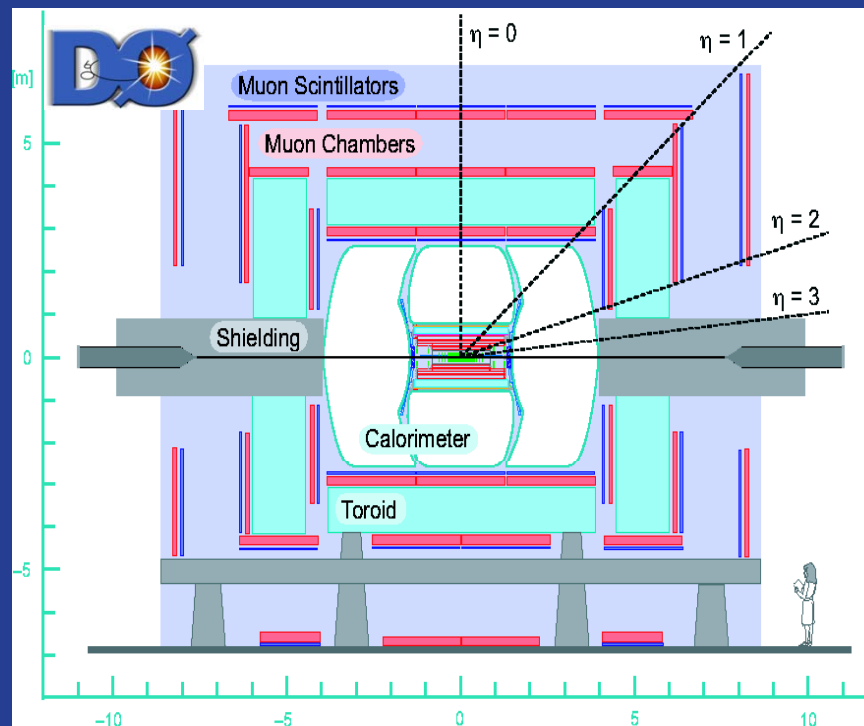
Quark sub-structure?

Origin of mass?

Matter-antimatter
asymmetry?

What is cosmic dark
matter? SUSY?

What is space-time
structure? Extra
dimensions?...



The DØ Collaboration

DØ is international Collaboration of 510 physicists from 18 nations

The DØ Collaboration

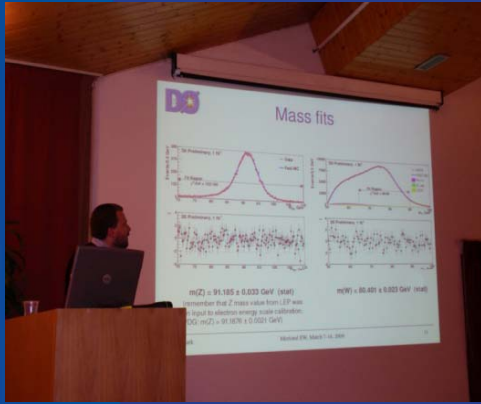
AZ U. of Arizona
 CA U. of California, Berkeley
 U. of California, Riverside
 Cal. State U., Fresno
 Lawrence Berkeley Nat. Lab.
 FL Florida State U.
 IL Fermilab
 U. of Illinois, Chicago
 Northern Illinois U.
 Northwestern U.
 Indiana U.
 U. of Iowa-Dames
 Purdue U. Calumet
 IA Iowa State U.
 KS U. of Kansas
 Kansas State U.
 LA Louisiana Tech U.
 MD U. of Maryland
 MA Boston U.
 Northampton U.
 MI U. of Michigan
 Michigan State U.
 MS U. of Mississippi
 NE U. of Nebraska
 NJ Princeton U.
 NY Columbia U.
 U. of Rochester
 SUNY Binghamton
 SUNY, Stony Brook
 Brookhaven Nat. Lab.
 OK Langston U.
 U. of Oklahoma
 Oklahoma State U.
 RI Brown U.
 TX Southern Methodist U.
 U. of Texas at Arlington
 Rice U.
 VA U. of Virginia
 WA U. of Washington

ARGENTINA: U. de Buenos Aires
 BRAZIL: LAFEX, CBPF, Rio de Janeiro State U. de Rio de Janeiro, U. Federal do ABC, Sao Paulo State U. Paulista, São Paulo
 CANADA: U. of Alberta, McGill U., Simon Fraser U., York U.
 CHINA: U. of Science and Technology, U. de los Andes, Bogotà of China, Hebei
 CZECH REPUBLIC: Charles U., Prague, Czech Tech. U., Prague, Academy of Sciences, Prague
 INDIA: U. Sun Francisco de Orléans, IIT, Chennai-Ferrand, IISc, INSP, Coimbatore, CPPL, INSP, Marseille, LAL, INSP, Orsay, LPNHE, INSP, Paris, DAPNIA-SPT, CEA, Saclay, IRS, Strasbourg, IAN, INSP, Villeurbanne
 ITALY: U. of Aachen, Bonn U., U. of Freiburg, U. of Mainz, Ludwig-Maximilians U., Munich, U. of Wuppertal
 JAPAN: KEK, Korea U., Seoul, Sungkyunkwan U., Suwon
 MEXICO: UNIVESTAV, Mexico City
 POLAND: KUL, Korea U., Seoul, Sungkyunkwan U., Suwon
 RUSSIA: JINR, Dubna, ITEP, Moscow, Moscow State U., NIKHEF, Troitsino, PNPI, St. Petersburg
 SOUTH AFRICA: Lund U., RIT, Stockholm, Stockholm U., Uppsala U.
 SOUTH KOREA: KUL, Korea U., Seoul, Sungkyunkwan U., Suwon
 SWEDEN: Lund U., RIT, Stockholm, Stockholm U., Uppsala U.
 UNITED KINGDOM: Lancaster U., Imperial College, London, U. of Manchester

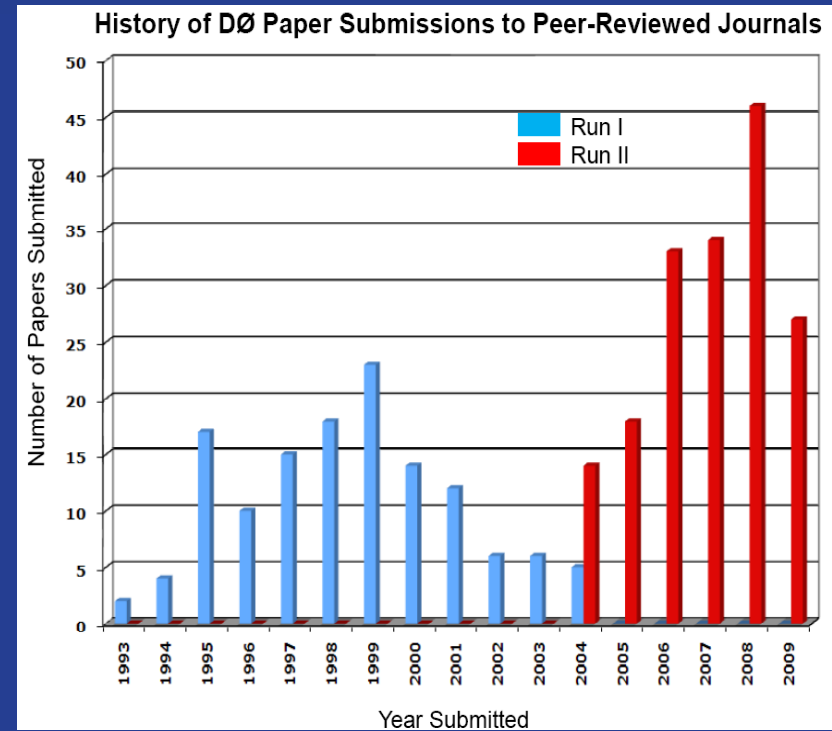
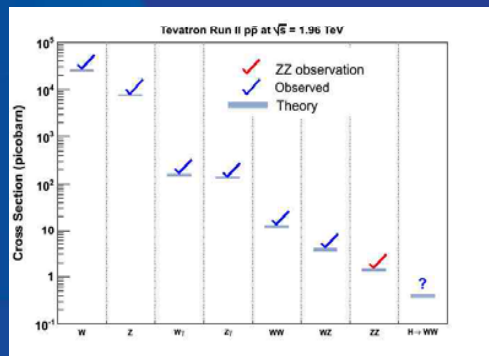
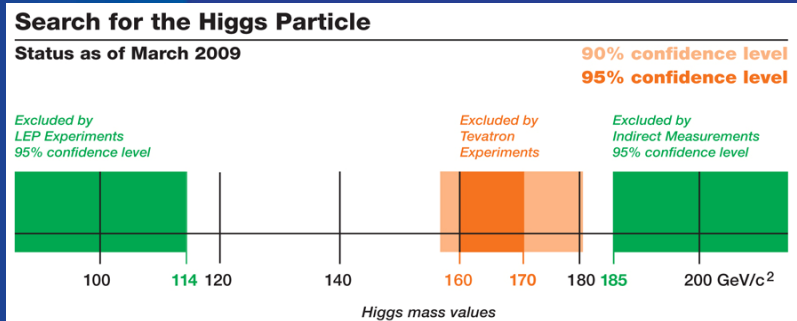


- **Institutions**
 - 90 total: 38 US, 52 non-US
- **Collaborators**
 - 50% from US
- **Fermilab scientists represent ~6% of the collaboration**

Highlights of Successes of the DØ Experiment



- ~1 paper/week published
- ~ 100 preliminary results announced per year
- ~ 200 invited talks at conferences
- ~ 30 PhDs awarded/year



Areas of Fermilab Scientists Responsibilities

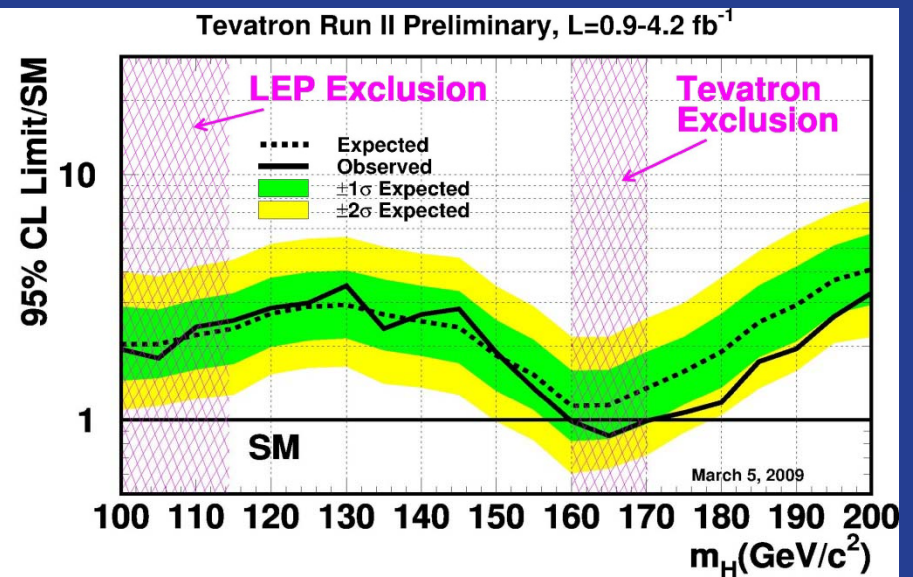
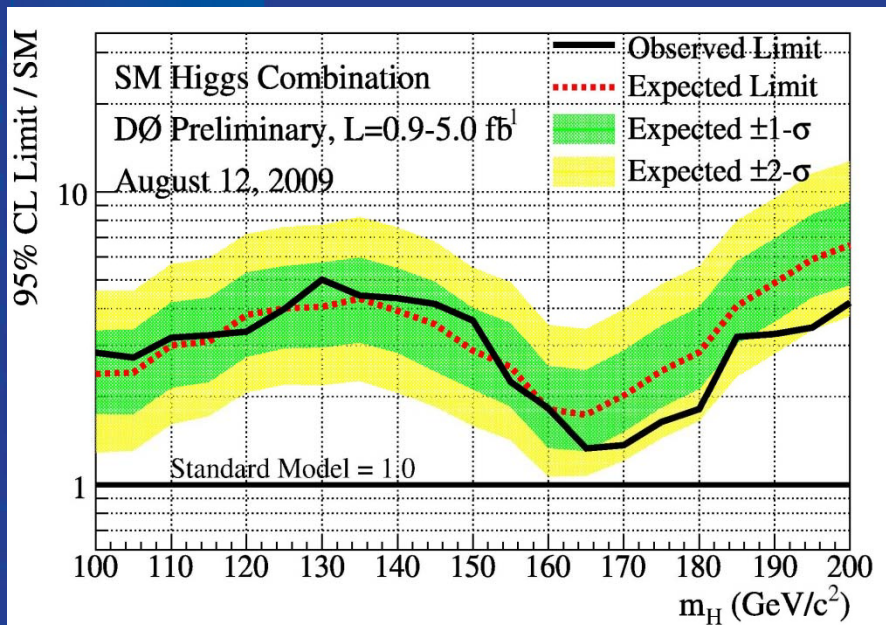
- Fermilab scientists, representing host Laboratory, play special role in the experiment to ensure that
 - The detectors are working well and collecting data with high efficiency
 - The data collected is quickly processed and made available for analysis
 - The experiment publishes world-class results
- Long term participation of the Fermilab scientists in the experiment assures
 - Continuity of knowledge about detectors, algorithms and computing
 - Training of newcomers including students and postdocs
 - Quality of physics results based on deep expertise with detector, algorithms, computing and analysis

Contribution of Fermilab the DØ Experiment

- Fermilab's scientists are critical for the experiment's success
 - ~50% of the experiment leadership
 - ~17% of the experiment conveners and groups leaders
- Operations positions
 - ~25% Fermilab scientists
- Fermilab personnel share of shifts
 - Experts ~30%, Captains ~30%
- Computing and algorithms
 - ~15% of leaders are from Fermilab
- Physics analysis
 - All Fermilab scientists are involved in physics analysis
 - ~15% of physics organization leaders are from Fermilab

Higgs Searches

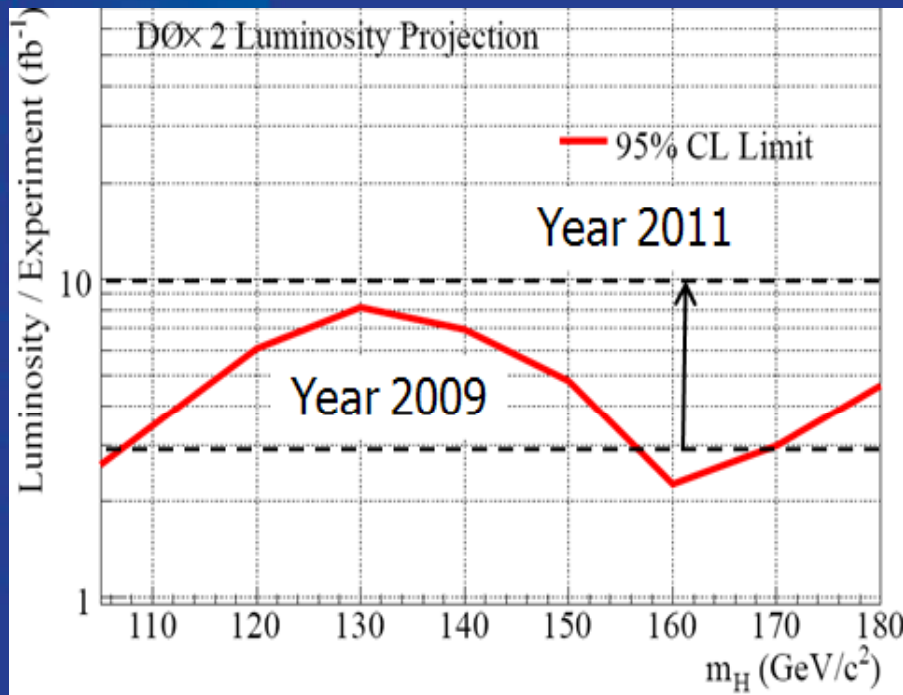
- Combining 10's of analysis channels into Higgs search summary
 - DØ only combination
 - Tevatron combination



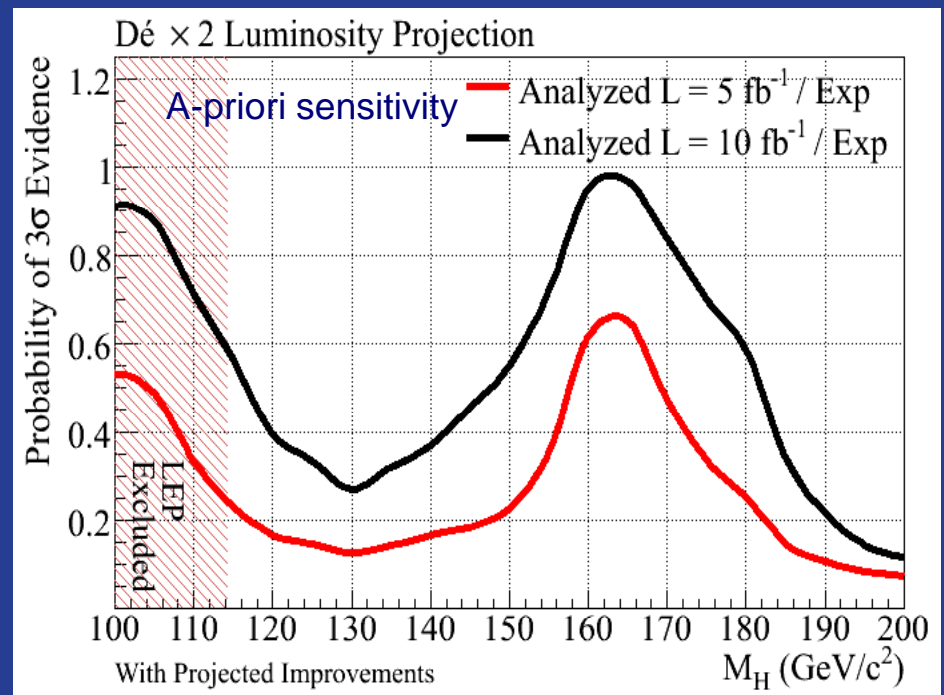
- With major contributions from Fermilab scientists Tevatron excludes Higgs in the 160-170 GeV mass range
 - Tevatron demonstrated sensitivity to SM Higgs!
- At 115 GeV the limit is factor of ~2.5 from SM

Higgs Future Tevatron Projections

- Search for SM Higgs boson is one of the major physics goals of the Tevatron
- Tevatron is already sensitive to the SM Higgs boson
 - Including data from 2011 run each Tevatron experiment expects to analyze $\sim 10 \text{ fb}^{-1}$ of luminosity
 - Including 2011 data, the Tevatron will be able to exclude the SM Higgs at 95% CL over the entire allowed mass range of 114-185 GeV
 - Or see evidence of its existence!



95% CL Exclusion



3σ Evidence



Personnel Needs and Resources

- We have estimates for resources required to run the experiment in 2011 based on our past experience and future plans
 - ~100 FTEs total needed
- ~30 FTEs are required for control room shifts and experiment management
 - Well defined collaboration rules for shifts
 - No issues are anticipated with experienced and enthusiastic managers
- ~70 FTEs are needed for algorithms, computing and detector support activities
 - Many experiment groups and individuals have very high level of commitment to the detectors, algorithms and computing contributions they made
 - Fermilab provides critical support in many areas
 - There is substantial influx of collaborators committed for at least 2-3 years
 - ~40 over last year
 - Newcomers are regularly trained in specific areas to replace departing experts
 - Funding agencies are supportive
 - Support of DOE groups and targeted help by DOE
 - Support of NSF groups
 - International Fellows program by the laboratory
 - ~\$1M visitors budget provided by the laboratory
 - Facilitates availability of ~40 FTEs
- International finance committee demonstrated long term support for DØ groups

The DØ Experiment Resources

- Table below summarizes
 - Actual manpower efforts in operations, algorithms, computing and management in 2008
 - Expected manpower needs in 2011
- Total expected available manpower in 2011 is currently estimated at ~170 FTEs

Physicist FTE's	Operations	Algorithms	Computing	Management	Total
2008 actual	55	26	16	10	107
2011 estimate	~50	~20	~15	~10	~100

- Matching collaborators to tasks is well known challenge for the experiment management
 - Working closely with the experiment groups, individuals, funding agencies and the laboratory
 - Have been able to meet this challenge efficiently
 - Assuming that support continues and based upon the interest and commitments from the collaboration, we expect to have the necessary manpower to run through at least 2011

Support for Guests and Visitors

- Fermilab provides opportunities for many scientists to participate actively in exciting Tevatron program
- **International Fellowship program**
 - ~2 International Fellows selected from large number of applicants to work on DØ per year
 - From students to professors from non-US groups
China, UK, Czech Republic, Korea, Russia, France, Germany...
 - Improves international cooperation and enhances Tevatron program
- **Guests and visitors support**
 - To address critical for the experiment needs
 - Teaching buyout for the experiment leadership
 - Support for foreign students and postdocs to stay at Fermilab
 - This support is very productive providing ~40 FTEs to the experiment per year via splitting support with collaborating groups
- Fermilab provides excellent environment where scientists from all nations feel welcome and work as colleagues at the energy frontier accelerator