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# LARP Software

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# LARP/LHC Software

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- List, define and explain S/W projects
  - Define "endpoints"
    - *Especially: Inception and completion*
  - Find common issues
  - Help with common solutions
- Identify people who will do the work
- Ensure that all effort benefits LHC
  - Especially initial commissioning!

# Possible LARP Software (1)

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- SDA
  - E. McCrory & J. Slaughter
  - Needs to be better defined on what this means
- CHEF for linear and nonlinear analysis & diagnosis
  - L. Michelotti & J-F Ostiguy
- Passive tune control from Schottky data
  - R. Moore
- Orbit control feedback
  - V. Ranjbar

# Possible LARP Software (2)

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- Control of tune and chromaticity drift at injection and ramp
  - M. Martens
- Schottky monitor software
  - A. Jansson, et al.
- PLL and tune feedback
  - C-Y Tan

# Other LHC Software at FNAL

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- Not part of LARP mission:
  - LHC@FNAL
    - *Remote operations center, to be located, we think, in WH1*
    - *E. Gottschalk, et al.*
  - Helping with the writing of LHC applications
    - *S. Gysin starting to investigate this*
- LARP web pages
  - [larp.fnal.gov](http://larp.fnal.gov)
    - *My feeble attempt to make a LARP web page*
  - [dms.uslarp.org](http://dms.uslarp.org)
    - *A Plone-based DMS in TD*
    - *J. Konc & E. McCrory*

# Summary of LARP S/W Issues

- Devise an algorithm for LHC
  - How does LHC differ from our experience?
    - *Hardware, lattices, studies, etc.*
- Implement the algorithm at CERN
  - We need an LHC "Hello World!" application
    - *How do you write, compile, test, store, release an application?*
    - *How do you get data?*
    - *Long-term support?*

# LARP/Lab support: Logistics

- LARP and the lab need to decide:
  - Will we really be able to spend significant time on LARP?
  - Will we really be able to move to CERN for a year?
    - *Abandon local responsibilities?*
    - *Homes here/lodging there, taxes, schools, spouses, etc.*
- Most respondents echoed these concerns

# For each piece of S/W ...

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- Is it a realistic project that can be completed/made useful
  - In 6 months?
  - In one year?
- If so ...
  - Who is going to do it?
  - How long will it take
    - *In calendar days and in FTE effort*
  - How will it be used at LHC?
  - What, specifically, will it do?
  - Test during SPS re-commissioning in Summer 06?



# SDA Acronym

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- **Sequenced Data Acquisition**
  - Storing any data into a relation DB
  - Indexed by the "shot number"
    - *"Time" is translated to human-understandable form*
      - *Case, Set*
  - Applicable to any "big event"
- **Shot Data Analysis**
  - The Supertable
  - High-level summaries of Sequenced Data Acquisition "shots"
  - Includes calculations that cannot be done easily in front ends
    - *Transmission efficiencies*
    - *Emittances from beam widths*

# SDA at LARP

- SDA Acronym
  - Sequenced Data Acquisition
  - Shot Data Analysis
    - *See next slide*
- LHC does not have this concept
  - Post Mortem only for failures
  - Timber
    - *Would be a crucial part of SDA*
    - *But does not have time abstraction or re-calculations*
- Probably cannot simply take our software and run it at LHC
  - M. Lamont has tentatively assigned worker(s?) to think about this idea.



# CHEF

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- Francois Ostiguy and Leo Michelotti
  - LM has transferred to CD
- MXYZPTLK, Beamline, etc.
  - Well established differential algebra tracking software
    - *Arbitrary order*
  - Extensive libraries
    - *Operator overloading is fundamental*
  - C++
    - *Completely rewritten in the last 3 months*
      - *E.g., "smart pointers"*
    - *60 times faster than previous version*
  - Python (PyCHEF)

# CHEF: Mxyzptlk

Mister Mxyzptlk (pronounced miks-yeez-pit'l-ik) is the name used on Earth (his true name is untranslatable) by a devilish being from another plane of reality, completely different from our own, which he calls the "Fifth Dimension." A trickster whose deviousness knows no bounds or limits, he is only able to travel to our dimension once every ninety days. Once here, his only goal is to cause as much trouble as he can. His past "pranks" have included forcing Superman and the Flash to compete against each other in an around-the-world foot race, and the creation of Red Kryptonite, a variant version of the more deadly green Kryptonite which temporarily robbed Superman of his powers. Ever unpredictable, Mxyzptlk continues to plot and scheme, waiting for his next opportunity to cause mayhem and mischief.

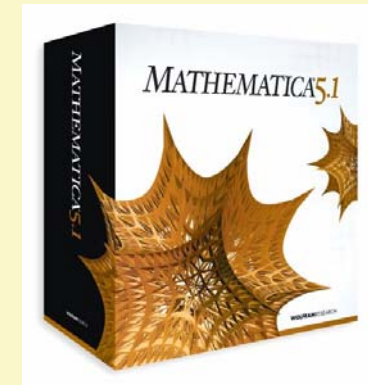




# CHEF and Python



- All Mxyzptlk classes are cast to be used in Python - PyCHEF.
  - Magic of C++ templates!
- All Python data analysis classes avail
  - FFT, signal processing, etc...
  - Same libraries used by Mathematica
- Simple examples for powerful operations
  - See J-F. Ostiguy for demonstration.



# CHEF: LHC Plan

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- Get Lattice Files
  - Dynamically
  - ...
- Determine relevance to commissioning
  - Algorithms specified so far are simple to implement

# CHEF: LHC Lattice Files

- Specified in "sequence files"
  - MAD X input scheme
    - *Drifts are implied, not specified directly*
  - Completely flat lattice description
    - *Yuck!*
  - Gigantic files!
    - *Used in the control system*
- J-F. O. will write parser for this
  - About 1 month of work
  - Can reuse a lot of existing code
    - *E.g., expressions*



# CHEF: Possible Calculations

- Suggestions from T. Sen
- Linear analysis
- Nonlinear analysis





# CHEF: Linear Analysis

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- Using difference orbits data
  - Beta beating, dispersion beating etc
  - Find sources of error
    - *Mis-powered or misaligned quads etc*
    - *Valishev has an algorithm that uses the orbit response matrix*
- Using turn by turn orbit data, extract with high precision:
  - Beta and dispersion functions, phase advances between BPMs, coupling angles, ...

# CHEF: Nonlinear Analysis

- With turn by turn orbit data
  - Detuning with amplitude,
  - Resonance driving terms
    - *Frank Schmidt has algorithm*
- Linear & 2<sup>nd</sup> order chromaticity of an insertion
  - With thick quads
  - Chromatic dependence of the usual Twiss functions.
- Calculate measures of nonlinearity of a map
  - L2 measure of a map at specified amplitudes,
  - Nonlinear resonance driving terms,
  - Resonance widths,
  - Detuning with amplitude
- Algorithms for nonlinear correction of the IR
  - E.g. the one implemented in the baseline LHC optics
- Frequency map analysis and chaotic boundary with short term tracking

# CHEF: Short-term plan

- Next 3 months
  - Generate sample of what CHEF can do
  - Get another person to help
- Generate an algorithm that is relevant to LHC commissioning
  - E.g., Schmidt's algorithm from 10-Nov-05 seminar
- Make this easy to use
- Demonstrate it far and wide



# Schottky Monitor Software

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- Collaborators

- FNAL

- *R. Pasquinelli, P. Lebrun, D. Sun, D. Tinsley, A. Jansson*

- BNL

- *P. Cameron, P. Oddo*

- CERN

- *F. Caspers, R. Jones*

- Porting the Fermilab Schottky analysis software to the CERN control system framework.

- CERN provides the generic controls communications software and the platform for running the code.

- (FNAL, FY'06-07)

# PLL and Tune Feedback

- C-Y. Tan
- "Bar B Q"
- Will follow the same path as Schottky
  - Use vector signal analyzer?
    - *Probably just a port of existing Tevatron software*
  - Use VSA, DAQ board, etc.?
    - *Much bigger software effort*
    - *Again, rely on Schottky solution*



# Passive Control from Schottky Data

- Ron Moore

- Experienced Java programmer
- Wants to help!
  - *User interfaces?*
  - *Bunch by bunch display*
    - *This may be our "Hello World!" example*



- Our experience

- The pbar tunes must be adjusted throughout the store due to beam-beam tune shift
- Have implemented an alarm to advise when to change tunes

- Will LHC be willing to run PLL/BBQ during stores?

- If not, then this sort of passive tune data may be necessary to do a feedback.

# Orbit Control Feedback

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- Vahid Ranjibar
  - CERN folks: Jorg Wenninger & grad student
    - *Also working on collimation*
- Our experience
  - Tevatron orbit control works now
  - Simple algorithms to enable global orbit control
  - But has been a major effort
    - *Highly iterative*

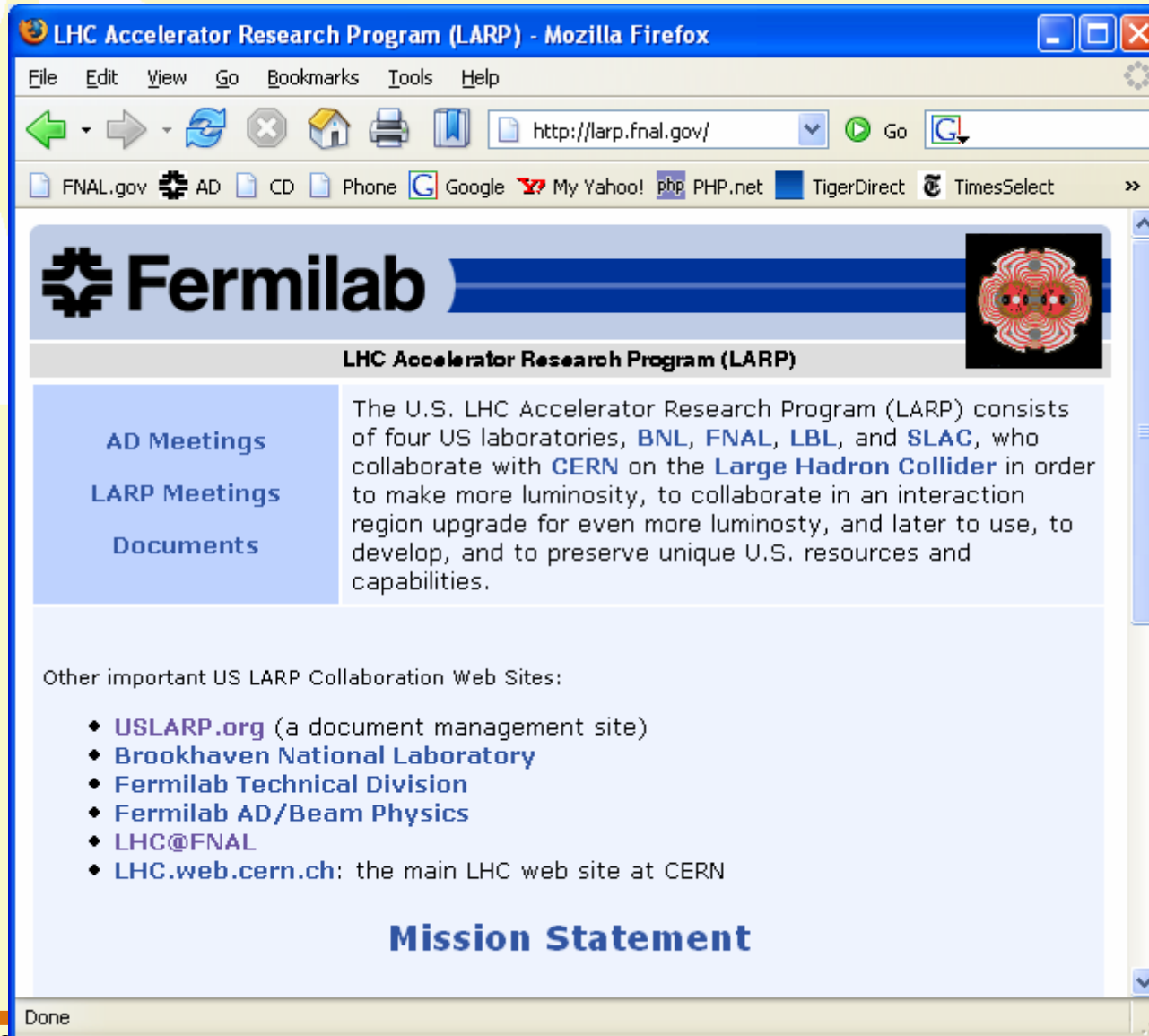
# Tune/Chromaticity Drift Control

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- Mike Martens
- Ordered to-do list
  - Understand the magnets
    - *Chromaticity circuits*
    - *How do they ramp?*
  - Get beam-based studies to determine
    - *Details of magnet fields*
      - *Magnet measurements are incomplete, by design*
    - *Specifics of the algorithms necessary*
  - Implement the algorithm
    - *Actually, a small amount of work, once the previous steps are completed.*



# LARP Web Pages: [larp.fnal.gov](http://larp.fnal.gov)



The screenshot shows a Mozilla Firefox browser window titled "LHC Accelerator Research Program (LARP) - Mozilla Firefox". The address bar displays "http://larp.fnal.gov/". The browser's toolbar includes navigation buttons (back, forward, home, stop, refresh) and search engines (Google, My Yahoo!, PHP.net, TigerDirect, TimesSelect). The website content features the Fermilab logo and a navigation menu with links for "AD Meetings", "LARP Meetings", and "Documents". A main text block describes the LARP program, mentioning its four US laboratories (BNL, FNAL, LBL, and SLAC) and its collaboration with CERN on the Large Hadron Collider. Below this, a section titled "Other important US LARP Collaboration Web Sites:" lists several links, including USLARP.org, Brookhaven National Laboratory, Fermilab Technical Division, Fermilab AD/Beam Physics, LHC@FNAL, and LHC.web.cern.ch. A "Mission Statement" link is also visible at the bottom of the page.

LHC Accelerator Research Program (LARP)

**Fermilab**

**LHC Accelerator Research Program (LARP)**

[AD Meetings](#)  
[LARP Meetings](#)  
[Documents](#)

The U.S. LHC Accelerator Research Program (LARP) consists of four US laboratories, [BNL](#), [FNAL](#), [LBL](#), and [SLAC](#), who collaborate with [CERN](#) on the [Large Hadron Collider](#) in order to make more luminosity, to collaborate in an interaction region upgrade for even more luminosity, and later to use, to develop, and to preserve unique U.S. resources and capabilities.

Other important US LARP Collaboration Web Sites:

- ◆ [USLARP.org](#) (a document management site)
- ◆ [Brookhaven National Laboratory](#)
- ◆ [Fermilab Technical Division](#)
- ◆ [Fermilab AD/Beam Physics](#)
- ◆ [LHC@FNAL](#)
- ◆ [LHC.web.cern.ch](#): the main LHC web site at CERN

**Mission Statement**

Done

# USLARP.org Plone Site

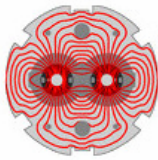
The screenshot shows a Mozilla Firefox browser window displaying the USLARP Document Management System. The browser's address bar shows the URL <https://dms.uslarp.org/>. The page features a navigation menu with links for home, news, and members. The main content area is titled "Welcome to the USLARP Document Management System" and includes a mission statement and a list of other LARP resources on the web. A sidebar on the left contains a navigation tree and a "recent items" section. A right sidebar shows a "news" section with a link to "New Tips and Help for Users" dated 2005-10-29 and a calendar for November 2005.

Welcome to the USLARP Document Management System — USLARP - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://dms.uslarp.org/

small text normal text large text

 **U.S. LARP** Large Hadron Collider Accelerator Research Project

home news members

mccrory my folder my preferences undo plone setup log out

you are here: home

navigation

- Home
- Members
- Groups
- Accelerator Systems
- Magnet R&D
- Program Management
- Presentations
- Help & How-Tos
- LARP DMS Log
- Protected Folders
- LARP Schedule

recent items

No items published or changed since your last log-in.

More...

contents view edit properties sharing

add new item state: published

## Welcome to the USLARP Document Management System

This repository can be used to store, organize and exchange documents relating to LARP.

**LARP Mission Statement** (see [this BNL site](#)):

The US LHC Accelerator Research Program enables U.S. accelerator specialists to take an active and important role in the LHC accelerator during its commissioning and operations, and to be a major collaborator in LHC performance upgrades. In particular, LARP will support U.S. institutions in LHC commissioning activities and accelerator science, accelerator instrumentation and diagnostics, and superconducting magnet R&D to help bring the LHC on and up to luminosity quickly, to help establish robust operation, and to improve and upgrade LHC performance. Furthermore, the work we do will be at the technological frontier and will thereby improve the capabilities of the U.S. accelerator community in accelerator science and technology to more effectively operate our domestic accelerators and to position the U.S. to be able to lead in the development of the next generation of high-energy colliders.

- Other LARP resources on the web...
  - BNL [USLARP](#) page
  - FERMI/AD [USLARP](#) web page
  - FERMI/TD [USLARP](#) web page
  - LBL [USLARP](#) web page
- Some important [Tips](#) for users of this site

news

- New Tips and Help for Users 2005-10-29

More...

<< November 2005 >>

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Done

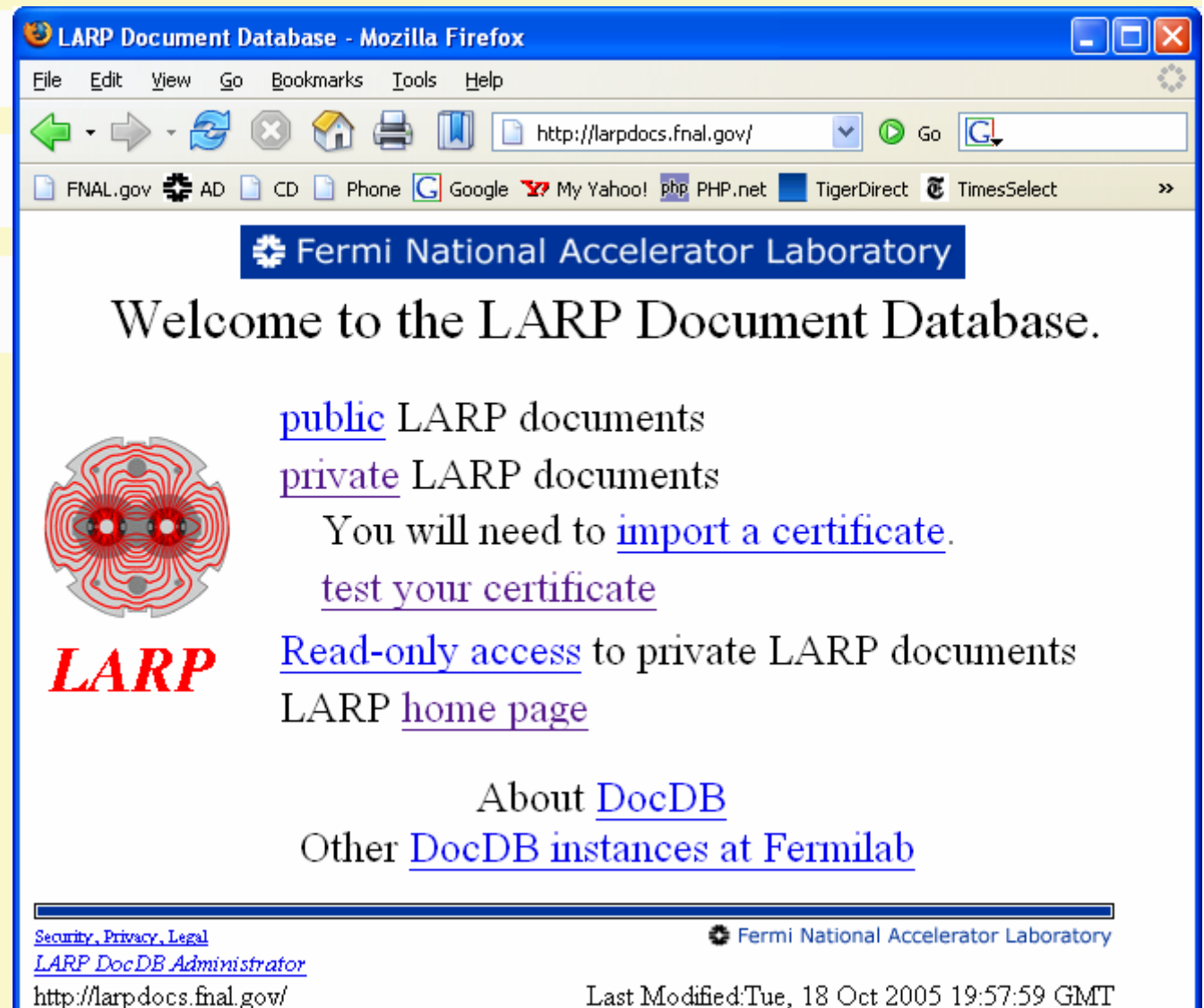
dms.uslarp.org

# LARP = Live Action Role Playing



# Larpdocs.fnal.gov

- No longer needs certificate  
➤ Hurray!!



The screenshot shows a Mozilla Firefox browser window titled "LARP Document Database - Mozilla Firefox". The address bar contains "http://larpdocs.fnal.gov/". The page content includes the Fermi National Accelerator Laboratory logo, a welcome message, and several links: "public LARP documents", "private LARP documents", "You will need to import a certificate.", "test your certificate", "Read-only access to private LARP documents", "LARP home page", "About DocDB", and "Other DocDB instances at Fermilab". The footer contains "Security, Privacy, Legal", "LARP DocDB Administrator", "http://larpdocs.fnal.gov/", "Fermi National Accelerator Laboratory", and "Last Modified: Tue, 18 Oct 2005 19:57:59 GMT".

LARP Document Database - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

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http://larpdocs.fnal.gov/

Fermi National Accelerator Laboratory

Last Modified: Tue, 18 Oct 2005 19:57:59 GMT

# LHC@FNAL To Exist in WH1



- Or maybe on the West Side...

# Summary

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- Everyone in the same boat for writing software for LHC
- Need a practical understanding of how to do this
  - S. Gysin (CD)
  - "Hello, World!" controls application