

# LHC Theory Initiative: Accomplishing Cultural Change

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# Recurring Questions:

- Is there enough support for collider physics in the United States?
- Is collider physics sufficiently appreciated at universities?
- Are we training an appropriate number of particle theory students and postdocs whose work has direct impact on the experimental program?

# Why Collider Theory?

“If there is a single defining theme for the mathematical and physical sciences, it is the deep partnership between theory and experiment. Powerful experiments and observations lead to impressive advances ... in the mathematical and physical sciences, highly developed theoretical structures play an equal role.”

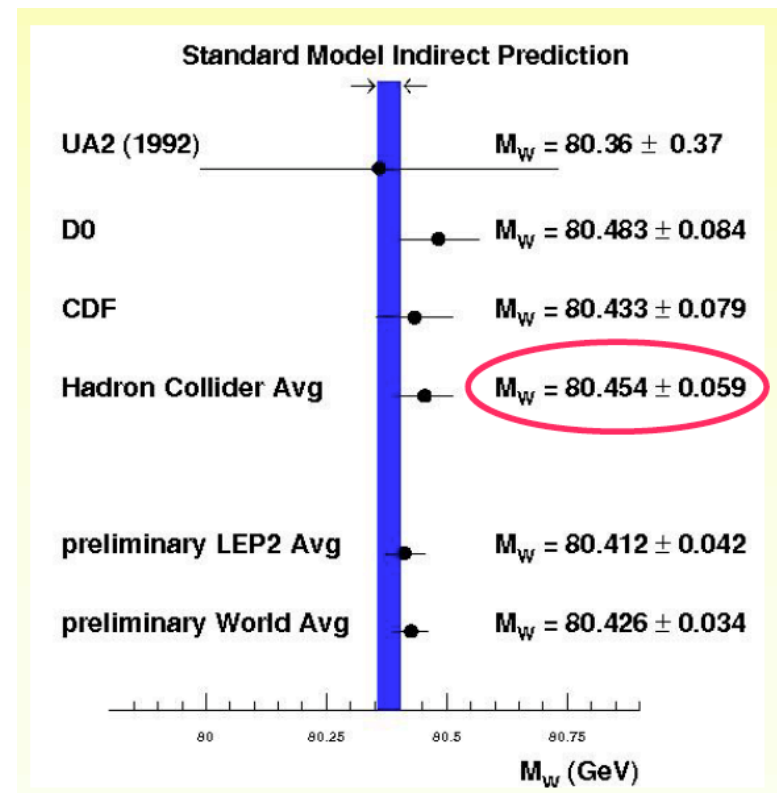
- Report of MPS-wide Workshop on Theoretical Science, Oct. 28-29, 2004

## W-mass from Run I

### Correlated uncertainties on W mass

	CDF	DØ
PDF	15	8
Radiative corr	11	12
W width	10	10
Total	19 MeV	

F. Deliot, Moriond EW'05



# Many Examples

## APPENDIX D: LIST OF LARGE-SCALE PROJECTS

The following is a representative list of topics which could benefit from systematic and ongoing theoretical analysis:

- (1) Structure functions: the advent of large hadron colliders accentuates the need for a systematic project to develop standardized structure function programs that are reliable and accurate over a wide kinematic range. This would have to incorporate all data relevant to structure functions (regularly updated and including the propagation of the uncertainties in the data) as well as the best possible QCD-derived theoretical expressions.
- (2) Fragmentation: the development of realistic Monte Carlos for the description of jet fragmentation, incorporating all relevant theory and experiment, are essential for the interpretation of almost all high energy experiments.
- (3) Systematic calculations of all relevant hard processes involving quarks and gluons, at least through order- $\alpha_s$
- (4) Jet Physics, theory and phenomenology: this involves the combination of the results of (1), (2), and (3) above for the full description of jet physics. The goals are to predict observables, compare the predictions with data, and apply the results to QCD tests, tests of electroweak and other standard model physics, and to searches for new physics.
- (5) Detailed calculations of QCD backgrounds for top quarks, supersymmetry, etc.

First Five from Peccei Committee Report, 1990

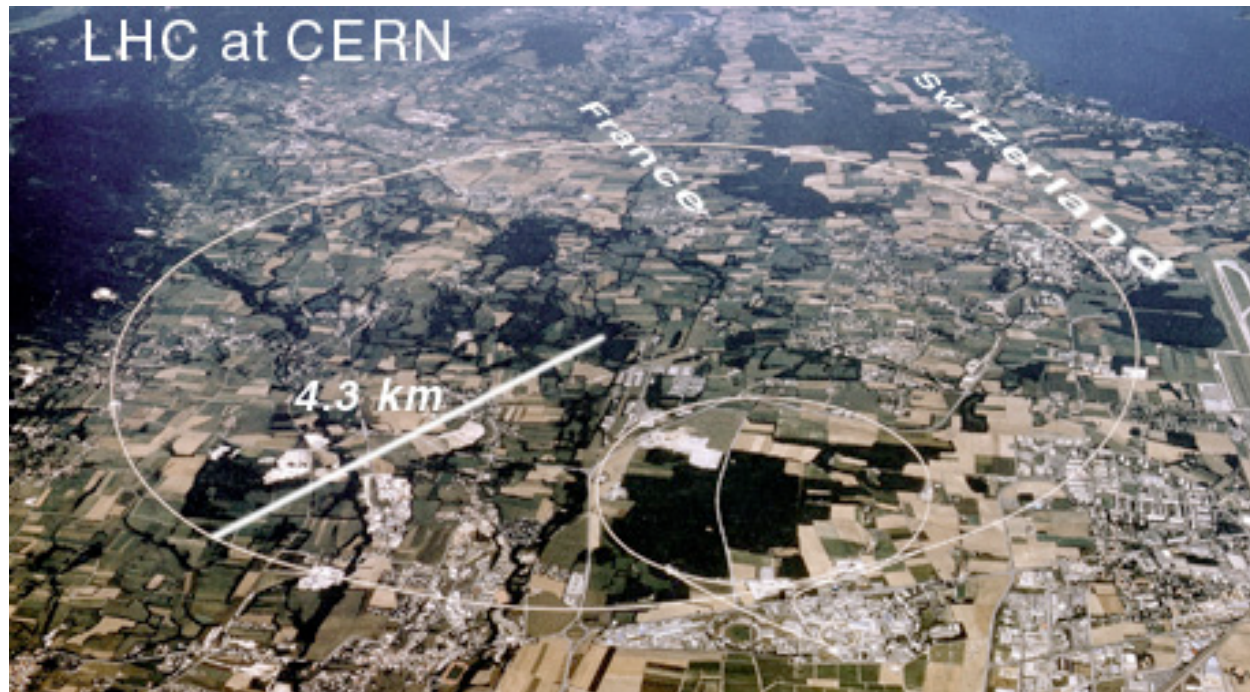
# Peccei Report (1990):

“Over the past five years or so, many theorists have moved toward more formal, mathematical physics...

...a great many physics departments have added young faculty whose interests lie in these directions...

... this has led to a concern among the community that theoretical particle physics will drift too far from problems more directly accessible experimentally.”

# The Future is Now



# Needed: More Collider Theory Faculty at Universities

- Encourage balance in particle theory between mathematically motivated and experimentally driven investigation.
- Retain physicists intimately involved with the initiation of physics from the LHC.
- Train more students and postdocs for the future: ILC, etc.
- Departments value what they know best:  
*The more departments with faculty involved in collider theory, the better.*

# A Straw Man Proposal

- Create \$10K<sup>\*</sup> fellowships for postdocs to recognize creative collider physics work which...
- ...entitles postdocs to apply (in collaboration with a university) for a \$300K<sup>\*</sup> LHC junior faculty fellowship...
- ... if university hires fellow in a tenure-track line.
- Goal: 20<sup>\*</sup> postdoctoral fellowships and 10<sup>\*</sup> faculty fellowships over next decade.

\* Numbers for illustration only!

# Benefits

- **Works with Universities** - which respond to programmatic and funding opportunities.
- Hire collider theorists into **tenure-track** lines, yielding **long-term impact**.
- Could accelerate hiring (e.g. \$300K could provide “bridge funding” to retirement).
- **Flexibility**: works within existing job market.
- **Relatively inexpensive**: A fully funded postdoctoral position costs ~\$100K/yr.
- **Benefits the field as a whole**, instead of temporarily benefiting a few.

# Summary

- Our goal should be to insure a vibrant collider theory community over the entire 20+ year LHC lifetime...
- ... by encourage the hiring of collider theorists into tenure-track positions.
- NSF and DOE can play a large role in making this happen.