High Energy Theory

BNL

April 22, 2003

W. Kilgore

Group Members

Senior staff

Creutz, Dawson, Marciano, Paige, Pisarski, Soni, Trueman

Associate physicist

Kilgore

Post-docs

Berruto, Chen, Izubuchi (left 2/1/03), Kulesza

(Izubuchi paid by Japanese funds, left for permanent job at Kanazawa U.)

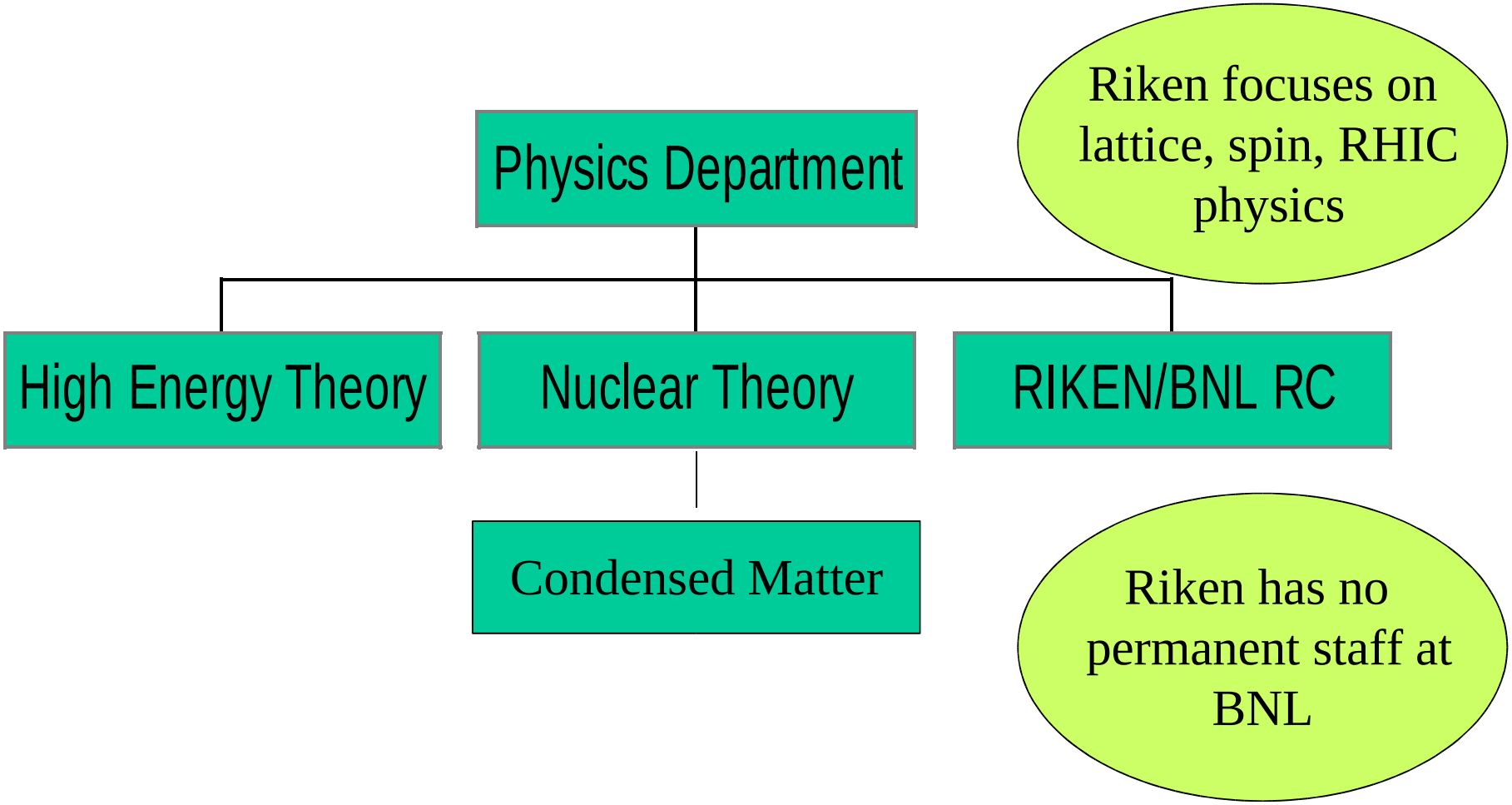
Group Activities

Closely linked to US experimental program

1. Collider physics
2. SUSY studies
3. Electroweak precision physics
4. QCD and Higgs physics
5. Lattice gauge theory
6. Field theory
7. Spin studies
8. Neutrino studies
9. B physics
10. Model Building

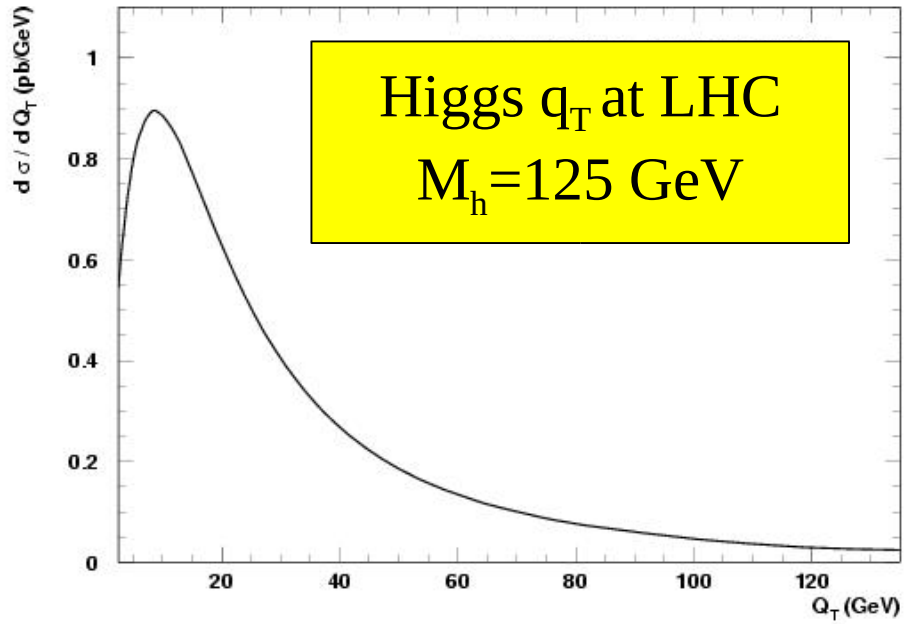
Large Theoretical Effort in Physics department

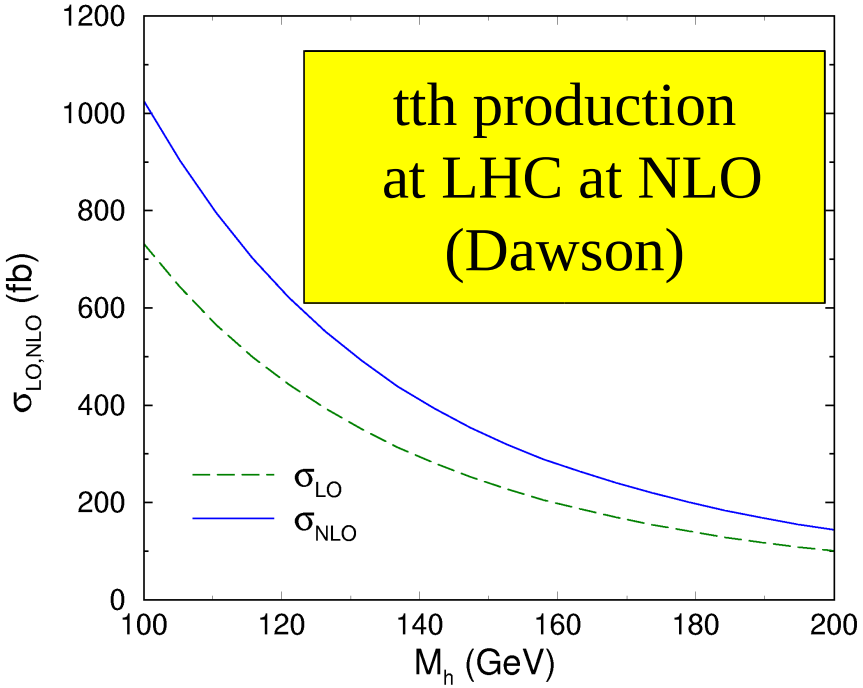
45 Theorists, (11 in HE)



Higgs Physics and QCD

(Dawson)





Resummation of large logs in pp→h (Kulesza)

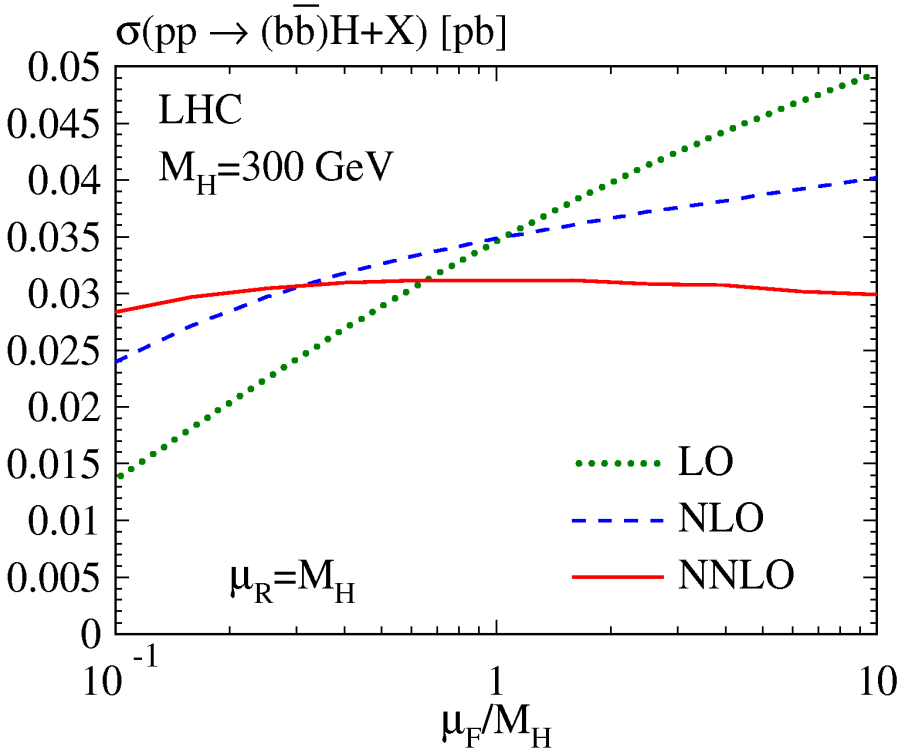
Higgs Physics and QCD (Kilgore)

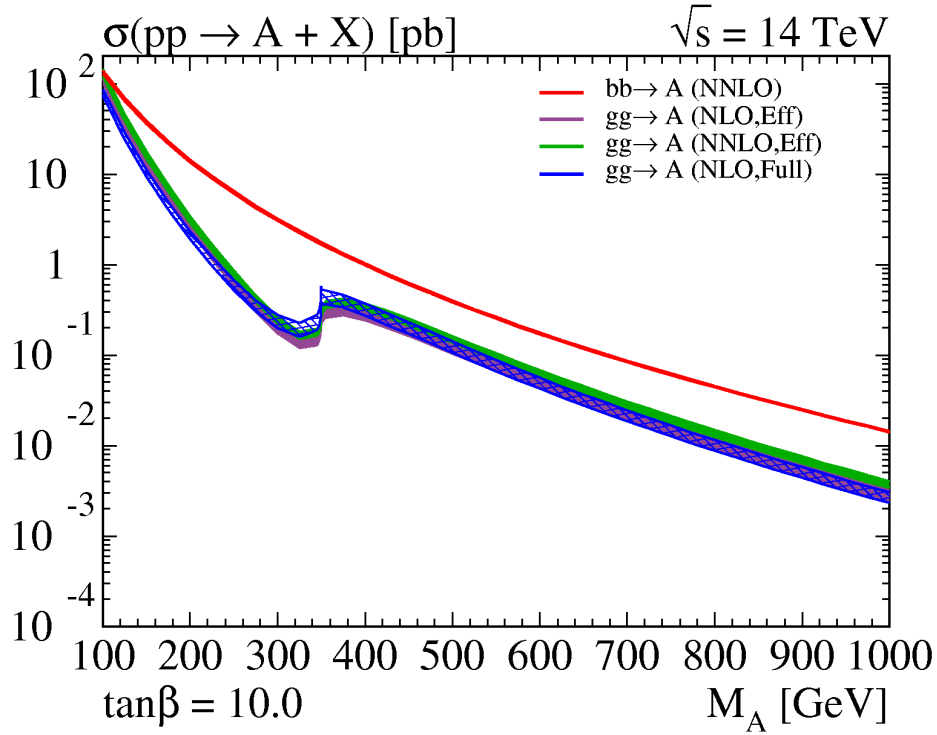
$b\bar{b}\to H/A$ at NNLO

$b\bar{b}\to H/A$ can dominate at large tan β because

$\sigma_{bb}\sim m_b^2/M_H^2 \tan^2\beta$ while

$\sigma_{gg}\sim A \cot^2\beta + B\, m_b^2/M_H^2 + C\, m_b^4/M_H^4 \tan^2\beta$





SUSY at LHC (Paige)

If SUSY is discovered, it will be important to have accurate calculations of masses and decays to compare results with models.

Several improvements in treatment of SUSY in ISAJET:

- Include complete finite parts of 1-loop mass corrections.
  [Pierce, et al., 1997]. (Logarithmic terms were always included by changing β functions at thresholds.)
- Higgs vev's now included in RGE's.
  (Effects are typically 1--5%. Now good agreement among calculations.)
- Modified convergence and EWSB requirements to obtain better stability (e.g., in "focus point" region where $\mu^2 \rightarrow 0$.)
- Many small changes and bug fixes.

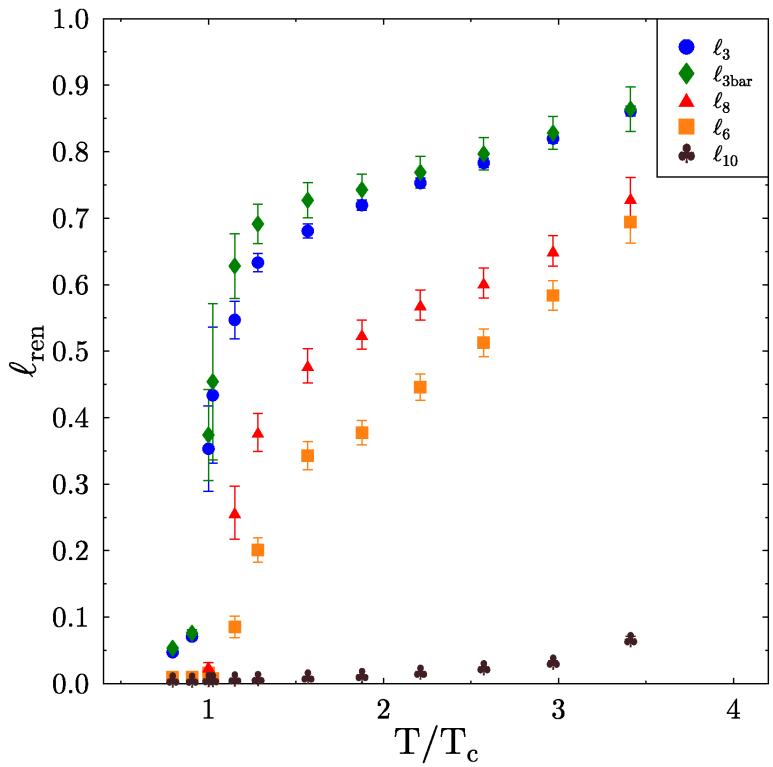
Thermal Field Theory and RHIC (Pisarski)

Renormalized Polykov Loops in SU(3) gauge theory

Extract values for different representations from bare lattice data as a function of temperature.

- Fundamental
- Sextet
- Adjoint
- Decuplet

Goal is to relate values to high p_T baryon excess at RHIC.



Public Service

- Editorial work
  - PRD - Dawson,Pisarski,Paige
  - JHEP - Marciano
  - Computers in Science & Eng. - Creutz
- Lattice QCD SciDAC-EC
  - Creutz
- APS Service
  - APS Council, DPF chair-elect - Dawson
  - NYSS-EC - Kilgore
- DOE Service
  - P5, Facilities - Marciano
  - HEPAP Communications - Dawson

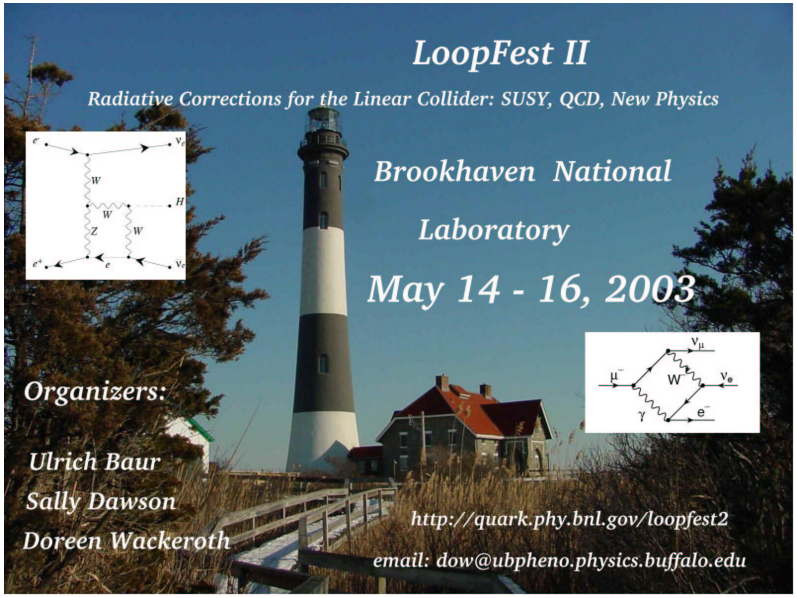
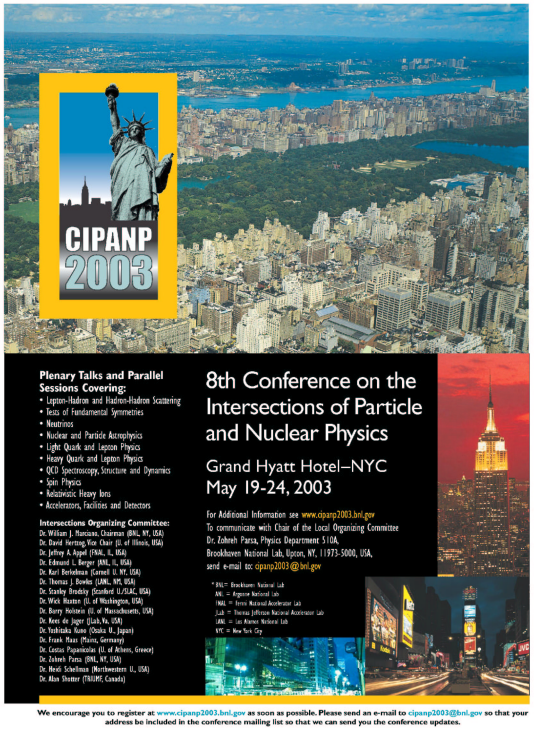
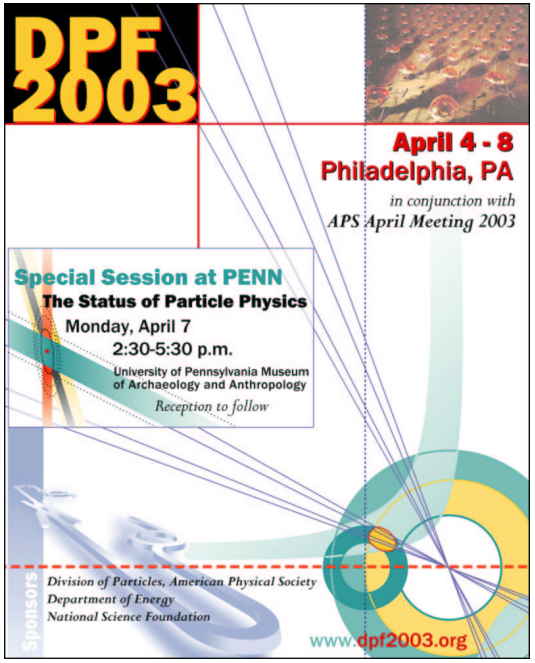
Teaching

- Marciano, Adjunct at Yale, *Quantum Field Theory*, *Spring, 2002*
- Creutz, Adjunct at Stony Brook, *Lattice Gauge Theory*, *Spring, 2001*
- Dawson, Adjunct at Stony Brook, *Electroweak Symmetry Breaking*, *Fall, 2001; Particle Physics*, *Fall, 2003.*
- Graduate students:
  Kyoto (Pisarski), Princeton (Soni) & Stony Brook (Dawson)
- Summer Schools:
  PSI (Marciano), TASI (Dawson), Cargese (Pisarski)

Planning for the future

- Neutrino physics
  - BNL working group (Chen, Marciano)
  - Underground Laboratory Steering Committee (Marciano)
- ATLAS
  - SUSY group leader (Paige)
- Linear Collider Studies
  - Working group leaders (Dawson, Marciano, Paige)
  - LC Steering Committee (Dawson)
- B Physics working group (Soni)

Meetings organized by Theory Group Members

Large Scale Computations in Nuclear Physics Using the QCDOC

Hadron Structure from Lattice QCD