

SLAC HEP Theory

DOE site visit 2010

M. E. Peskin
September 2010

Major Projects of the SLAC HEP Theory Group

Hadronic structure and light-cone dynamics

Perturbative QCD for hadron collider physics

Phenomenology of new particles,
and searches at Tevatron and LHC

Models of dark matter and direct detection

String models of inflation and predictions for the CMB

Understanding strongly coupled electron systems
through AdS/CFT duality

Personnel of the group:

Faculty + Staff:

Stan Brodsky
Lance Dixon
JoAnne Hewett
Shamit Kachru (1/2)
Michael Peskin
Thomas Rizzo
Eva Silverstein (1/2)
Jay Wacker
Marvin Weinstein

recent retirement:

Helen Quinn

Research Associates:

Yang Bai
Rouven Essig
Stefan Hoeche
Jared Kaplan
Gonzalo Torroba
Giovanni Villadoro

Research Associates
in summer 2008:

Johan Alwall
Darren Forde (NIKHEF)
Peter Graham (Stanford)
Roni Harnik (Fermilab)
Masahiro Ibe (Tokyo)
Philip Schuster (Perimeter Inst.)
Mithat Unsal

Since then,

K.C. Kong (Kansas)
Timo Weigand (Heidelberg)
and a Stanford postdoc
Natalia Toro (Perimeter Inst.)

(institutes in parens represent faculty or staff positions)

Graduate students:	year	Advisor	topic
Daniele Alves	4	Wacker	SUSY at colliders
Ning Bao	2	Silverstein	(new)
Kassahun Betre	4	Peskin	top + jets
Boucher-Veronneau	4	Dixon	N=6,8 SUGRA
Randy Cotta	4	Hewett	SUSY dark matter
Xi Dong	5	Silverstein	de Sitter duality
Sarah Harrison (*)	2	Kachru	(new)
Sonia El-Hedri	2	Wacker	DM halo + direct det.
Anson Hook	3	Wacker	DM kinetic mixing
Bart Horn (*)	4	Silverstein	string inflation
Ahmed Ismail	3	Hewett	amplitude 0's in SUSY
Eder Izaguirre	4	Wacker	SUSY at colliders
Martin Jankowiak	4	Wacker	composite DM
Andrew Larkoski	4	Peskin	parton showers w. top
My Phuong Le	5	Hewett	SUSY at colliders
Jeff Pennington	4	Dixon	IR singularities at 3loop
Siavosh Rezan Behbahani	4	Wacker	inelastic DM
Dusan Simic (*)	5	Kachru	SUSY duality cascades
Huijia Wang	2	Kachru	(new)

FY10 activities and accomplishments (samples):

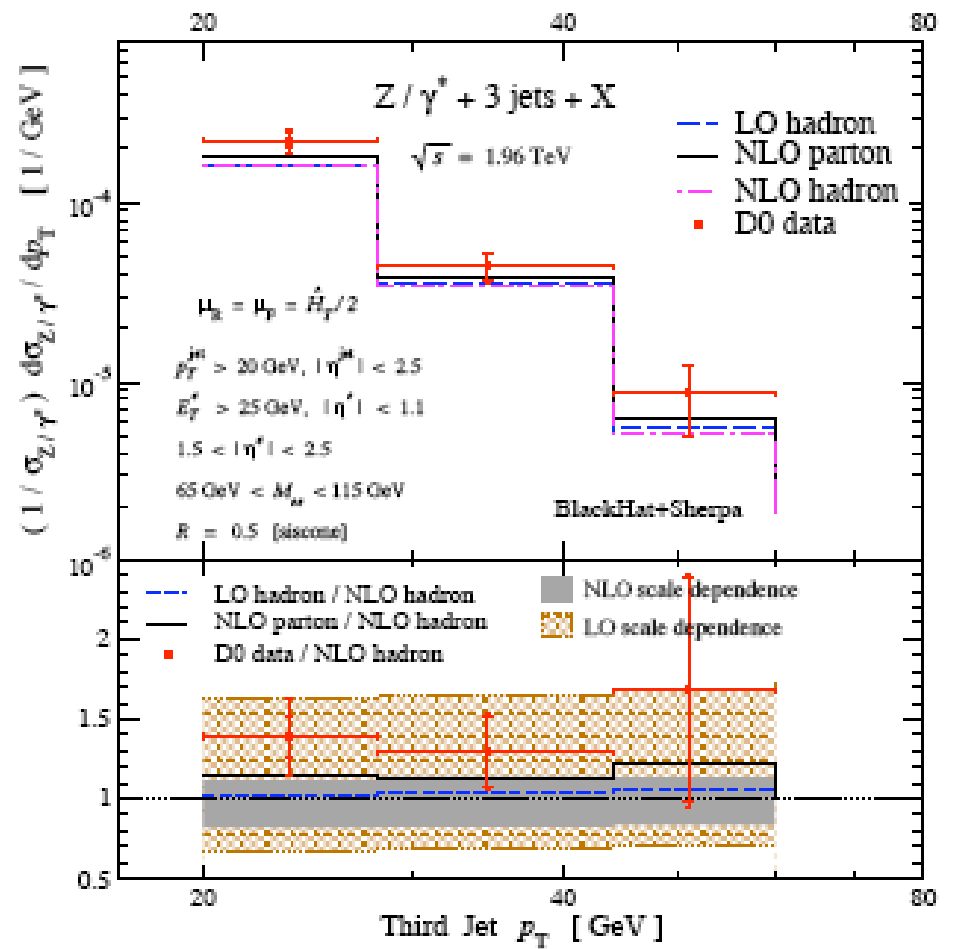
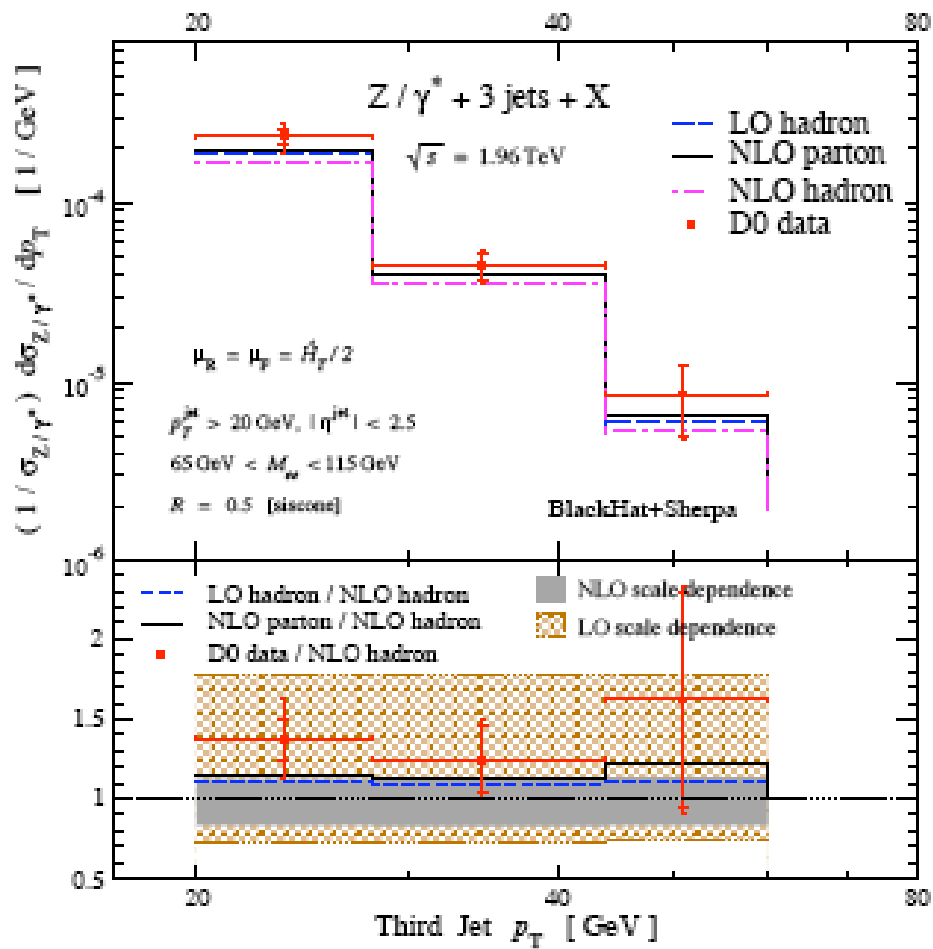
First predictions from NLO QCD of W, Z + 3 jet production at hadron colliders. This is an output of a more general code called BlackHat for NLO calculation of multi-jet processes. (Dixon)

Analysis of optimal search strategies for supersymmetry at the LHC, including the first new SUSY exclusions from 70 nb⁻¹ of ATLAS data. (Wacker)

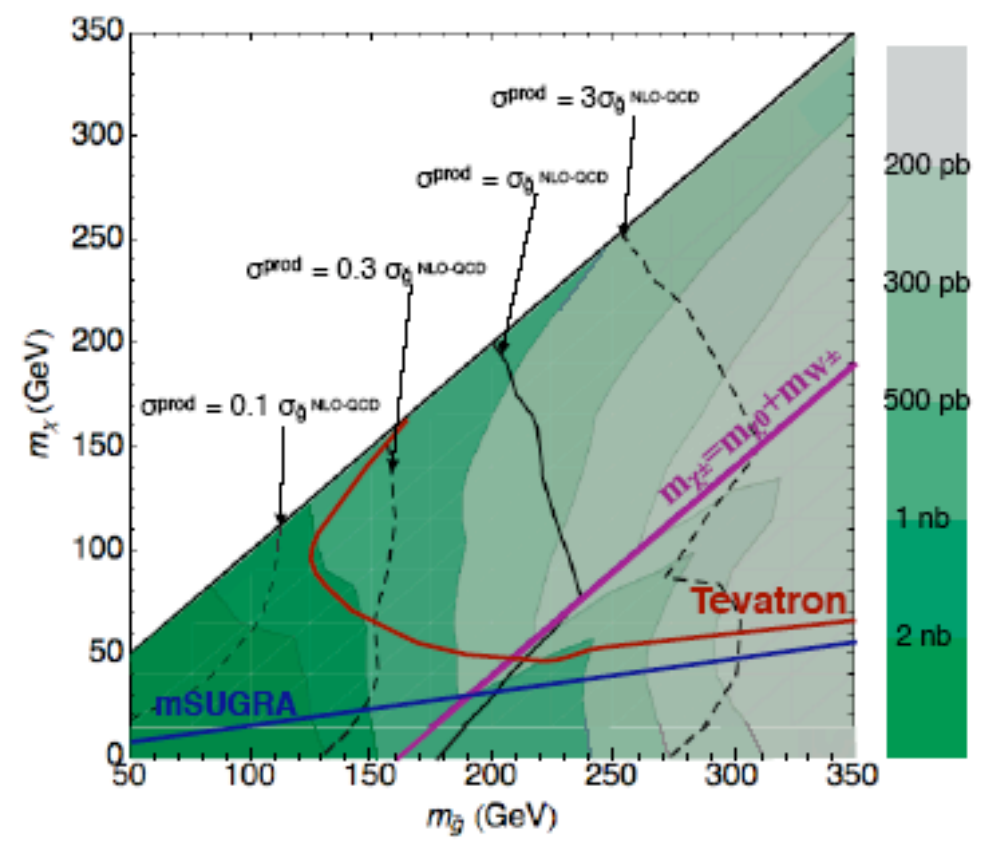
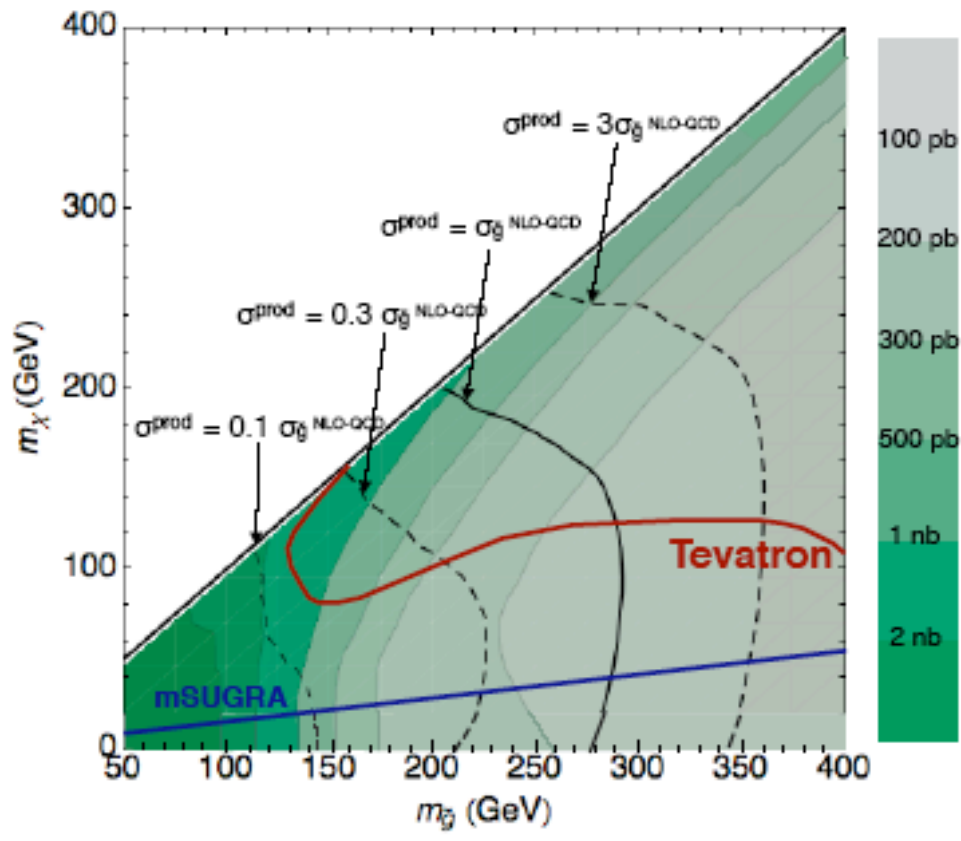
Analysis of a set of 70,000 SUSY models consistent with all current data, to understand regularities and exceptions relevant to collider searches and dark matter. (Hewett-Rizzo).

Creation of single-sector models of supersymmetry breaking that incorporate flavor hierarchies. (Kachru)

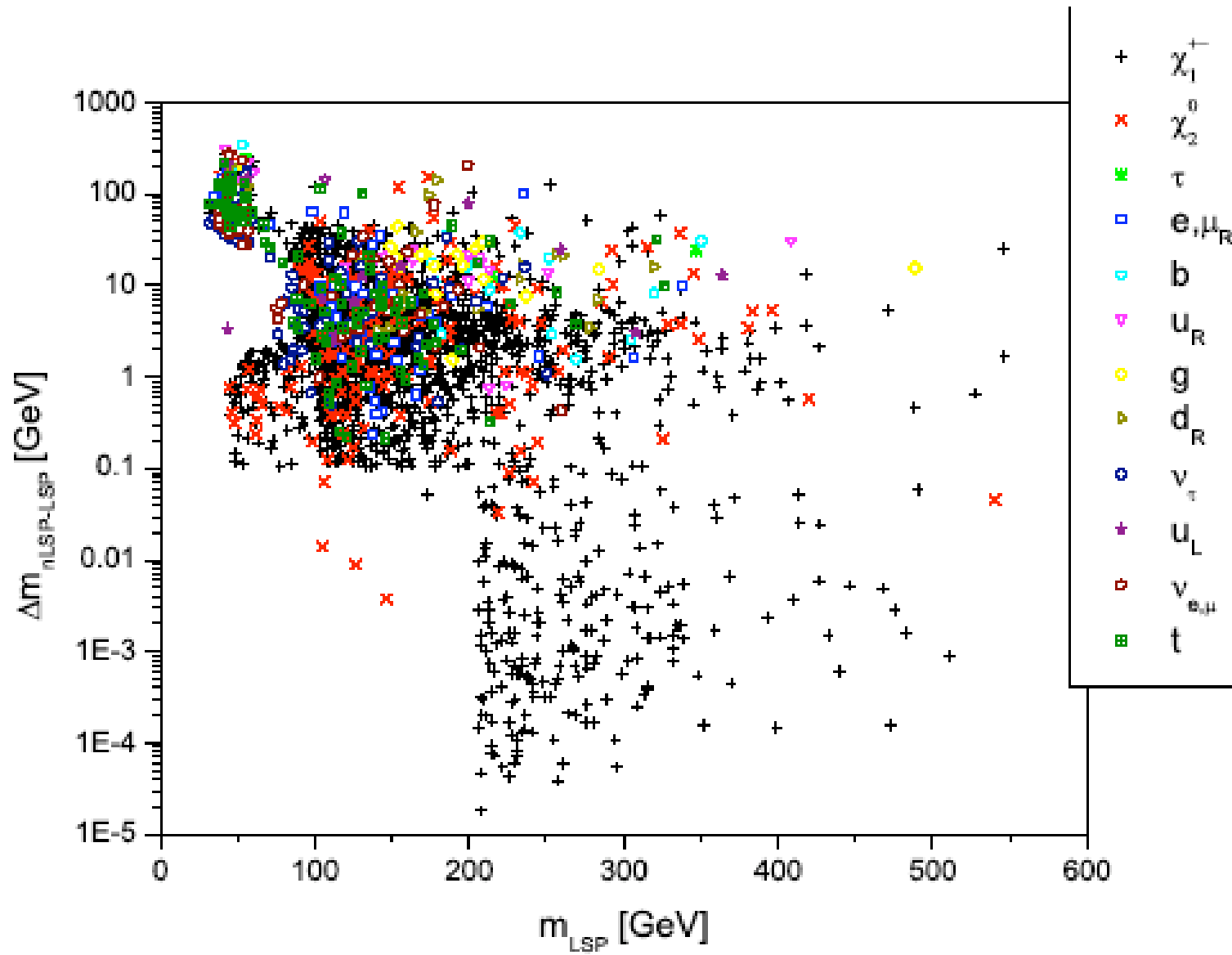
Creation of a string holographic dual of the 'strange metal' phase of strongly coupled 2-d electron systems. (Silverstein)



BlackHat vs. D0 data



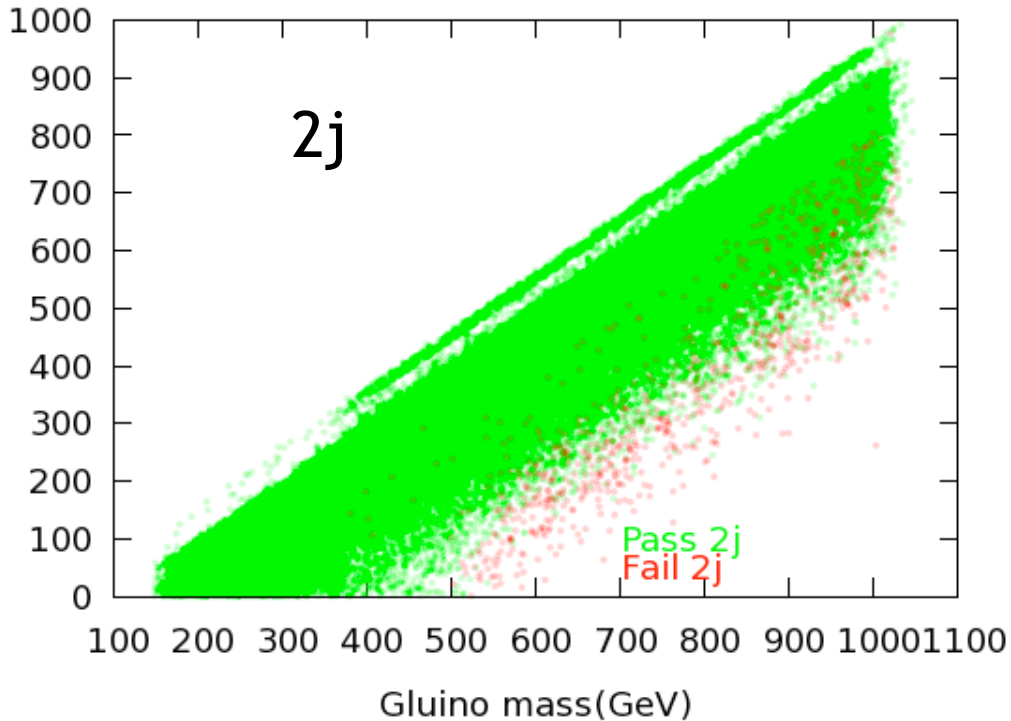
Alves, Ezaguirre, and Wacker



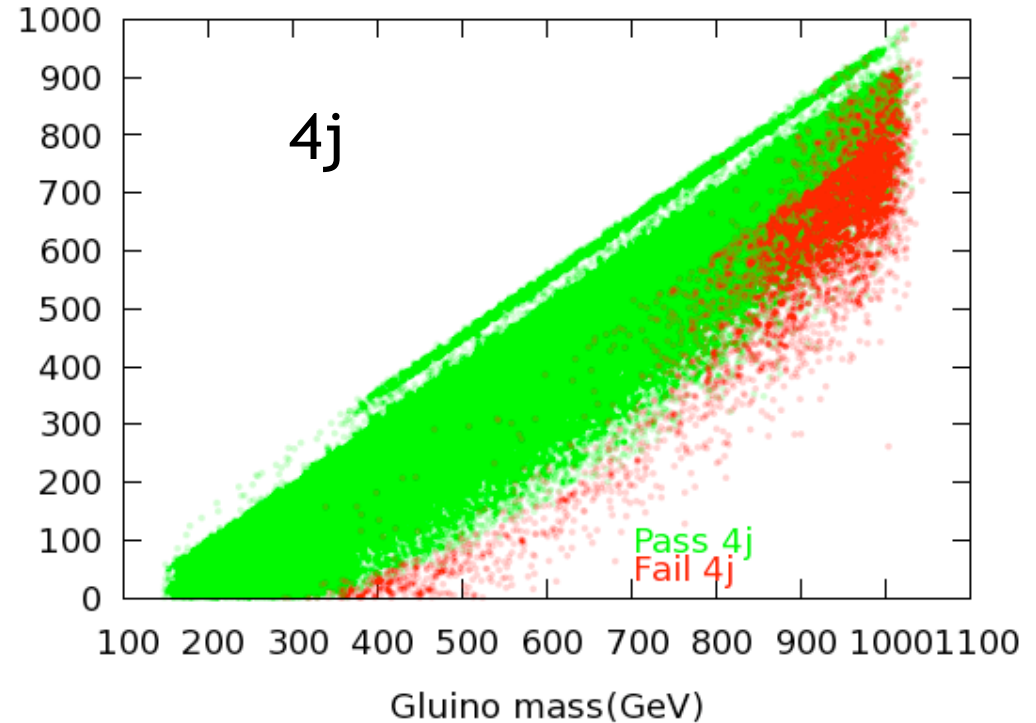
Berger et al.

efficacy of the ATLAS 2j/4j + 0,1 l searches at 14 TeV

2j analysis for flat priors, 1fb^{-1}



4j analysis for flat priors, 1fb^{-1}



Conley et al.

Planned activities:

After our review in 2008, we decide to dedicate a portion of our summer visit funds to workshops on specific focus topics. These cost \$ 10 - 15 k, mainly for travel expenses for visiting theorists.

We held two of these last summer:

“Giving New Physics a Boost” July 9-10, 2009

discussion of exotic jets at hadron colliders created by boosted top, Higgs, and new particles. This workshop brought together all of the major theoretical and experimental groups working in this area. Boost-3 took place in Oxford on June 22-25, 2010.

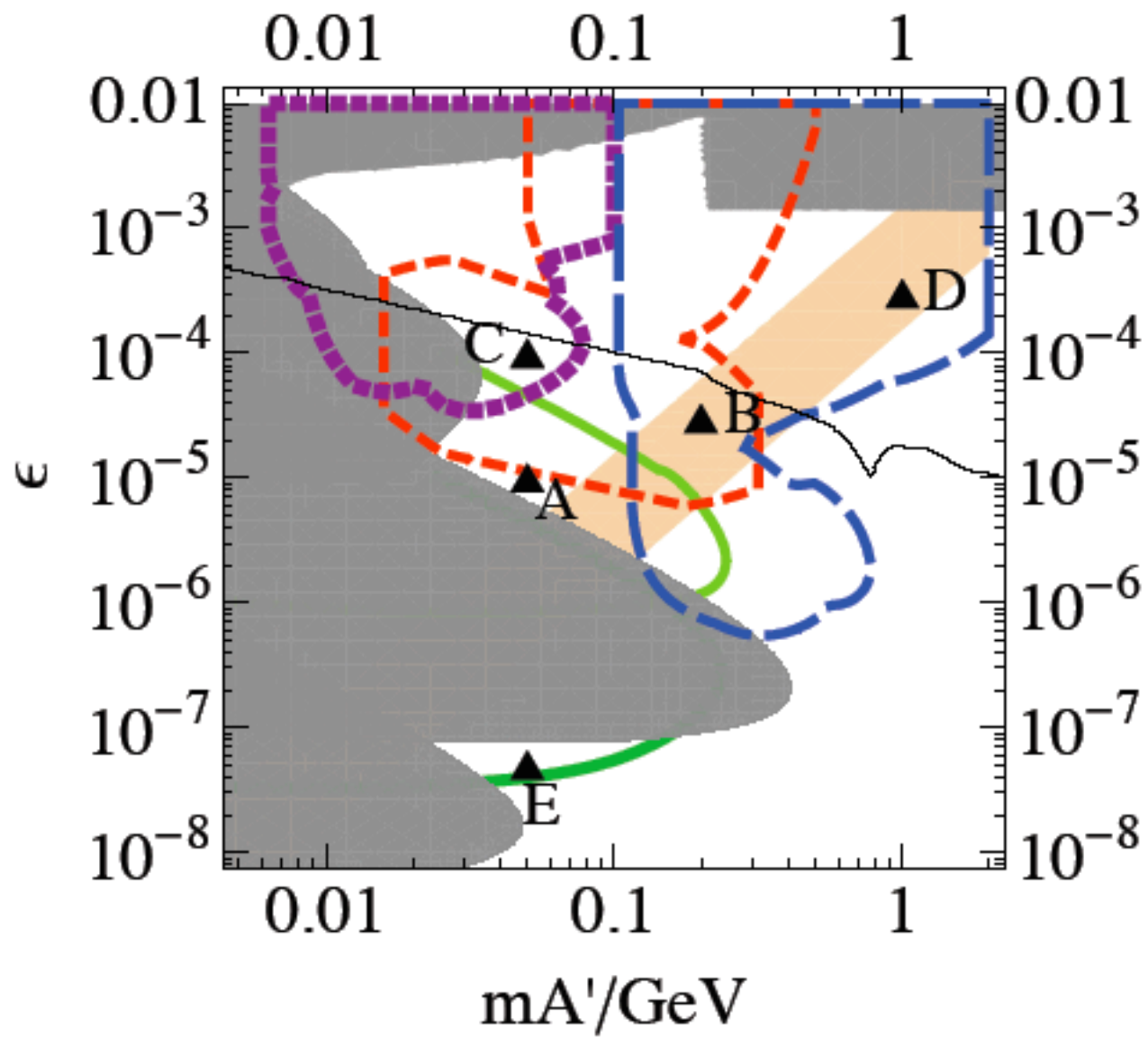
<http://www-conf.slac.stanford.edu/Boost2009/>

“Dark Forces Workshop”

Sept. 24-26, 2009

discussion of possible weakly-coupled MeV to GeV mass particles relevant to theories of dark matter. This workshop brought together the major theorists working in this area and many experimenters from e^+e^- and electron fixed target facilities. The workshop initiated new at least 3 new HEP-oriented experimental proposals for Jefferson Lab.

<http://www-conf.slac.stanford.edu/darkforces2009/>



Bjorken, Essig, Schuster, Toro

Next week, we will hold the next of these workshops:

“Topologies for Early LHC Searches” Sept. 22-25, 2010

discussion of strategies and search regions for general topological searches at LHC sensitive to a broad class of new physics models. Part of the vision is that results from these signal regions will feed back information to the HEP community in a way that is not tied to a specific model or benchmark point.

This meeting follows the meeting on “Characterization of New Physics at the LHC” held at CERN on June 4, 2010, and will provide input from theorists to a followup meeting at CERN on Nov. 5. This series of meetings is organized by the ATLAS and CMS exotics groups together with Theory Group members Philip Schuster and Natalia Toro.

<http://www-conf.slac.stanford.edu/topologies10/>

New staff position:

SLAC - Junior/ Senior

Computational collider phenomenology (AJO-374 / 35514)

The SLAC National Accelerator Laboratory is seeking a staff scientist in elementary particle theory with a strong background in collider phenomenology. Depending on the candidate's experience and qualifications, the appointment will be at either the Staff Scientist level (a continuing appointment), or at the Associate Staff Scientist level (3-5 year entry-level term position, leading to possible promotion to Staff Scientist). The successful candidate would be expected to pursue a strong and independent program of forefront research in collider phenomenology.

The next step in the BlackHat program is to release the software package publicly. This will initially be a program for parton-level $W + \text{jets}$ at NLO, but Dixon's hope is that this will evolve into a general-purpose software package for multi-jet NLO simulation. We are searching for new staff member who would have responsibility for development, distribution, and user support of this package.

We expect that we will be able to hire one of the top young scientists in the world in perturbative QCD for this position.