

# QCD & Colliders overview

Gavin Salam

CERN (80%), Princeton (20%) & LPTHE/CNRS (Paris, on leave)

TH retreat  
4 November 2010

## QCD & Colliders

Fellows already here last year:

Darren Forde, Terrance Figy, Graeme Watt, Francesco Tramontano

Fellows who arrived recently:

Jan Winter, Chul Kim

Fellows coming soon (~ January):

Daniel Maitre and Alex Mitov

Staff:

Stefano Frixione, Michelangelo Mangano, GPS, Peter Skands

*I'll briefly mention activities of those not talking today*

## Heavy-ions

▶ Fellows:

Jorge Casalderrey Solana, Cyrille Marquet

▶ Staff:

Urs Wiedemann

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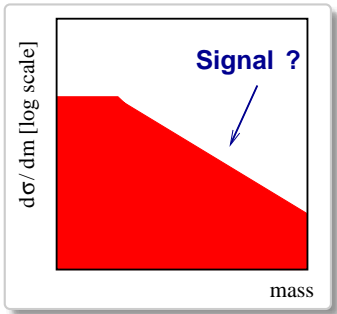
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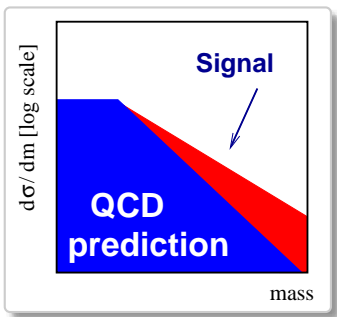
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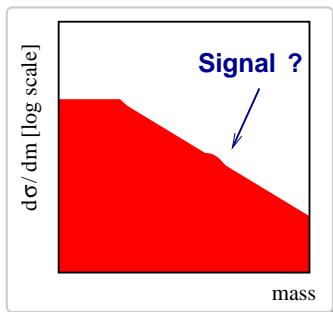
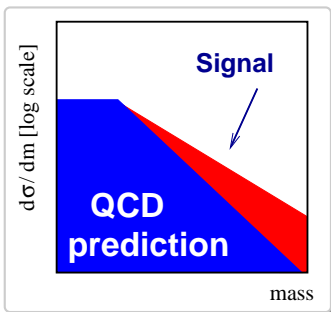
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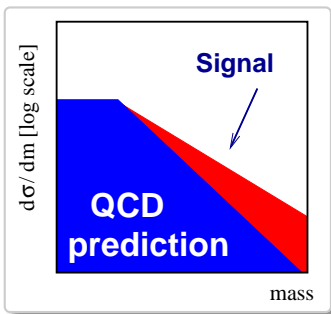




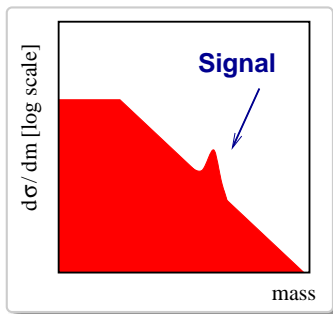
Telling us what the background is, so we can see any excess



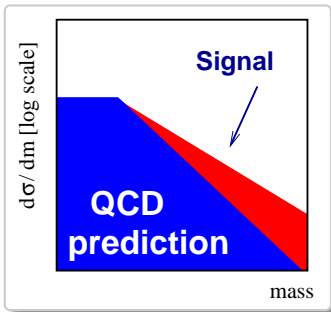
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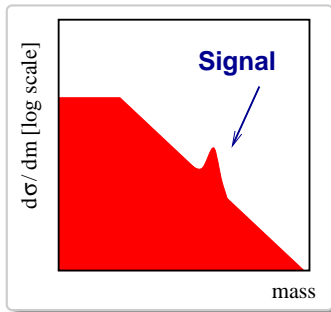
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Teaching us how to reduce the background, sharpen the signal



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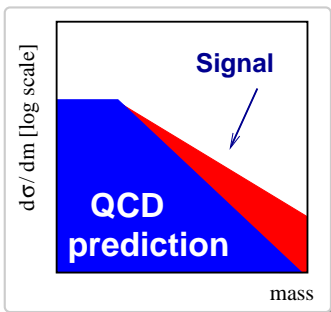


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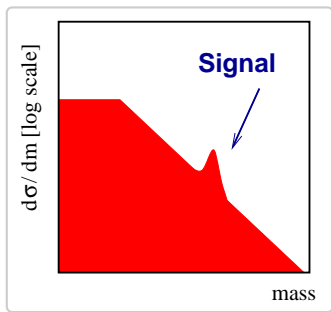
Constraining any discoveries:

mass  
couplings  
etc.





Telling us what the background is, so we can see any excess



Teaching us how to reduce the background, sharpen the signal

Constraining any discoveries:

mass  
couplings  
etc.

And as input to nearly all measurements

LHC event

≡

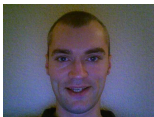
parton showering  $\otimes$  matrix-elements  $\otimes$  parton-distribution  
functions

## LHC event



parton showering  $\otimes$  matrix-elements  $\otimes$  **parton-distribution functions**

The distribution of quarks & gluons inside the proton drives the normalisation of all signals and backgrounds.



MSTW “global fits”

Graeme  
Watt

LHC event

≡

parton showering  $\otimes$  **matrix-elements**  $\otimes$  parton-distribution functions

1-loop (NLO) calculations: getting a modicum of accuracy (10-20%) for the full range of QCD backgrounds [automatically]



Darren  
Forde

Blackhat



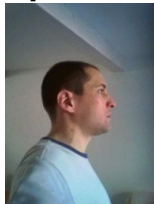
Daniel  
Maitre

Blackhat



Francesco  
Tramontano

Samurai



Jan  
Winter

1-loop on GPUs



Terrance  
Figy

NLO & BSM

LHC event

≡

parton showering  $\otimes$  **matrix-elements**  $\otimes$  parton-distribution  
functions

2-loop (NNLO) calculations: getting utmost accuracy (few %) for special processes like top-quark production



Alex Mitov

## LHC event



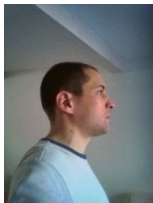
parton showering  $\otimes$  matrix-elements  $\otimes$  parton-distribution functions

“Parton showering”, because real events involves many tens of particles — but needs to be done consistently with matrix elements



MC@NLO  
MadFKS, ...

Stefano  
Frixione



Sherpa

Jan Winter

LHC event

≡

parton showering  $\otimes$  matrix-elements  $\otimes$  parton-distribution functions



Michelangelo  
Mangano



Peter  
Skands



Chul  
Kim

Will tell you what they're up to themselves!

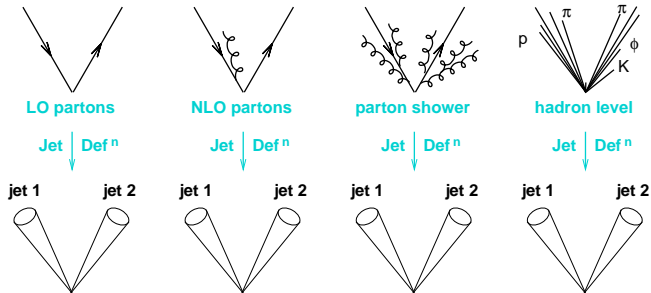


FastJet  
etc.

Gavin  
Salam

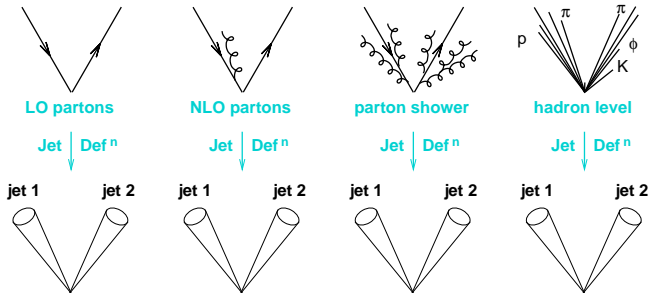


# What research in the group? [Jets]



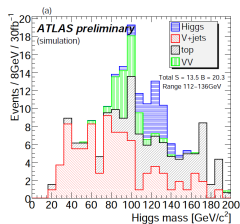
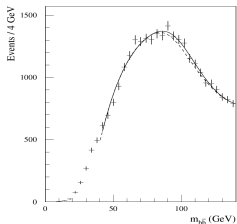
**Projection to jets provides "common" view of different event levels**

# What research in the group? [Jets]



Projection to jets provides "common" view of different event levels

ATLAS TDR  
 $WH, H \rightarrow b\bar{b}$



after QCD-  
 inspired  
 jet "tricks"

- ▶ “TH Theoretical seminar” Wednesdays 2pm
- ▶ “Particle and Astro-Particle Physics Seminars” Fridays 2pm
- ▶ LPCC physics days Topical day, first Friday of each month  
More about LPCC in a few minutes from Michelangelo

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## **NEW: Collider Cross-Talk**

Discussion forum for QCD & colliders, with frequent experimental involvement tentatively  $\sim$  every other Thursday at 11am, complementary to BSM forum

Main organizers: Nazila Mahmoudi and Jan Winter  
with input from Michelangelo Mangano, Peter Skands & GPS