

Precise QCD predictions and LHC phenomenology

Fabrizio Caola

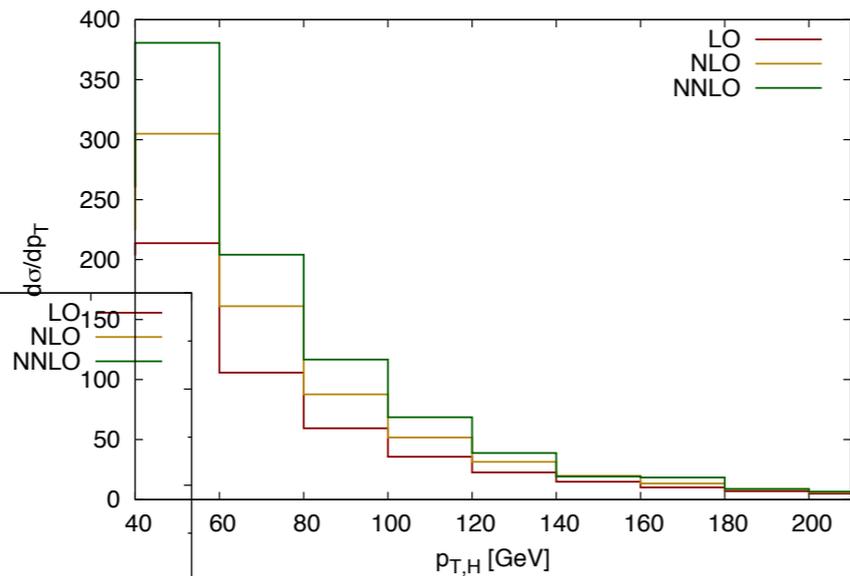
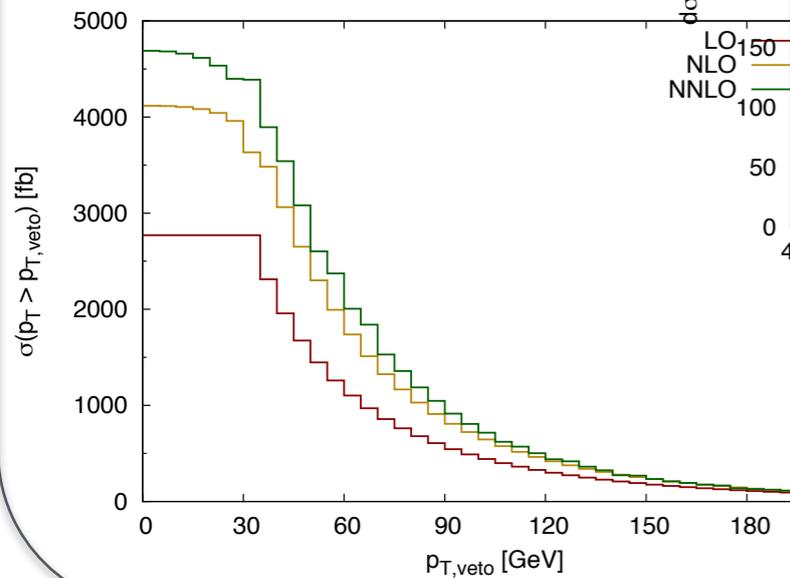
Les Houches, CERN Theory Retreat, 2014

My history

- PhD in Milano with S. Forte
 - BFKL resummation, factorization theorems
 - Beyond pure DGLAP evolution in PDF physics
- Last 6 months of PhD at Fermilab with J. Campbell and K. Ellis
 - NLO techniques, Wb studies [4FNS vs 5FNS, matching...]
- First PostDoc at Johns Hopkins (+Karlsruhe) with K. Melnikov
 - NNLO computations
 - Higgs studies, off-shell Higgs and the Higgs width

Main recent activity & interests

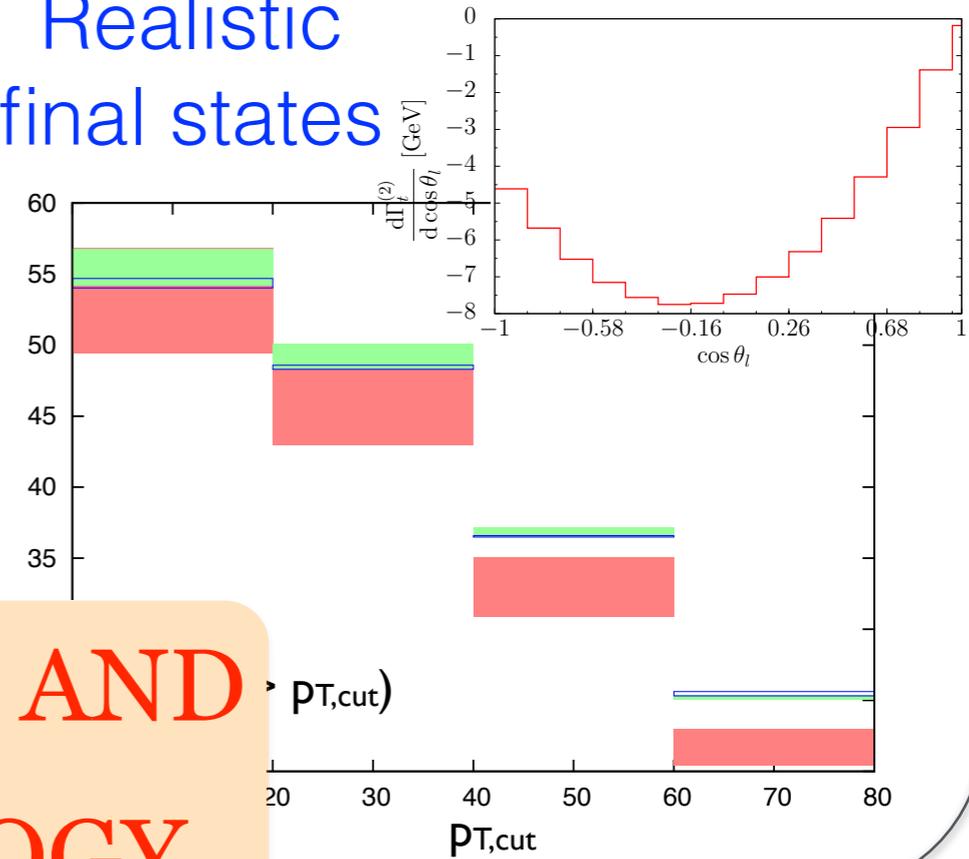
H+Jet,
proof of concept



NNLO THEORY AND PHENOMENOLOGY

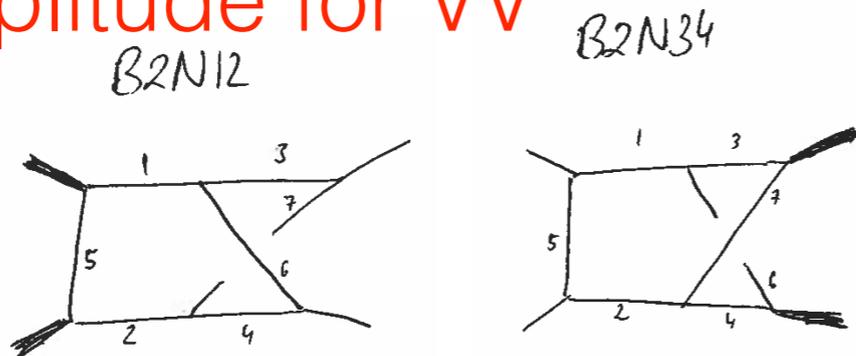
Single top+top decay

Realistic
final states



2-loop amplitude for VV^*

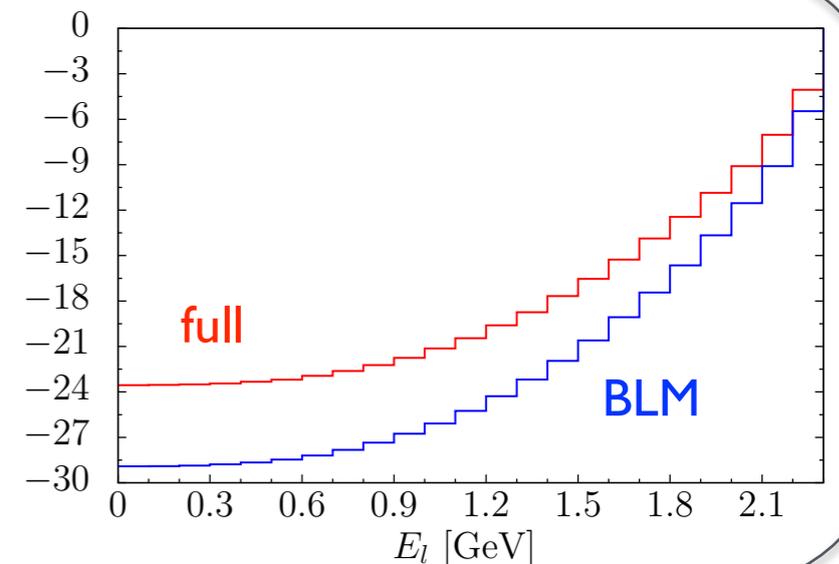
new ideas
for FI
at work



$$\partial_x \vec{f} = \epsilon \hat{A}_x(x, y, z, \dots) \vec{f}$$

$$G(a_n, a_{n-1}, \dots, a_1, t) = \int_0^t \frac{dt_n}{t_n - a_n} G(a_{n-1}, \dots, a_1, t_n)$$

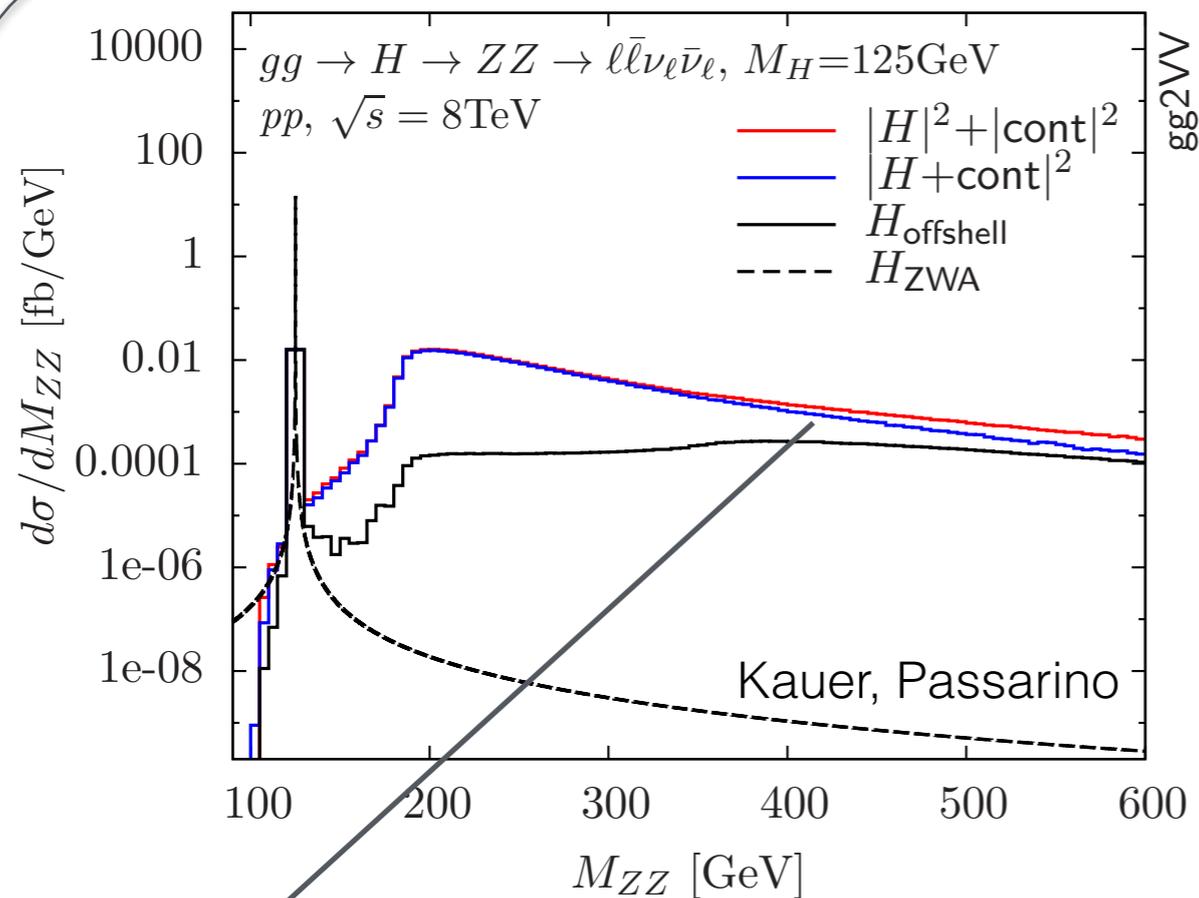
$b \rightarrow u$
and
 V_{ub}



Current NNLO plans + (much) more ambitious interests

- NNLO phenomenology
 - H+J: finish validation + LHC pheno (H->WW, $p_{T,H}$, veto)
 - single-top: let the top decay
 - VV: from the amplitude to the LHC
 - Z+J (with S. Carrazza)
- Pushing the NNLO boundary further
 - more efficient NNLO schemes
 - 2->3 processes (with S. Badger)
 - beyond GPL: elliptic functions, K3... (with J. Henn)
- Beyond NNLO
 - generic NNLO + PS
 - from NNLO for 2->2 to N³LO for 2->1

Off-shell Higgs and the Higgs width



Melnikov, FC

$$N^{off} = \frac{\Gamma_H}{\Gamma_{H,SM}} N_{SM}^{off} - [e^{i\theta}] \sqrt{\frac{\Gamma_H}{\Gamma_{H,SM}}} N_{SM}^{int}$$

$$\Gamma_H < 22 \text{ MeV [CMS]}$$

$$\Gamma_H < 20\text{-}32 \text{ MeV [ATLAS]}$$

- Interpretation issues
 - How to constrain model-dependence?
 - Higgs p_T (with finite m_T)
 - HZZ anomalous couplings...
- SM computations: $gg \rightarrow VV$
 - soft approximations
 - mass effects from m_t expansion + Regge asymptotic? [studying it for HH production with S. Marzani and G. Ridolfi]
- Info from off-shell Higgs?
 - couplings...