QCD & γ-γ physics (WG5): Status report & Miniworkshop on high-precision α_s

FCC-ee coord. meeting

CERN – 4th May 2015

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CERN

WG5 group activities

- WG5 page : http://cern.ch/fcc-ee/content/wg5-exp
- fcc-ee-qcd@cern.ch: ~50 registrants (but no email traffic in months)
- 7 working areas:

  QCD-1: High-precision strong coupling α_s measurement

  QCD-2: High-precision parton radiation with multi-jets

  QCD-3: High-precision parton-to-hadron (g,q, Q) fragmentation

  $\gamma\gamma$-1: QCD meas. $\gamma\gamma \rightarrow X$ ($\sigma_{\gamma\gamma}$, VV, γ PDF, γ FF) + FCC-ee backgds.

  $\gamma\gamma$-2: EWK meas.: $\gamma\gamma \rightarrow \tau\tau$, WW, H, ... (anomalous couplings, moments)

  $\gamma\gamma$-3: BSM measurements: $\gamma\gamma \rightarrow$ radion, dilaton, ...

  QCD,$\gamma\gamma$ detector requirements: forward $e^{\pm}$ taggers,PID,...

- MCs under consideration or being used already:

  - QCD: PY8, HW++,Ariadne, SHERPA, VINCIA, WIZARD, MG5
  - $\gamma\gamma$: PY6 (full event, hadronic backgrounds), WIZARD, PY8 (new developments ongoing). Few dedicated processes: LPAIR(++),...

- 1st WG5 meeting on June 2014: http://indico.cern.ch/event/316025/

  No other meeting since then, but individual progress in some areas...

Progress in WG5 activities

- QCD-1: High-precision strong coupling α_s measurement
  - Novel NNLO* α_s extraction via energy evolution of low-z parton-to-hadron FFs (so far applied to LEP/HERA data, easily extendible to FCC-ee).
  - Miniworkshop with world experts planned for 2nd half of 2015 (see next)
- QCD-2: High-precision parton radiation with multi-jets
  No news.
- QCD-3: High-precision parton-to-hadron (g,q, Q) fragmentation
  No news.
- $\gamma\gamma$-1: QCD meas. $\gamma\gamma \rightarrow X$ ($\sigma_{\gamma\gamma}$, VV, γ PDF, γ FF) + FCC-ee backgds.
  PYTHIA6 simulation set up to compute $\gamma\gamma$ backgrounds (CERN summie project)
- $\gamma\gamma$-2: EWK meas.: $\gamma\gamma \rightarrow \tau\tau$, WW, H, ... (anomalous couplings, moments)
  Progress (by P.Rebello) on $\gamma\gamma \rightarrow$ WW, H(bbbar) with PYTHIA6 ($e^{\pm}$ tagging).
- $\gamma\gamma$-3: BSM measurements: $\gamma\gamma \rightarrow$ radion, dilaton, ...
  A few EWK/BSM studies in arXiv for ILC/CLIC. Coordination w/ CLICdp started.
- Detector requirements (forward $e^{\pm}$ tag,PID,...) embedded in each one
  No news. But ongoing $\gamma\gamma$ studies do include $e^{\pm}$ taggers acceptances.

Miniworkshop on high-precision α_s at FCC-ee

Title:"High-precision measurements of the QCD coupling: from LHC to FCC-ee"
Location: CERN
Dates: 1.5-2 days in Oct. 2015 (checked no overlap with other confs.)

- Draft Program/Speakers (we'd like to start sending invitations this week):

~25 (half-an-hour) talks

======= 1st day =======

- Presentation / Goals of the workshop: 15'
- α_s world average: 35' S.Bethke
- Impact of α_s on EW vacuum stability, GUT, BSM: 20' Strumia?
- Impact of α_s on Higgs prod. & decay uncertainties: 20' Spira

* α_s at low scales:
- α_s from lattice QCD : 25' A.S. Kronfeld
- α_s from pion decay factor : 25' J.-L. Kneur/A. Neveu
- α_s from hadronic tau decays : 25' A.Pich
- α_s from hadronic quarkonia decays: 25' J.Soto
- α_s from parton-to-hadron FFs : 25' R.Perez/D.d'E.

* α_s at high scales:
- α_s from DIS (PDFs) : 20' J.Bluemlein
- α_s from DIS (NNPDF) : 20' Ubiali?
- α_s from DIS (jets, photoproduction) : 25' M. Klasen
- α_s from e+e- event shapes : 25' G. Dissertori
- α_s from e+e- C-parameter evt shape: 25' Hoang/Mateu
- α_s from jet x-sections in e+e -: 25' G. Zanderighi
- α_s from hadronic Z decays : 25' K. Moenig?
- α_s from hadronic W decays : 25' D.Kara?
- α_s from the total e+e--->had. x-section 25' J.H. Kuhn
- α_s from precision EW fit: 25' J.Erler

======= 2nd day =======

* as at hadronic colliders
- α_s from top-quark at the LHC : 25' Czakon? Melnikov?
- α_s from jets at the LHC : 25' NNLO-jet TH team(s)
- α_s extractions from CMS (EXP status & plans): 25'
- α_s extractions from ATLAS (EXP status & plans) : 25'
- Summary talk (e.g. Altarelli ?)

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- Workshop Goals (questions to speakers):
  * What is the current state-of-the-art of all α_s determination methods from the theoretical & experimental point of view ?
  * What is the current size of the theoretical uncertainties (missing higher orders, electroweak corrections, power corrections, hadronization corrections,...) ?
  * What is the expected α_s uncertainty in ~10 years from now (theoretical developments + ~1 ab^{-1} p-p at 14 TeV at the LHC) ?
  * What are the expected improvements brought about by the FCC-ee (10^{12} Z's at $\sqrt{s}=m_Z$; 10^8 W's at $\sqrt{s}=m_{WW}$; similar orders-of-magnitude for tau, jets,...) ?
  * Anything else?
- Do we want to have proceedings (e.g. PoS) ?
  We need to have this topic well covered in the Yellow Report.
  Proceedings could be a way to get some pre-digested material from high-quality people, which could be condensed & referred to in the YR.

Backup slides