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MC program

- VBFNLO
- MCFM: MCFM
Precision physics

- 0510061: G.J. Gounaris, Contrasting the anomalous and the SM-MSSM couplings at the Colliders
- 1205.4991: Why precision?
- Hall C Summer 2007: Susan Gardner, Hunting Traces of TeV-Scale Physics in Low-Energy Processes
- TASI lecture: Konstantin Matchev, LECTURES ON PRECISION ELECTROWEAK PHYSICS
Multiboson Twiki

LHC Upgrade Note

- ATLAS-PHYS-PUB-2012-005: Studies of Vector Boson Scattering with an Upgraded ATLAS Detector at a High-Luminosity LHC

QGC

- CMS WWgam/WZgam: http://cds.cern.ch/record/1563302?ln=en
  - https://twiki.cern.ch/twiki/bin/viewauth/AtlasProtected/TopMC12DiTopGamma
- arXiv:1211.1641: Probing W+W-gamma Production and Anomalous Quartic Gauge Boson Couplings at the CERN LHC by Daneng Yang, Yajun Mao, Qiang Li, Shuai Liu, Zijun Xu, Ke Ye
- arXiv:1305.5979: The CERN LHC Sensitivity on measuring WZGamma Production and Anomalous WWZGamma Coupling by Ke Ye, Daneng Yang, Qiang Li
  - arXiv:0907.5299: Quartic Gauge Couplings and the Radiation Zero in pp to l nu gamma gamma events at the LHC by Paul Bell

Neutral QGC

- hep-ph/0009262: Anomalous Quartic Gauge Boson Couplings at Hadron Colliders, ZAjj, AAjj
- C02-07-24: Anomalous triple neutral and quartic gauge boson couplings by S. Wynhoff
  - arXiv:1111.3354: Probing Quartic Neutral Gauge Boson Couplings using diffractive photon fusion at the LHC by Rick S. Gupta

High Energy WW scattering

- http://feynrules.irmp.ucl.ac.be/wiki/AnomalousGaugeCoupling#no1
  - pdf: EWSB QandA by Chivukula
- 1201.2768: The WLWL scattering at the LHC: improving the selection criteria by Krzysztof Doroba, et. al.
- 1212.4158: Longitudinal WW scattering in light of the Higgs discovery by Dom’enec Espriu and Brian Yencho
- 9611454: T. Barklow et al, Anomalous Gauge Boson Couplings
  - TEV 33 Convener Reports url
- 9804322: John Ellison, Jose Wudka, Study of Trilinear Gauge Boson Couplings at the Tevatron Collider, reviewing the effective Lagrangian formalism, the indirect constraints on the couplings from low-energy experiments, and the expected values of the couplings in theories beyond the standard
model.

- Snowmass 2001 Report: New Physics at the TeV Scale and Beyond
- 1211.4580: Robust Determination of the Higgs Couplings: Power to the Data
  - There are eight P and C even dimension six operators that modify the Higgs couplings to the electroweak gauge bosons, while there is just one operator containing gluons
  - The dimension six effective operators in Eq. (2) give rise to Higgs interactions with SM gauge boson pairs that take the following form in the unitary gauge
  - The dimension six operators modifying the Higgs interactions with fermion pairs and the Yukawa interactions are also considered
  - all dimension-six operators related to WWA, WWZ are also expressed
- 1205.4231: Effective Field Theory: A Modern Approach to Anomalous Couplings
  - Dimension-six operators (3 CP-even and 2 CP-odd) are implemented in the MadGraph
  - Relation to the WWA and WWZ effective Lagrangian is also discussed
- 1107.3149: Z\gamma\gamma production with leptonic decays and triple photon production at NLO QCD
- 1106.4009: Precise predictions for Wγγ+jet production at hadron colliders
- 0310141: Bosonic Quartic Couplings at LHC
  - O.J. P. Eboli, M.C. Gonzalez-Garcia, S. M. Lietti, VBF production for jjGamGam and jjZGam
- 0002175: Anomalous triple and quartic gauge boson couplings
  - WWgam, Zgamgam calculation for Tevatron
- 0606118: pp -> j j e+/−μ+/− nu nu and j j e+/−μ−/+ nu nu at O(\{em\}^6) and O(\{em\}^4 s^2) for the Study of the Quartic Electroweak Gauge Boson Vertex at LHC
- 0009262: Anomalous Quartic Gauge Boson Couplings at Hadron Colliders
  - O. J. P. Eboli, M. C. Gonzalez-Garcia, S. M. Lietti, S. F. Novaes, gamgamZZ, gamgaWW production
- Triboson
  - *0804.0350: NLO QCD corrections to tri-boson production
    - T. Binoth, G. Ossola, C. G. Papadopoulos, R. Pittau, VVV process at NLO, V=W,Z
  - 0703273: QCD corrections to tri-boson production
    - Achilles Lazopoulos, Kirill Melnikov, Frank Petriello, ZZZ calculation
    - Neutral triple electroweak gauge boson production in the large extra-dimension model at the LHC
    - M. C. Kumar, Prakash Mathews, V. Ravindran, Satyajit Seth, VVVV (V=gam,Z) coupling
- Neutral Gauge Coupling
  - 0005269: G.J. Gounaris, J. Layssac, F.M. Renard, Off-shell structure of the anomalous Z and gamma self-couplings
    - one CP-even, one CP-odd operator in Dim8 for neutral tripple gauge coupling
    - define the relation to hiV, fV parameters
- talk: Celine Degrande, Anomalous Gauge Coupling using Effective Field Theory
  - 3 CP-even operators and their dependence to the WLWL, WLWT and WTWT scattering are described
- talk: Michael Rauch, Diboson-VBF-production in VBFNLO
  - describe the EFT approach in Dim6 and Dim8 operators and unitarity bound in VBF process
- talk: Oscar Eboli, Anomalous QGC in the effective lagrangian framework
  - motivate the Dim8 operators for QGC studies
  - LEP2 coupling:
    - triple: WWA, WWZ, ZAA, ZZA, ZZZ
    - Quartic: WWAA, WWZA, WWZZ, WWWW, ZZAA; final state ee→nunuAA, qq→AA to probe a0^Z, ac^Z or a0^W, ac^W; ee→WWA to probe a0^W, ac^W, an
### Charged TGC - WWA, WWZ: Final State - WW, Single W, Single Photon

- Most general effective Lagrangian has 7+7 parameters.
- Ask for C and P invariance: $5 \ (g_{1Z}, k_A, k_Z, \lambda_A, \lambda_Z)$
- Low energy constraint and gauge invariance: $k_Z = g_{1Z} - (k_A - 1) \tan^2 \theta_W$, $\Lambda_A = \Lambda_Z$
- W electro-magnetic structure:
  - $W$ charge: $e \ g_{1A}$
  - Magnetic dipole: $\mu_W = e / (2 \ m_W (g_{1A} + k_A + \lambda_A))$
  - Electric quadrupole: $q_W = -e / (m_W^2 (k_A - \lambda_A))$

### Neutral TGC - ZA $h^V_{i,iV}$, ZZ $f^V_{i,iV}$

- $e\rightarrow ZA, \ qqA, \ \nu\nuA$
  - CP conserving: $h_{3A}, h_{4A}, h_{4Z}, h_{4Z}$
  - CP violating: $h_{1A}, h_{2A}, h_{1Z}, h_{2Z}$
- $e\rightarrow ZZ (4l, ll\nu\nu, \ qq\nu\nu, \ qq\nu\nu)$
  - CP conserving: $f_{5A}, f_{5Z}$
  - CP violating: $f_{4A}, f_{4Z}$

### Quartic Gauge Coupling - Final State: WWA, $\nu\nu A$, $qq A$

- Only look at quartic terms not associated to the TGC
- $WWAA: a_{0W}, a_{cW}$: probe with final state $WWA, A\nu\nu A$
- $WWZA: a_{nW}$: probe with final state $WWA$
- $ZZAA: a_{0Z}, a_{cZ}$: probe with final state $A\nu\nu A, AAqq A$
- $WWWW$ and $WWZZ$ not accessible at LEP (why?)

### Snowmass 2013

- Snowmass EWK 2013
Results

- Z coupling
  - PDG 2012
    - $\phi$ $ZZ$, $Z\gamma$, AND $ZZ\nu$ (hep-ex/0511027)
    - $ZA$: $h_1Z$, $h_2Z$, $h_3Z$, $h_4Z$, $h_1A$, $h_2A$, $h_3A$, $h_4A$
    - $ZZ$: $f_4Z$, $f_5Z$, $f_4A$, $f_5A$
    - QGC: $a_0/\Lambda^2$, $ac/\Lambda^2$ using $AA\nu\nu$, $AAqq$ * W coupling * [ ]
Generator

- Eboli and Gozalez-Garcia: AGQC
- VBFNLO:
  - VBF WW: CP-even Dim6 operators: FBW, FDW, FWW, FBB
  - VBF WW: CP-odd Dim6 operators: FWWt, FWt, FBt, FBWt, FDWt, FWWt, FBBt
  - triboson: dimension 8 operators $f_i/\Lambda^4$: FS0, FS1, FM0-FM7, FT0-FT2, FT5-FT7
  - 400/10/20/30/40 pp$\rightarrow$WWZ, WZZ, WWW
  - 610/20 pp$\rightarrow$W Aj, 630/40WZj
- O. J. P. Eboli, M. C. Gonzalez-Garcia and J. K. Mizukoshi, “pp jje$\pm$+$\mu$ and jje$\pm$+$\mu$ at O(6) and O(4 2) for the study of the quartic electroweak gauge


- 1205.4231: MadGraph, EwkDim6 - Effective Field Theory: A Modern Approach to Anomalous Couplings
Diffractive physics

- 1111.3354: Probing Quartic Neutral Gauge Boson Couplings using diffractive photon fusion at the LHC.
  - Rick S. Gupta. pZZp, pZgamp, pGamGamp
- Royon's talk: Quartic WWGampGam and ZZGampGam at LHC, Christoph Royon’s talk in diff2010
Analysis Twiki

- CMS EWK results
- WZObservation7TeV
- WZjetsSubgroup

Approval for ICHEP

- ATLAS-CONF-2010-051: Measurement of the W->lnu production cross-section and observation of Z->ll production in proton-proton collisions at root(s)=7 TeV with the ATLAS detector
- ATLAS-CONF-2010-076: Measurement of the Z to ll production cross section in proton-proton collisions at sqrt(s)=7 TeV with the ATLAS detector
- ATL-COM-PHYS-2010-264
- ATL-COM-PHYS-2010-265: Observation of W->munu and Z->munu in proton-proton collisions at sqrt(s) = 7TeV with the ATLAS Detector
- ATL-COM-PHYS-2010-297: W to e nu and Z to ee Observations supporting note
- ATL-COM-PHYS-2010-325: Double differential Z,W cross sections and their ratios in the electron channels

W/Z paper approval

- arXiv:1010.2130: Measurement of the Wl and Zll production cross sections in proton-proton collisions at s=7 TeV with the ATLAS detector
- ATL-COM-PHYS-2010-701: Wenu and Zee cross-section measurements in proton-proton collisions at ps = 7 TeV with the ATLAS Detector
- ATL-COM-PHYS-2010-685: Wmunu and Zµµ cross-sections measurements in proton-proton collisions at ps = 7 TeV with the ATLAS Detector
- ATL-COM-PHYS-2010-703: Supporting Document:Total inclusive W and Z boson cross-section measurements and cross-section ratios in the electron and muon decay channels at ps = 7 TeV
Zee forward electron

- ATL-COM-PHYS-2010-1057: Title Z->ee cross-section measurement at forward rapidity in proton-proton collisions at sqrt(s) = 7 TeV with the ATLAS Detector, Aharrouche, M, et. al.
- talk: Inclusive Z Cross-section using forward electrons, status report (15 mins) by ELLINGHAUS, Frank
Wjet analysis

- Supporting doc: http://cdsweb.cern.ch/record/1292774
- PR plot: http://cdsweb.cern.ch/record/1309845
- talk: Alexander Paramonov, Discussion on jet and Etmiss object for W+jets analysis
- ATL-PHYS-INT-2011-020: Measurement of the cross-section for jets produced in association with a W-boson in pp collisions at sqrt(s) = 7 TeV
- ATL-COM-PHYS-2011-280: Measurement of the cross-section for jets produced in association with a W-boson in pp collisions at sqrt(s) = 7 TeV
Zjet analysis

- Sep 28 2010 Zmumu+jets Jet Energy Resolution Uncertainty by M.Schram and R.Mantifel
- JES/JER/Flavour systematics so far from: McGill, Barcelona, Goettingen
Ztautau analysis

• ZToTwoTausToLepHad

-- ShihChiehHsu - 12-Nov-2010