PDG-RPP report on Gauge bosons W and Z

A report to the PDG Advisory Committee

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Evolution of statistics

- **Papers read:**

1992	94	96	98	2000	02	04	06	08	10	12	2014
?	80	86	93	98	83	31	49	44	37	23	49

(LHC effect)

- **Nodes (Particle properties):**

	1992	94	96	98	2000	02	04	06	08	10	12	2014
Z	47	75	107	128	134	134	140	145	148	152	152	154
W		14	14	15	28	30	30	33	33	33	33	33

- **Pages in RPP**

	1992	94	96	98	2000	02	04	06	08	10	12	2014
Z	7	13	15	18	18	20	21	22	21	22	22	23
W	2	3	3	5	7	7	7	7	7	8	9	9

Data averaging: LEP

- **To obtain best LEP average measurements, results from the four experiments obtained over several years had to be combined using averaging procedures which accounted for correlated errors.**
- **LEP Electroweak Working Group; LEP W-group**
- **THIS LEP WG → PDG INTERFACE PLAYED A CRITICAL ROLE OVER THE YEARS.**

Data averaging: Tevatron, LHC

- **TEVATRON EWWG played a similar role for RUN-II data on W and Z**
- **Expectedly, an LHC ElectroWeak Working Group exists and we are on the mailing list**
- **For the Triple Gauge Couplings LEP, Tevatron and LHC experiments have different ways of presenting results and it needs to be dealt with**

Mini-reviews

- **PDG: Providing world averages a crucial task (most quoted reference).**
- **Purpose of MINI-REVIEW: Explain complicated averaging procedures, clarify terminology, present preliminary results:**
  - **Long mini-reviews: Notes on Z-boson, W-mass.**
  - **Shorter ones on: W-TGC's (γWW, ZWW),**
    ZZγ, Zγγ, ZZV Couplings
    Anomalous W/Z Quartic couplings.
- **All are revised for every hardcopy/WEB edition, and a new one written if necessary.**

Oct 2012: Expectations for 2013-14

- **LEP:** The final LEP-2 combos should be available for the 2013 (2014?) update
- **Tevatron:** some improvements in W-mass & TGC's ??
- **LHC: many new results expected from full 2011-12 data**

Watch out for

- Even more precision determination of W-mass

  → while a Higgs may have been found, internal consistency checks of SM would benefit greatly

- More precise determination of TGC's

  → could indicate BSM physics

Actuality 2014 edition

- **LEP Combos:** In the Z-section, limits for anomalous h_i^V and f_i^V parameters characterizing the $Z\gamma V$ and ZZV couplings have been carried out in 2013.
- **Tevatron:** No further improvement in W-mass and width; some additional results on couplings (TGCs)
- **LHC:** Many new results on couplings. None yet on W-mass etc…

- **Higgs has indeed been discovered.**
- **Look forward to more precise W-mass from LHC to test internal consistency of SM**

Oct 2012: Issues to sort out for 2014 RPP

- **There will be no LEP quartic (QGC) combination based on last (2004) results, so we may make one of our own… if it's too problematic will have to consider what to do…**

- **The issue of TGC conventions:**
  Tevatron: with form factors
  LEP: without form factors, using gauge constraints,
  LHC: without form factors, using HISZ constraints

- **Need to understand the LEP/LHC conventions a bit better as the situation has got somewhat confused**

- **To work closely with the LHC EWWG**

Actuality 2014 edition on issues

- **LEP combo QGC limits**: still pending.

- **LHC TGC related issues:** we are in touch with the LHC EW/TGC groups. ATLAS and CMS will come out with their publications by end-2014/early-2015 before the upgraded LHC starts. They are discussing the issue of combination etc and it should be sorted out at that time scale.

W: LEP, Tevatron, LHC

- **Summary of W measurements:**
- Mass, Total width: **Tevatron (±16, ± 49 MeV)**
  LEP (±33, ± 83 MeV)
- W BRs, Decay modes: **All LEP,** except μ/e, τ/e Tevatron
- Particle multiplicities in decay: **ALL LEP**
- TGCs: Actual measurements: LEP
  Limits: Tevatron and LHC

- **So, LEP and Tevatron have both contributed heavily.**
- **LHC now coming on-line; expected to dominate eventually**

Z: LEP/SLC, Tevatron, LHC

- **Summary of Z measurements:**
- Dominated by LEP/SLC results

  LEP most precise for purely statistics limited measurements (Mass, width, BRs, …)

  SLC-SLD most precise for measurements which use beam-polarization (asymmetry related).
- Exceptions(!): g_V^e from CDF q qbar → Z/γ^* → e+e-
- g_V^u, g_V^d, g_A^u, g_A^d from Tevatron, HERA, LEP-SLC
- $g^{\nu(e,\mu)}$ from CHARM2 (ν beam)
- Anomalous ZZγ, Zγγ, ZVV couplings from LEP, Tevatron, LHC…

Expectation for 2015-16

- **LEP:** tapered off

MG + AG will arrange to do the LEP QGC combo limits for 2015 web edition

- **Tevatron:** tapering off now

- **Main action will from LHC**

W, Z couplings and W-mass: Expect Run I publications on couplings (and hopefully the LHC combo) by time of winter conferences 2015 (March).

If so, will include in 2015 PDG web edition.

- **2016 hard-copy edition: All the above + Run II data!!**

Thank you