Special D0 meeting / Concluding Remarks

Gregorio Bernardi / LPNHE-Paris / June 10th 2014

Special collaboration meeting is indeed Special

Yesterday, on top of the introductory talk, review of computing, IB meeting, we reviewed the analysis aimed at ICHEP:

ICHEP Analyses Talks: Bs lifetime (15')	Alberto Sanchez Hernandez (CINVESTAV Mexico City)
ICHEP Analyses Talks: Z phi* (15')	Terry Wyatt (University of Manchester, UK)
Omega_b (20')	Jose Garcia Gonzalez (D0, Cinvestav MX)
top quark polarization (20')	Kamil Augsten (Czech Technical University in Prague)
W+c/b (20')	Olga Gogota (KNU)
Direct CPV in D+ -> K-pi+pi+ decays (20')	Mark Williams (Indiana University)
Lorentz violation in B decay (20')	Iain Bertram (Lancaster University)
Wmass (20')	Jan Stark (LPSC Grenoble - IN2P3)
top mass dileptons, v-wgting (20')	Huanzhao Liu (Southern Methodist University)
A_FB bb(bar) (20')	Julie Hogan (Rice University)
top mass all jets (20')	Gianluca Petrillo (University of Rochester)
tt(bar) gluon fraction (20')	SungWoong Cho (Korea University/D0 Fermilab) Jae hoon Lim (Korea University)
ttH, t' (20')	Christian Schwanenberger (University of Manchester)

Today, we just had a great ride through Dzero

Dawn of DZero	Paul Grannis
Run I physics	Hugh Montgomery
Run II upgrade	Hendrik Weerts
DZero algorithms	Erich Varnes
Computing and Reco from VAX to CAB	Amber Boehnlein
Running the D0 detector (25')	George Ginther
DZero students and postdocs (25')	Stefan Soldner-Rembold
DZero International Cooperation	John Womersley
Heavy flavor from heavy baryons to CP asym.	Marjorie Corcoran
Precision EW measurements (25')	Terry Wyatt
Studies of QCD (25')	Bob Hirosky
Looking for BSM physics at Tevatron	Marco Verzocchi
From limits to evidence – road to Higgs	Aurelio Juste
Top quark precision measurements Run II	Darien Wood
Physics Workshop summary and beyond	Rick Van Kooten

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MANY THANKS FOR ALL THESE INSPIRING TALKS !!

And more to come this evening

Riverview Banquets

1117 North Washington Avenue, Batavia

With after dinner speeches by

Roger Dixon, Cecilia Gerber, Brajesh Choudhary, Ursula Bassler, John Hobbs (Mark reading), Christian Schwanenberger and more!

Summary of Computing

- Clued0 and CAB will continue to be available, but gradually reduce their capacity.
- MC production continues. Please submit MC requests now.
- Internal documents, D0notes and Agenda server, are preserved.
  - More than half of d0notes have gone public already
- Migrating D0 data to newer tape storage is going smoothly.
- New SAM interface, samweb, is available.
- The new job submission tool to run jobs on FermiGrid is ready.

Many people contributed to D0 data preservation effort.

Thanks to everyone involved!

Special thanks to Qizhong!!!

Retirement: Yes! From Dzero: No!

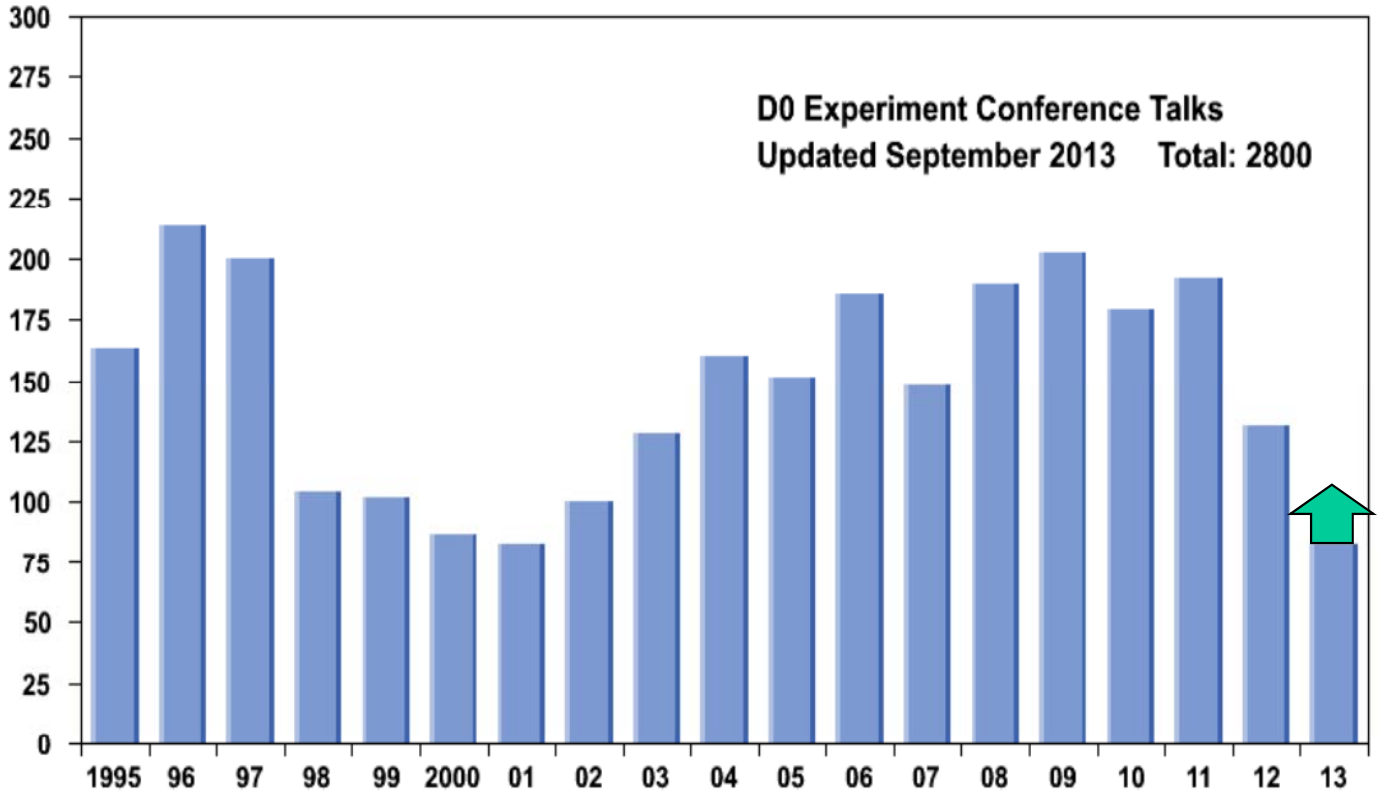
Speakers Bureau

We are still getting many talks, so there are plenty of opportunities.

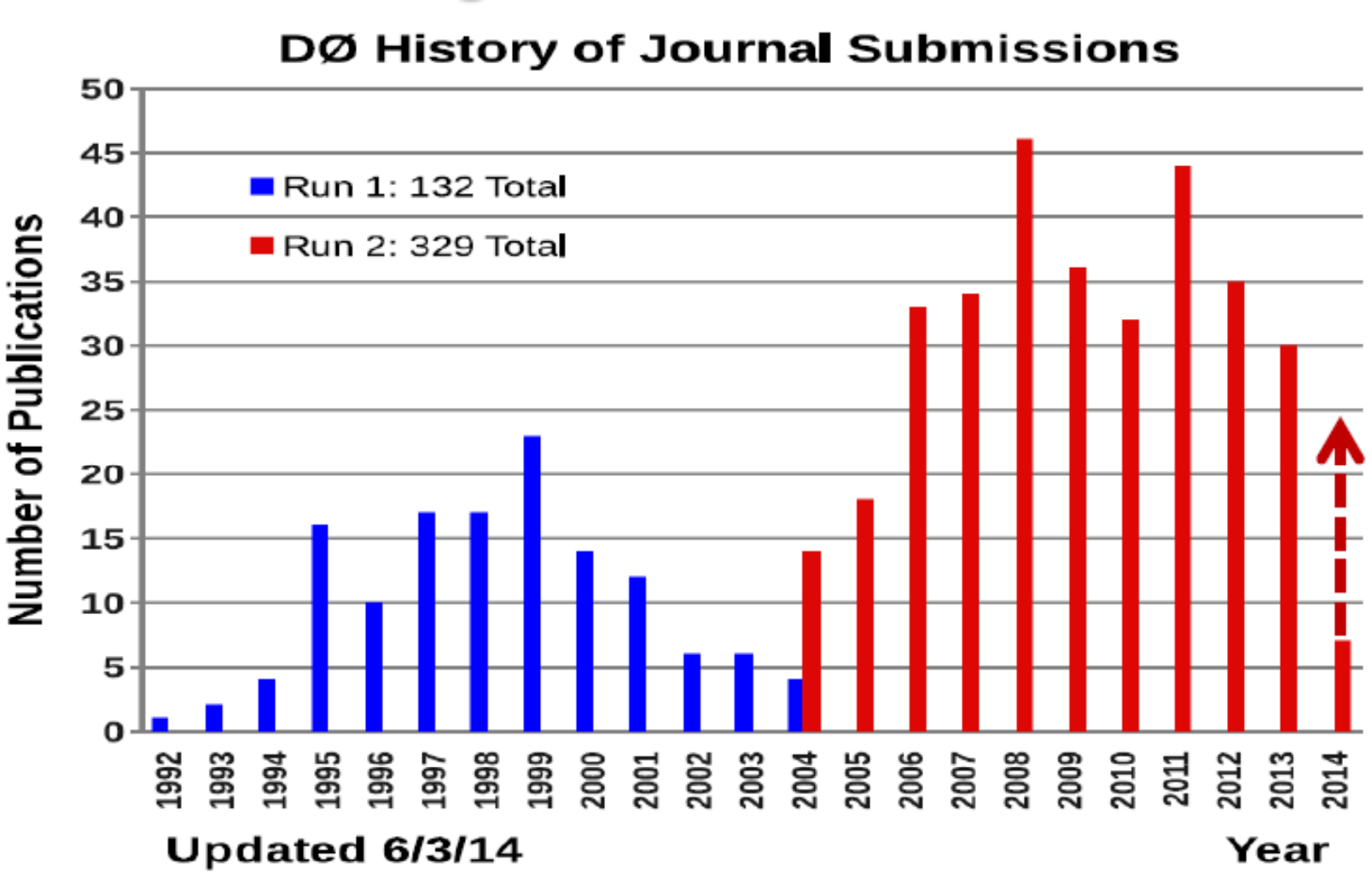
In 2013 / 2014 Dzero collaborators gave ~ 90 / 60 talks!

Number of talks is decreasing, but active collaborators as well, so opportunities for talks remain good.

Please talk to Horst if you are interested in giving a talk



Publications, we keep going



- Very good rate of publications: 7 papers already submitted this year
- We expect ~40 paper to be published bringing total number of our publications to ~500
- Publications is our main goal - publish, publish and publish!

Most cited papers since 2010

176. Combination of Tevatron Searches for the Standard Model Higgs Boson **TOPCITE = 100+** **PRL Editor Suggestion** **PRL Cover** **"Physics" Viewpoint article**
in the W^+W^- Decay Mode
Co-authors: DØ and CDF collaborations. Published 2/12/10: Phys. Rev. Lett. **104**, 061802 (2010), arXiv:1001.4162 plots

180. Double Parton Interactions in γ+3 Jet Events in $p\bar{p}$ Collisions at $\sqrt{s} = 1.96$ TeV **TOPCITE = 50+**
Published 3/31/10: Phys. Rev. D **81**, 052012 (2010), arXiv:0912.5104 plots $1.0\ fb^{-1}$

179. b-Jet Identification in the DØ Experiment **TOPCITE = 50+**
Published 3/20/10: Nucl. Instrum. Methods in Phys. Res. Sect. A **620**, 490 (2010), arXiv:1002.4224 plots

184. Search for Randall-Sundrum Gravitons in the Dielectron and Diphoton Final States **TOPCITE = 50+**
with $5.4\ fb^{-1}$ of Data from $p\bar{p}$ Collisions at $\sqrt{s} = 1.96$ TeV

2010

185. Combined Tevatron Upper Limit on $gg \rightarrow H \rightarrow W^+W^-$ and **TOPCITE = 50+**
Constraints on the Higgs Boson Mass in Fourth-Generation Fermion Models
Co-authors: DØ and CDF collaborations. Published 7/15/10: Phys. Rev. D **82**, 011102 (2010), arXiv:1005.3216 plots

188. Evidence for an Anomalous Like-Sign Dimuon Charge Asymmetry **TOPCITE = 100+** **PRL Editors' Suggestion** **"Physics" Viewpoint article**
Published 8/16/10: Phys. Rev. Lett. **105**, 081801 (2010), arXiv:1007.0395 plots press coverage, seminars $6.1\ fb^{-1}$

191. Search for Scalar Bottom Quarks and Third-Generation Leptoquarks **TOPCITE = 50+**
in $p\bar{p}$ Collisions at $\sqrt{s} = 1.96$ TeV
Published 8/19/10: Phys. Lett. B **693**, 95 (2010), arXiv:1005.2222 plots $5.2\ fb^{-1}$

195. Search for the Rare Decay $B_s^0 \rightarrow \mu^+\mu^-$ **TOPCITE = 50+**
Published 9/18/10: Phys. Lett. B **693**, 539 (2010), arXiv:1006.3469 plots $6.1\ fb^{-1}$

2011 - 2012

219. Bounds on an Anomalous Dijet Resonance in W+Jets Production in $p\bar{p}$ Collisions **TOPCITE = 50+**
"Physics" Synopsis article
at $\sqrt{s} = 1.96$ TeV
Published 6/30/11: Phys. Rev. Lett. **107**, 011804 (2011), arXiv:1106.1921 plots 4.3 fb^{-1}

222. Measurement of the Top Quark Pair Production Cross Section in the Lepton+Jets Channel **TOPCITE = 50+**
in Proton-Antiproton Collisions at $\sqrt{s} = 1.96$ TeV
Published 7/25/11: Phys. Rev. D **84**, 012008 (2011), arXiv:1101.0124 plots 5.3 fb^{-1}

2011

232. Measurement of the Anomalous Like-Sign Dimuon Charge Asymmetry with 9 fb^{-1} of pp Collisions
Published 9/16/11: Phys. Rev. D **84**, 052007 (2011), arXiv:1106.6308 plots 9.0 fb^{-1} **TOPCITE= 100+**

239. Model-Independent Measurement of t-Channel Single Top Quark Production **TOPCITE = 50+**
in $p\bar{p}$ Collisions at $\sqrt{s} = 1.96$ TeV
Published 10/20/11: Phys. Lett. B **705**, 313 (2011), supplemental material arXiv:1105.2788 plots 5.4 fb^{-1}

243. Forward-Backward Asymmetry in Top Quark-Antiquark Production **TOPCITE = 100+**
Published 12/12/11: Phys. Rev. D **84**, 112005 (2011), arXiv:1107.4995 plots 5.4 fb^{-1}

249. Measurement of the CP-Violating Phase $\varphi_s^{J/\psi\,\varphi}$ using the Flavor-Tagged Decay **TOPCITE = 50+**
$B_s^0 \rightarrow J/\psi\,\varphi$ in 8 fb^{-1} of $p\bar{p}$ Collisions
Published 2/22/12: Phys. Rev. D **85**, 032006 (2012), arXiv:1109.3166 plots 8.0 fb^{-1}

2012

280. Combination of the Top-Quark Mass Measurements from the Tevatron Collider **TOPCITE = 100+**
Published 11/08/12: Phys. Rev. D **86**, 092003 (2012), arXiv:1207.1069 plots 5.8 fb^{-1}

270. Evidence for a particle produced in association with weak bosons and decaying to a **TOPCITE = 100+** **PRL Editors' Suggestion** "Physics" Viewpoint article
bottom-antibottom quark pair in Higgs boson searches at the Tevatron

2013 - 2014

285. Measurement of the Semileptonic Charge Asymmetry using $B_s^0 \to D_s \mu X$ Decays
Published 01/03/13: Phys. Rev. Lett., **110**, 011801 (2013), arXiv:1207.1769 plots 10.4 fb^{-1}

308. Evidence for *s*-channel single top quark production in $p\bar{p}$ collisions at $\sqrt{s}$=1.96 TeV
Published 11/04/13: Phys. Lett. B **726**, 656 (2013), arXiv:1307.0731 plots 9.7 fb^{-1}

307. Measurement of the differential cross section of photon plus jet production in $p\bar{p}$ collisions at $\sqrt{s}$ = 1.96 TeV
Published 10/21/13: Phys. Rev. D **88**, 072008 (2013), arXiv:1308.2708 plots 8.7 fb^{-1}

306. Combination of CDF and D0 W-Boson Mass Measurements
Published 09/24/13: Phys. Rev. D **88**, 052018 (2013), arXiv:1307.7627 plots 5.3 fb^{-1}

2013

305. Higgs Boson Studies at the Tevatron
Published 09/17/13: Phys. Rev. D **88**, 052014 (2013), arXiv:1303.6346 plots 10 fb^{-1}

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17. Measurement of the direct CP-violating charge asymmetry in $D_s^{\pm} \to \phi\pi^{\pm}$
Published 03/21/14: Phys. Rev. Lett **112**, 111804 (2014), arXiv:1312.0741 plots 10.4 fb^{-1}

20. Double Parton Interactions in γ + 3 jets and γ + b/c + 2 jets events in $p\bar{p}$ collisions at $\sqrt{s}$ = 1.96 TeV in D0
Published 04/08/14: Phys. Rev. D **89**, 072006 (2014), arXiv:1402.1550 plots 8.7 fb^{-1}

4. Precision measurement of the top quark mass in lepton+jets final states at D0
Submitted 05/08/14: Phys. Rev. Lett., arXiv:1405.1756 plots 9.7 fb^{-1}

3. Measurement of the forward-backward asymmetry in $p\bar{p} \to t\bar{t}$ production in l+jets channel
Submitted 05/02/14: Phys. Rev. D, arXiv:1405.0421 plots 9.7 fb^{-1}

2014

2. Measurement of the W boson production charge asymmetry in $pp \to W + X \to e\nu + X$ events at $\sqrt{s}$ = 1.96 TeV
Published 04/18/14: Phys. Rev. Lett **112**, 151803 (2014), arXiv:1312.2895 plots 9.7 fb^{-1}

1. Measurement of differential $t\bar{t}$ production cross sections in $p\bar{p}$ collisions
Submitted 01/21/14: Phys. Rev. D, arXiv:1401.5785 plots

1. Observation of s-channel production of single top quarks at the Tevatron **PRL Editors' Suggestion**
Accepted 04/24/14: Phys. Rev. Lett., arXiv:1402.5126 plots up to 9.7 fb^{-1}

Our continued efforts are bearing fruit

By systematically completing our program, looking carefully at the full dataset we keep expanding the Tevatron legacy.

Just to list a few recent achievements:

- ➔ **Best top mass measurement****
- ➔ **First evidence for s-channel, combined observation****
- ➔ **Best precision on Afb, showing compatibility with SM**

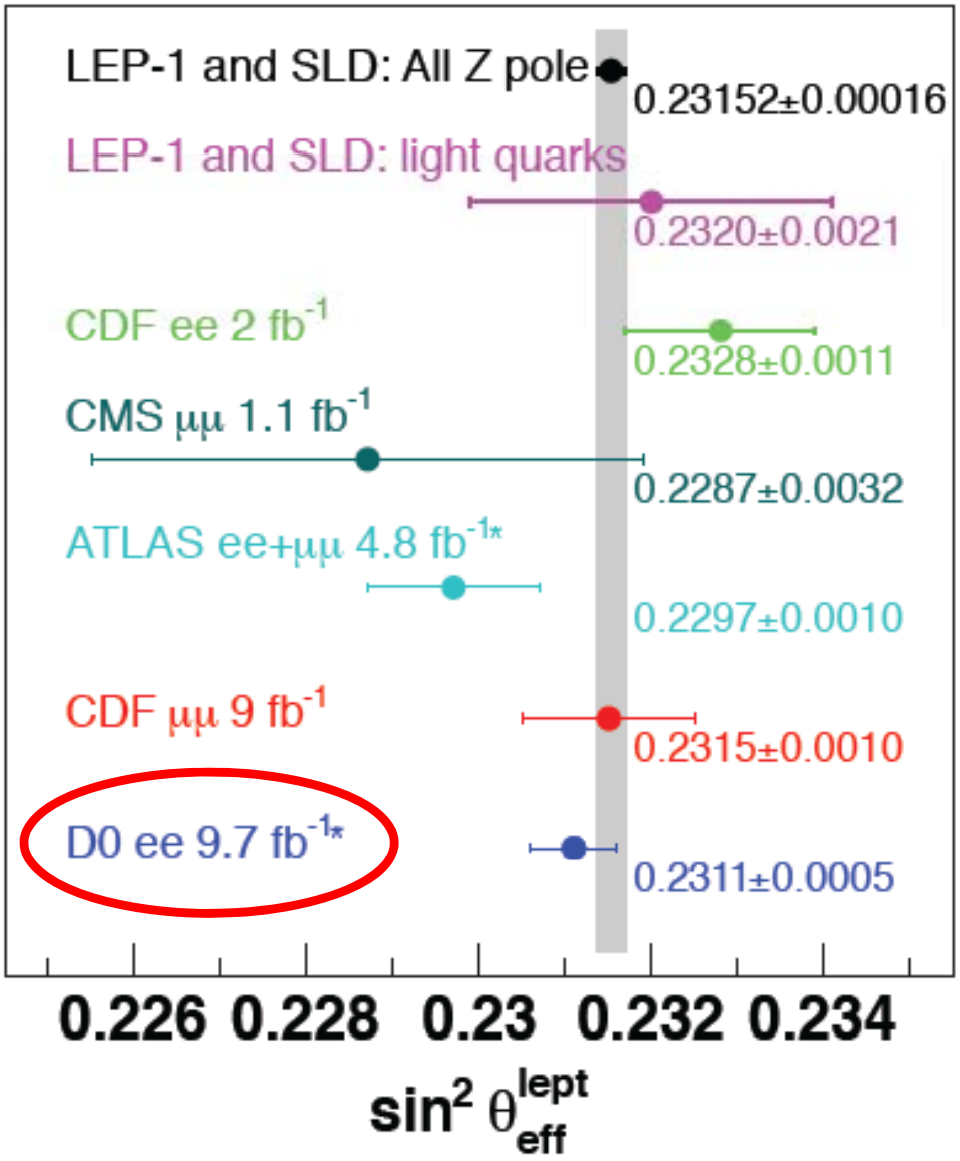
- ➔ **Dimuon asymmetry remains unchallenged**
- ➔ **CPV program has produced several papers. Soon bb FB asymmetry**
- ➔ **We are understanding Omega_b and will update it**

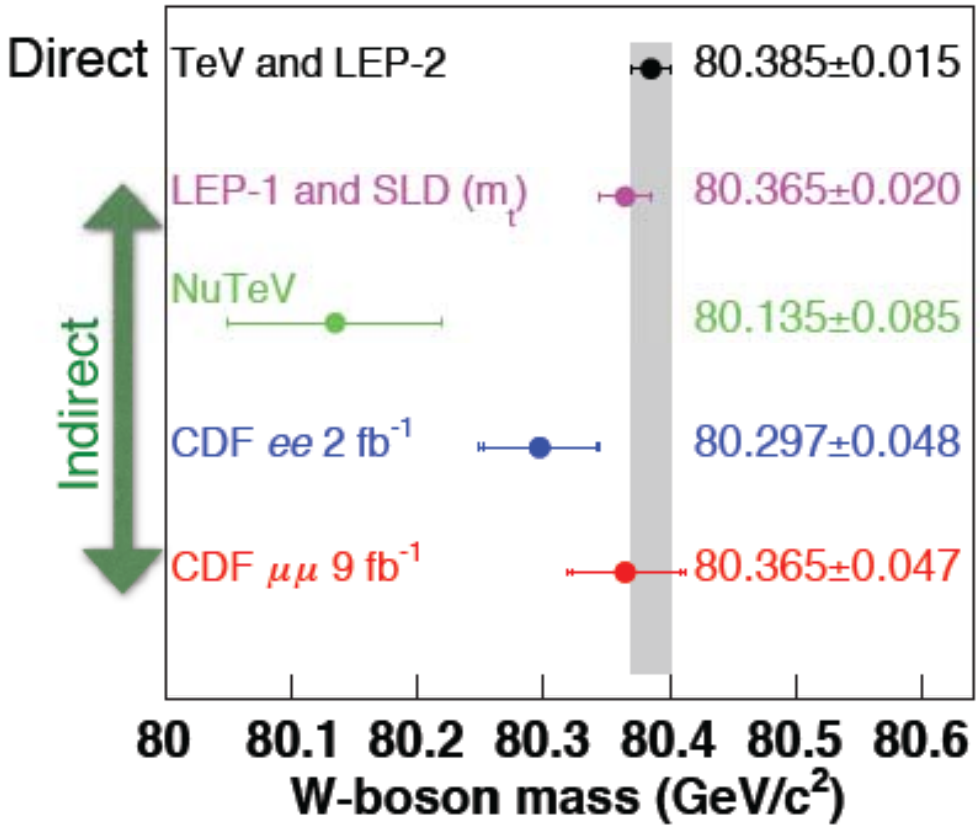
- ➔ **Many Precise Boson+jets (with/wo HF) results**
- ➔ **Double parton results are unique and extensive → see W&C on Friday**

- ➔ **W mass is Tevatron domain, and we will still improve**
- ➔ **More eweak precision meas. best at hadron colliders, challenging LEP****
- ➔ **Higgs spin-parity using an original approach (D0 only, combination?)**

In the community, D0 is often seen as reference of what can still be done@Tev

$\sin^2 \theta_w$ summary (shown at LHCP)

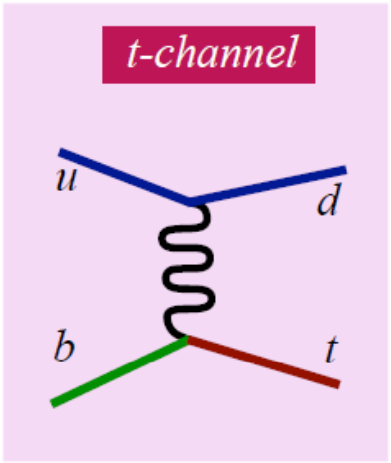


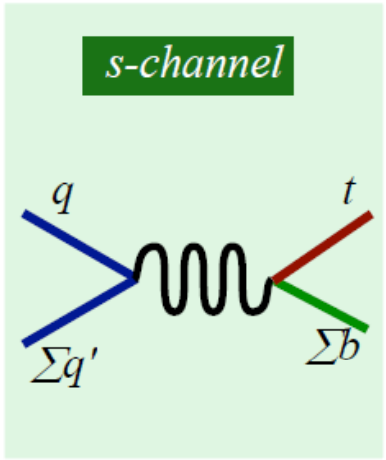


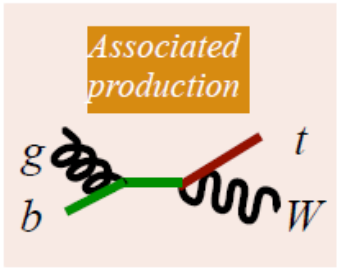
Combined CDF+D0 indirect M_W in both channels will have **~20 MeV** precision

Time for Dzero to produce indirect W-mass result

s-channel Single Top observation → through combination…



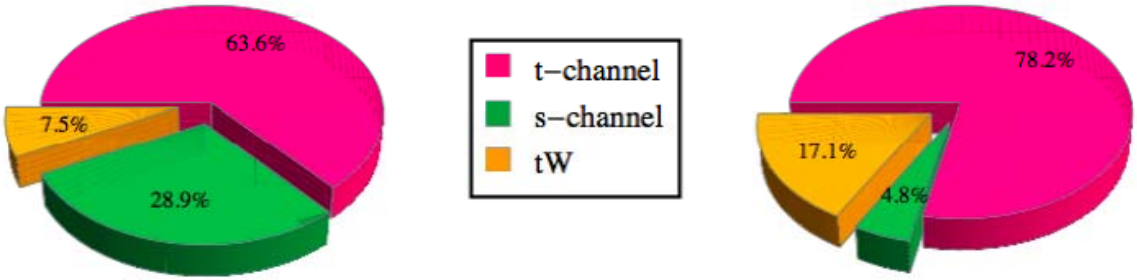




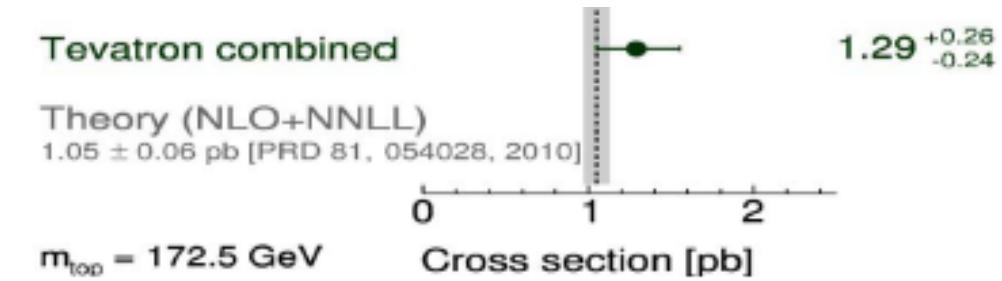
Single top observation	CDF&D0
t-channel	D0
s-channel	CDF+D0
tW channel	CMS

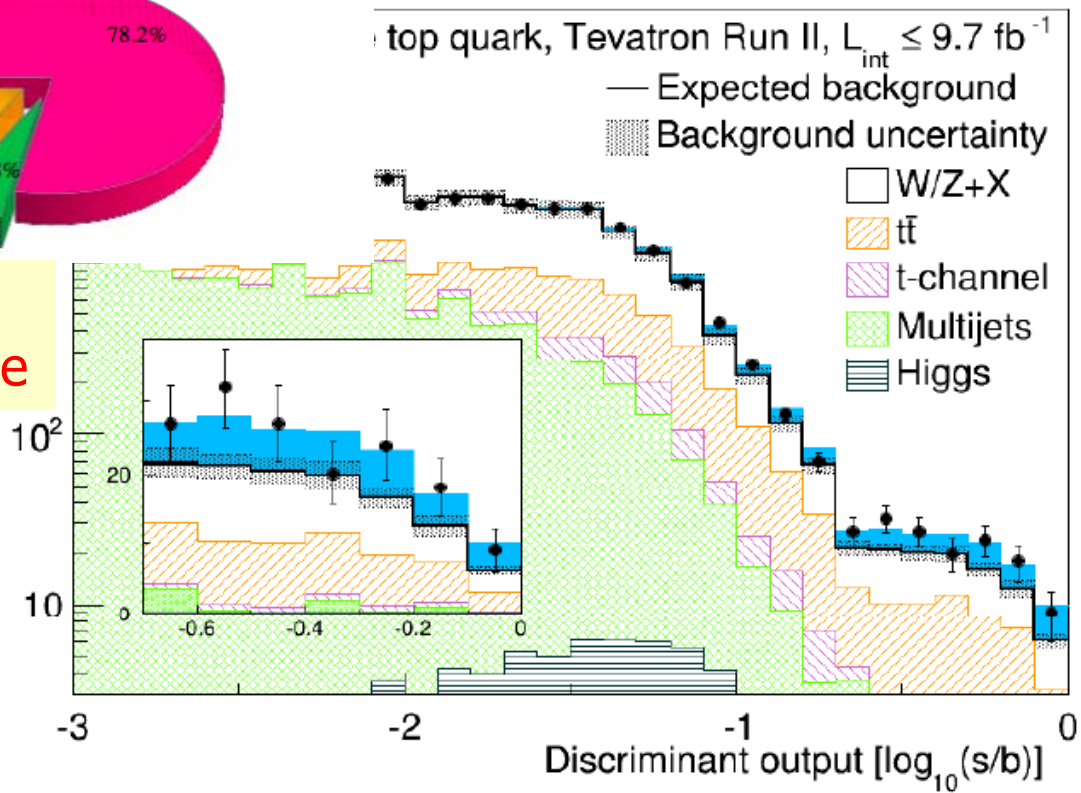
…and benefitting from ppbar vs. pp initial state

Tevatron: σtot = 3 pb *LHC: σ_{tot} = 114 pb @ 8 TeV*



Combination of evidence results from CDF and D0 →observation with 6.3σ significance





Top Mass

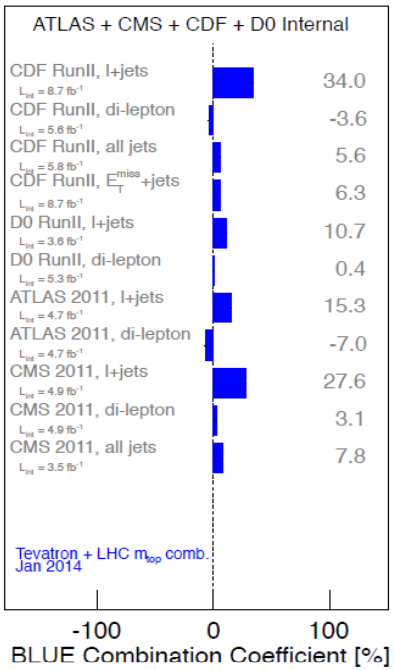
➔LHC now combines with Tevatron

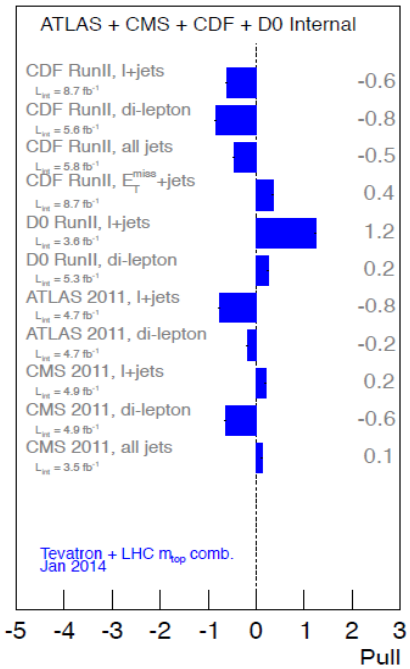
Tevatron+LHC NOTE

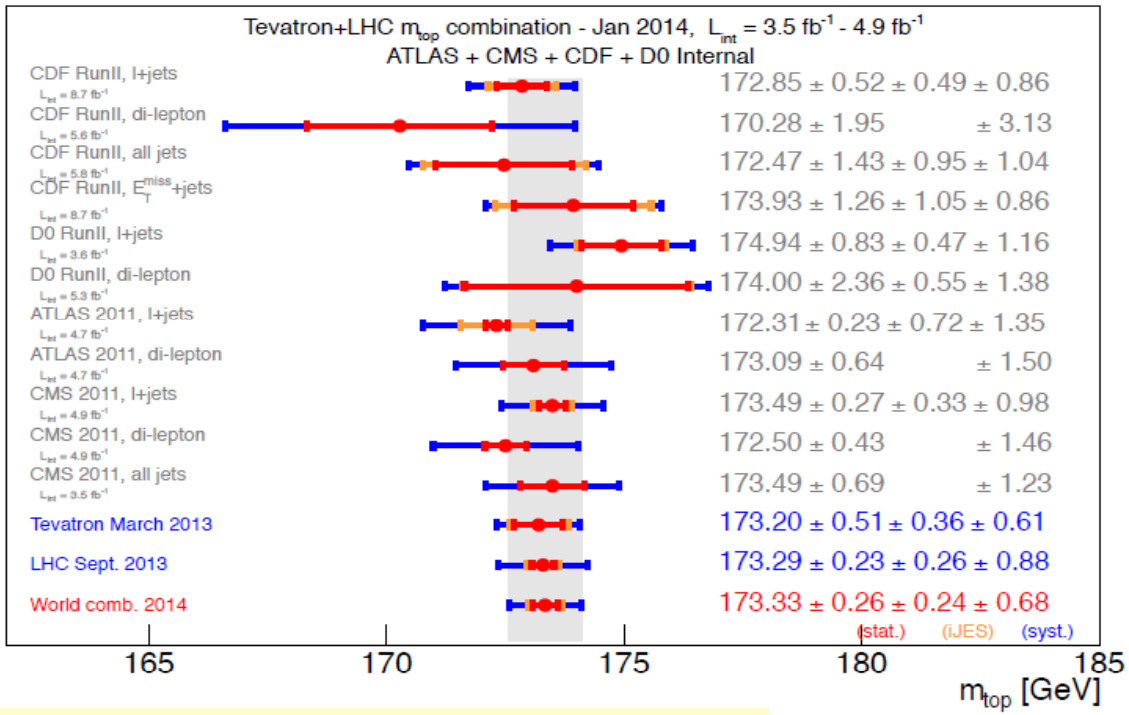
CDF note 11071
D0 note 6416
ATLAS-COM-CONF-2014-001
CMS PAS TOP-13-014

January 28, 2014

$t\bar{t} \rightarrow$ lepton+jets, $t\bar{t} \rightarrow$ di-lepton, $t\bar{t} \rightarrow$ all jets and $t\bar{t} \rightarrow E_T^{miss}$+jets channels. The resulting combined measurement of the top-quark mass is $m_{top} = 173.33 \pm 0.26$ (stat) ± 0.72 (syst) GeV, with a total uncertainty of 0.77 GeV.



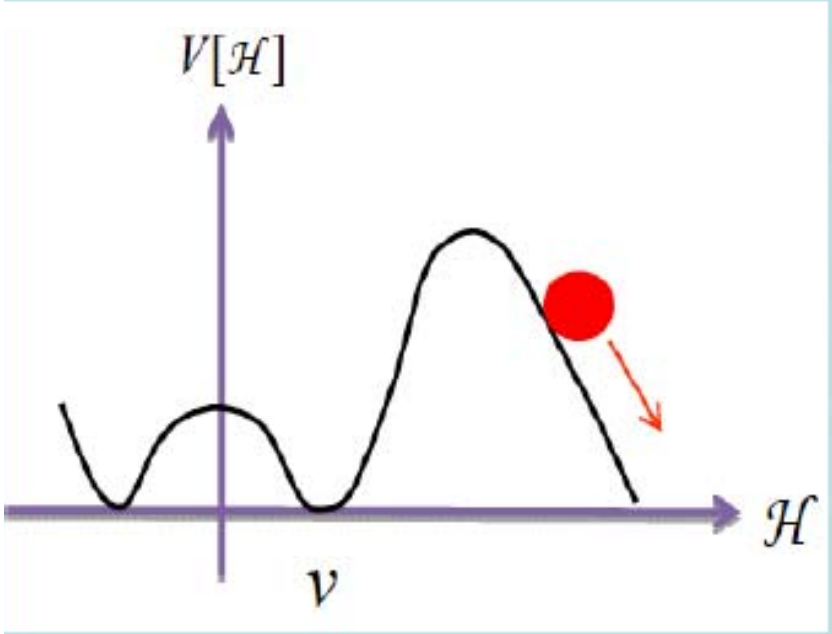


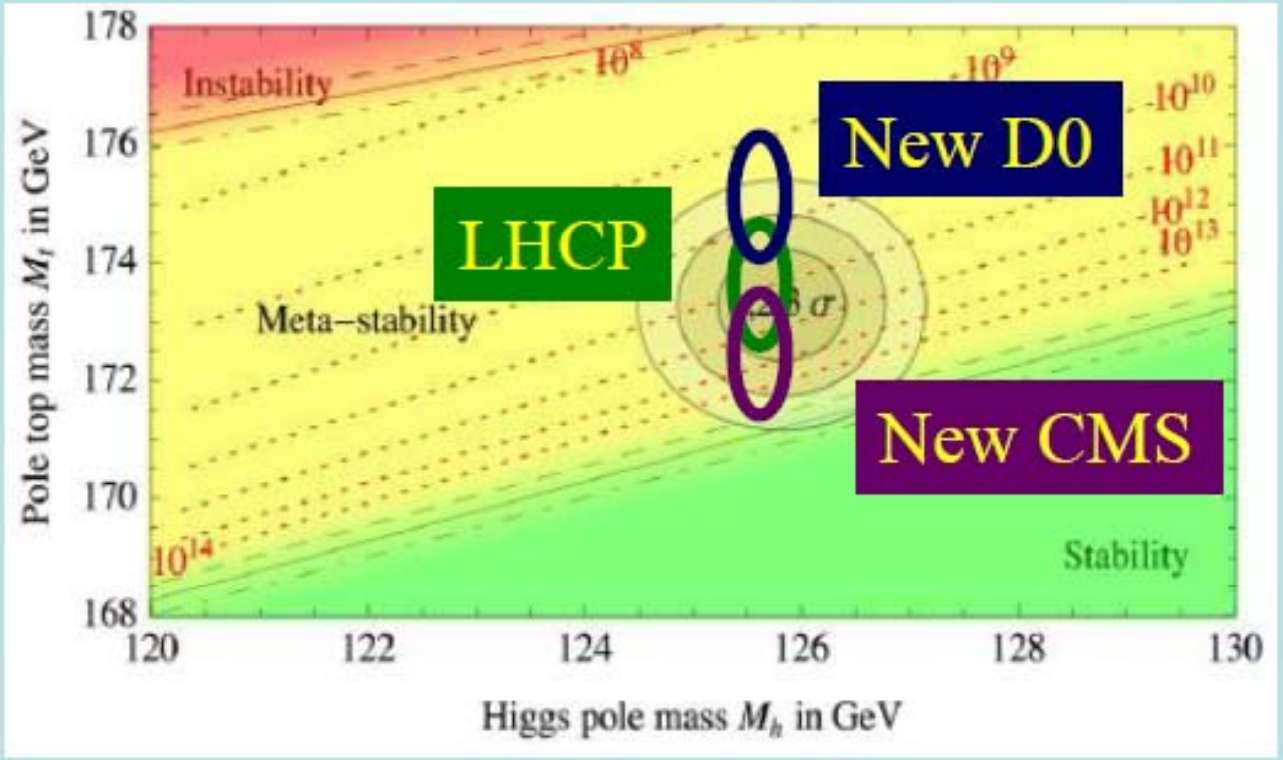


And we need more now combinations!

Vacuum Instability in the SM

- Very sensitive to m_t as well as M_H





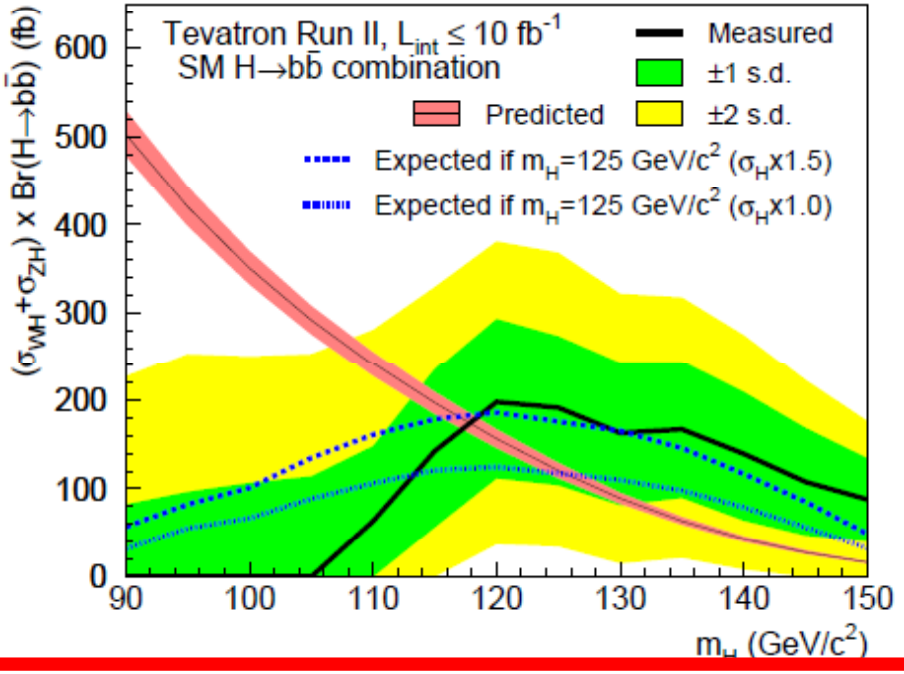
- Instability scale: Buttazzo, Degrassi, Giardino, Giudice, Sala, Salvio & Strumia, arXiv:1307.35

$$\log_{10}\frac{\Lambda_I}{\text{GeV}} = 11.3 + 1.0\left(\frac{M_h}{\text{GeV}} - 125.66\right) - 1.2\left(\frac{M_t}{\text{GeV}} - 173.10\right) + 0.4\,\frac{\alpha_3(M_Z) - 0.1184}{0.0007}$$

- **$m_t = 173.8 \pm 1$ GeV ➔ $\log_{10}(\Lambda/\text{GeV}) = 10.3 \pm 1.3$**

From John Ellis LHCP-2104 summary talk, last week

H→bb: will it be combined with LHC results?



$$(\sigma_{WH} + \sigma_{ZH}) \times \mathcal{B}(H \to b\bar{b}) = 0.19 \pm 0.09 \ (\text{stat} + \text{syst}) \ \text{pb}$$

SM Higgs @ 125 GeV: 0.12 ± 0.01 pb

Tevatron: σ(VH) = 1.6 ± 0.7 (stat. + syst.) × SM
CMS: σ(VH) = 1.0 ± 0.5 (stat. + syst.) × SM
ATLAS: σ(VH) = 0.2 ± 0.6 (stat. + syst.) × SM

All expected sensitivities are ~ 2sigma, so combination would make sense.
Even at Run II ATLAS and CMS will have a hard time observing this process

We can be proud of what we did in Higgs physics

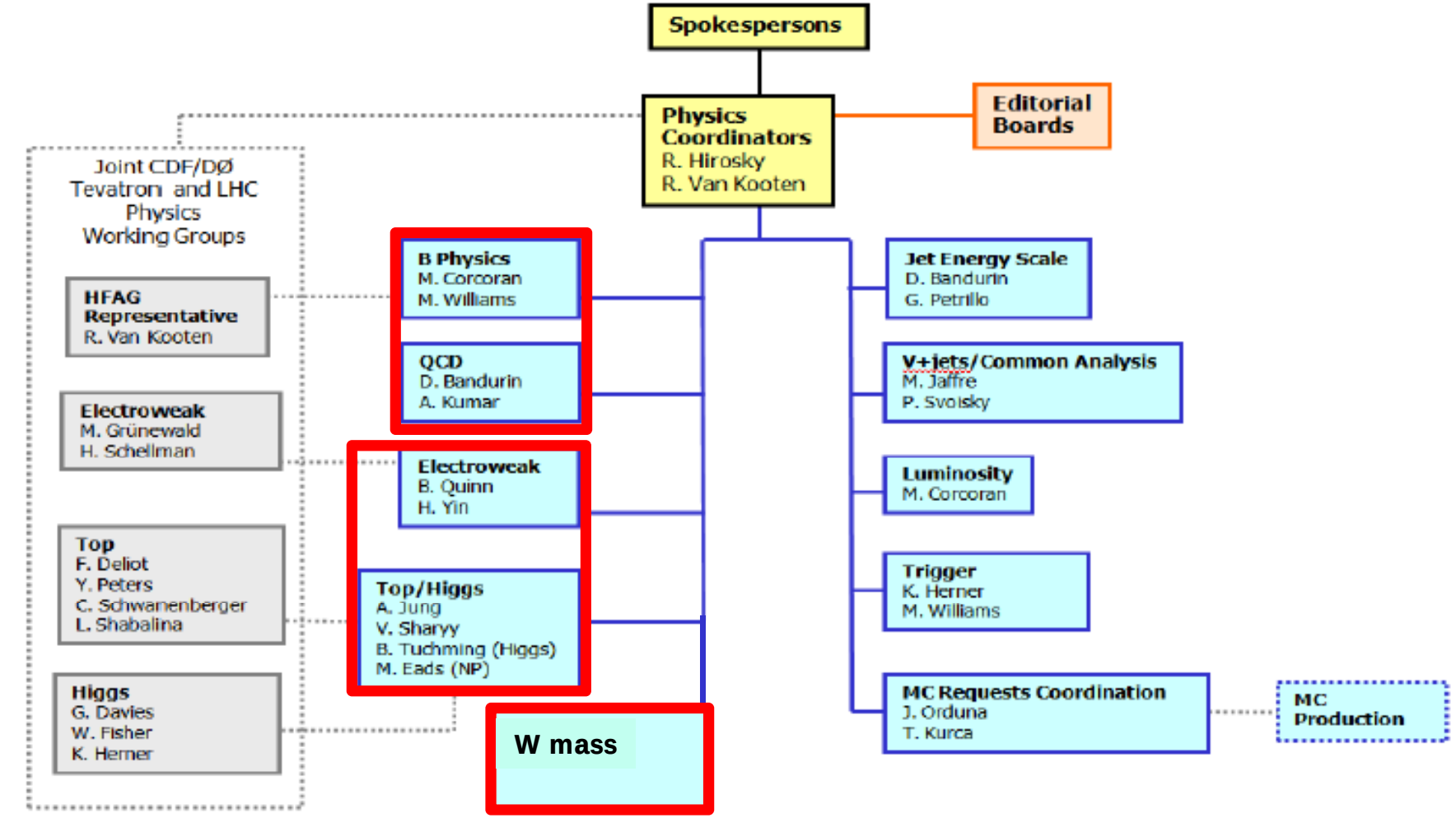
Plan for future publications

Topic	By Moriond 2014	2014+	Total
Electroweak	4	5	9
Higgs	1	1	2
Top	3	5	8
QCD	3	5	8
Heavy Flavor	2	3	5
Combinations	3	4	7
NIM	-	1	1
Total	16	24	~40

Many publications in all groups, important fraction of combinations!
Combination groups will remain important

But we want to consolidate our efforts ➔

Physics organization



Joint combination groups will continue with minor adjustments

JES, V+jets, luminosity, trigger and MC coordination groups will continue

- **Reduced level of efforts**

Physics groups will be arranged as: B/QCD, EW/top and W mass

- **Rick and Bob agreed to continue as physics coordinators**
- **New conveners will be announced in July with start date of September 1st**

Conferences / Presentations

- LHCP conference (NYC/Columbia) June 2-7
- D0 SPECIAL MEETING IN 2014 June 9-10
- FNAL Users' Meeting June 11-12

- **P5 report for student / UD0 / Rick Van Kooten June 13**
- **Wine and Cheese, Dmitry Bandurin**

Probing the Nucleon Structure with Multiple Parton Interactions at D0

- **ICHEP 2014 (Valencia) July 2-9**
- Top workshop (Cannes) September 29-Oct 3

Many opportunities to present our new results

Looking forward

- Great results in front of us, including our best legacy!
- Mainly precision measurements (symbolized by W mass Top mass, including all-hadronic channel)
- LHC will restart early 2015, at ~twice the energy. Attention will become very focused to the LHC new results.

➔ let's try to finish as much as we can our analyses before then

- After ICHEP and Top workshop, we would benefit a lot by publishing all our remaining papers by Moriond 2015

Summary

The collaboration is healthy, the computing & algorithms projects have been finalized and the physics keep coming out at the expected high rate / quality
➔ Only small changes to our successful organization.

We have to continue exploiting the 10 fb^{-1} dataset, with optimized analysis methods for the 30-40 publications to come

We are bringing complementary information to LHC's in particular with world's best measurements of the masses of the Top quark and W boson.
First Top mass combination Tevatron-LHC, more LHC-TeV combinations to come

We are making many precise measurements in QCD, Top, e-weak and B physics, which we confront to the latest theoretical calculations ➔ new contraints.
We are finalizing the investigation of our puzzling effects in Top and B

➔let's publish these papers, most of them in 2014, 99% before Moriond 2015

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"you can check out anytime you like,
but you can never leave..." 1977

We are 150 today !

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