New physics searches for the LHC

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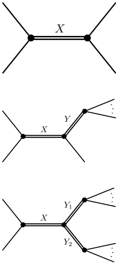
Supermodels

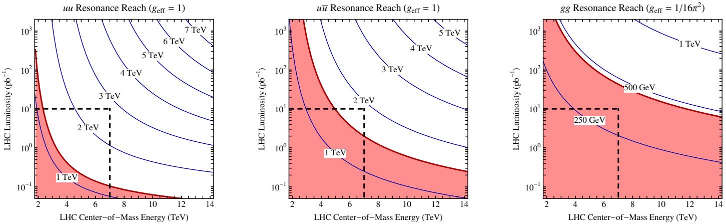
General consideration for early LHC [Bauer, Ligeti, Schmaltz, Thaler, Walker; talk Nadia Pastrone]

– models competitive with Tevatron

10 LHC events in 10 pb^{-1}
not ruled out by LEP and flavor physics
not ruled out by Tevatron for 10 fb^{-1} [shaded red]
decay to (leptonic) background-free signatures

– candidates: single production via $g_\text{eff}^2 G^{\mu\nu} G_{\mu\nu}$ [similar for $q\bar{q}$, qq]





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- Z' or $q\bar{q}$ resonance
  decaying to new stable particles [heavy leptons, poster Fedor Ratnikov]
  decaying to heavy quark pairs $Q \to \ell^+ \ell^- q$
- diquarks/lepto-diquarks $uu \to D$, $D \to \ell^- L$, $L \to \ell^+ 2j$
- R parity violating squarks $\tilde{b}^c \to b\,\chi_1$, $\chi_1 \to \ell^+ \tilde{\ell}$, $\tilde{\ell} \to \ell^- 3j$

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⇒ LHC below 100 pb^{-1} a Standard Model machine

Top asymmetry

Experimental anomaly [talks Erich Varnes, Tom Schwarz]

– forward-backward asymmetry $A_{FB}^{exp} = 0.193 > A_{FB}^{SM} = 0.051$ [Rodrigo; Kühn]

– heavy colored gauge boson
QCD the diagonal of $SU(3)_1 \times SU(3)_2$ [$g_1 \neq g_2$ needed]
candidate model $g_L^t, g_R^q \sim 1 - \cos^2\theta$

$SU(3)_1$			$SU(3)_2$				ΔA_{FB}	
			$(t,b)_L$	q_L	t_R, b_R	q_R	$= 0$	coloron
		q_R	$(t,b)_L$	q_L	t_R, b_R		$= 0$	
	t_R, b_R		$(t,b)_L$	q_L		q_R	$= 0$	
q_L			$(t,b)_L$		t_R, b_R	q_R	$= 0$	
q_L	t_R, b_R		$(t,b)_L$			q_R	> 0	candidate
q_L		q_R	$(t,b)_L$		t_R, b_R		$= 0$	top-color
	t_R, b_R	q_R	$(t,b)_L$	q_L			< 0	axigluon
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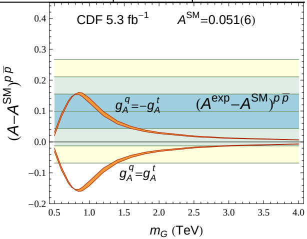

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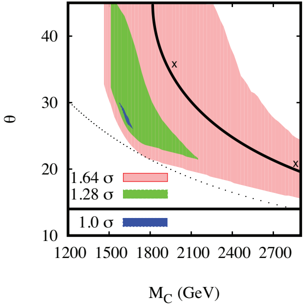
- additional constraints [Framton, Shu, Wang; Chivucula, Simmons, Yuan]
  B_d mixing: $M_c \sin 2\theta > 1.8$ TeV [solid]
  e-w precision data: $M_c > \cot\theta \times 700$ GeV [dotted]



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  B_d mixing: $M_c \sin 2\theta > 1.8$ TeV [solid]
  e-w precision data: $M_c > \cot\theta \times 700$ GeV [dotted]
- allowed parameter points: $A_{FB} = 0.04, 0.03$ [$M_C = 2000, 2850$ GeV]
- axigluon interpretation not possible

- alternatives: colored scalars, weak gauge bosons,... [t channel, flavor violating]
  exciting search channel $qq \to tt$
- LHC at least 5 fb^{-1} at 7 TeV

Dark matter

Historically: Dirac dark matter to explain PAMELA [Harnik & Kribs; Benakli]

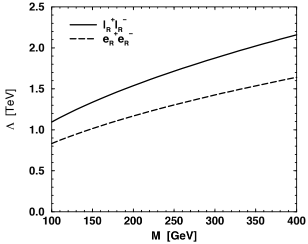
– interacting via higher-dimensional operators [SUSY: $\Lambda = m_{\tilde{f}}$; no coupling to Z]

$$\mathcal{O}_{D5} = \frac{1}{\Lambda} \overline{D} D H^\dagger H \qquad \mathcal{O}_{D6} = \frac{c_L}{\Lambda^2} \overline{D}\gamma^\mu D \, \bar{f}\gamma_\mu P_L f \qquad \mathcal{O}_{D6} = \frac{c_R}{\Lambda^2} \overline{D}\gamma^\mu D \, \bar{f}\gamma_\mu P_R f$$

– annihilation rate $\langle \sigma v \rangle \sim \sum_f c_{L,R}^2 / \Lambda^4$

Dirac bino: dominated by leptons $c \sim (Y g')^2$ [R-symmetric MSSM]

explaining PAMELA positron excess



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Effective theory analysis of dark matter [Goodman, Ibe, Rajaraman, Sheperd, Tait, Yu]

– complex/real scalars, Majorana/Dirac fermions coupling to Standard Model fields

– list of operators

	Operator	Coefficient
C1	$\chi^\dagger \chi \bar{q} q$	m_q / Λ^2
C2	$\chi^\dagger \chi \bar{q} \gamma^5 q$	$i m_q / \Lambda^2$
C3	$\chi^\dagger \partial_\mu \chi \bar{q} \gamma^\mu q$	$1 / \Lambda^2$
C4	$\chi^\dagger \partial_\mu \chi \bar{q} \gamma^\mu \gamma^5 q$	$1 / \Lambda^2$
C5	$\chi^\dagger \chi G_{\mu\nu} G^{\mu\nu}$	$\alpha_s / 4\Lambda^2$
C6	$\chi^\dagger \chi G_{\mu\nu} \tilde{G}^{\mu\nu}$	$i \alpha_s / 4\Lambda^2$
R1	$\chi^2 \bar{q} q$	$m_q / 2\Lambda^2$
R2	$\chi^2 \bar{q} \gamma^5 q$	$i m_q / 2\Lambda^2$
R3	$\chi^2 G_{\mu\nu} G^{\mu\nu}$	$\alpha_s / 8\Lambda^2$
R4	$\chi^2 G_{\mu\nu} \tilde{G}^{\mu\nu}$	$i \alpha_s / 8\Lambda^2$

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D4	$\bar{\chi} \gamma^5 \chi \bar{q} \gamma^5 q$	m_q / Λ^3
D5	$\bar{\chi} \gamma^\mu \chi \bar{q} \gamma_\mu q$	$1 / \Lambda^2$
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D7	$\bar{\chi} \gamma^\mu \chi \bar{q} \gamma_\mu \gamma^5 q$	$1 / \Lambda^2$
D8	$\bar{\chi} \gamma^\mu \gamma^5 \chi \bar{q} \gamma_\mu \gamma^5 q$	$1 / \Lambda^2$
D9	$\bar{\chi} \sigma^{\mu\nu} \chi \bar{q} \sigma_{\mu\nu} q$	$1 / \Lambda^2$
D10	$\bar{\chi} \sigma_{\mu\nu} \gamma^5 \chi \bar{q} \sigma_{\alpha\beta} q$	i / Λ^2
D11	$\bar{\chi} \chi G_{\mu\nu} G^{\mu\nu}$	$\alpha_s / 4\Lambda^3$
D12	$\bar{\chi} \gamma^5 \chi G_{\mu\nu} G^{\mu\nu}$	$i \alpha_s / 4\Lambda^3$
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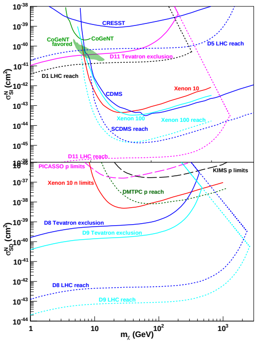
– complex/real scalars, Majorana/Dirac fermions coupling to Standard Model fields

– WIMP-nucleon cross section [direct detection]
compared to Tevatron/LHC reach $\chi\chi$+jets

$\Rightarrow$ colliders dominant for light WIMP
interpretation unclear for UV completions...



MRSSM

Opposite of anomaly: understand 6×6 squark mass matrix?

– flavor violation: K-$\overline{K}$ mixing, etc
– CP violation in flavor sector
– flavor-violating decays: $b \to s\gamma$
– electric dipole moments...

$\Rightarrow$ flavor symmetries required

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Solution [Kribs, Poppitz, Weiner]

– start from well-known R parity [proton decay, dark matter,...]
expand to continuous, global symmetry [Hall & Randall]
avoid spontaneous breaking to break SUSY [Affleck, Dine, Seiberg, Nelson & Seiberg]

– forbidden soft-breaking terms $\phi^3, \phi^*\phi^2, \tilde{\lambda}\tilde{\lambda}$
allowed soft-breaking terms $\phi^2, \phi^*\phi, \tilde{\lambda}\psi$

– no Majorana masses, no A, μ, δ_{LR} terms [Majorana neutrino okay]

– gluino Dirac mass via additional state [chiral superfield with sgluon]

$\Rightarrow$ squark mixing hardly constrained

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Sgluons at the LHC [TP & Tait]

– complex sgluon field G, G^*
– supersymmetric QCD

$$\mathcal{L} = (D_\mu G)^* \left(D^\mu G\right) + i\sqrt{2}\, g_S\, f^a_{bc}\, \bar{\tilde{g}}^b \;\left(G\, P_L + G^*\, P_R\right)^a \tilde{g}^c$$

fixed g-G-G, $\tilde{g}$-$\tilde{g}$-G couplings at tree level

– allowed soft-breaking terms

$$\mathcal{L} = m_1^2\, GG^* + \frac{1}{2} m_2^2 \left(G^2 + G^{*\,2}\right) - \sqrt{2} g_S m_{\tilde{g}} \left(G + G^*\right) \sum_{\tilde{q}} \tilde{q}^*\, T^a \tilde{q}$$

fixed mass and $\tilde{q}$-$\tilde{q}$-G couplings at tree level [go to mass eigenstates]

– G-g-g coupling loop-induced $\propto m_{\tilde{g}}/m_G^2$ [D5 operator]
G-q-q coupling loop-induced $\propto m_{\tilde{g}} \delta_{qq'}\, m_q/m_G^2$ [D4 operator]

$\Rightarrow$ pair production, decay to top quark

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Close relatives

– axigluons: strong coupling to quarks [Bagger, Schmidt, King, 1988]

– supersoft SUSY breaking: sgluon not relevant for pheno [Fox, Nelson, Weiner]

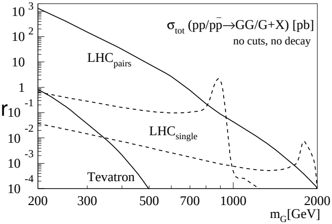
– Randall-Hall or $N = 2$ hybrid: minimal flavor violation [Popenda et al]

– non-supersymmetric octets: boosted tops discussed later

Sgluons at LHC

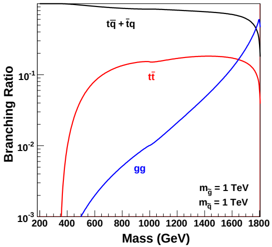
Production easy [TP & Tait, Popenda et al]

- pair production via SUSY-QCD
- single production at one-loop
- produced like stop pairs with new color factor



Decays with some structure

- $\Gamma(G \to gg) \propto m_{\tilde{g}}^2$
  $\Gamma(G \to t\bar{q} + \bar{t}q) \propto (m_t m_{\tilde{g}})^2$
  $G \to gg$ dominant for large m_G



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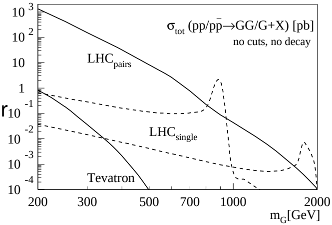

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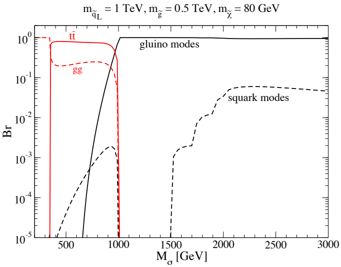
– SUSY decays possible
$G \to t\bar{t}$ useful with MFV
off-shell channels $<$ one-loop channels

– single production background-burdened

$\Rightarrow$ like-sign tops plus jets



Hidden valleys and portals

Skipping, ask me over coffee...

Chiral 4th Generation

Some questions

– simply phenomenological: why three generations? [review: Framton, Hung, Sher]

– anomaly cancellation?
light neutrinos and LEP?
Majorana neutrinos in neutrinoless double beta decay?
electroweak precision data?
flavor constraints?

⇒ none of the constraints convincing [Peccei: 'Why there should not be a fourth generation']

– strongly interacting theory? [Holdom; Burdman & De Rold]
electroweak baryogenesis? [Fok & Kribs]
dark matter?

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The model [old story]

– complete additional generation [Q_4, U_4, D_4, L_4, e_4, ν_4]

– masses from Yukawas

– representations as Standard Model: no FCNC

– charged currents: (4×4) fermion–mixing matrices [single-top (D0) $V_{bt} \gtrsim 0.68$]

– neutrino mass: $\mathcal{L} \sim y_4 \, \tilde{H}\bar{L}_4 \nu_{4R} + M \, \bar{\nu}^c_{4R} \nu_{4R}/2$

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Electroweak precision data [LEPEWWG]

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Just as the 3rd generation... [Holdom; Vysotsky,...; Kribs, TP, Spannowsky, Tait]

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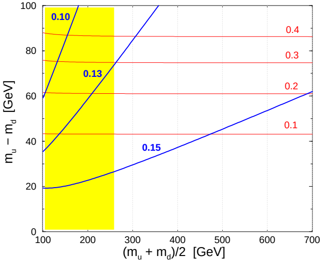
– okay, got is, some people prefer a Z'
let's be honest for a change...

– for our purpose: leading S and T [$\Delta U \sim 0$ as in SM]

– remember doublet: $\Delta S = N_f/(6\pi)(1 - 2Y \log m_u^2/m_d^2)$

(1) keep ΔS and ΔT small

[ΔS_q blue; ΔT_q red]



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Electroweak precision data [LEPEWWG]

(2) old trick: compensate $\Delta S \sim \Delta T > 0$ [Hill...]
small m_H: $\Delta T \sim \Delta S \sim 0.2$
large m_H: $\Delta T \sim \Delta S + 0.2 \sim 0.3$

– allowed parameter points [$m_{\nu_4} = 100$ GeV, $m_{\ell_4} = 155$ GeV]

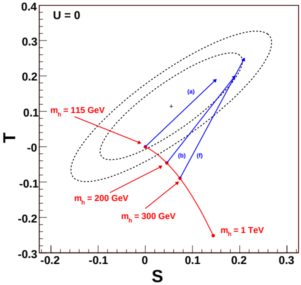
m_{u_4}	m_{d_4}	m_H	ΔS_{tot}	ΔT_{tot}
310	260	115	0.15	0.19
320	260	200	0.19	0.20
330	260	300	0.21	0.22
400	350	115	0.15	0.19
400	340	200	0.19	0.20
400	325	300	0.21	0.25

– within 68% CL of electroweak ellipse

– generic feature $m_{u_4} > m_{d_4}$ allows for $u_4 \to d_4 W$

– $\Delta S < 0$ but dangerous U for Majorana neutrino

[Kniehl, Kohrs]



Chiral 4th Generation

Dimension-5 Higgs couplings [e.g. SFitter-Higgs; got a hacked HDecay]

– loop effects of new particles [Arik, Arik, Cetin, Conca, Mailov, Sultansoy; Kribs, TP, Spannowsky, Tait]

– chiral fermions without Appelquist-Carazone decoupling

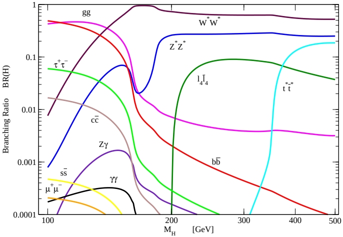
$$\Gamma_{H\to\gamma\gamma} = \frac{G_\mu \alpha^2 m_H^3}{128\sqrt{2}\pi^3} \left| \sum_f N_c Q_f^2 A_f(\tau_f) + A_W(\tau_W) \right|^2$$

$$\Gamma_{H\to gg} = \frac{G_\mu \alpha_s^2 m_H^3}{36\sqrt{2}\pi^3} \left| \frac{3}{4} \sum_f A_f(\tau_f) \right|^2 \qquad \text{with} \quad \tau_i = \frac{m_H^2}{4m_i^2}$$

$$A_f(\tau) = \frac{2}{\tau^2} \left[\tau + (\tau - 1) f(\tau) \right]$$

$$A_W(\tau) = -\frac{1}{\tau^2} \left[2\tau^2 + 3\tau + 3(2\tau - 1) f(\tau) \right] \qquad \text{with} \quad f(\tau \to 0) \to \tau$$

(1) increase $g_{ggH} \to 3 \times g_{ggH}$
decrease $g_{\gamma\gamma H} \to 1/3 \times g_{\gamma\gamma H}$
light–Higgs BRs suppressed by $H \to gg$



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– chiral fermions without Appelquist-Carazone decoupling

$$\Gamma_{H\to\gamma\gamma} = \frac{G_\mu \alpha^2 m_H^3}{128\sqrt{2}\pi^3} \left| \sum_f N_c Q_f^2 A_f(\tau_f) + A_W(\tau_W) \right|^2$$

$$\Gamma_{H\to gg} = \frac{G_\mu \alpha_s^2 m_H^3}{36\sqrt{2}\pi^3} \left| \frac{3}{4} \sum_f A_f(\tau_f) \right|^2 \qquad \text{with} \quad \tau_i = \frac{m_H^2}{4m_i^2}$$

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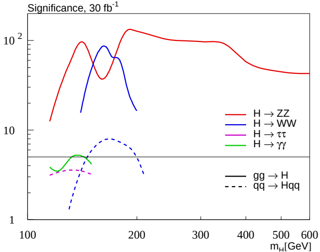
(1) increase $g_{ggH} \to 3 \times g_{ggH}$
decrease $g_{\gamma\gamma H} \to 1/3 \times g_{\gamma\gamma H}$
light–Higgs BRs suppressed by $H \to gg$

(2) factor 9 enhancement of $gg \to H$ [Tevatron!?]
$\sigma_{gg}\,\text{BR}_{\gamma\gamma} \to \sigma_{gg}\,\text{BR}_{\gamma\gamma}$
$\sigma_{gg}\,\text{BR}_{ZZ} \to (5 \cdots 8)\ \sigma_{gg}\,\text{BR}_{ZZ}$



Chiral 4th Generation

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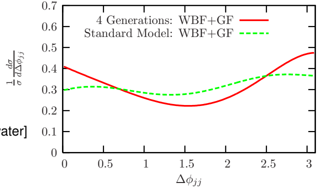
(3) misleading WBF correlations

(4) Higgs pair production the winner [Baur, TP, Rainwater]

⇒ if nothing else — what a great straw man!



New physics searches at the LHC

	missing energy (p.89)	cascade decays (p.91)	mono-jets/photon (p.15)	lepton resnce (p.109)	di-jet resnce (p.109)	top resnce (p.120)	WW/ZZ resnce (p.15)	W' resnce (p.93)	top partner (p.116)	charged tracks (p.123)	displ. vertex (p.123)	multi-photons (p.29)	spherical events (p.47,76)
SUSY (heavy grav.) (p.17,26)	$\checkmark\checkmark$	$\checkmark\checkmark$							$\checkmark$				
SUSY (light grav.) (p.17,27)	$\checkmark$	$\checkmark$	$\checkmark$						$\checkmark$	$\checkmark$	$\checkmark$		
large extra dim (p.39)	$\checkmark\checkmark$		$\checkmark\checkmark$										$\checkmark$
universal extra dim (p.47)	$\checkmark\checkmark$	$\checkmark\checkmark$		$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$				
technicolor (vanilla) (p.51)				$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark\checkmark$					
topcolor/top seesaw (p.53,54)					$\checkmark$	$\checkmark\checkmark$	$\checkmark$						
little Higgs (w/o T) (p.55,58)				$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$					
little Higgs (w T) (p.55,58)	$\checkmark\checkmark$	$\checkmark\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$				
warped extra dim (IR SM) (p.61,63)				$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$						
warped extra dim (bulk SM) (p.61,64)				$\checkmark$	$\checkmark$	$\checkmark\checkmark$	$\checkmark$	$\checkmark$					
Higgsless/comp. Higgs (p.69,73)				$\checkmark$	$\checkmark$	$\checkmark\checkmark$	$\checkmark\checkmark$						
hidden valleys (p.75)	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$

[arXiv:0912.3259, Morrissey, TP, Tait]

Boosted W bosons

Why fat jets?

1. decay products too collinear to resolve
2. automatic reduction of signal combinatorics
3. improved resonance mass reconstruction

Boosted particles at LHC [talk Erich Varnes]

1994 boosted $W \to 2$ jets from heavy Higgs [Seymour]

1994 boosted $t \to 3$ jets [Seymour]

2002 boosted $W \to 2$ jets from strongly interacting WW [Butterworth, Cox, Forshaw]

2006 boosted $t \to 3$ jets from heavy resonances [Agashe, Belyaev, Krupovnickas, Perez, Virzi]

2007 boosted $\tilde{\chi}_1^0 \to 3$ jets in R parity violating SUSY [Butterworth, Ellis, Raklev]

2008 boosted $H \to b\bar{b}$ [Butterworth, Davison, Rubin, Salam]

2009 boosted $t \to 3$ jets from top partners [TP, Salam, Spannowsky, Takeuchi]

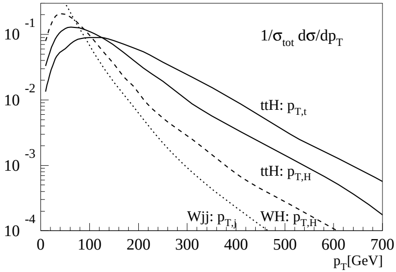
...

Boosted Higgs bosons

Hadronic Higgs decays [Butterworth, Davison, Rubin, Salam]

– S: large m_{bb}, boost-dependent R_{bb}
  B: large m_{bb} only for large R_{bb}
  S/B: large m_{bb} and small R_{bb}, so boosted Higgs

– fat Higgs jet $R_{bb} \sim 2m_H/p_T < 1$



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$\Rightarrow$ non-trivial challenge to jet algorithms

	σ_S/fb	σ_B/fb	$S/\sqrt{B}_{30}$
C/A, $R = 1.2$, MD-F	0.57	0.51	4.4
$k_\perp$, $R = 1.0$, y_{cut}	0.19	0.74	1.2
SISCone, $R = 0.8$	0.49	1.33	2.3

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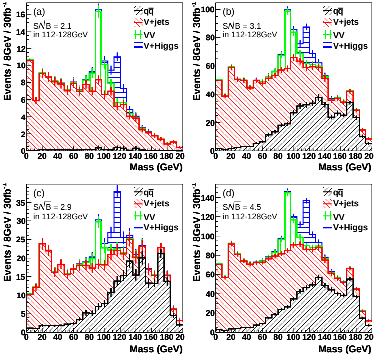
WH/ZH productionm $H \to b\bar{b}$

- combined channels $V \to \ell\ell, \nu\nu, \ell\nu$
- Z peak as sanity check
- confirmed to 20% [ATLAS: Piquadio]
  subjet b tag excellent [70%/1%]
  charm rejection challenging
  $m_H \pm 8$ GeV tough
- improvements possible [Soper, Spannowsky]

$\Rightarrow$ crucial to understand Higgs sector



More boosted Higgs bosons

Long death of $t\bar{t}H$, $H \to b\bar{b}$ [Cammin & Schumacher, CMS-TDR and Atlas-CSC worse]

– trigger: $t \to bW^+ \to b\ell^+\nu$
reconstruction and rate: $\bar{t} \to \bar{b}W^- \to \bar{b}jj$

– not a chance:
1– combinatorics: m_H in $pp \to 4b_{tag}\ 2j\ \ell\nu$
2– kinematics: peak-on-peak with $t\bar{t}b\bar{b}$, $t\bar{t}jj$
3– systematics: $S/B \sim 1/9$ [$S/\sqrt{B}$ irrelevant]

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Higgs tagger for $t\bar{t}H$ [TP, Salam, Spannowsky]

- uncluster one-by-one: $j \to j_1 + j_2$ [C/A algorithm, $R = 1.2$]
  1– mass drop: $m_{j_1} > 0.8 m_j$ means QCD; discard j_2
  2– soft $m_{j_1} < 30$ GeV means QCD; keep j_1
- double b tag [possibly add balance criterion]
  three leading $J = p_{T,1}p_{T,2}(\Delta R_{12})^4$ vs m_{bb}^{filt}
  no mass constraint — side bin
- jets everywhere; underlying event and pileup deadly
  filter reconstruction jets [Butterworth–Salam]
  decay plus one add'l jet at $R_{\text{filt}} \sim R_{jj}/2$
  reconstruct masses w/ QCD jet

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Higgs tag plus top tag

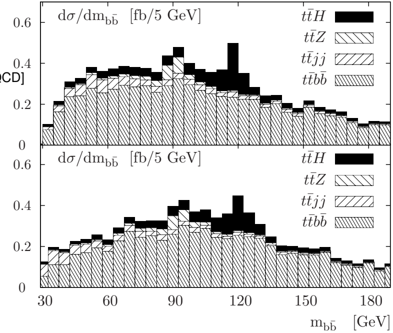
– tagged top and tagged Higgs
trigger on lepton

– add'l continuum b tag [remove $t_\ell \to b$ plus QCD]

– side bin in continuum $t\bar{t}b\bar{b}$

– promising, but 100 fb^{-1}

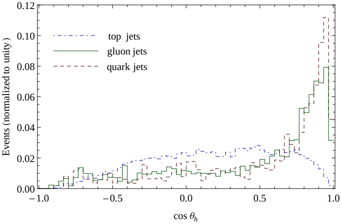
m_H	S	S/B	$S/\sqrt{B}$
115	57	1/2.1	5.2 (5.7)
120	48	1/2.4	4.5 (5.1)
130	29	1/3.6	2.9 (3.0)

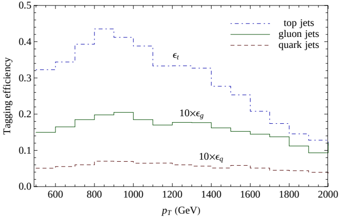


Boosted top quarks

Highly boosted top quarks [Kaplan, Rehermann, Schwartz, Tweedie; Princeton, Seattle...]

- identify hadronic tops with $p_T \gtrsim 800$ GeV
  isolation and b tagging challenging
- C/A algorithm with p_T drop criterion
  all top decay jets identified
  3 kinematic constraints: $m_W, m_t, \cos\theta_{\text{hel}}$ [no b tag]
- top mass included, no sidebins
- improvement $S/B \to 15 \times S/B$





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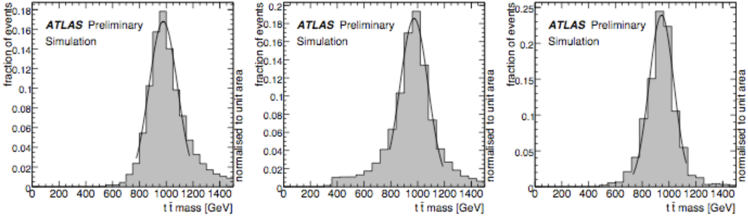
- ATLAS studies on semi-leptonic channel promsing



(a) minimal (b) full reconstruction (c) mono-jet

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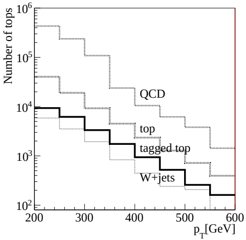
Standard Model: HEPTopTagger [TP, Salam, Spannowsky, Takeuchi]

- extend reach to $p_T \gtrsim 250$ GeV
- start like Higgs tagger [mass drop, $R = 1.5$]
  kinematic selection: $m_{jjj}, m_{jj}^{(1)}, m_{jj}^{(2)}$ [no b tag, filtered]
- no id of top decay products
  no boost
  complicated kinematics instead



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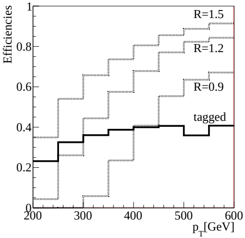

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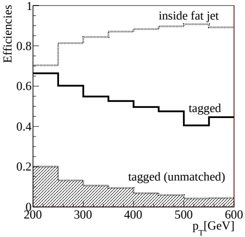

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- no id of top decay products
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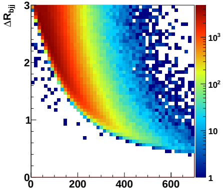
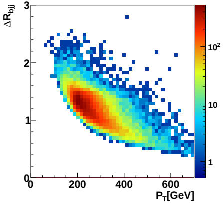
  complicated kinematics instead
- realistic for $t\bar{t}$ in SM
- waiting to be tested: Tevatron/LHC





Top squarks

Reconstructing hadronic tops

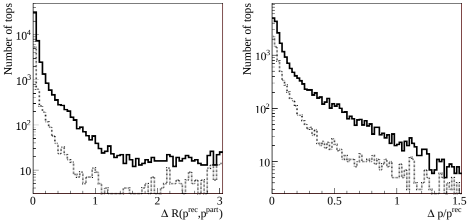
– reconstruction of $G \to t\bar{t}$ and $\tilde{t} \to t\tilde{\chi}$

– competitive with semi-leptonic channel? [$t\bar{t}$ resonance: $\not{E}_T$ plus m_W]

– top mass decisive for tagger
top 3-momentum add'l requirement [Wang et al; Moortgat-Pick et al; Weiler et al]

– strong dependence on $p_T > 200, 300$ GeV

$\Rightarrow$ hadronic top tag really like b tag



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Stop pairs [TP, Spannowsky, Takeuchi, Zerwas]

– top partner most important particle in MSSM [hierarchy problem]
comparison to other top partners [Meade & Reece]

– dark matter difficult for semi-leptonic channel

– purely hadronic: $\tilde{t}\tilde{t}^* \to t\tilde{\chi}_1^0\,\bar{t}\tilde{\chi}_1^0$ [CMS-TDR: leptons as life guards]

events in 1 fb^{-1}	$\tilde{t}_1\tilde{t}_1^*$						$t\bar{t}$	QCD	W+jets	Z+jets	S/B	$S/\sqrt{B}_{10\ \text{fb}^{-1}}$
$m_{\tilde{t}}$[GeV]	340	390	440	490	540	640					340	
$p_{T,j} > 200$ GeV, ℓ veto	728	447	292	187	124	46	87850	$2.4 \cdot 10^7$	$1.6 \cdot 10^5$	n/a	$3.0 \cdot 10^{-5}$	
$\not{E}_T > 150$ GeV	283	234	184	133	93	35	2245	$2.4 \cdot 10^5$	1710	2240	$1.2 \cdot 10^{-3}$	
first top tag	100	91	75	57	42	15	743	7590	90	114	$1.2 \cdot 10^{-2}$	
second top tag	15	12.4	11	8.4	6.3	2.3	32	129	5.7	1.4	$8.3 \cdot 10^{-2}$	
b tag	8.7	7.4	6.3	5.0	3.8	1.4	19	2.6	$\lesssim 0.2$	$\lesssim 0.05$	0.40	5.9
$m_{T2} > 250$ GeV	4.3	5.0	4.9	4.2	3.2	1.2	4.2	$\lesssim 0.6$	$\lesssim 0.1$	$\lesssim 0.03$	0.88	6.1

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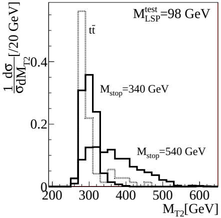
– stop mass from m_{T2} endpoint [like slepton pairs]

– not even a hard analysis



Outlook

Watching Tevatron and LHC

– new physics only starting around 1 fb^{-1}

– anomalies either unexplainable or unconvincing

– little happening in model space [arXiv:0912.3259, Morrissey, TP, Tait]

⇒ time for helpful phenomenology

– parton shower/matrix element merging [CKKW, MLM, MC@NLO, POWHEG, CKKW@NLO]

– automized higher order calculations [SM & BSM]

– new physics interfaces in event generators [FeynRules]

– effective theories of new physics [useful?]

– personally: boosted heavy particles

⇒ time to test tools on Tevatron/LHC data [HEPTopTagger]