

INTRO to LOW-SCALE TECHNICOLOR

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(with Estia Eichten, Adam Martin and others)

- ETC problem: FCNC's: $M_{ETC} \gtrsim 1000\text{TeV}$

$\implies m_q \sim \text{MeV}, M_{\pi_T} \sim \text{GeV}$:

Cured by walking TC gauge coupling!

$(\alpha_{TC}(IRFP) = \alpha_{TC}(\chi SB) + \epsilon$

$\implies \beta(\alpha_{TC}) \simeq 0$ from Λ_{TC} to $\lesssim M_{ETC}$)

WTC \implies enhanced $\langle \bar{T}T \rangle_{ETC}$ and M_{π_T} .

- TC problem: $S > 0, \mathcal{O}(1)$:

Possibly cured by walking α_{TC} .

WTC \implies usual (QCD-based) assumptions

for S are **wrong!**

WTC suggests towers of $I = 1$ ρ_T and a_T

extending up to ... ?

- Walking TC strongly suggests $N_D \gg 1$.

$$\implies \text{(e.g.) } \underline{F_T = 246 \text{ GeV} / \sqrt{N_D} \lesssim 100 \text{ GeV}}$$

\implies Many π_T and many ρ_T, a_T, ω_T

Focus on the lightest!

- $F_T \lesssim 100 \text{ GeV} \Rightarrow$ expect $M_{\pi_T} \simeq 100 - 400 \text{ GeV}$
- WTC enhancement of $M_{\pi_T} \implies \underline{M_{\rho_T} \lesssim 2M_{\pi_T} !!!}$
 $\implies M_{\rho_T}, M_{\omega_T} \simeq 200 - 700 \text{ GeV}$
 And ρ_T, ω_T are very narrow!!
- New observation from S:
 a_T is likely light, $M_{a_T} \simeq M_{\rho_T}$,
within reach if ρ_T, ω_T are!

⇒⇒ MANY striking experimental consequences
at Tevatron and LHC!

IF LSTC is responsible for EWSB —

It may be found at the Tevatron!

It can & will be found at the LHC!

$\rho_T^{\pm,0}(I=1)$, $\omega_T^0(I=0)$, $a_T^{\pm,0}(I=1)$ are produced via the Drell-Yan VMD process:

$$\bar{q}q \rightarrow \gamma, Z^0, W^{\pm} \rightarrow \rho_T, \omega_T, a_T \rightarrow \text{WHAT??}$$

- **WTC, S**

$$\implies \text{lightest } M_{\rho_T}, M_{\omega_T}, M_{a_T} \lesssim 2M_{\pi_T}$$

$$\implies \rho_T \rightarrow \pi_T \pi_T \text{ likely CLOSED!}$$

$$\implies \omega_T, a_T \rightarrow \pi_T \rho_T, 3\pi_T \text{ definitely CLOSED!}$$

HOW do ρ_T, ω_T, a_T DECAY?

Most likely LSTC observation channels:

Process	Tevatron	LHC $\gtrsim 10$ TeV
<ul style="list-style-type: none"> • $\omega_T \rightarrow \gamma\pi_T^0 \rightarrow \gamma\bar{b}b$ <li style="padding-left: 2em;">$\rightarrow \gamma Z^0 \rightarrow \gamma\ell^+\ell^-$ <li style="padding-left: 2em;">$\rightarrow \ell^+\ell^-$ 	<p style="text-align: center;">?</p> <p style="text-align: center;">??</p> <p style="text-align: center;">Y</p>	<p style="text-align: center;">??</p> <p style="text-align: center;">Y</p> <p style="text-align: center;">Y</p>
$\rho_T^0 \rightarrow W^\pm\pi_T^\mp \rightarrow \ell^\pm b\bar{q}$ $\rightarrow W^+W^- \rightarrow \ell^\pm\nu_e jj$ $\rightarrow \gamma\pi_T^0 \rightarrow \gamma\bar{b}b$ $\rightarrow \ell^+\ell^-$	<p style="text-align: center;">Y</p> <p style="text-align: center;">?</p> <p style="text-align: center;">?</p> <p style="text-align: center;">?</p>	<p style="text-align: center;">N</p> <p style="text-align: center;">??</p> <p style="text-align: center;">??</p> <p style="text-align: center;">?</p>
<ul style="list-style-type: none"> • $\rho_T^\pm \rightarrow W^\pm\pi_T^0 \rightarrow \ell^\pm\nu_e\bar{b}b$ <li style="padding-left: 2em;">$\rightarrow Z^0\pi_T^\pm \rightarrow \ell^+\ell^-b\bar{q}$ <li style="padding-left: 2em;">$\rightarrow W^\pm Z^0 \rightarrow \ell^\pm\nu_e\ell^+\ell^-$ <li style="padding-left: 2em;">$\rightarrow \gamma\pi_T^\pm \rightarrow \gamma b\bar{q}$ <li style="padding-left: 2em;">$\rightarrow \gamma W^\pm \rightarrow \gamma\ell^\pm\nu_e$ 	<p style="text-align: center;">Y</p> <p style="text-align: center;">?</p> <p style="text-align: center;">?</p> <p style="text-align: center;">?</p> <p style="text-align: center;">?</p>	<p style="text-align: center;">N</p> <p style="text-align: center;">Y</p> <p style="text-align: center;">Y</p> <p style="text-align: center;">??</p> <p style="text-align: center;">Y?</p>
$a_T^0 \rightarrow W^\pm\pi_T^\mp \rightarrow \ell^\pm\nu_e b\bar{q}$ $\rightarrow W^\pm W^\mp \rightarrow \ell^\pm\nu_e jj$ <ul style="list-style-type: none"> • $\rightarrow \ell^+\ell^-$ 	<p style="text-align: center;">Y</p> <p style="text-align: center;">?</p> <p style="text-align: center;">Y?</p>	<p style="text-align: center;">?</p> <p style="text-align: center;">??</p> <p style="text-align: center;">Y</p>
<ul style="list-style-type: none"> • $a_T^\pm \rightarrow \gamma\pi_T^\pm \rightarrow \gamma b\bar{q}$ <li style="padding-left: 2em;">$\rightarrow \gamma W^\pm \rightarrow \gamma\ell^\pm\nu_e$ <li style="padding-left: 2em;">$\rightarrow Z^0\pi_T^\pm \rightarrow \ell^+\ell^-b\bar{q}$ <li style="padding-left: 2em;">$\rightarrow W^\pm Z^0 \rightarrow \ell^\pm\nu_e\ell^+\ell^-$ 	<p style="text-align: center;">?</p> <p style="text-align: center;">?</p> <p style="text-align: center;">?</p> <p style="text-align: center;">?</p>	<p style="text-align: center;">??</p> <p style="text-align: center;">Y</p> <p style="text-align: center;">Y</p> <p style="text-align: center;">Y?</p>

Y = Yes, for a range of masses and nominal parameters

Y? = Maybe, needs more study

N = No, probably because of backgrounds

? = Needs more study

?? = Y? - ϵ