

# $E_{CM}^{bias}$ in the presence of Beamstrahlung

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# Summary of $E_{CM}$ Bias studies w/ Beamstrahlung OFF

(larger for WARM)      (larger for COLD)      (comparable at WARM, COLD)  
**Wakefields** + **Disruption**  $\longrightarrow$  **Y-Z Kink instability**

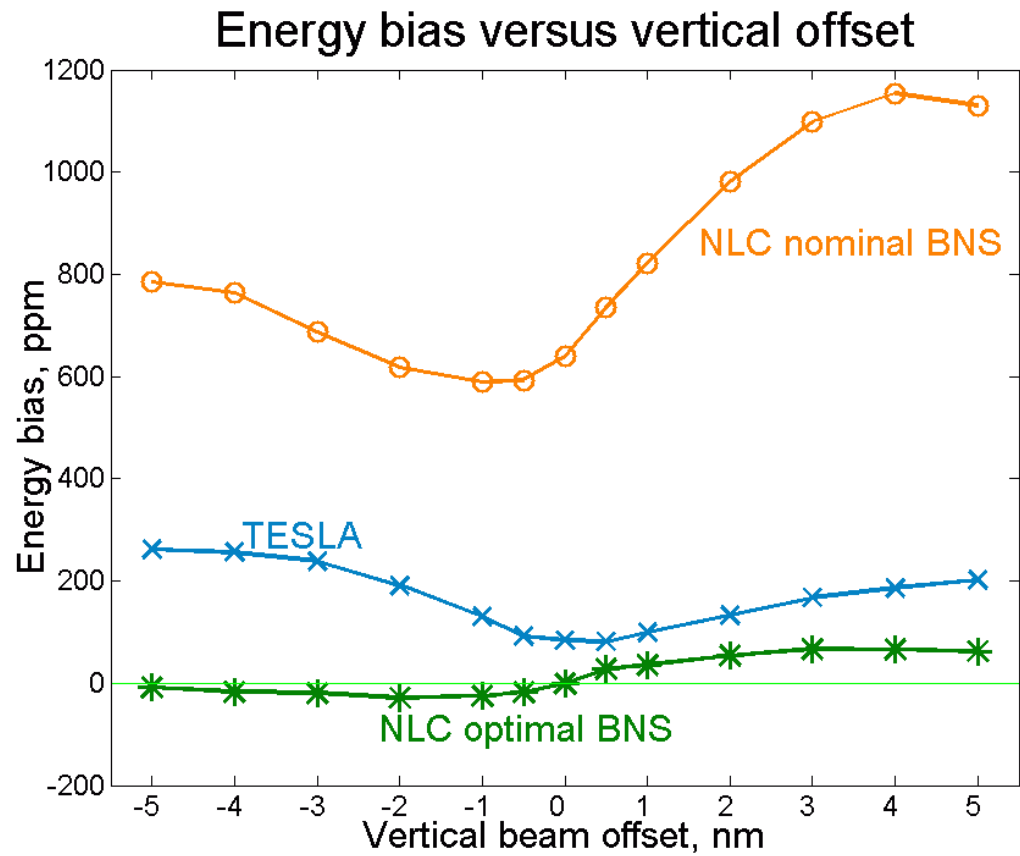
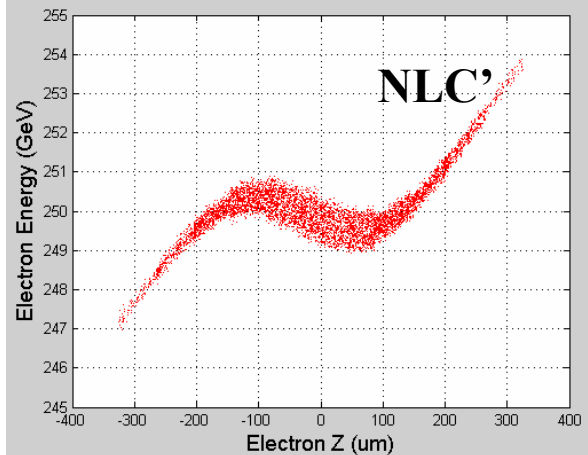
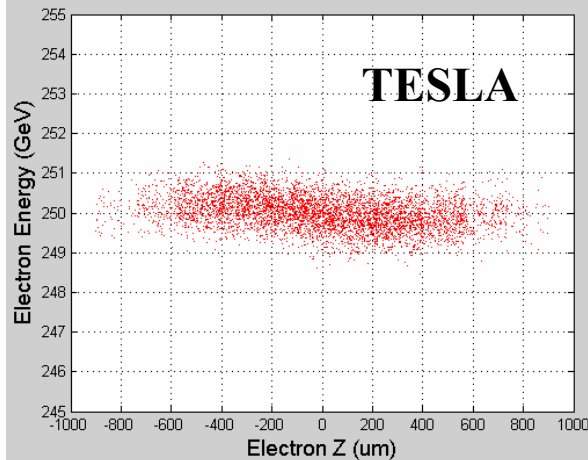
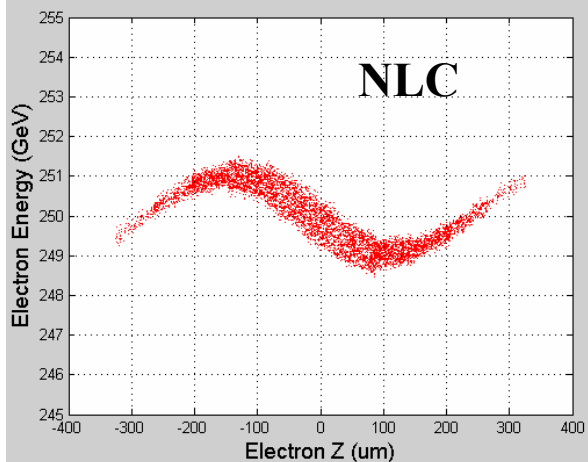
(larger for WARM)      (comparable at WARM, COLD)      (larger for WARM)  
**E-Spread + E-Z correlation + Y-Z Kink instability**  $\longrightarrow$   **$E_{CM}$  Bias**

$$E_{CM}^{Bias} = \frac{\langle E_1 \rangle + \langle E_2 \rangle - \langle E_{CM}^{lum-wt} \rangle}{\langle E_1 \rangle + \langle E_2 \rangle},$$

$E_1$  and  $E_2$  are beam energies measured by the energy spectrometers. (ISR and beamstrahlung are turned off for this study.)

Summary of  $E_{CM}^{bias}$

LC Machine Design	$\langle E_{CM}^{bias} \rangle$ ( $\Delta y = 0$ )	$\sigma(E_{CM}^{bias})$ ( $\Delta y = 0$ )	Max( $E_{CM}^{bias}$ ) ) vary $\Delta y, \eta_y$
WARM-500	+520 ppm	170 ppm	+1000 ppm
COLD-500	+50 ppm	30 ppm	+250 ppm



### Summary of $E_{CM}^{bias}$

LC Machine Design	$\langle E_{CM}^{bias} \rangle$ ( $\Delta y = 0$ )	$\sigma(E_{CM}^{bias})$ ( $\Delta y = 0$ )	Max( $E_{CM}^{bias}$ ) vary $\Delta y, \eta_y$
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<b>COLD-500</b>	+50 ppm	30 ppm	<b>+250 ppm</b>
<b>NLC'-500</b>	0 ppm	10 ppm	<b>+50 ppm</b>

# Definition of $E_{CM}^{Bias}$ (BSL OFF)

$$E_{CM}^{Bias} = \frac{\langle E_1 \rangle + \langle E_2 \rangle - \langle E_{CM}^{lum-wt} \rangle}{\langle E_1 \rangle + \langle E_2 \rangle},$$

$E_1$  and  $E_2$  are beam energies measured by the energy spectrometers. (ISR and beamstrahlung are turned off for this study.)

# Definitions of $E_{CM}^{Bias}$ (BSL ON) studied

$$\left( E_{CM}^{Bias} \right)^{BSL} = \left\langle E_{CM}^{lum-wt} \right\rangle_{cutoff}^{BSLon,normal} - \left\langle E_{CM}^{lum-wt} \right\rangle_{cutoff}^{BSLon,A}$$

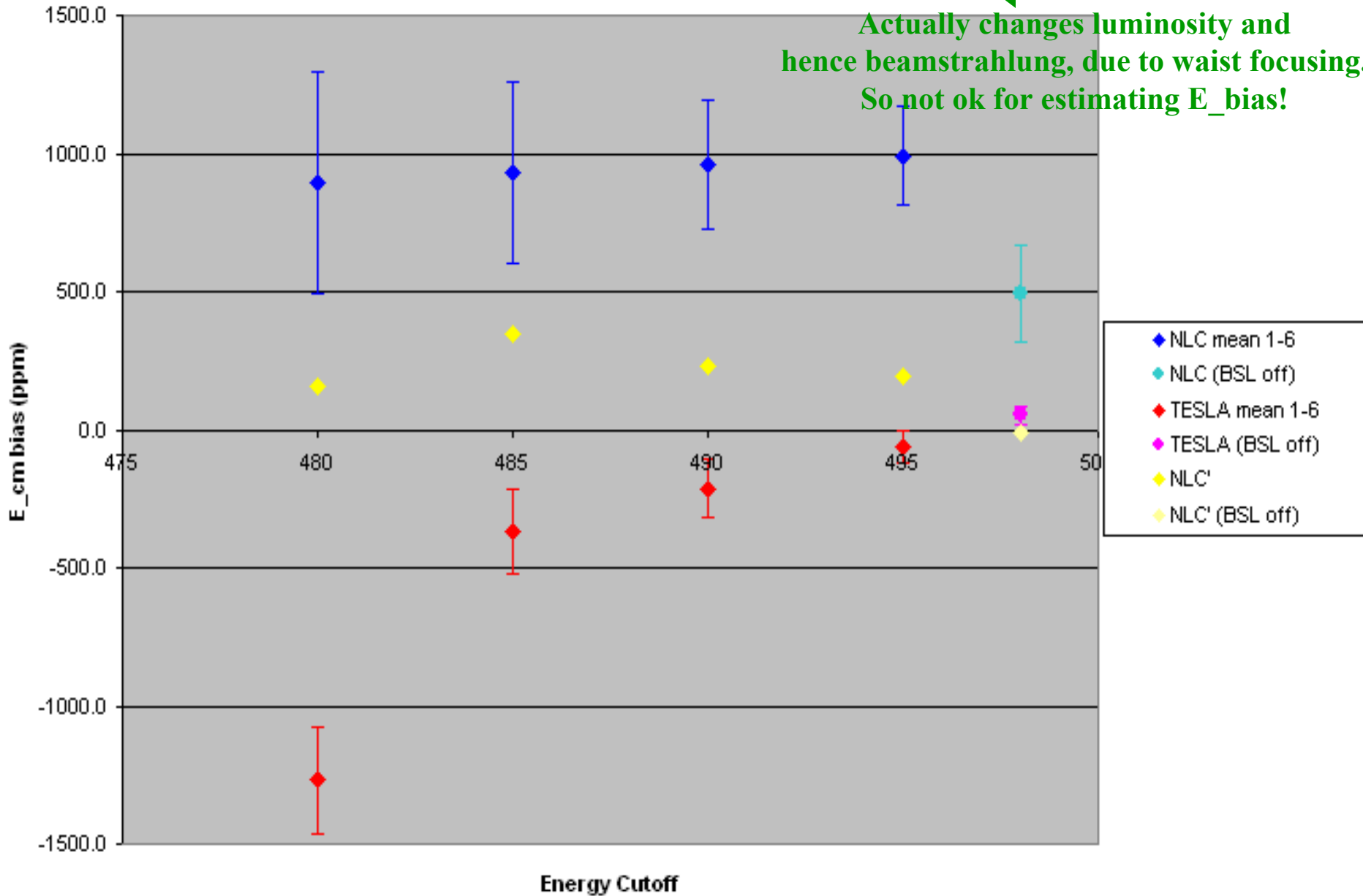
Vary cutoff energy from 480-495 GeV

**gives best results**

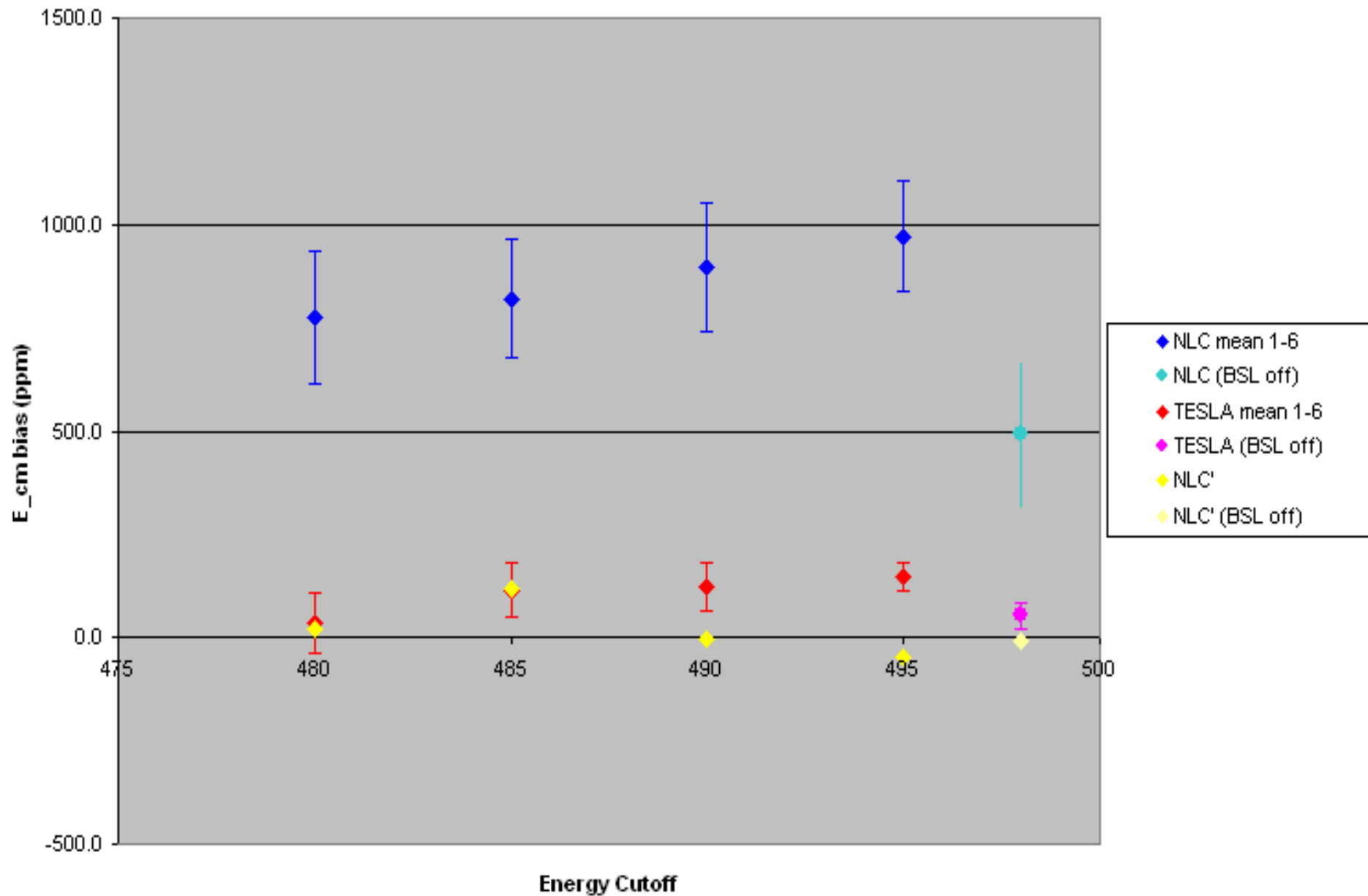
where  $A = \begin{cases} \text{espread off (all energies set to 250 GeV)} \\ \text{gaussian Z (z - distributions in electron.ini, positron.ini replaced w/random gaussian)} \\ \text{gaussian E (Energy - distributions in electron.ini, positron.ini replaced w/random gaussian)} \\ \text{random E (Energy distributions in electron.ini, positron.ini re - ordered randomly)} \end{cases}$

**E\_bias in the presence of Beamstrahlung**  
[E\_bias (espread on)] - [E-bias (espread on, gaussian Z)]

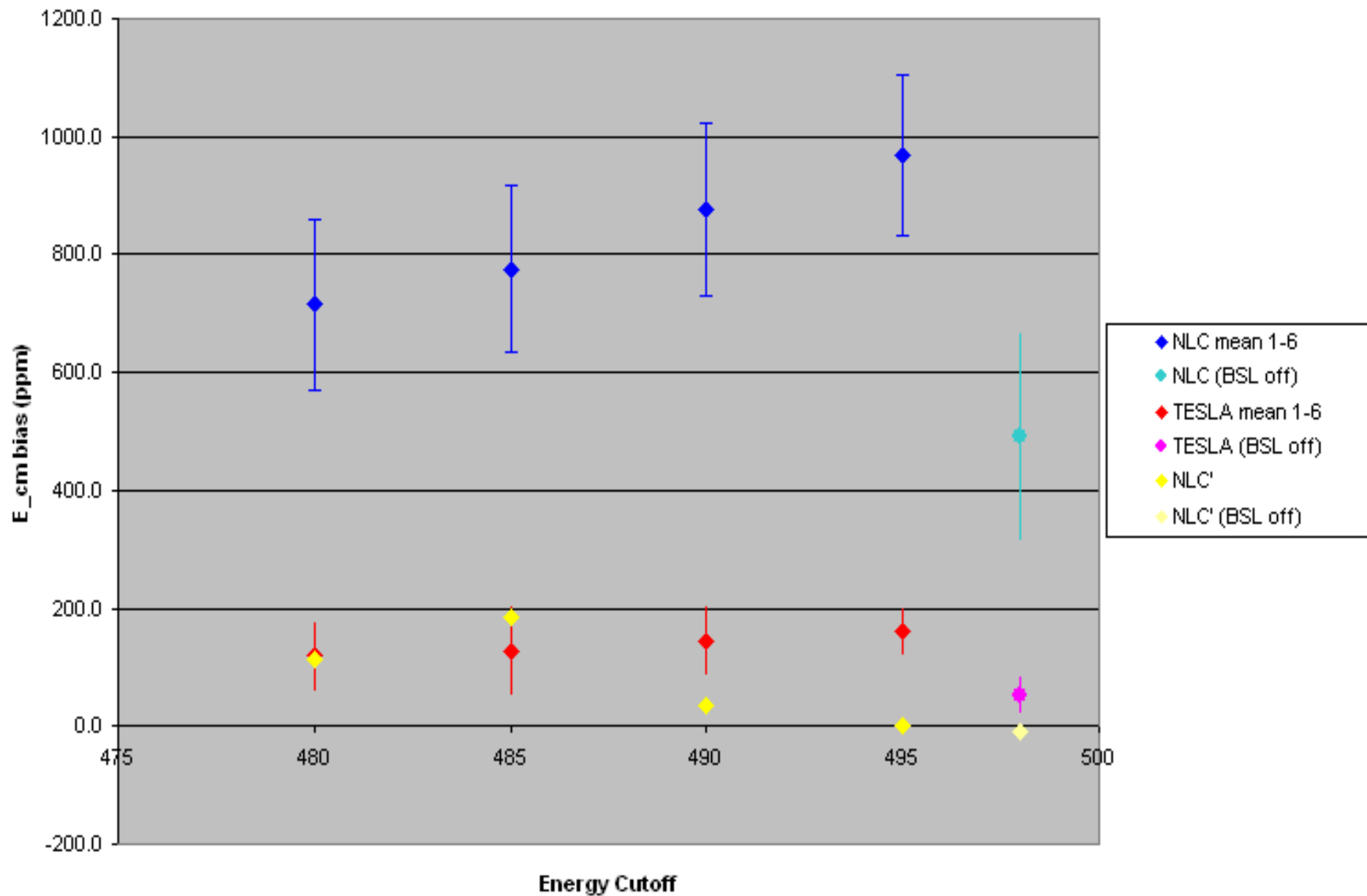
Actually changes luminosity and hence beamstrahlung, due to waist focusing.  
So not ok for estimating E\_bias!



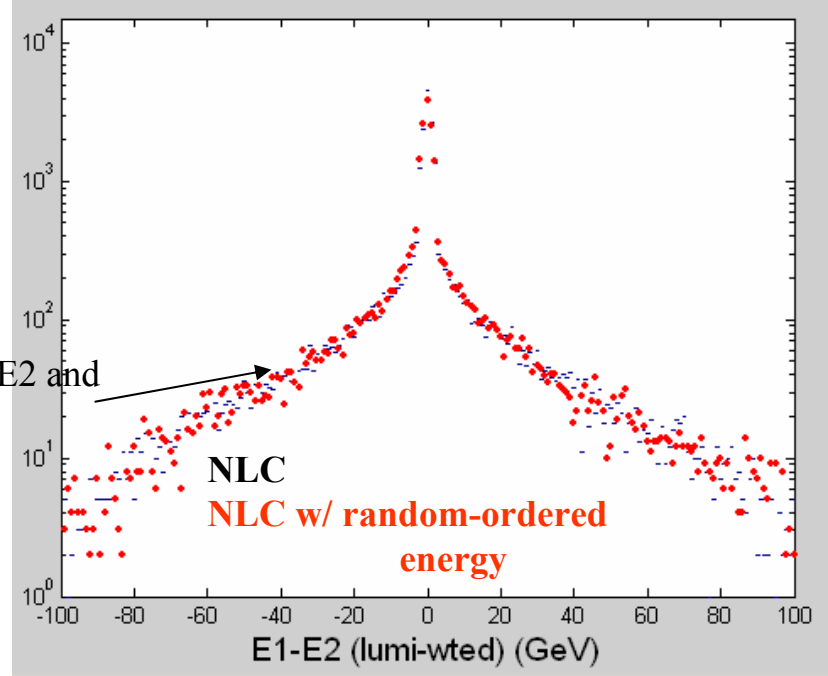
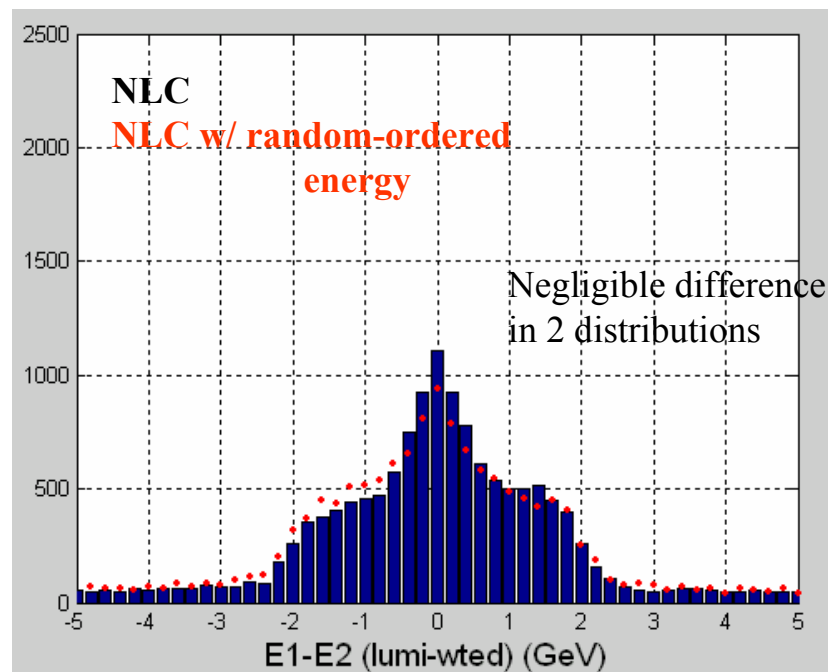
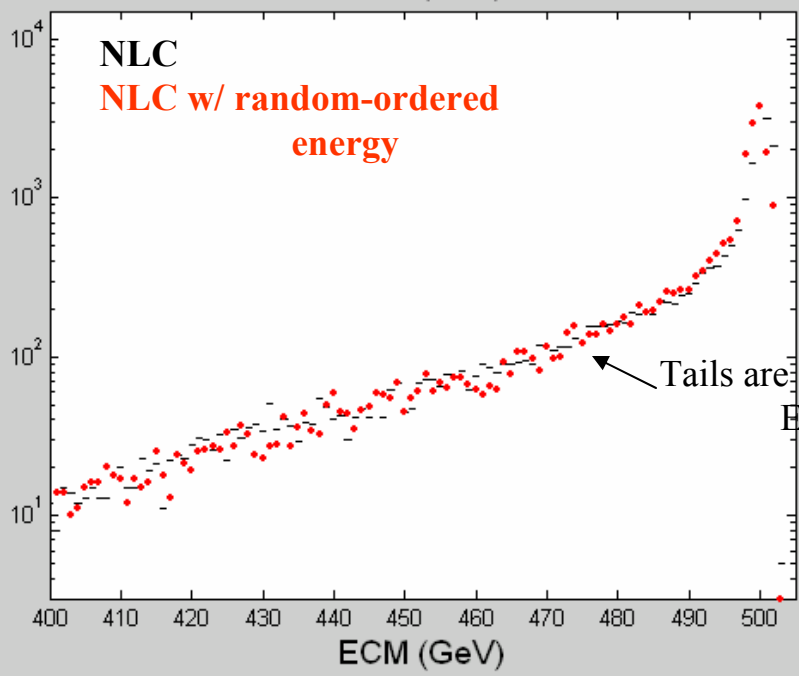
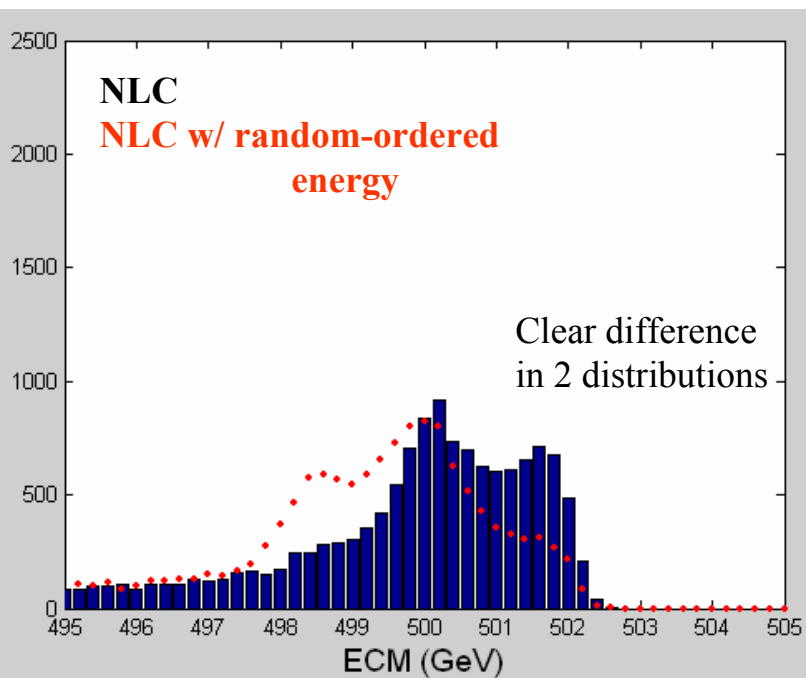
**E\_bias in the presence of Beamstrahlung**  
**[E\_bias (espread on)] - [E\_bias (no espread: e1+e2=500)]**



**E\_bias in the presence of Beamstrahlung**  
**[E\_bias (espread on)] - [E-bias (espread on, gaussian E)]**

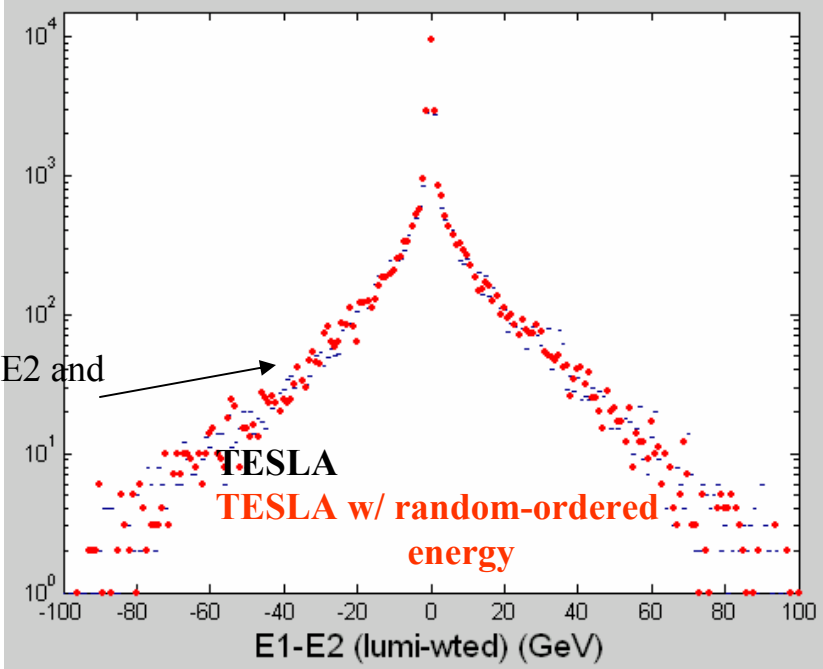
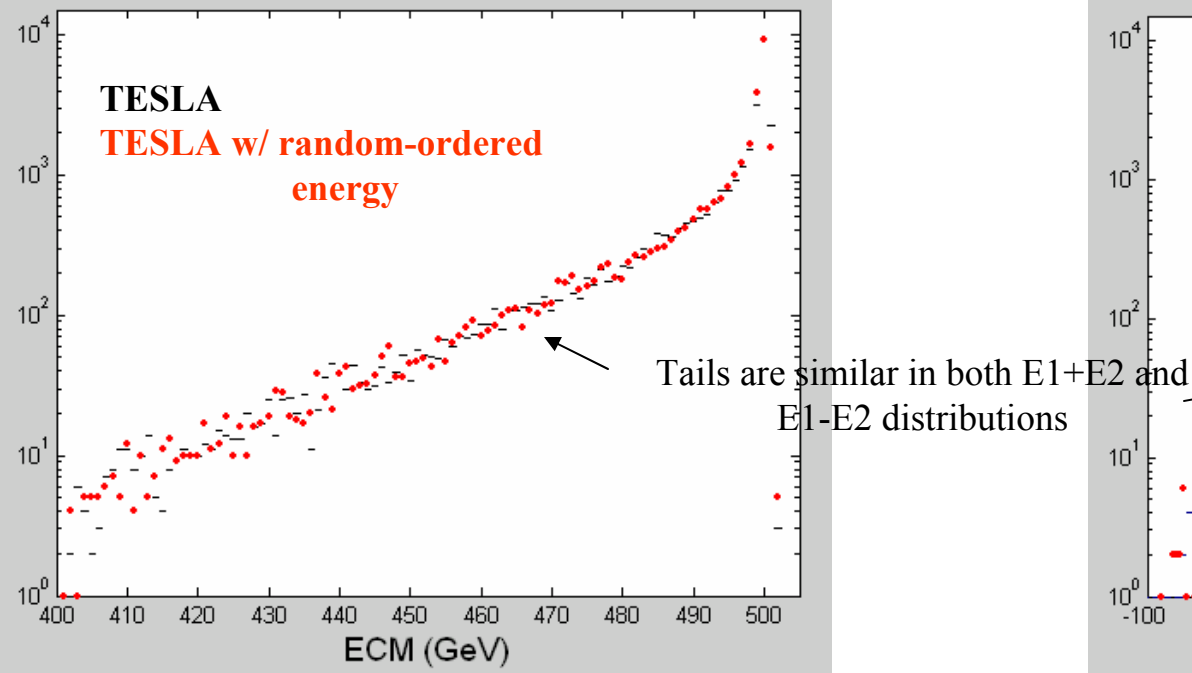
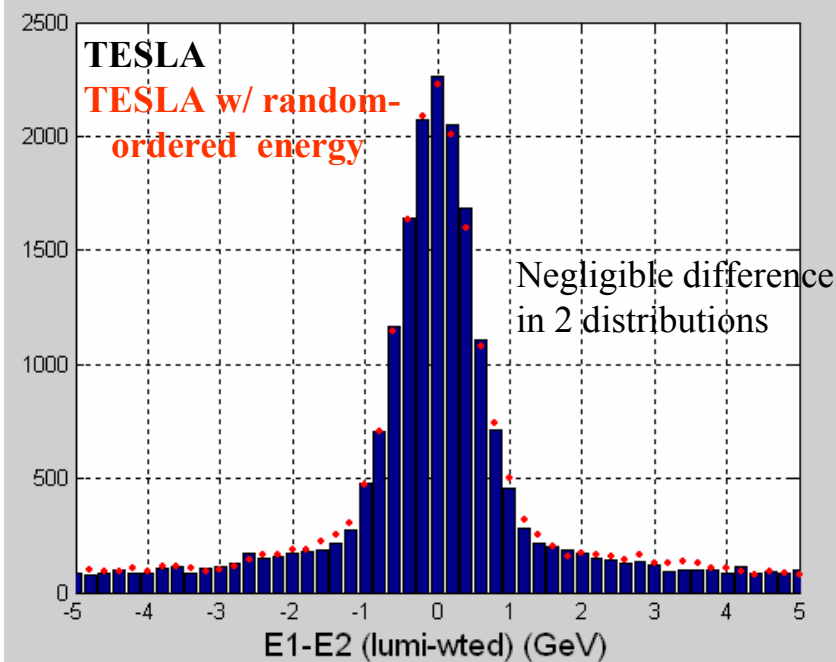
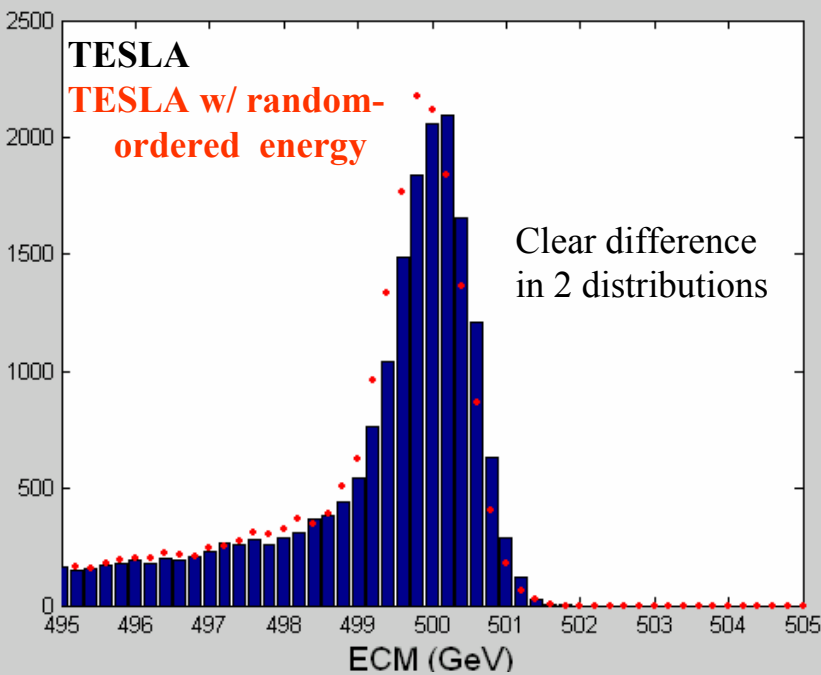


# NLC1

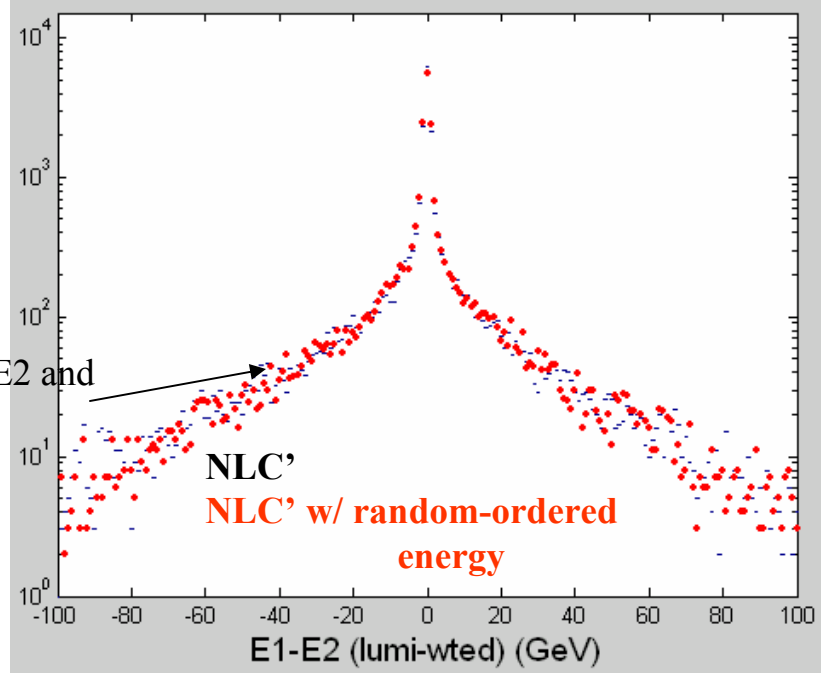
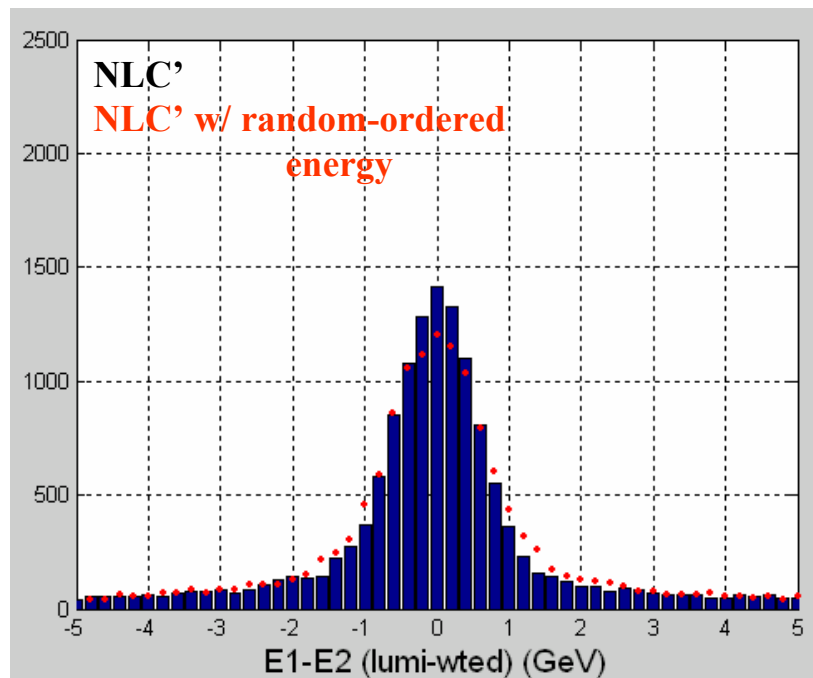
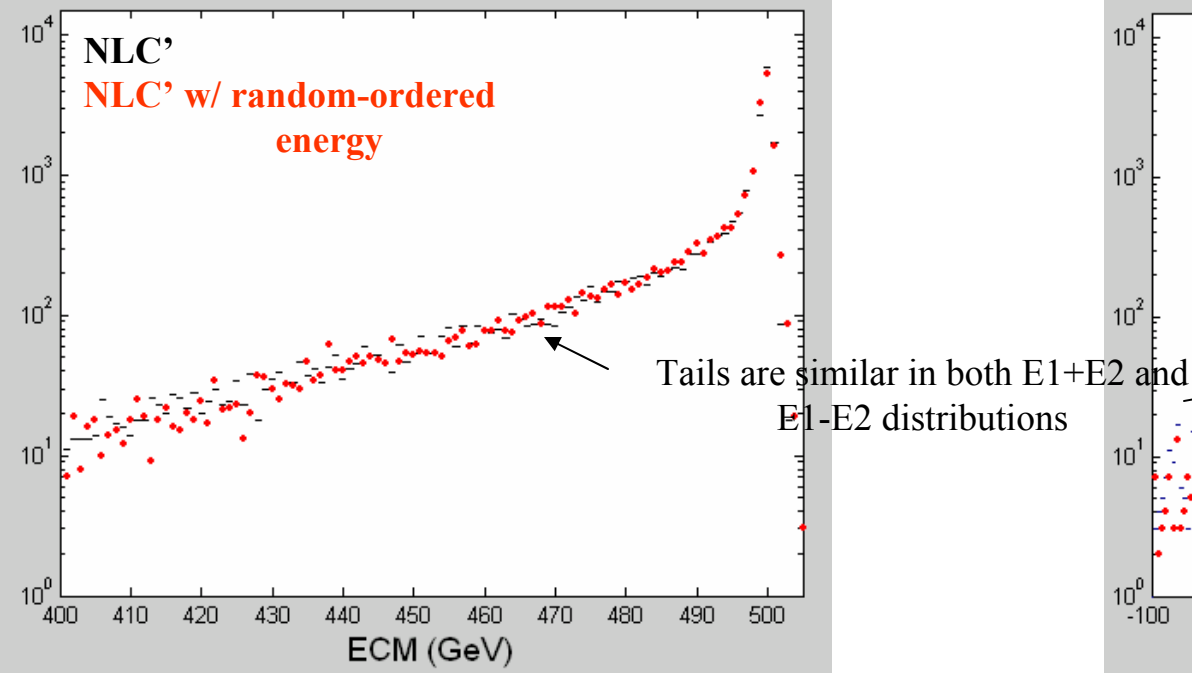
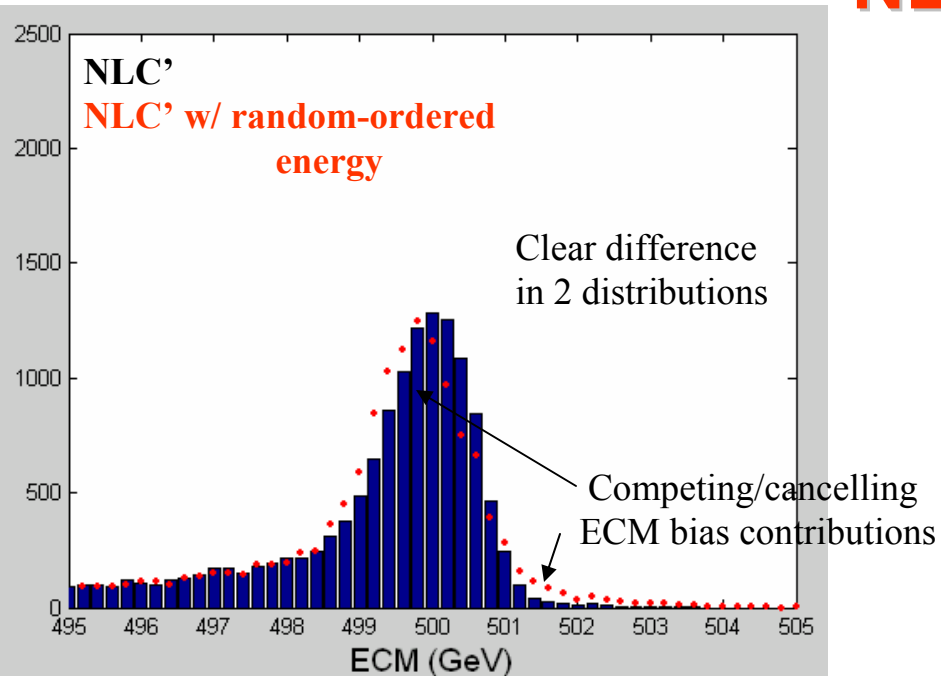




# TESLA1



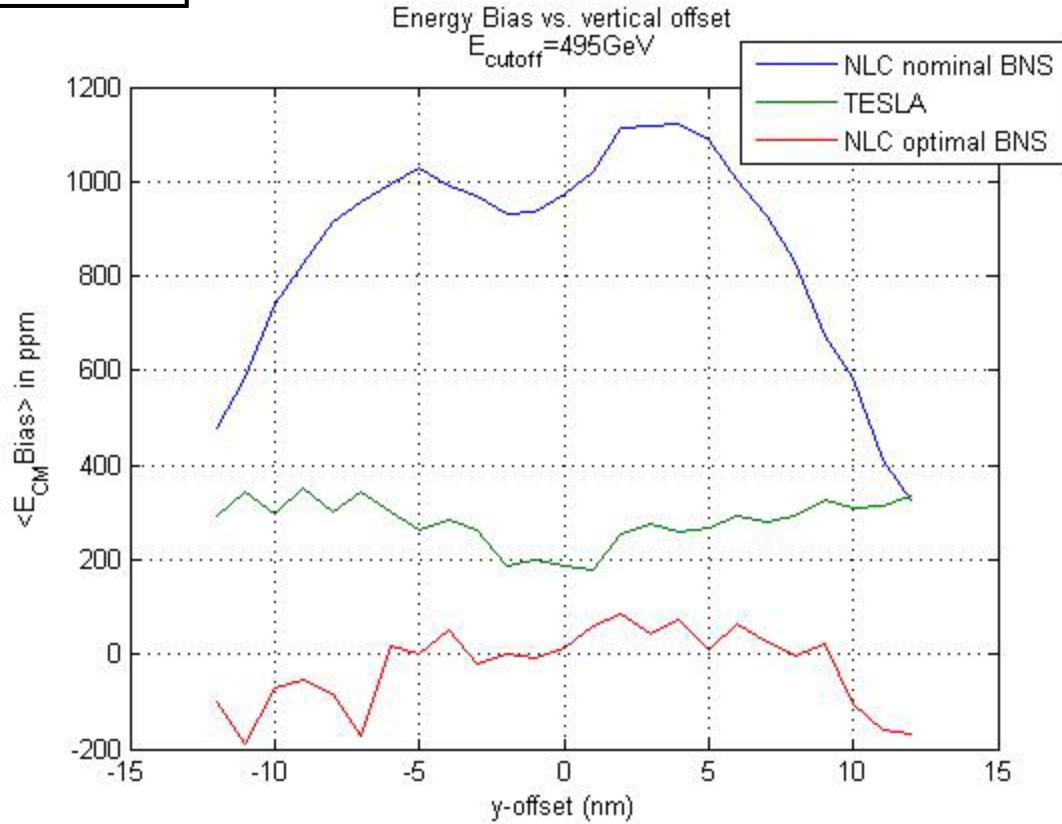
# NLC'



# Offset scan, $E_{CM}$ bias vs. y-offset Beamstrahlung turned on

$E_{cutoff} = 495 \text{ GeV}$

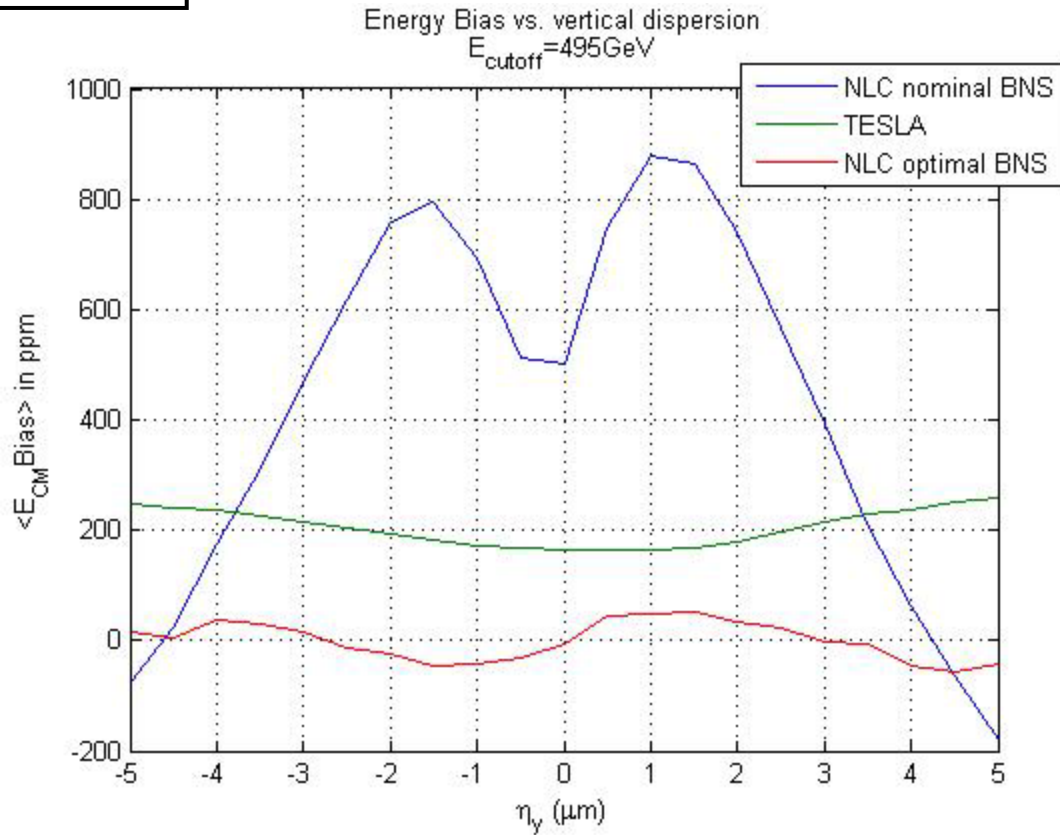
Espread on- gaussian E

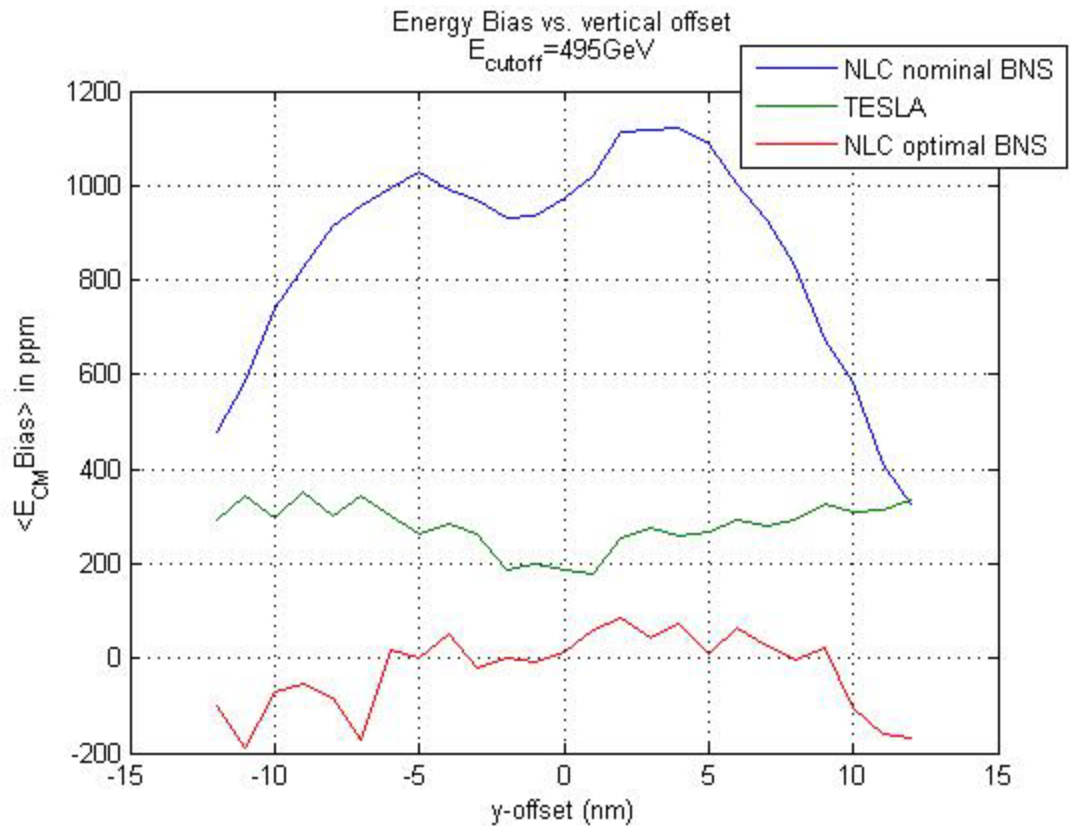
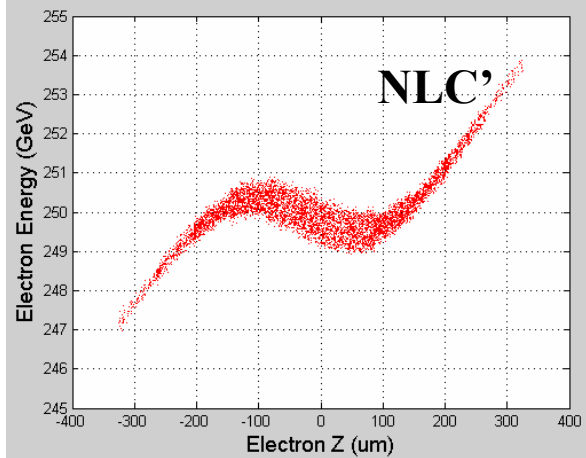
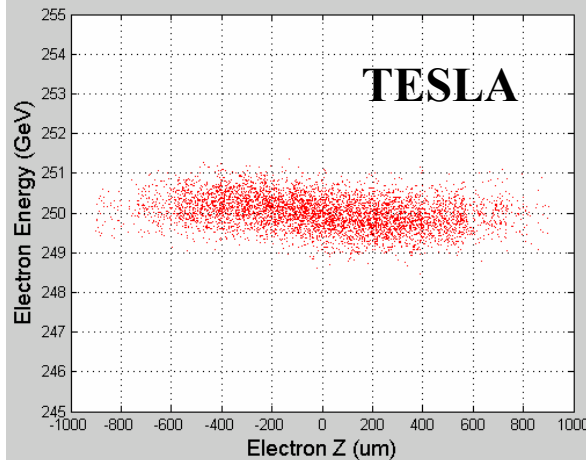
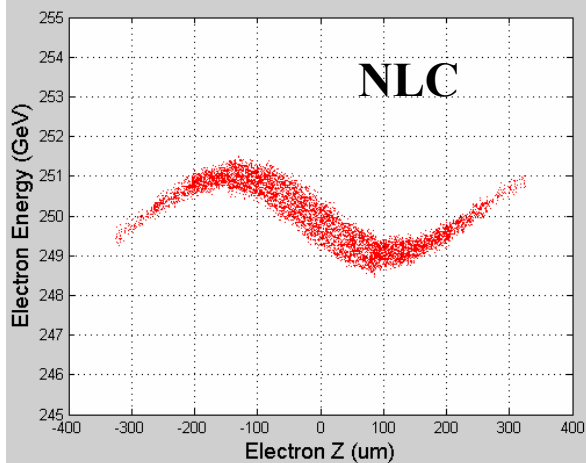


# Offset scan, $E_{CM}$ bias vs. $y$ dispersion Beamstrahlung turned on

$E_{cutoff} = 495 \text{ GeV}$

Es spread on- gaussian E





**Summary of  $E_{CM}^{bias}$  in presence of BSL**  
 (uses gaussian E results w/  $E_{cutoff} = 495 \text{ GeV}$ )

LC Machine Design	$\langle E_{CM}^{bias} \rangle$ ( $\Delta y = 0$ )	$\sigma(E_{CM}^{bias})$ ( $\Delta y = 0$ )	Max( $E_{CM}^{bias}$ ) vary $\Delta y, \eta_y$
WARM-500	+970 ppm	140 ppm	+1120 ppm
COLD-500	+170 ppm	40 ppm	+350 ppm
NLC'-500	2 ppm	23 ppm	-190 ppm

**Summary of  $E_{CM}^{bias}$  without BSL**

LC Machine Design	$\langle E_{CM}^{bias} \rangle$ ( $\Delta y = 0$ )	$\sigma(E_{CM}^{bias})$ ( $\Delta y = 0$ )	Max( $E_{CM}^{bias}$ ) vary $\Delta y, \eta_y$
WARM-500	+520 ppm	170 ppm	+1000 ppm
COLD-500	+50 ppm	30 ppm	+250 ppm
NLC'-500	0 ppm	20 ppm	+50 ppm

**Summary of  $E_{CM}^{bias}$  in presence of BSL (uses gaussian E results w/  $E_{cutoff} = 495$  GeV)**

LC Machine Design	$\langle E_{CM}^{bias} \rangle$ ( $\Delta y = 0$ )	$\sigma(E_{CM}^{bias})$ ( $\Delta y = 0$ )	Max( $E_{CM}^{bias}$ ) vary $\Delta y, \eta_y$
WARM-500	+970 ppm	140 ppm	+ 1120 ppm
COLD-500	+170 ppm	40 ppm	+350 ppm
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