

Comparação entre os métodos de Shuffling e Semi-Analítico

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SHUFFLING

- 1) Embaralhamento dos tempos de chegada
- 2) Criação de um conjunto simulado de eventos
- 3) Média dos conjuntos simulados de eventos

SEMI-ANALÍTICO

- Baseia-se no fit da distribuição em ângulo zenital (θ).
- O mapa de cobertura é obtido através de integrações numéricas:

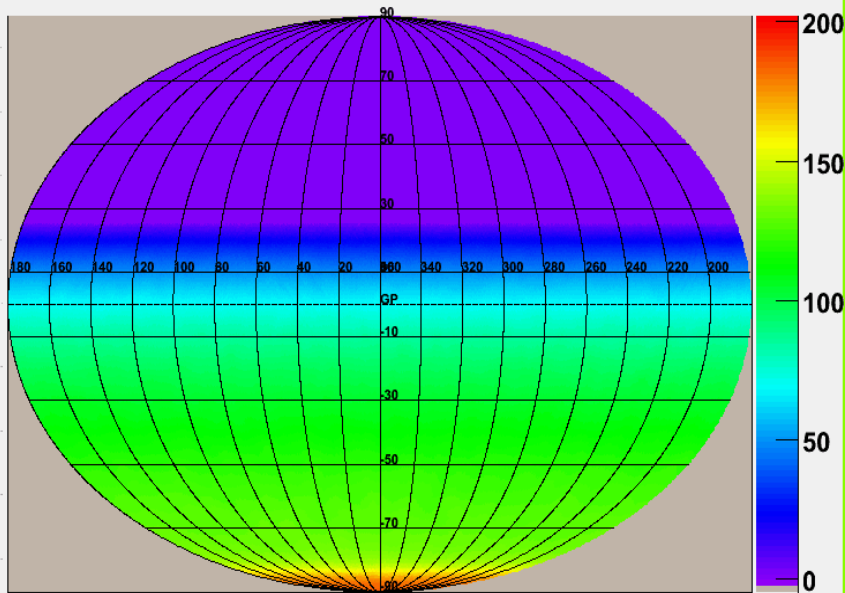
$$C(\delta) = \int_{\theta_h}^{\theta_h + 2\pi} a[\theta(\alpha, \delta)] d\alpha$$

PROCEDIMENTO

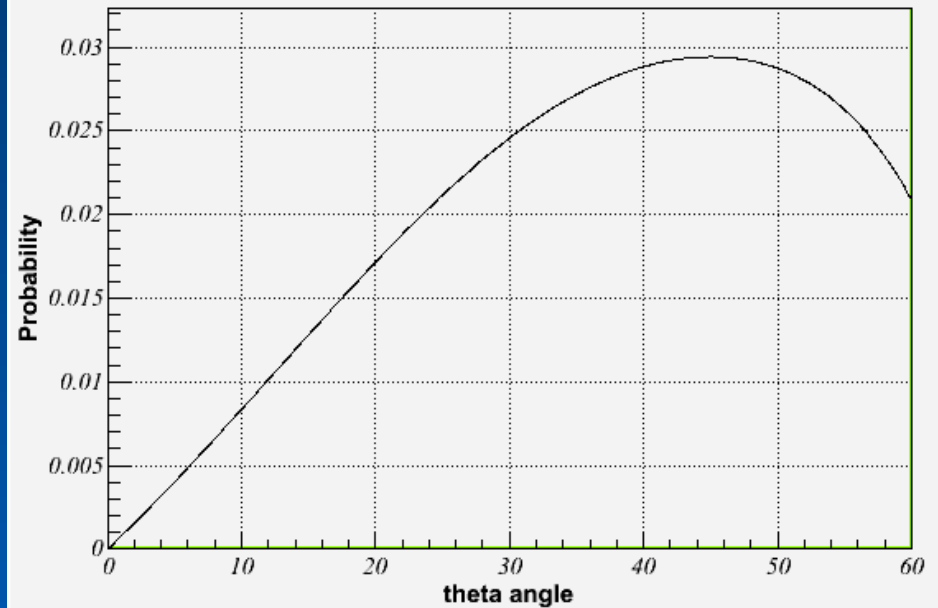
- CÉU ISOTRÓPICO, ACEITÂNCIA CONSTANTE:
 - 2000 shufflings
 - 100 000 eventos
 - 196 608 pixels
 - Cortes de energia:
 - $E > 1 \text{ EeV}$
 - $E < 2 \text{ EeV}$
 - $E > 5 \text{ EeV}$
- DIPOLO, ACEITÂNCIA CONSTANTE:
 - 2000 shufflings
 - 100 000 eventos
 - 196 608 pixels
 - Dipolo em:
 - $(0,0)$
 - $(0,-45)$
 - $(0,-90)$
 - Amplitudes: 5% e 20%
 - Cortes de energia:
 - $E > 1 \text{ EeV}$
 - $E < 2 \text{ EeV}$
 - $E > 5 \text{ EeV}$

CORTES DE ENERGIA: $E > 1 \text{ EeV}$

Real Events Map (smoothed) - Equatorial Coordinates (RA, Dec)=(0,0), full sky

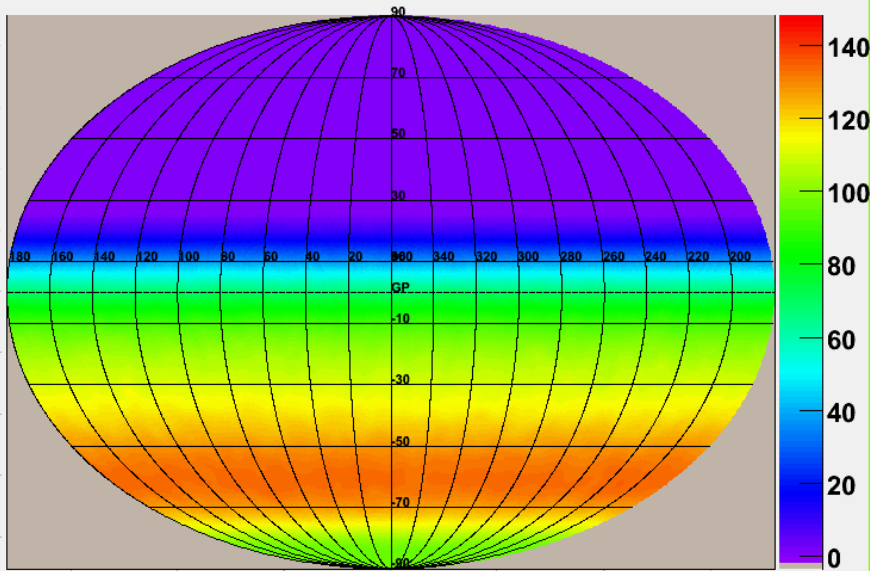


theta angle distribution

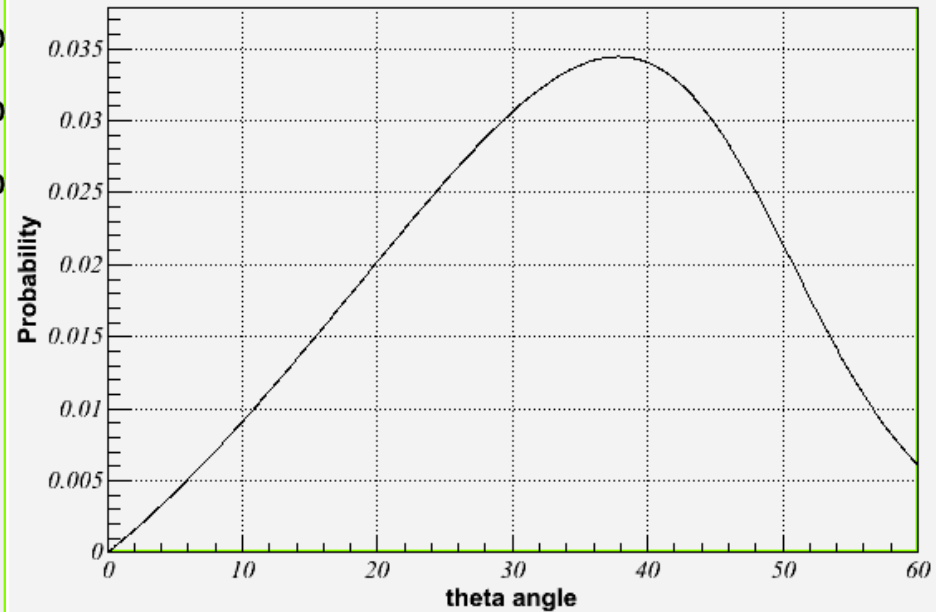


CORTES DE ENERGIA: $E < 2 \text{ EeV}$

Real Events Map (smoothed) - Equatorial Coordinates (RA, Dec)=(0,0), full sky

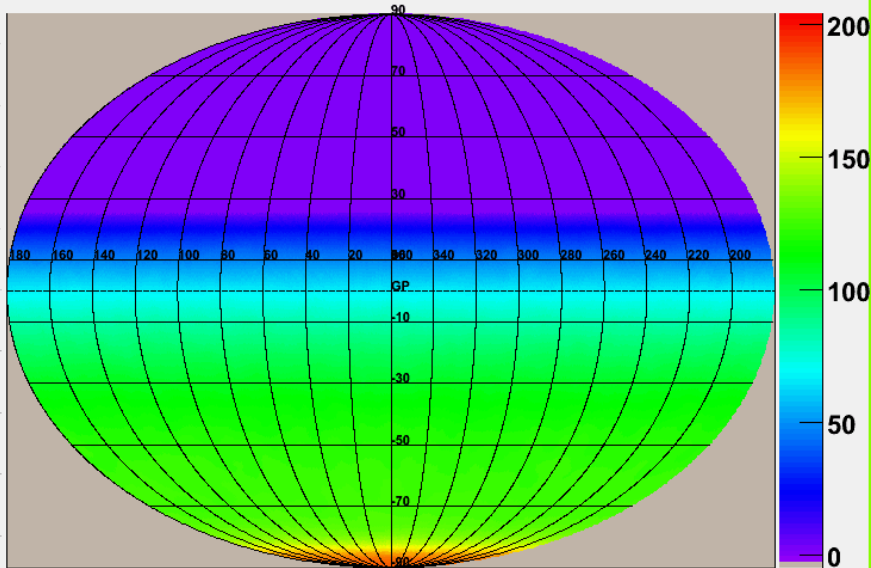


theta angle distribution

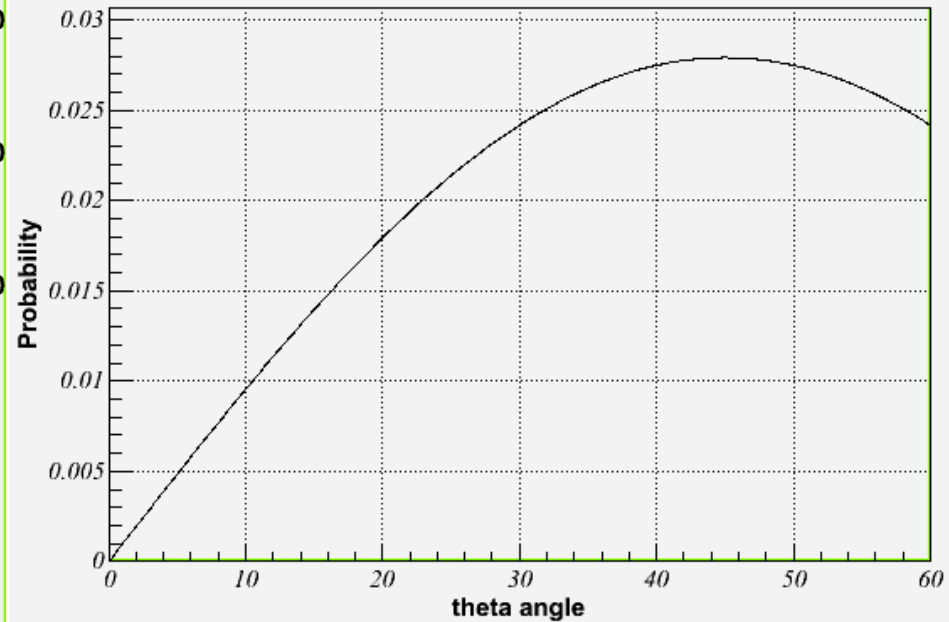


CORTES DE ENERGIA: $E > 5 \text{ EeV}$

Real Events Map (smoothed) - Equatorial Coordinates (RA, Dec)=(0,0), full sky



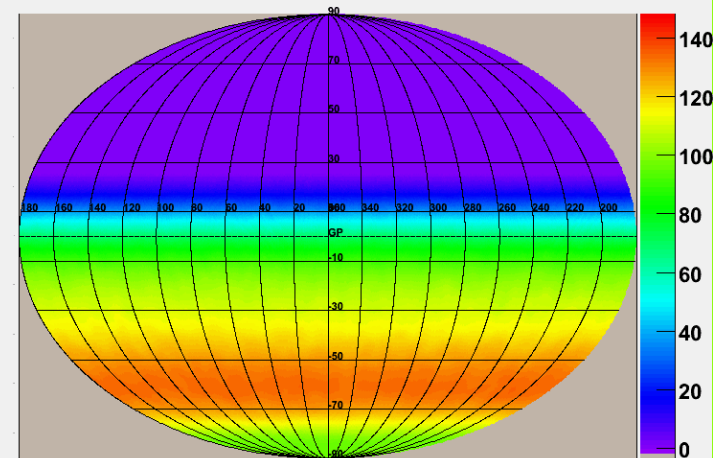
theta angle distribution



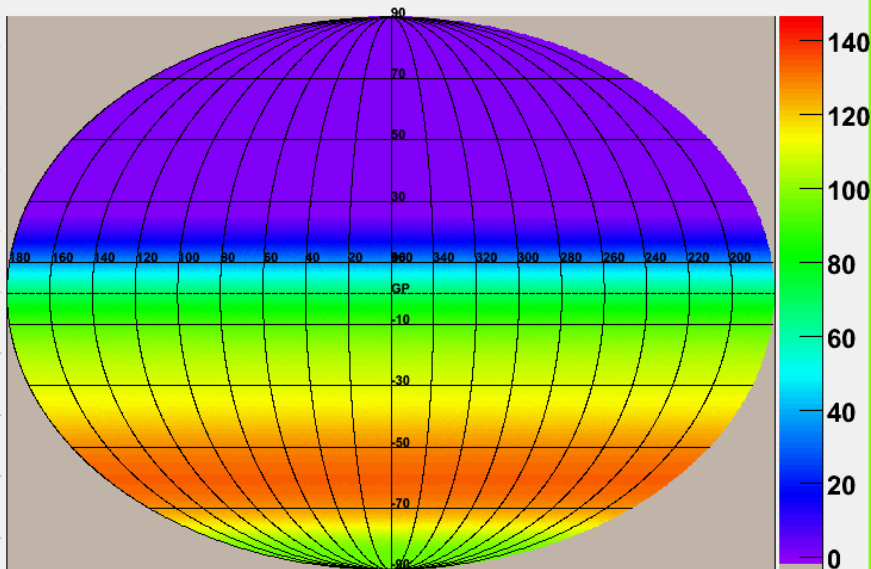
CÁLCULO DO VIÉS

$$Map\ Bias = \frac{Coverage\ Map - True\ Map}{True\ Map}$$

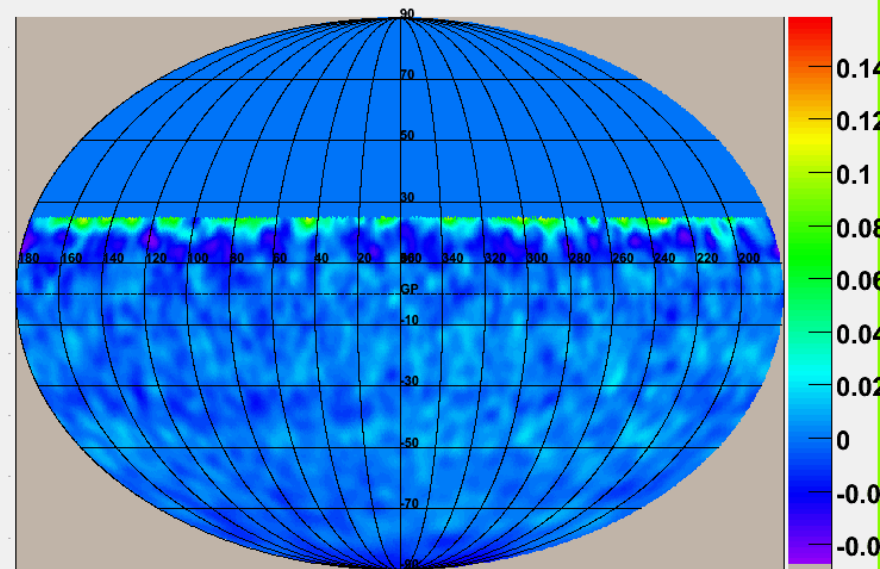
Real Events Map (smoothed) - Equatorial Coordinates (RA, Dec)=(0,0), full sky



Coverage Map (smoothed) - Semi-Analytical (RA, Dec)=(0,0), full sky

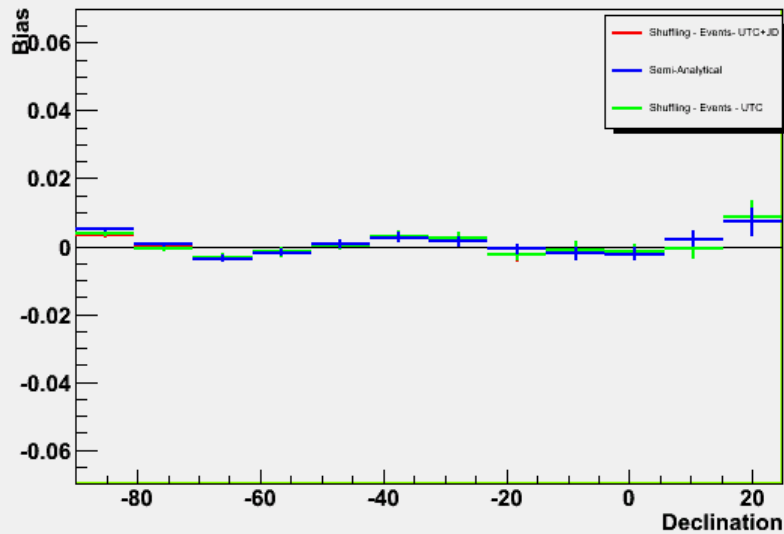


Map Bias Semi-Analytical (smoothed) (RA, Dec)=(0,0), full sky

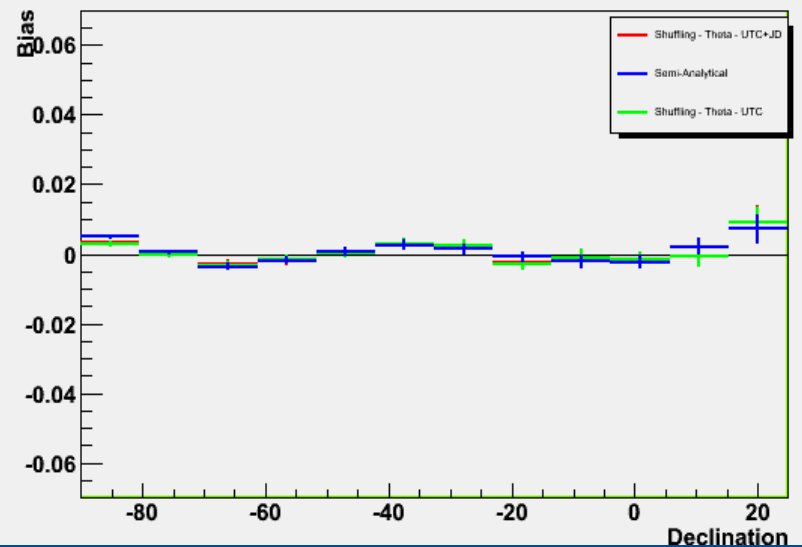


ISOTRÓPICO, $E > 1$ EeV

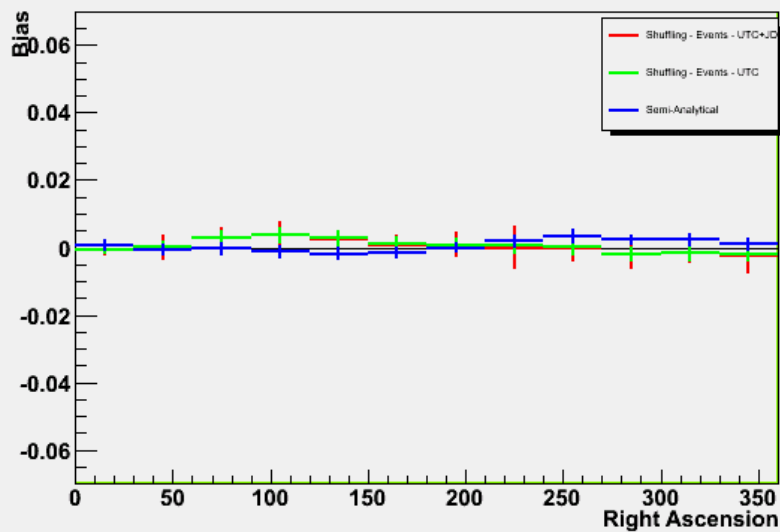
Bias: Declination



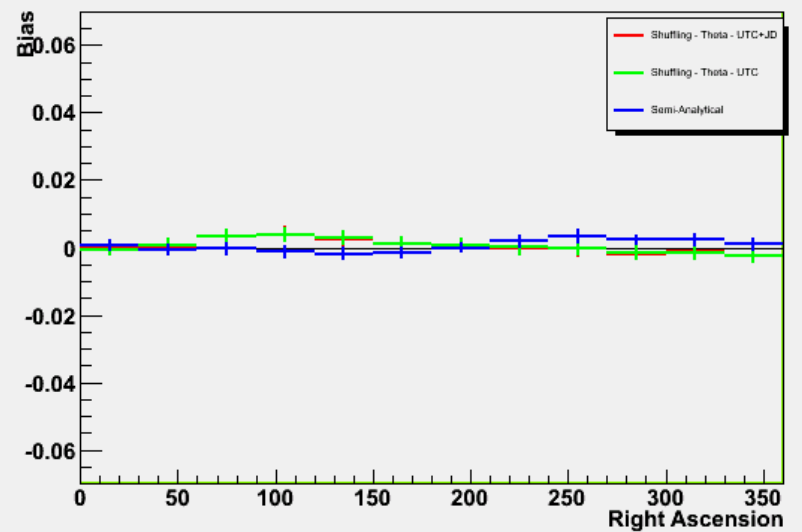
Bias: Declination



Bias - Right Ascension

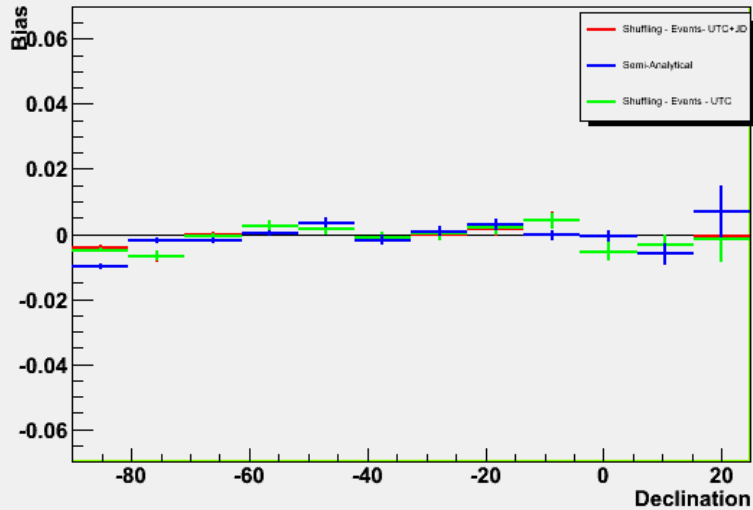


Bias - Right Ascension

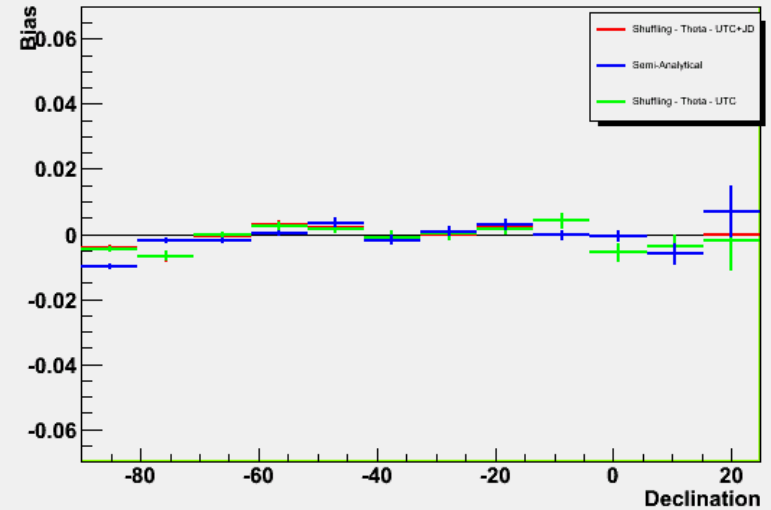


ISOTRÓPICO, $E < 2$ EeV

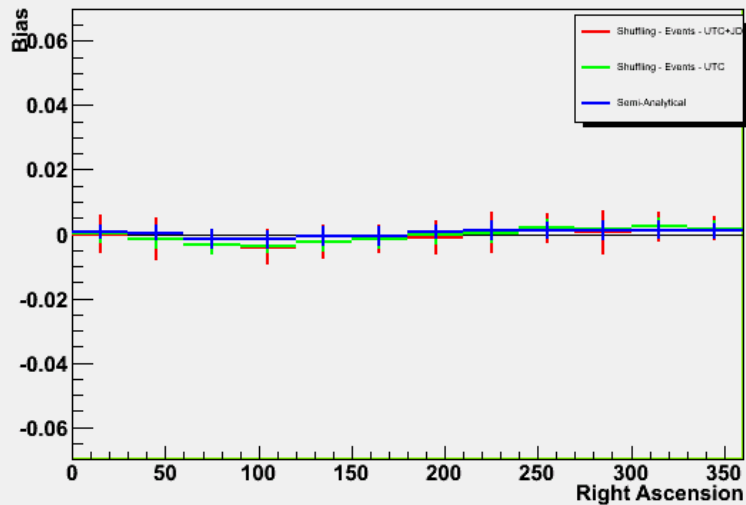
Bias: Declination



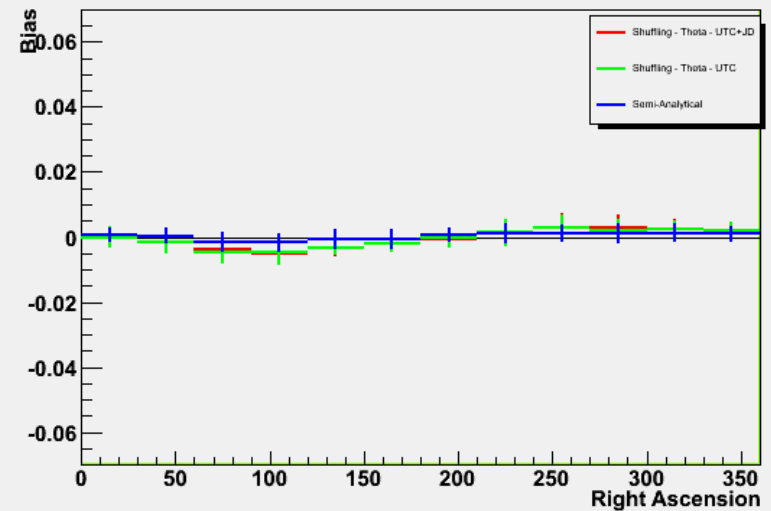
Bias: Declination



Bias - Right Ascension

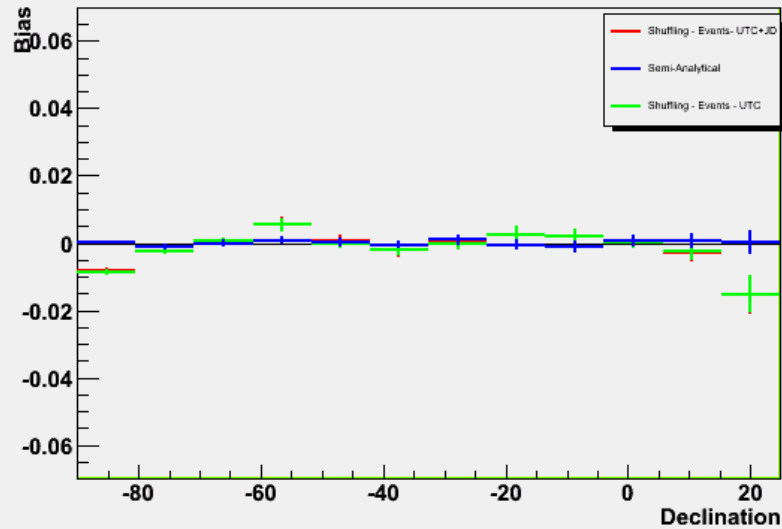


Bias - Right Ascension

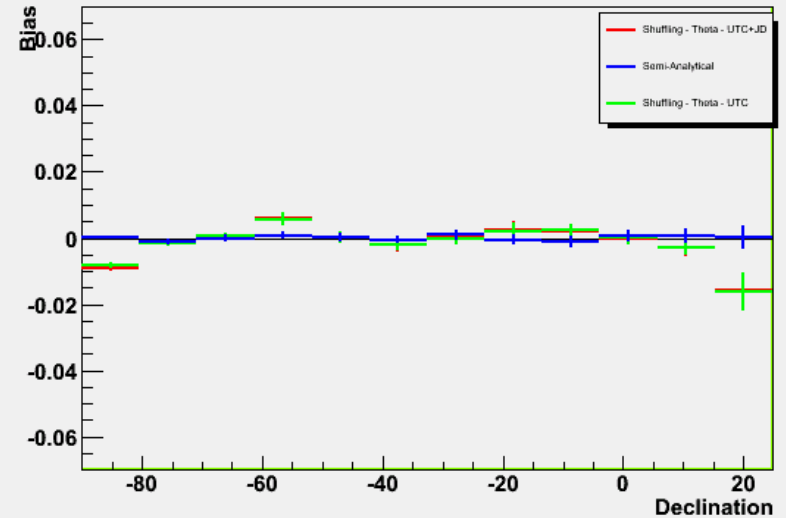


ISOTRÓPICO, $E > 5$ EeV

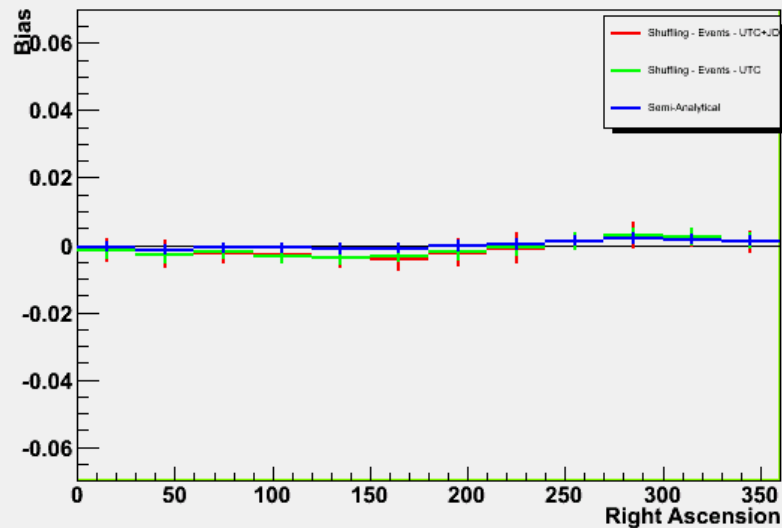
Bias: Declination



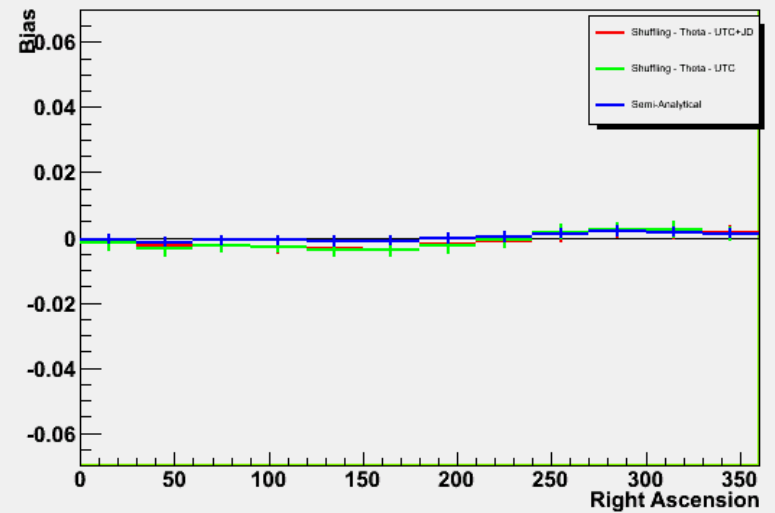
Bias: Declination



Bias - Right Ascension



Bias - Right Ascension



RMS: ISOTRÓPICO

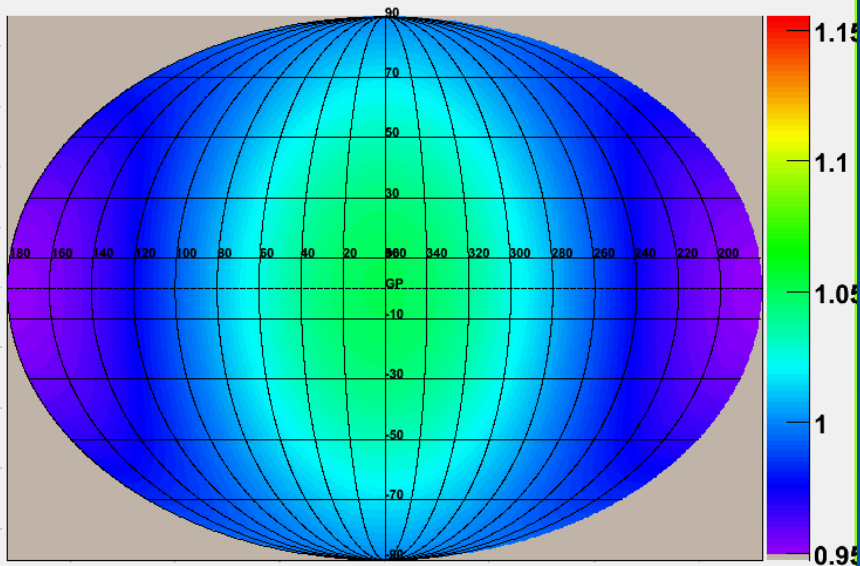
	Shuffling				SA	
Nside	Theta - UTC+JD	Theta - UTC	Events - UTC+J D	Events - UTC	SA	Energy Cut
128	0.00778921	0.00767459	0.0137948	0.00778406	0.00652992	>1
128	0.0118006	0.0116665	0.0184715	0.0100401	0.0096811	<2
128	0.00828422	0.00841423	0.0120966	0.0084235	0.00562429	>5

DIPOLO: (0,0)

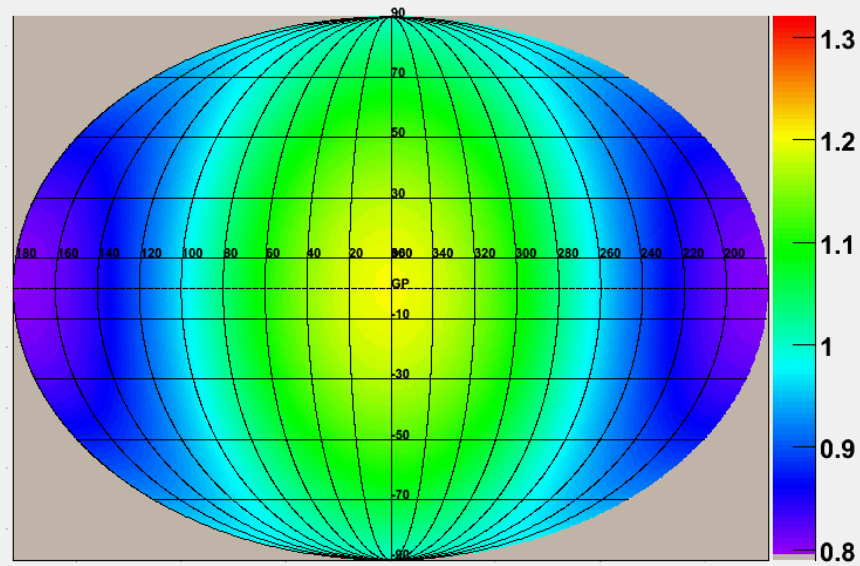
Amplitude 5%

Amplitude 20%

Simulated Dipole - Equatorial Coordinates (RA, Dec)=(0,0), full sky



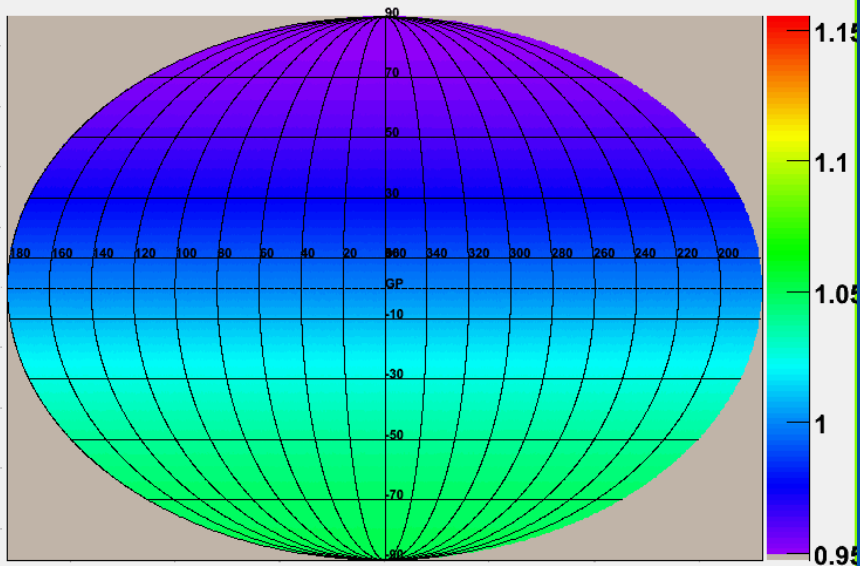
Simulated Dipole - Equatorial Coordinates (RA, Dec)=(0,0), full sky



DIPOLO: (0,-90)

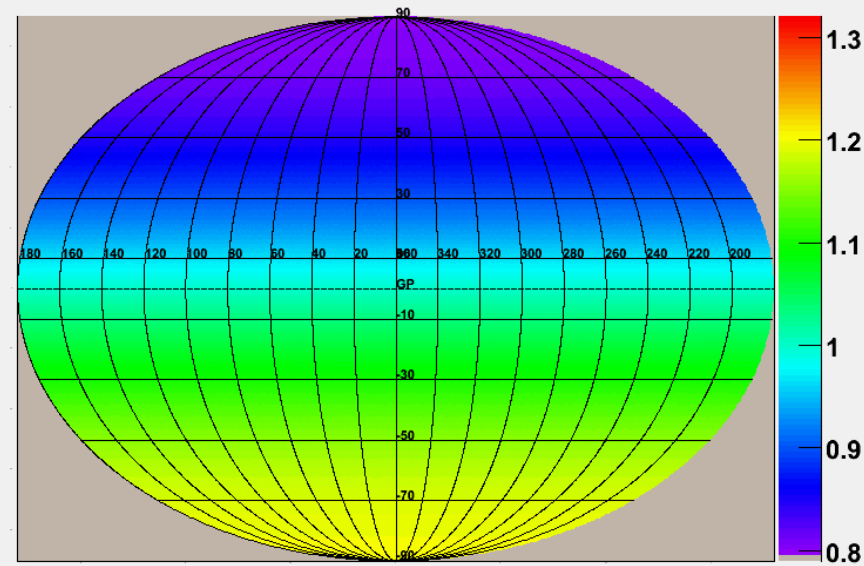
Amplitude 5%

Simulated Dipole - Equatorial Coordinates (RA, Dec)=(0,0), full sky



Amplitude 20%

Simulated Dipole - Equatorial Coordinates (RA, Dec)=(0,0), full sky

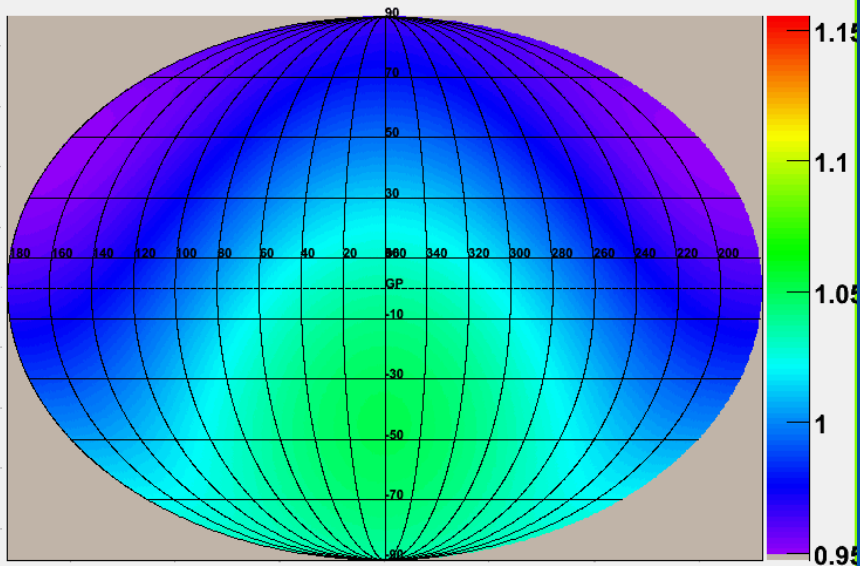


DIPOLO: (0,-45)

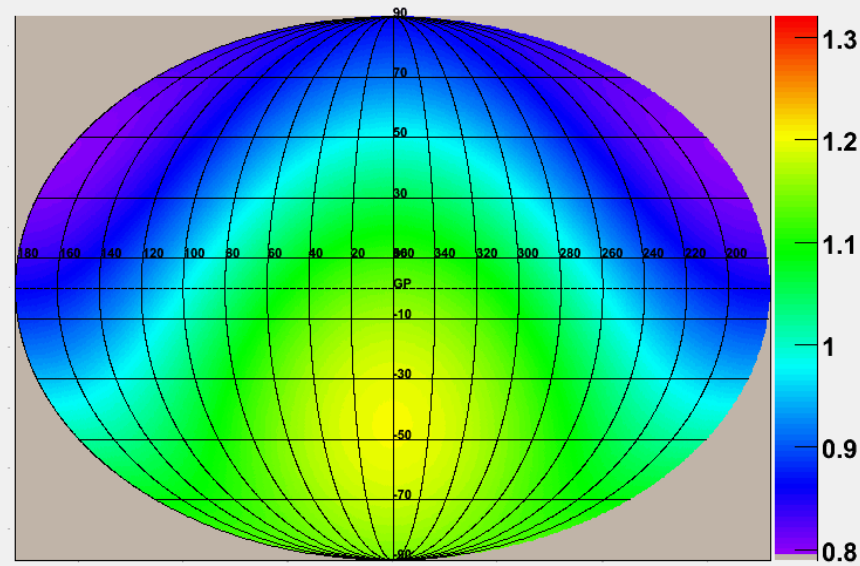
Amplitude 5%

Amplitude 20%

Simulated Dipole - Equatorial Coordinates (RA, Dec)=(0,0), full sky

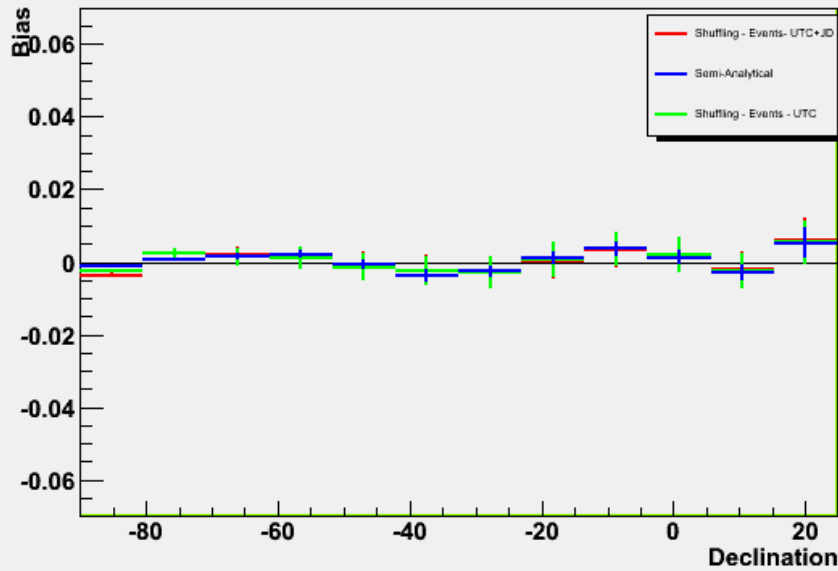


Simulated Dipole - Equatorial Coordinates (RA, Dec)=(0,0), full sky

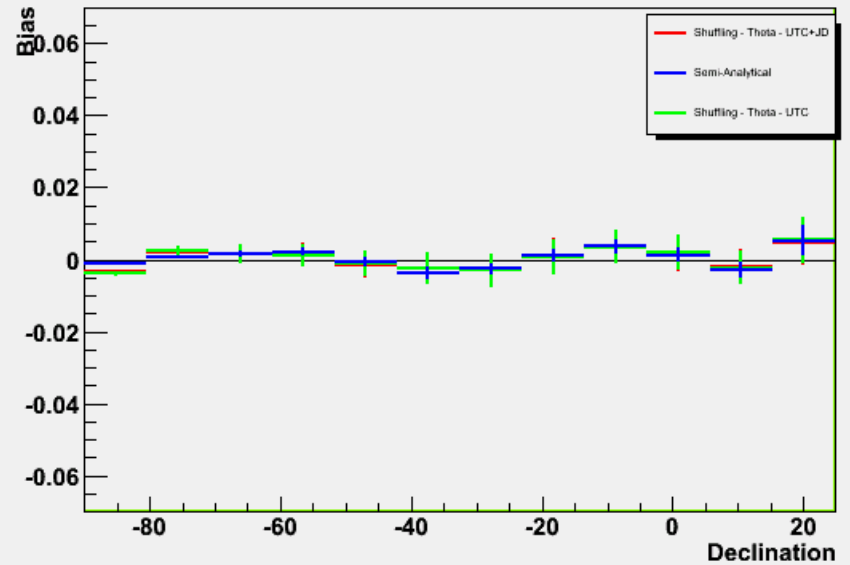


DIPOLO, $E > 1$ EeV, AMP 5%, (0,0)

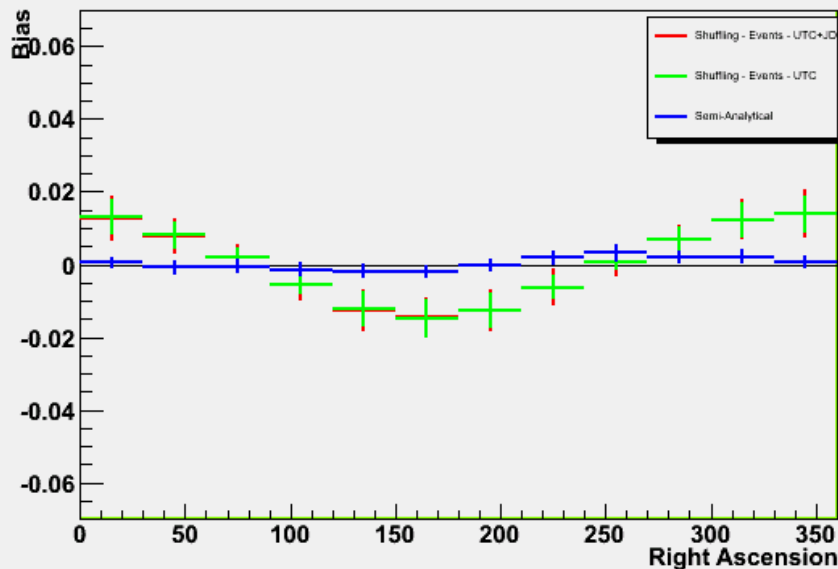
Bias: Declination



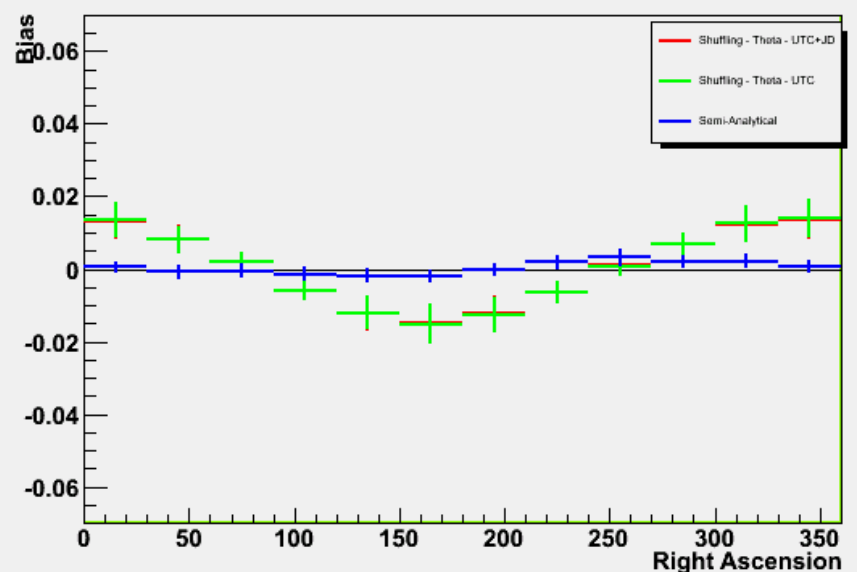
Bias: Declination



Bias - Right Ascension

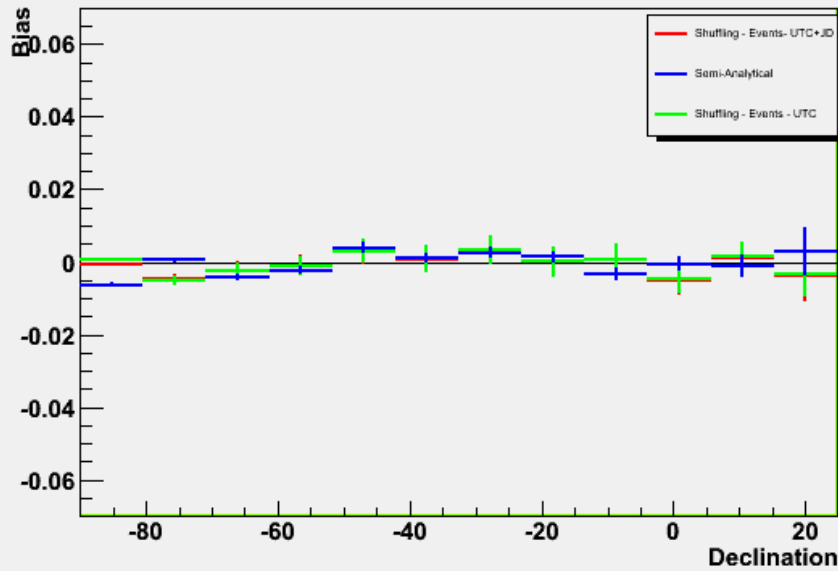


Bias - Right Ascension

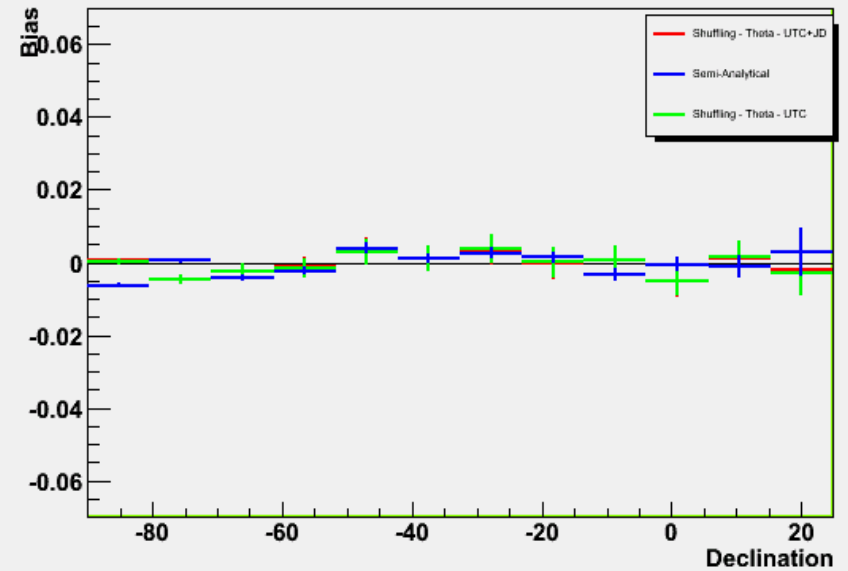


DIPOLO, $E < 2$ EeV, AMP 5%, (0,0)

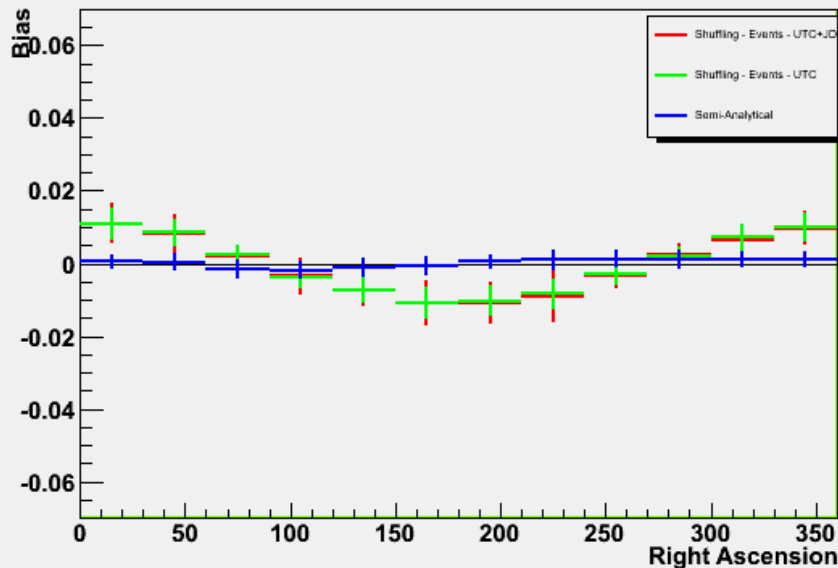
Bias: Declination



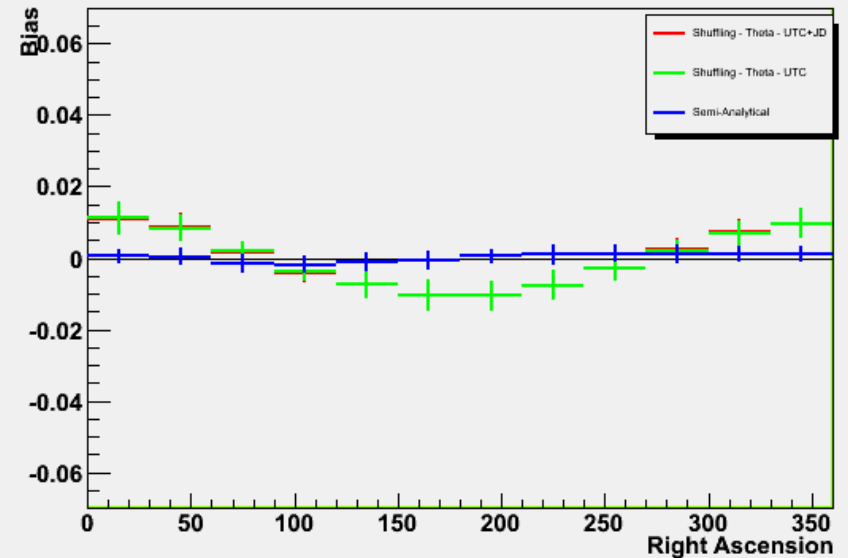
Bias: Declination



Bias - Right Ascension

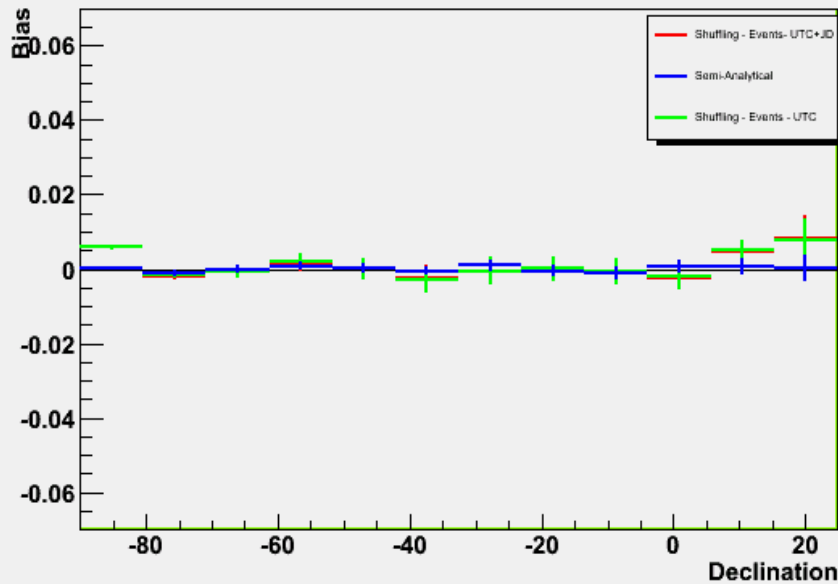


Bias - Right Ascension

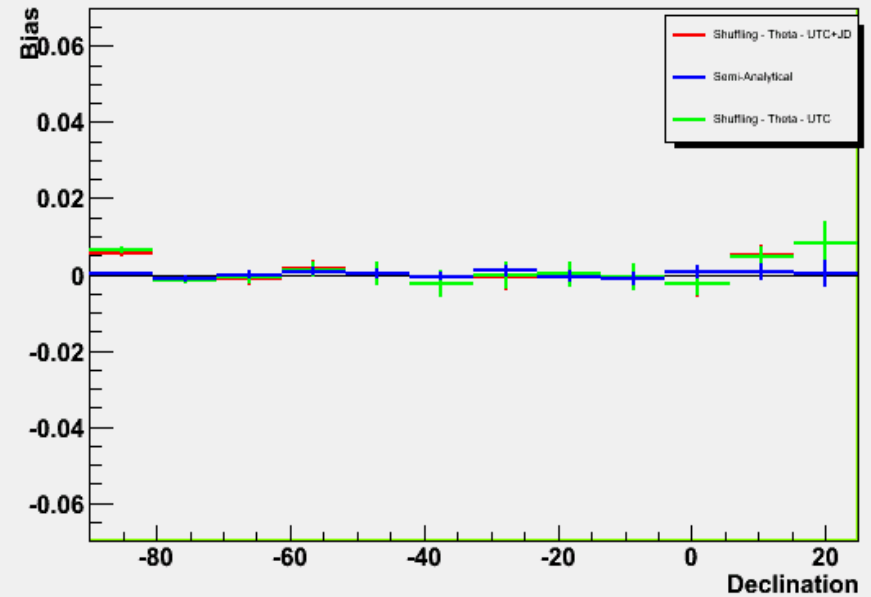


DIPOLO, $E > 5$ EeV, AMP 5%, (0,0)

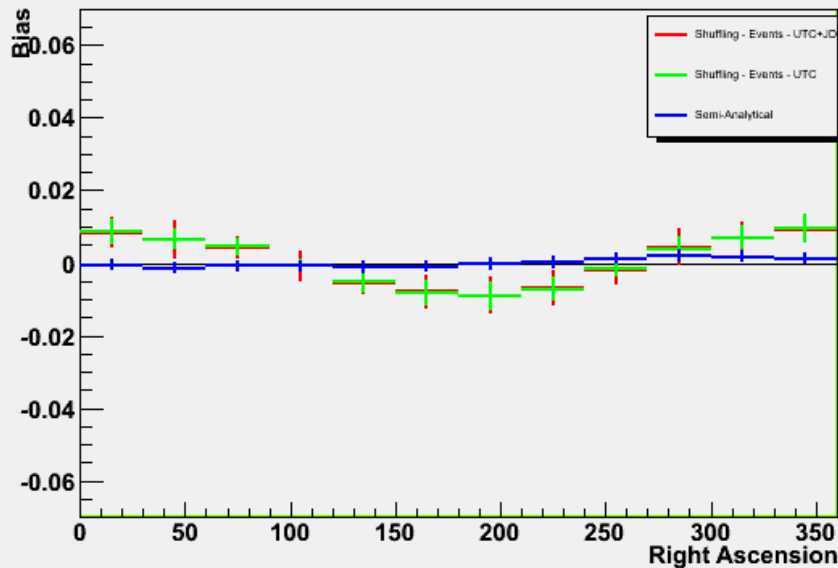
Bias: Declination



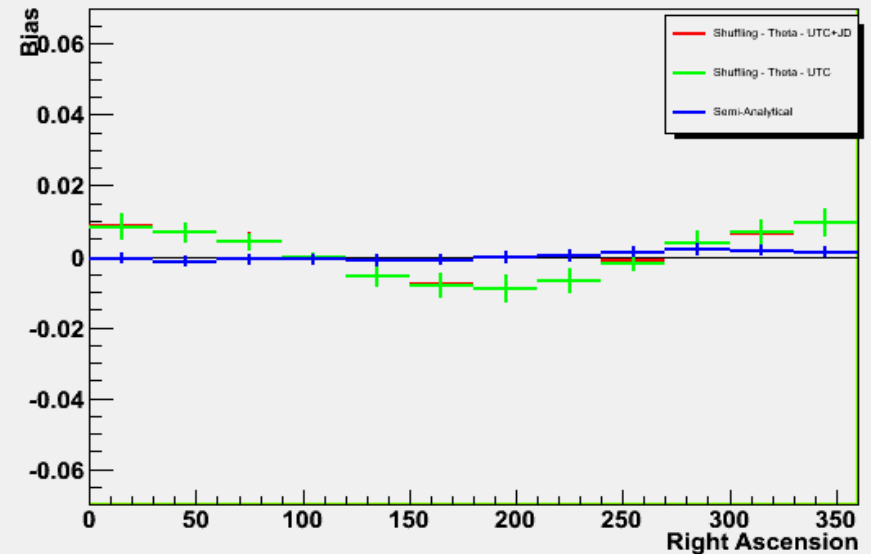
Bias: Declination



Bias - Right Ascension

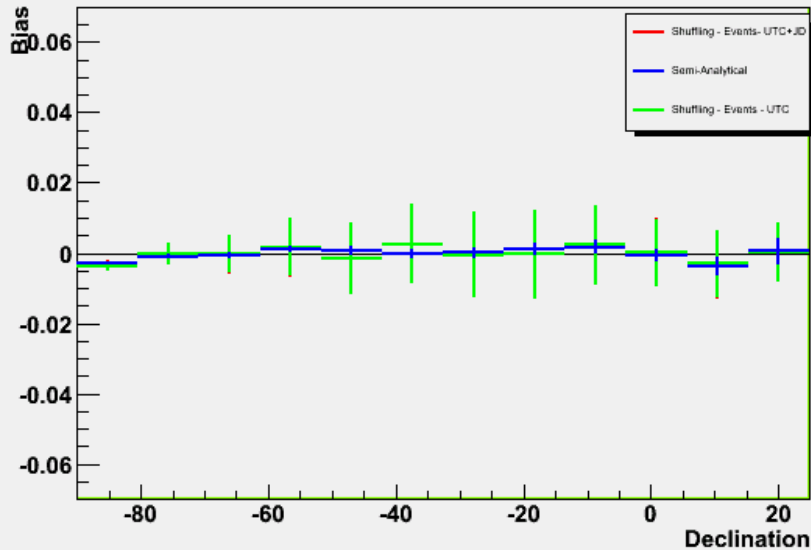


Bias - Right Ascension

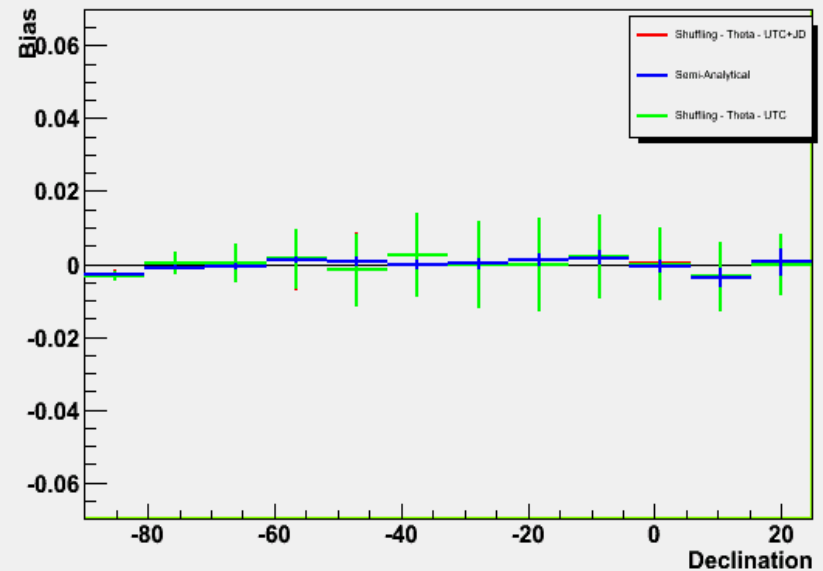


DIPOLO, $E > 1$ EeV, AMP 20%, (0,0)

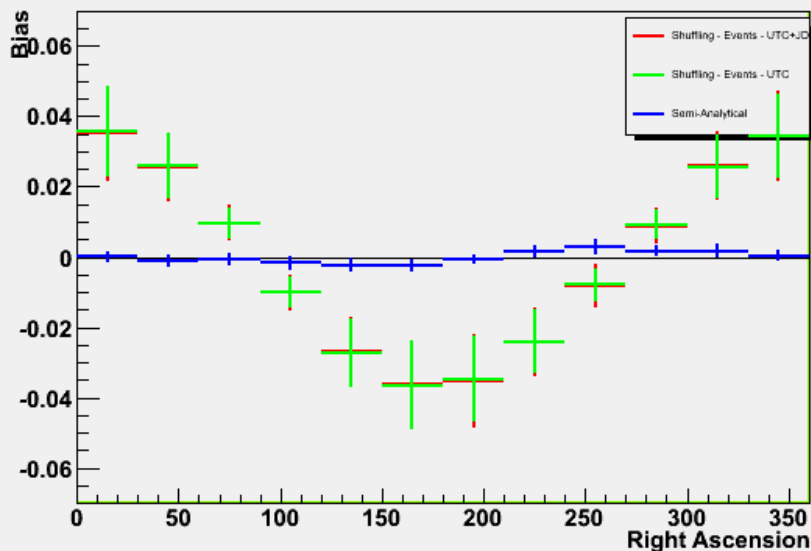
Bias: Declination



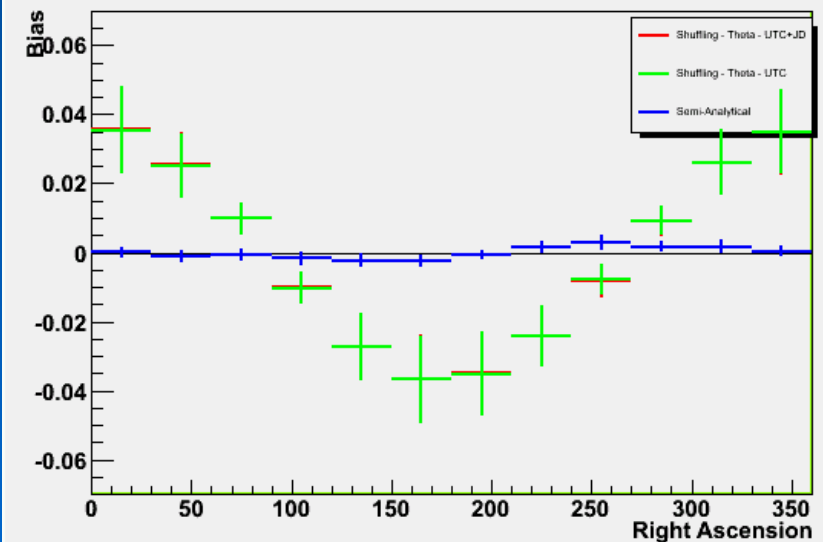
Bias: Declination



Bias - Right Ascension

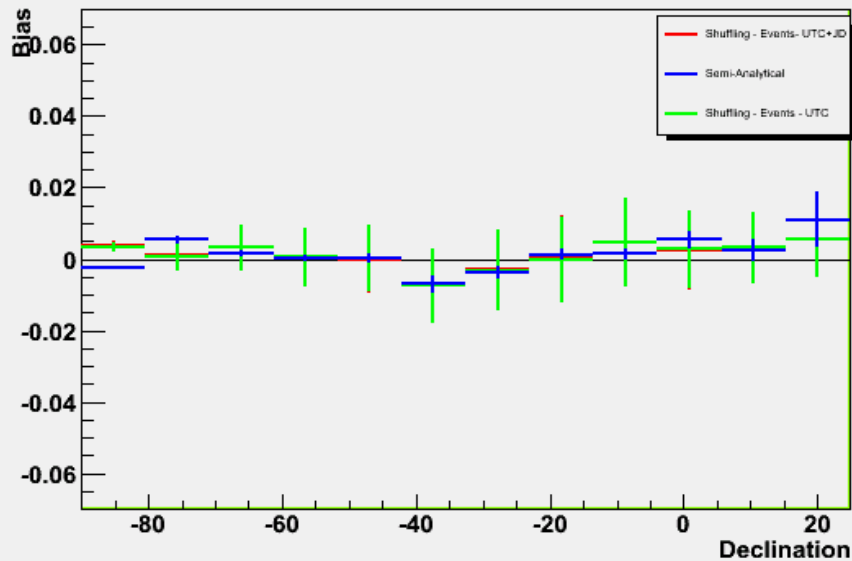


Bias - Right Ascension

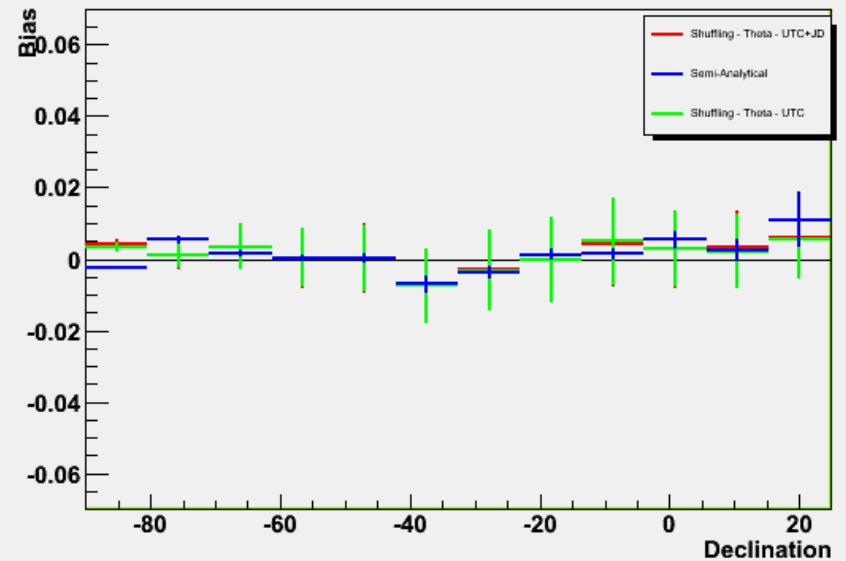


DIPOLO, $E < 2$ EeV, AMP 20%, (0,0)

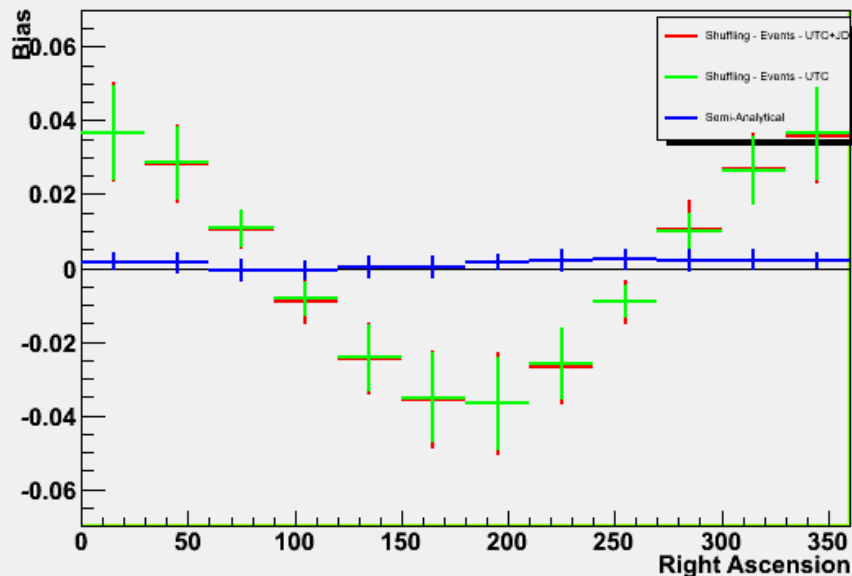
Bias: Declination



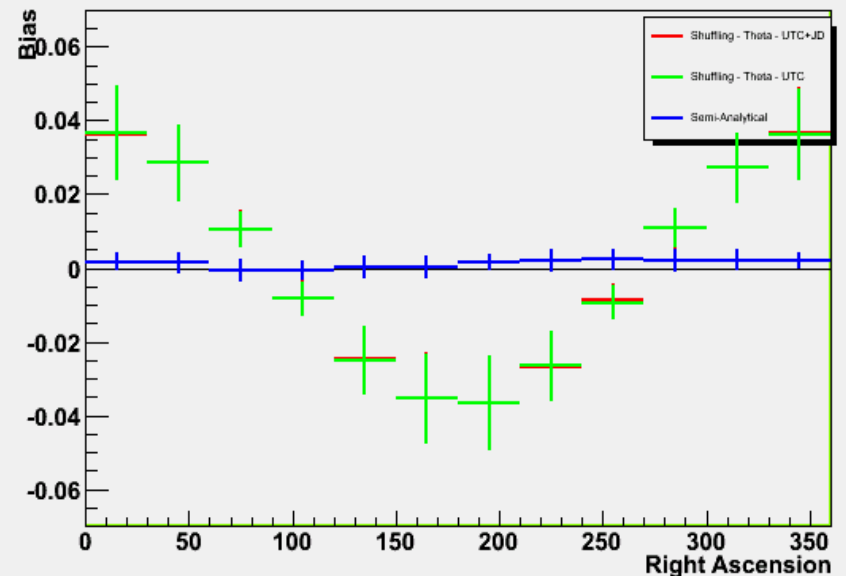
Bias: Declination



Bias - Right Ascension

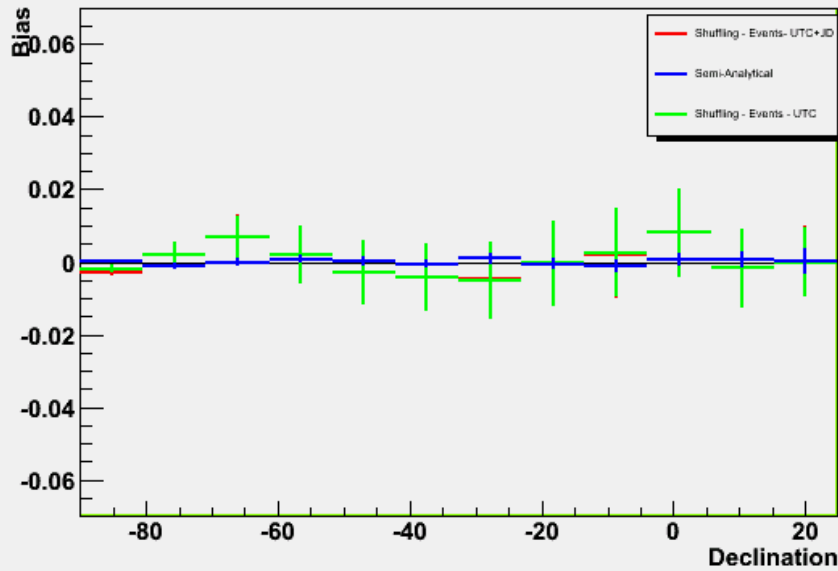


Bias - Right Ascension

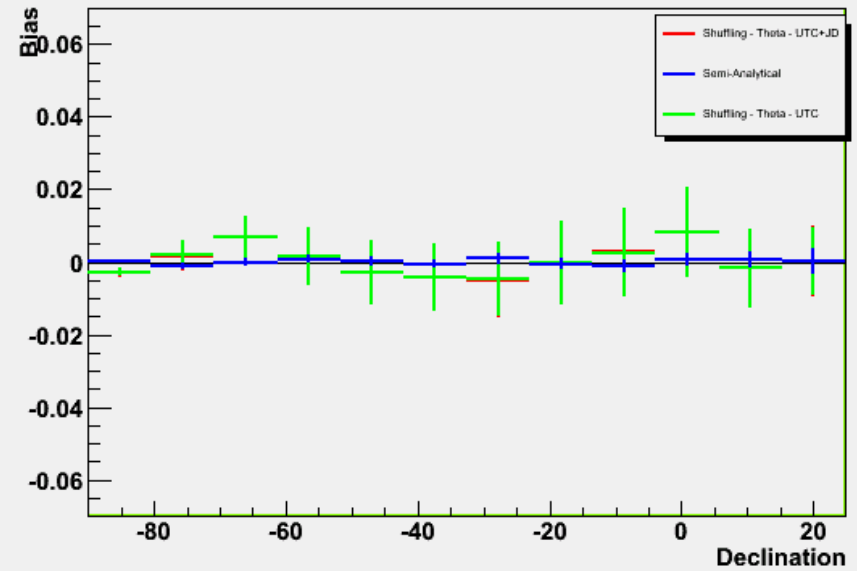


DIPOLO, $E > 5$ EeV, AMP 20%, (0,0)

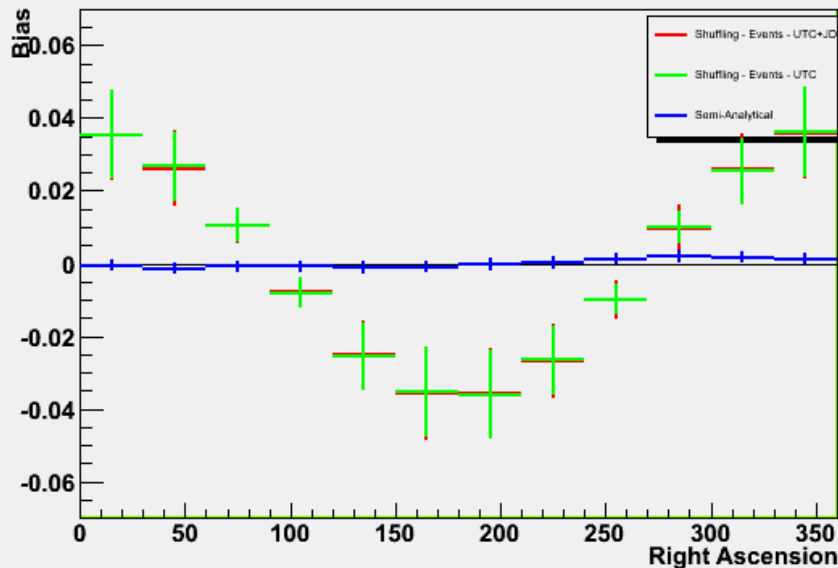
Bias: Declination



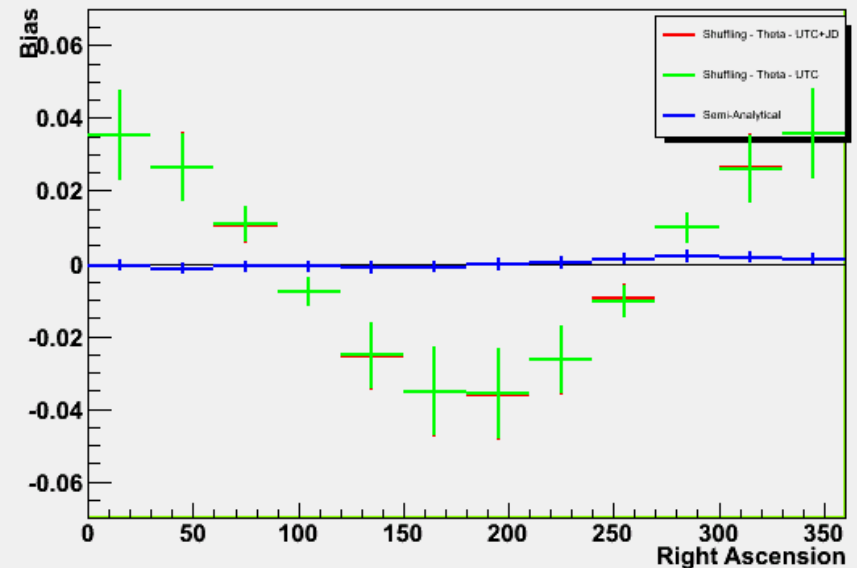
Bias: Declination



Bias - Right Ascension

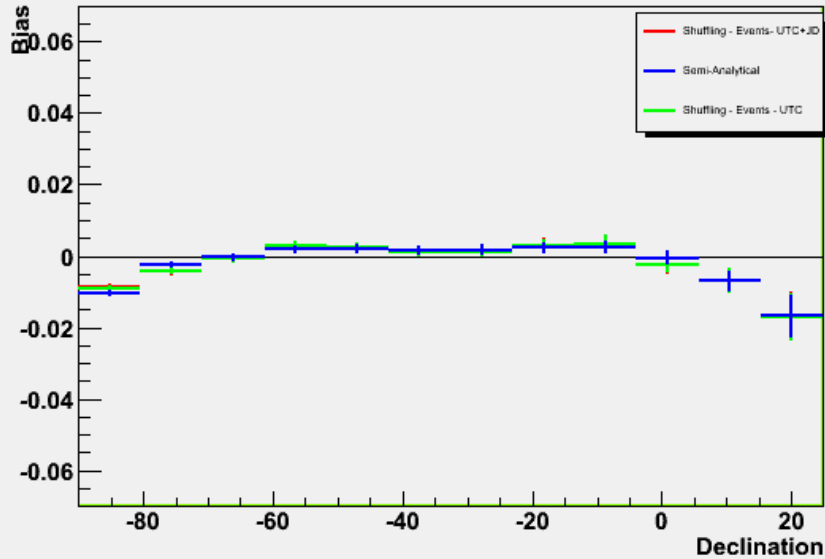


Bias - Right Ascension

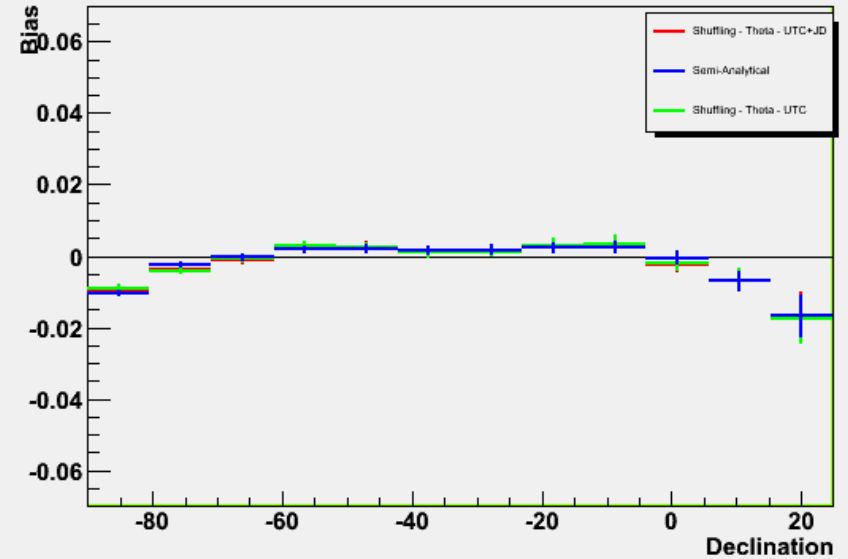


DIPOLO, $E > 1$ EeV, AMP 5%, (0,-90)

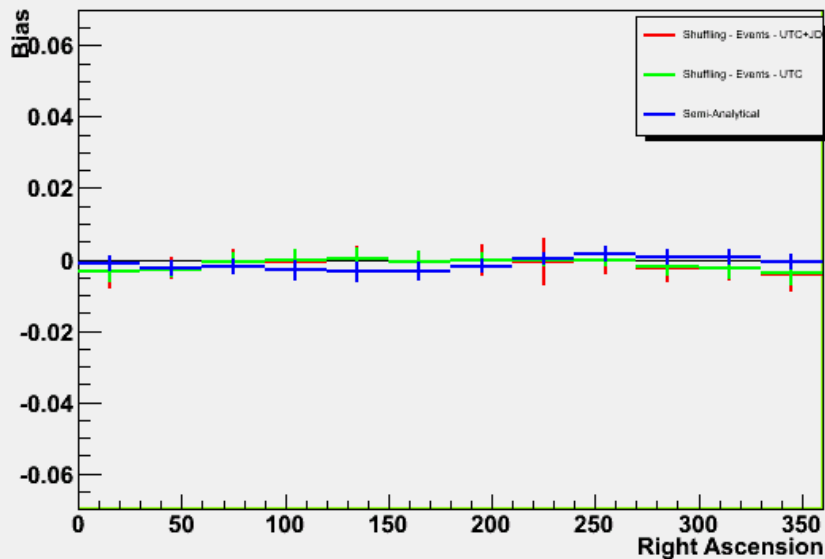
Bias: Declination



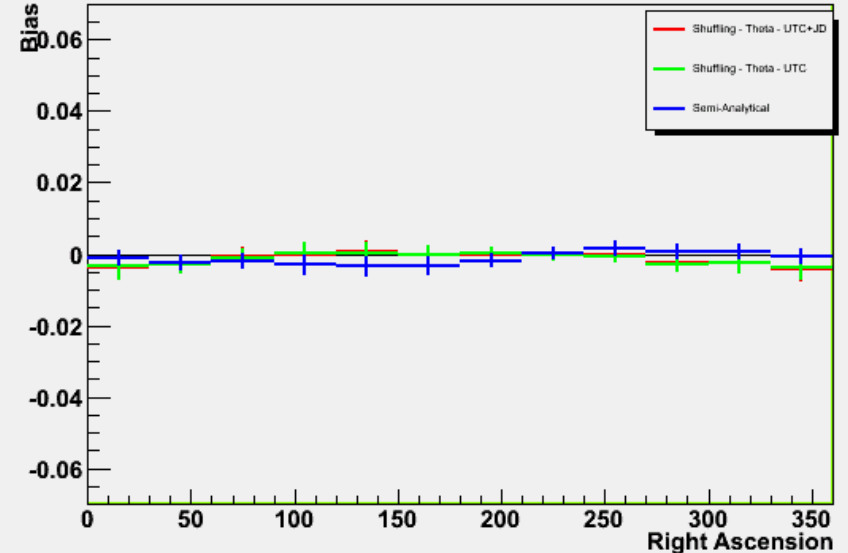
Bias: Declination



Bias - Right Ascension

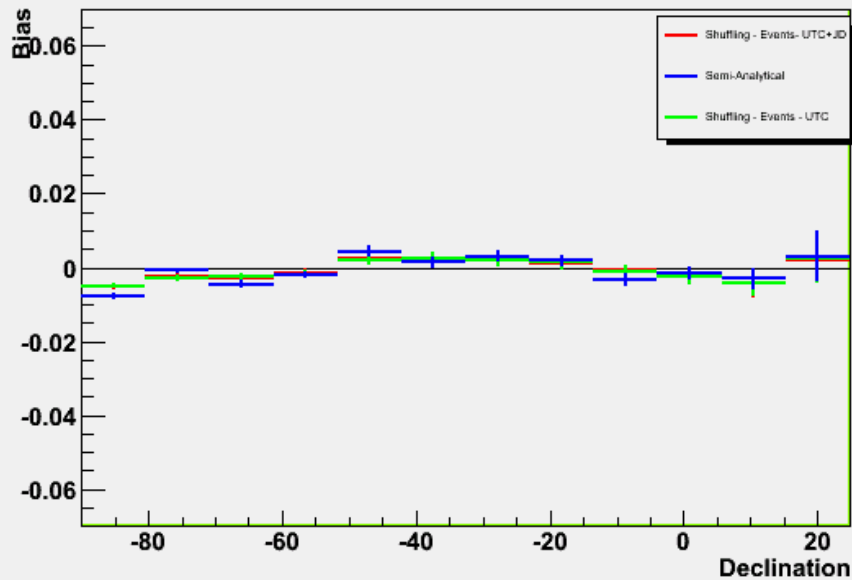


Bias - Right Ascension

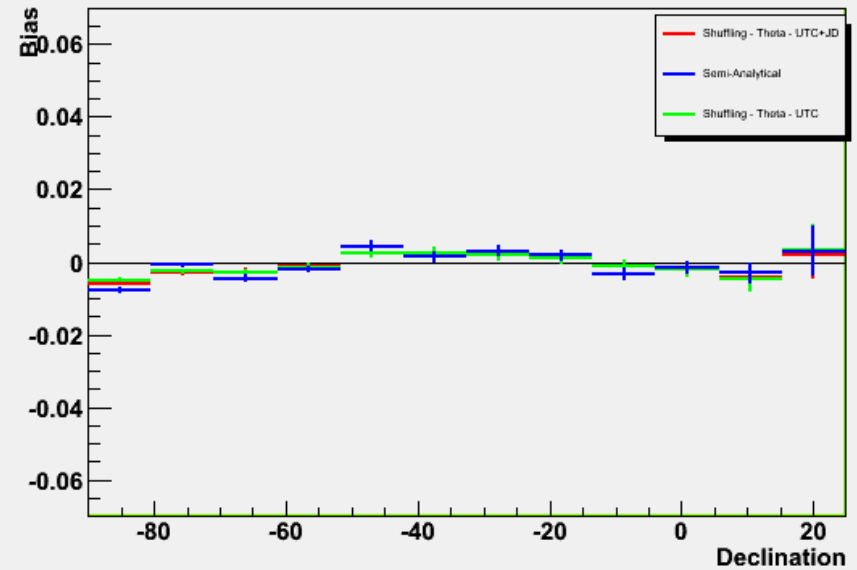


DIPOLO, $E < 2$ EeV, AMP 5%, (0,-90)

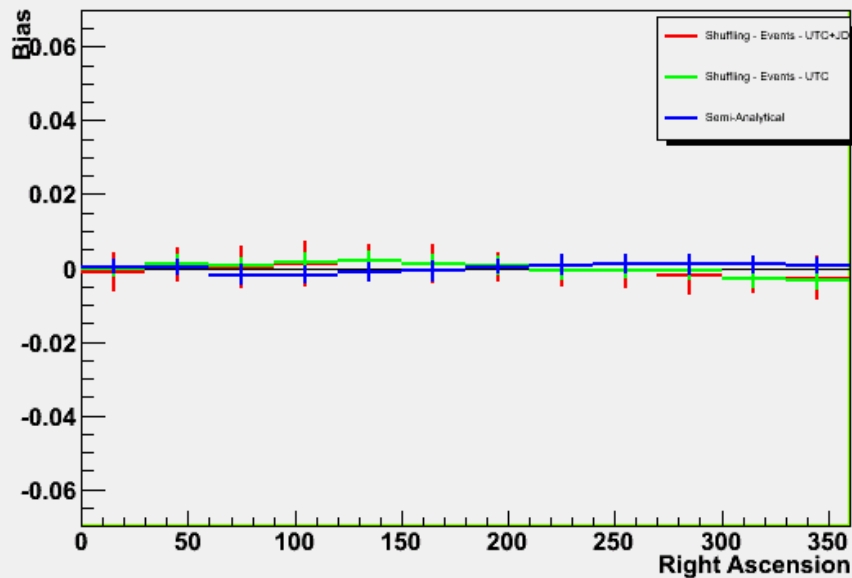
Bias: Declination



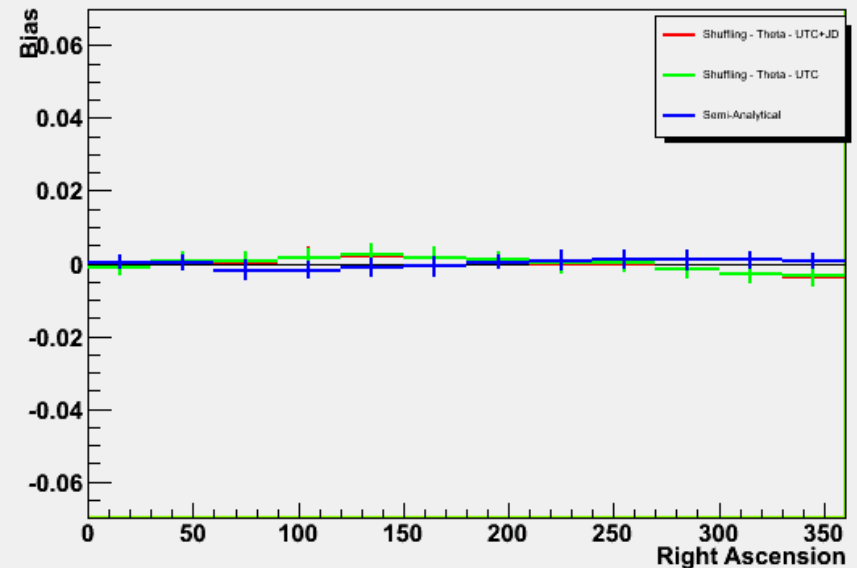
Bias: Declination



Bias - Right Ascension

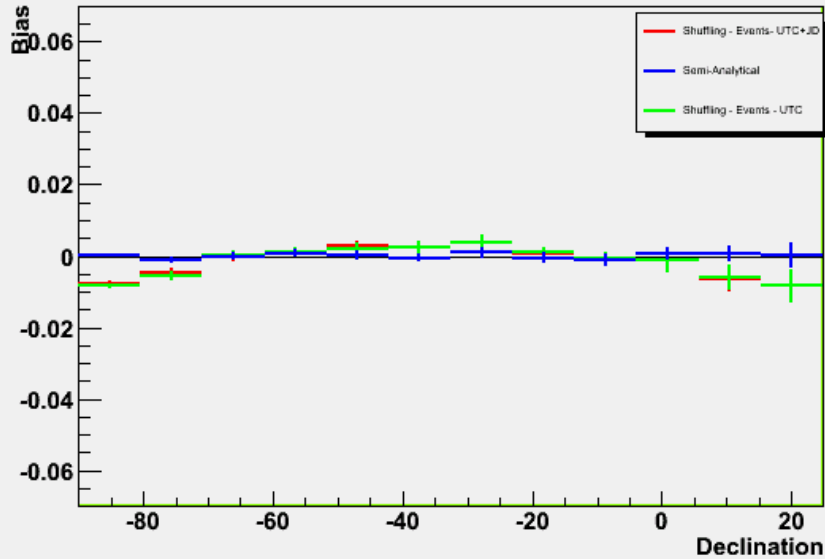


Bias - Right Ascension

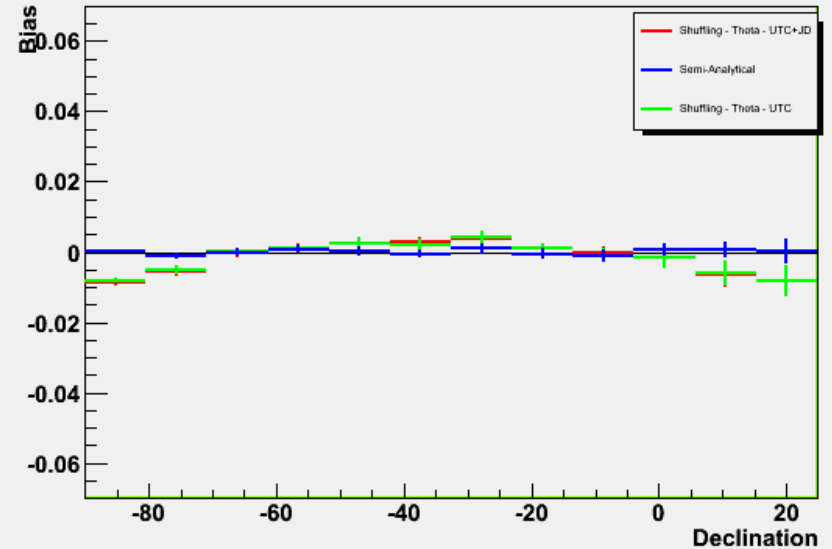


DIPOLO, $E > 5$ EeV, AMP 5%, (0,-90)

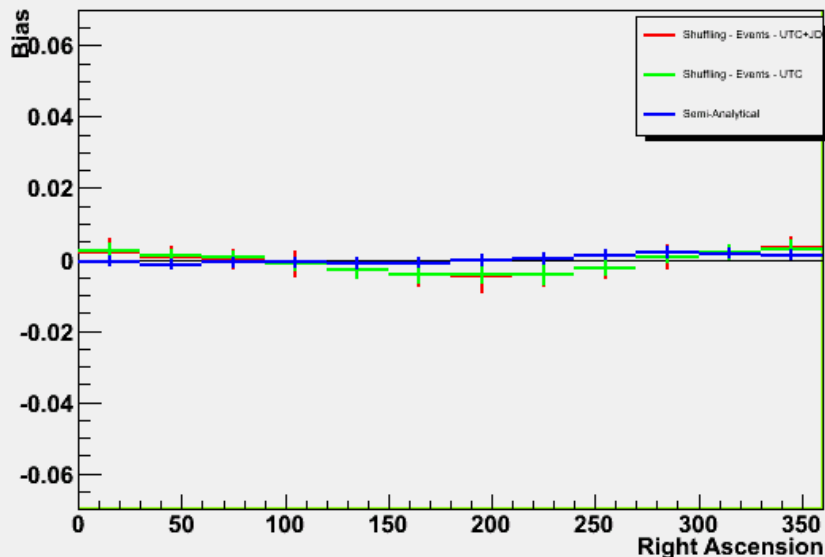
Bias: Declination



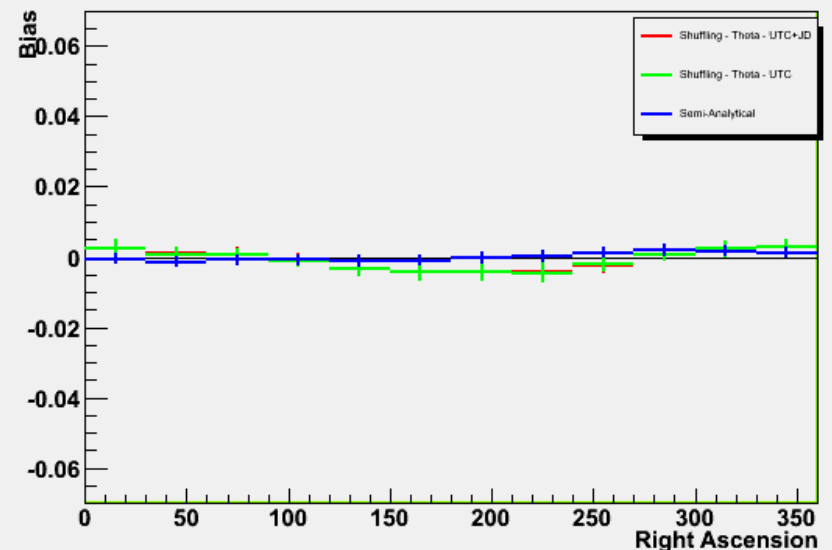
Bias: Declination



Bias - Right Ascension

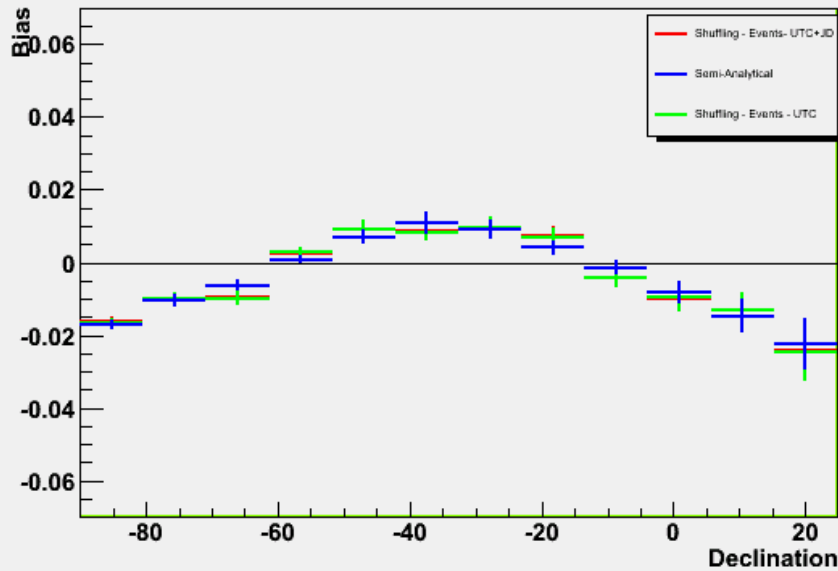


Bias - Right Ascension

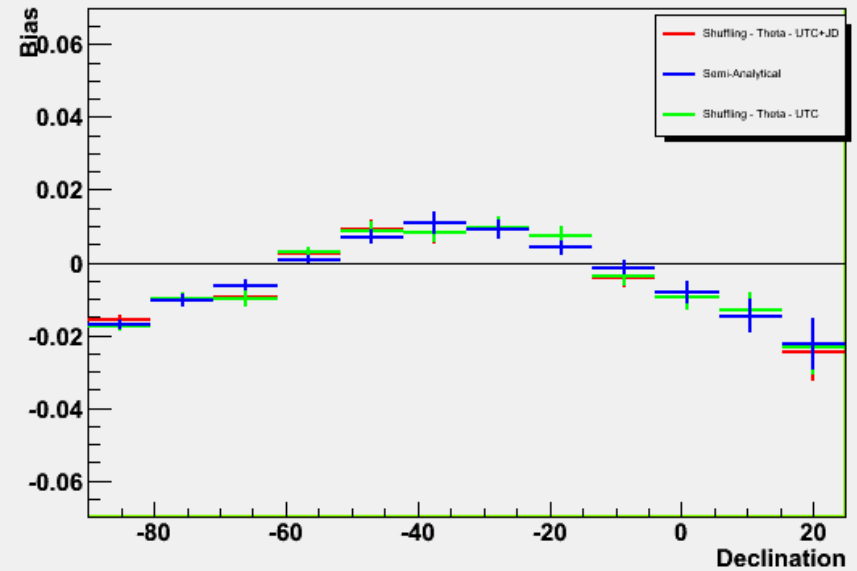


DIPOLO, $E > 1$ EeV, AMP 20%, (0,-90)

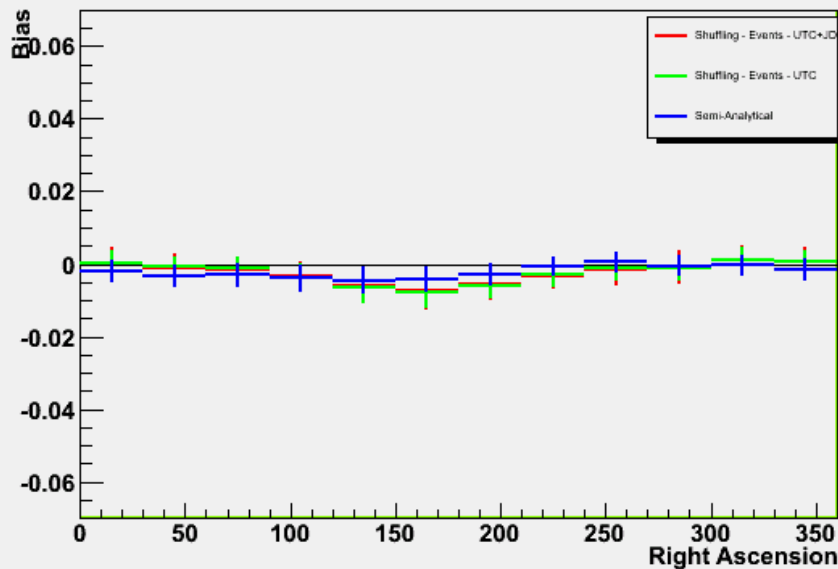
Bias: Declination



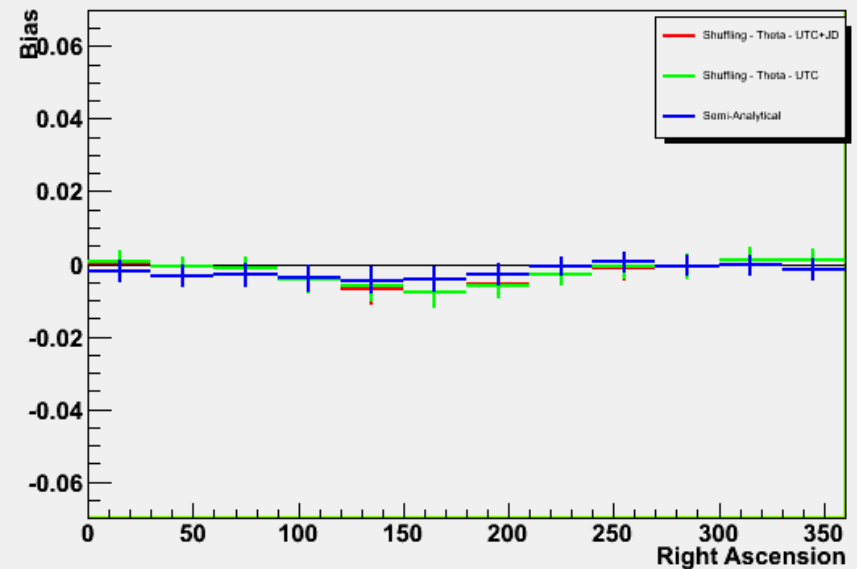
Bias: Declination



Bias - Right Ascension

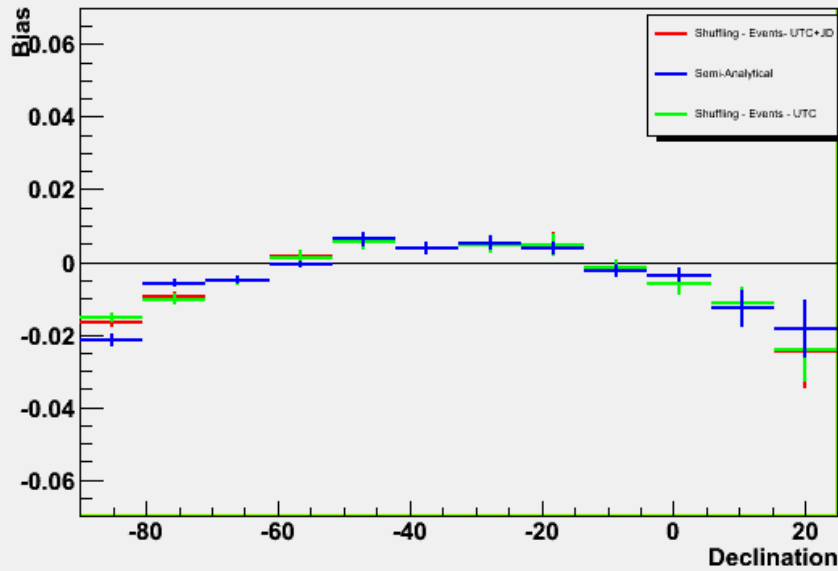


Bias - Right Ascension

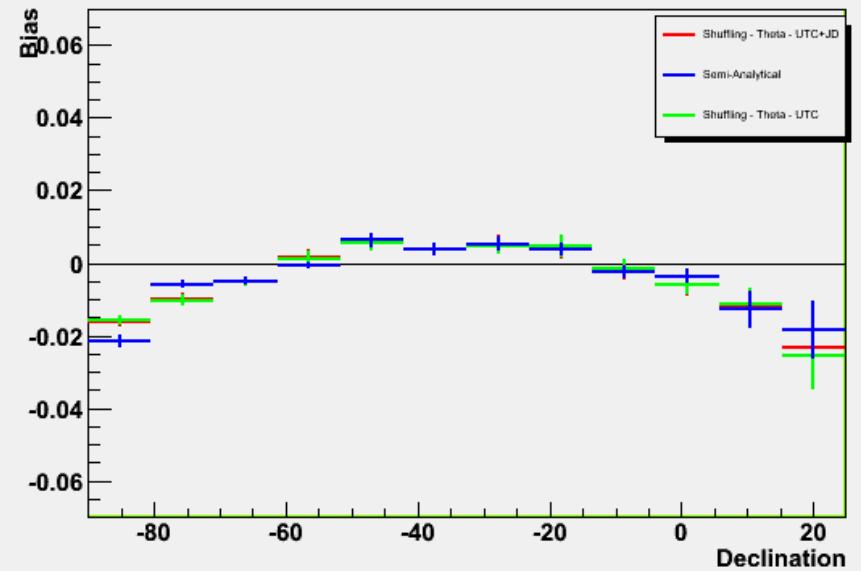


DIPOLO, $E < 2$ EeV, AMP 20%, (0,-90)

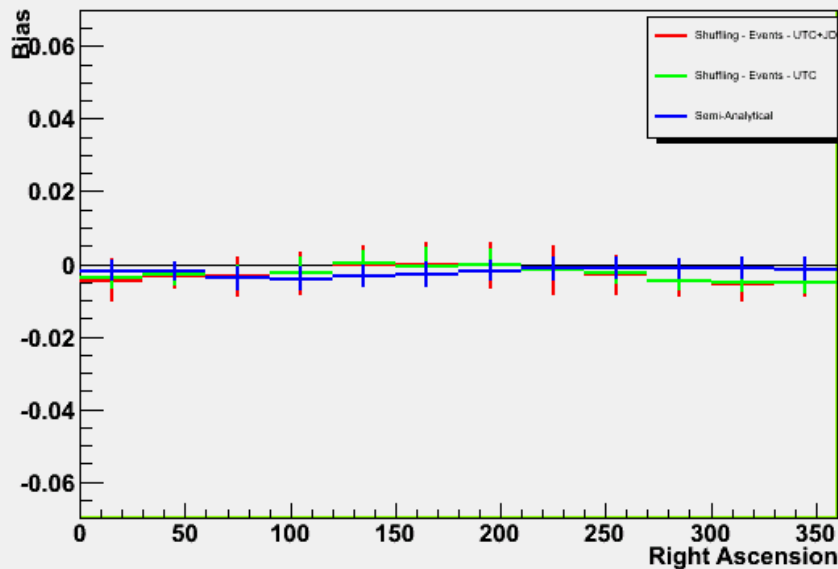
Bias: Declination



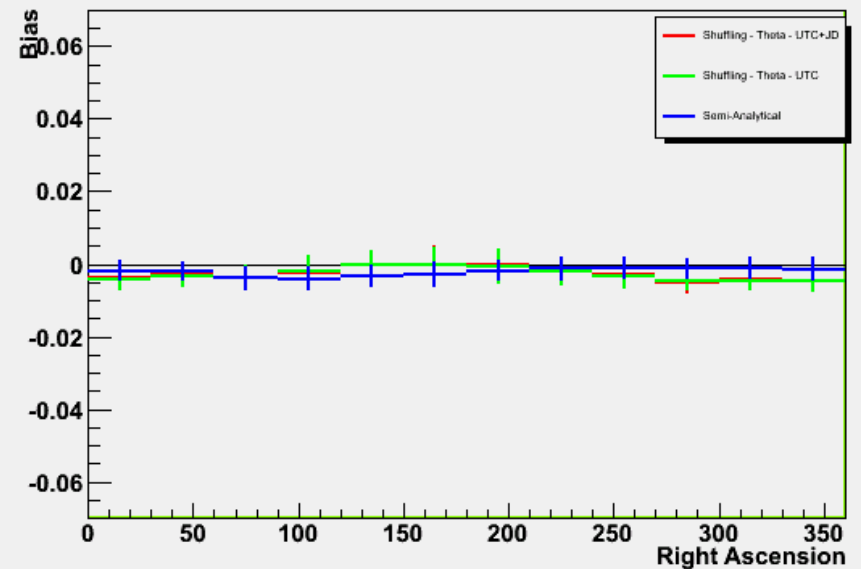
Bias: Declination



Bias - Right Ascension

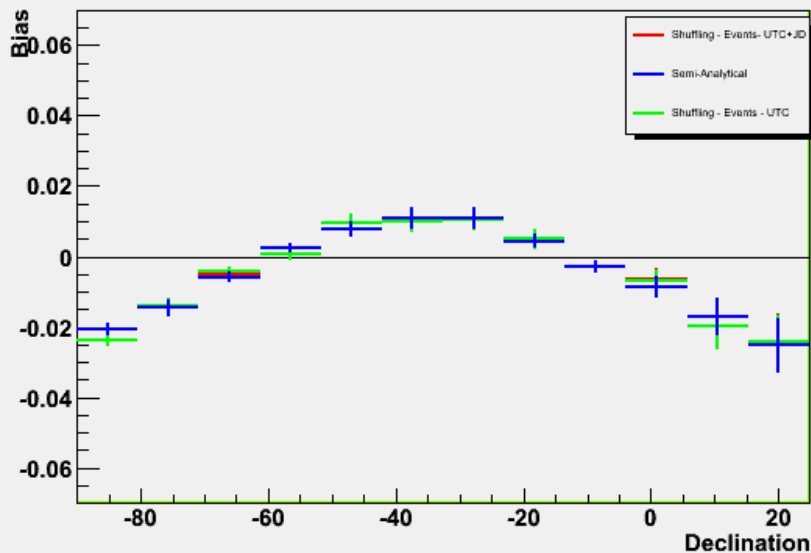


Bias - Right Ascension

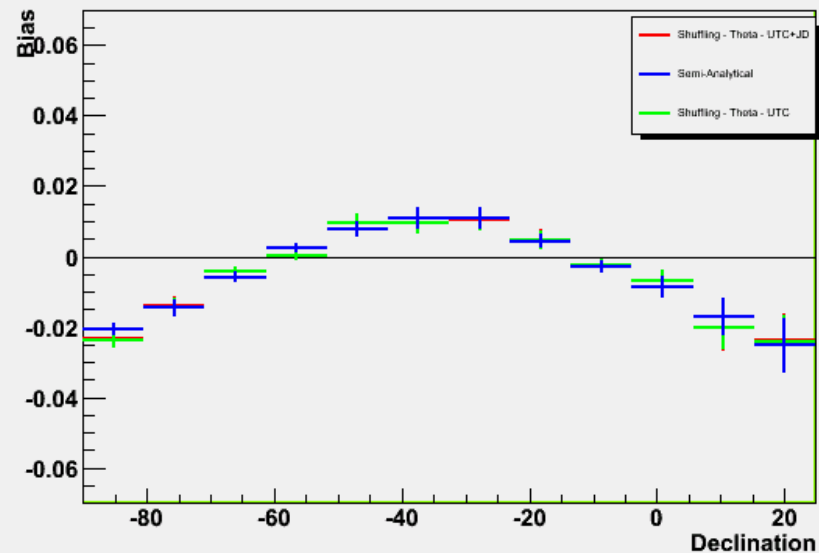


DIPOLO, $E > 5$ EeV, AMP 20%, (0,-90)

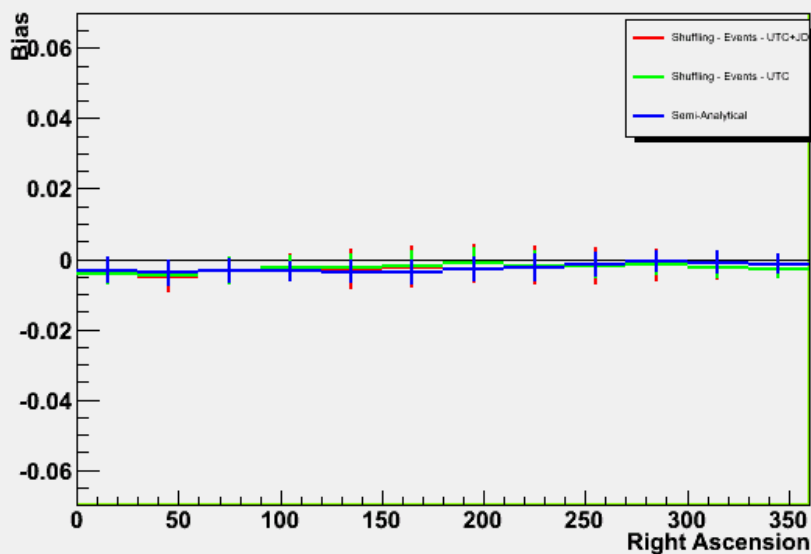
Bias: Declination



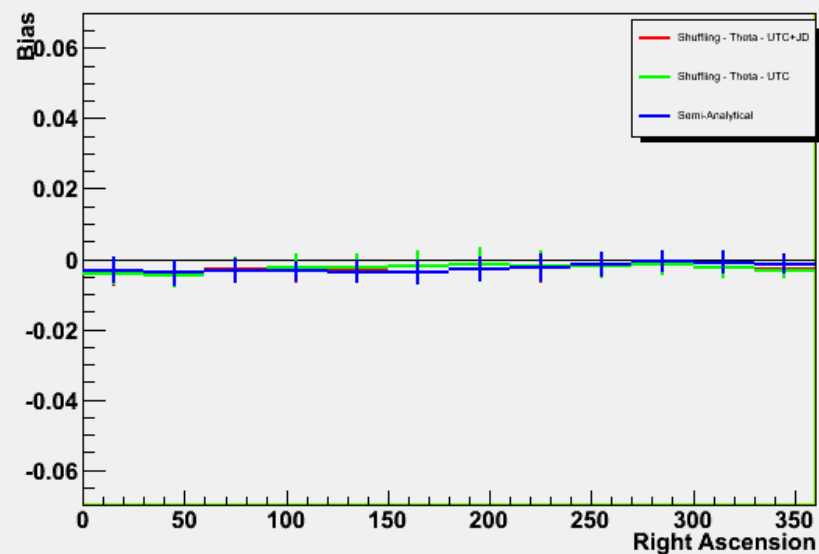
Bias: Declination



Bias - Right Ascension

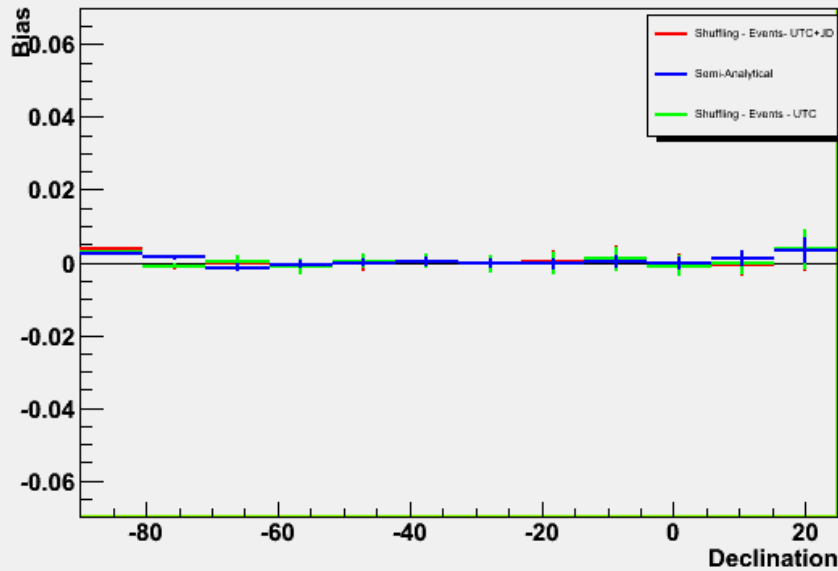


Bias - Right Ascension

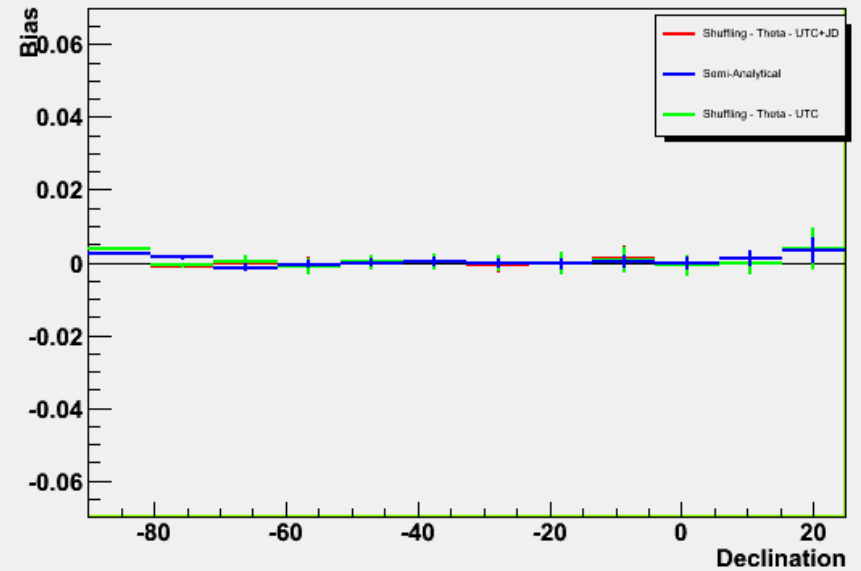


DIPOLO, $E > 1$ EeV, AMP 5%, (0,-45)

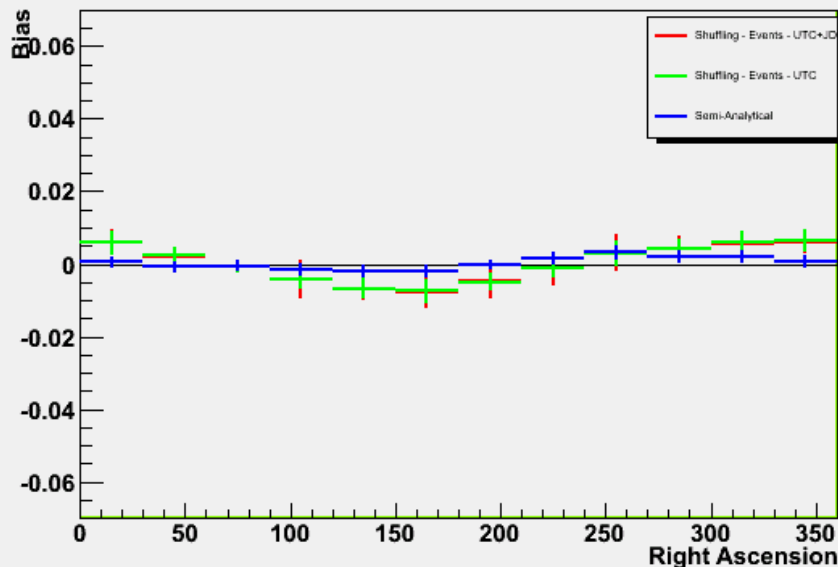
Bias: Declination



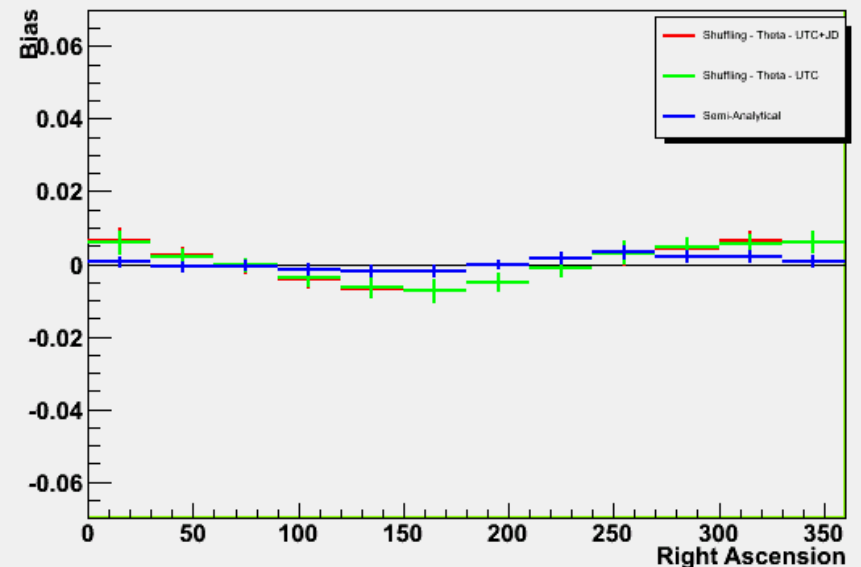
Bias: Declination



Bias - Right Ascension

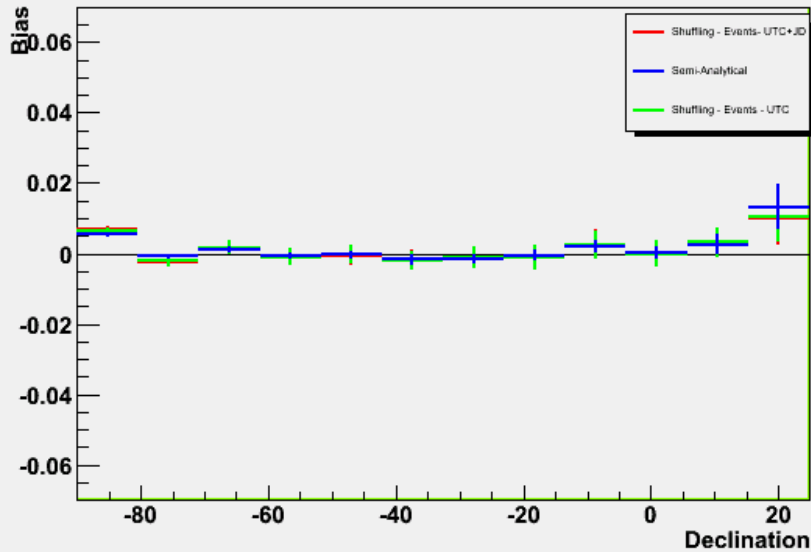


Bias - Right Ascension

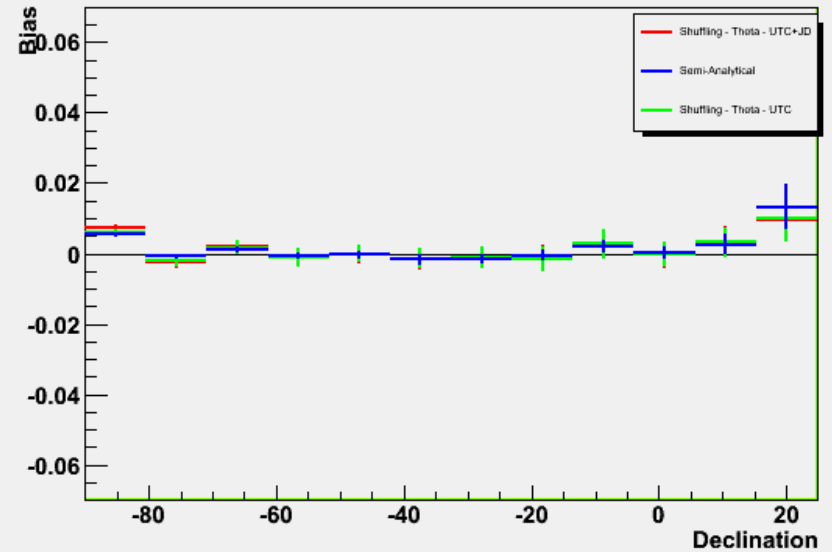


DIPOLO, $E < 2$ EeV, AMP 5%, (0,-45)

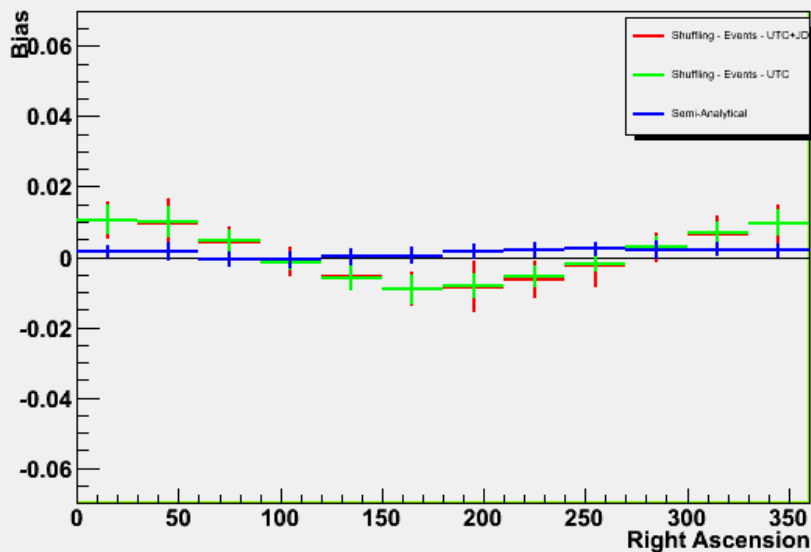
Bias: Declination



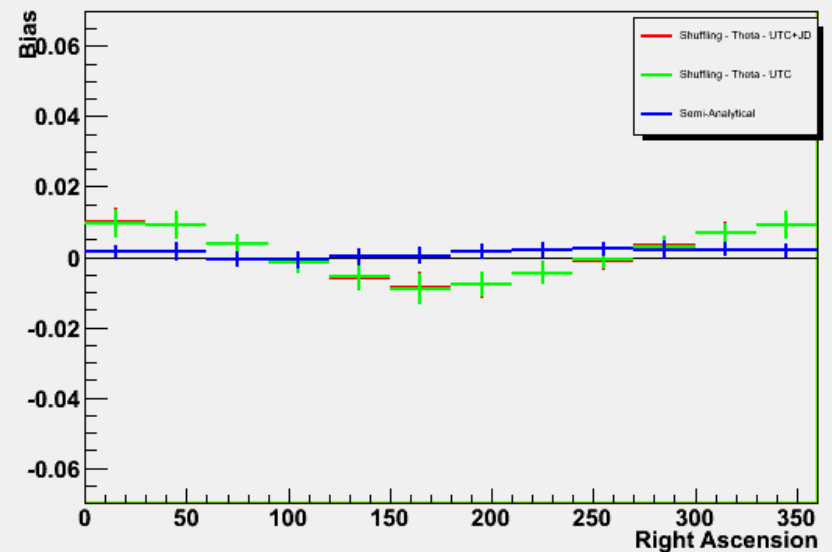
Bias: Declination



Bias - Right Ascension

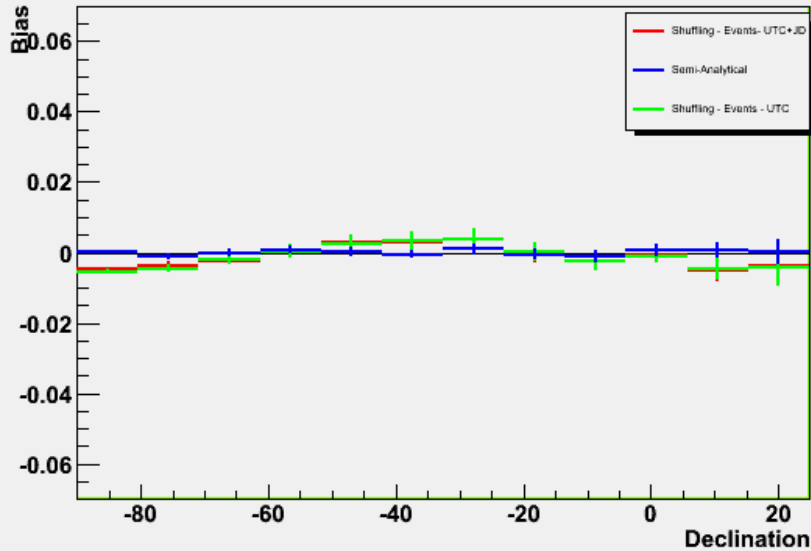


Bias - Right Ascension

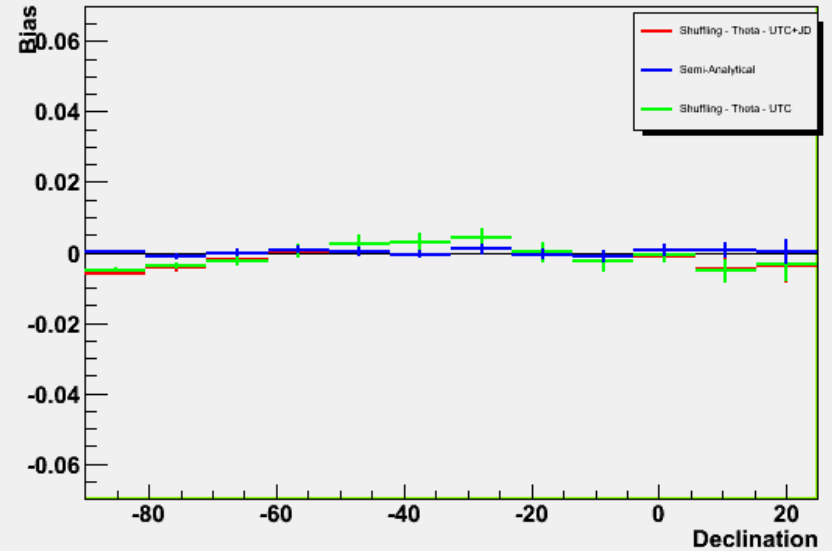


DIPOLO, $E > 5$ EeV, AMP 5%, (0,-45)

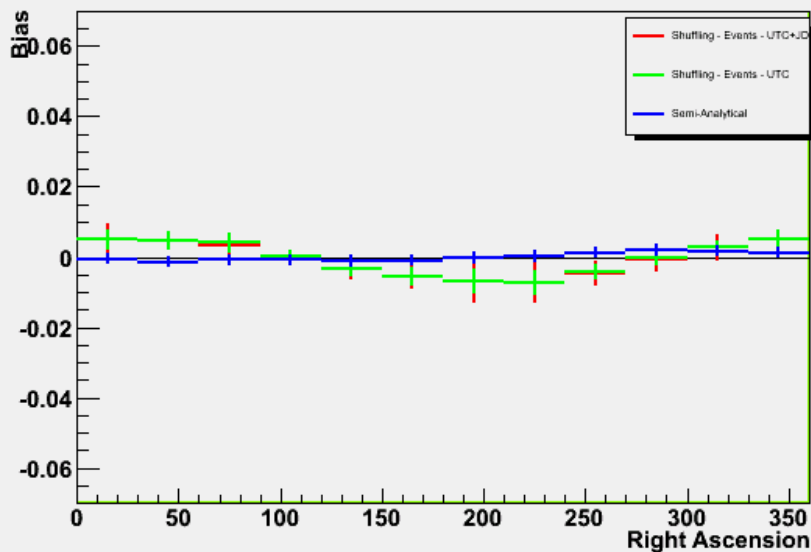
Bias: Declination



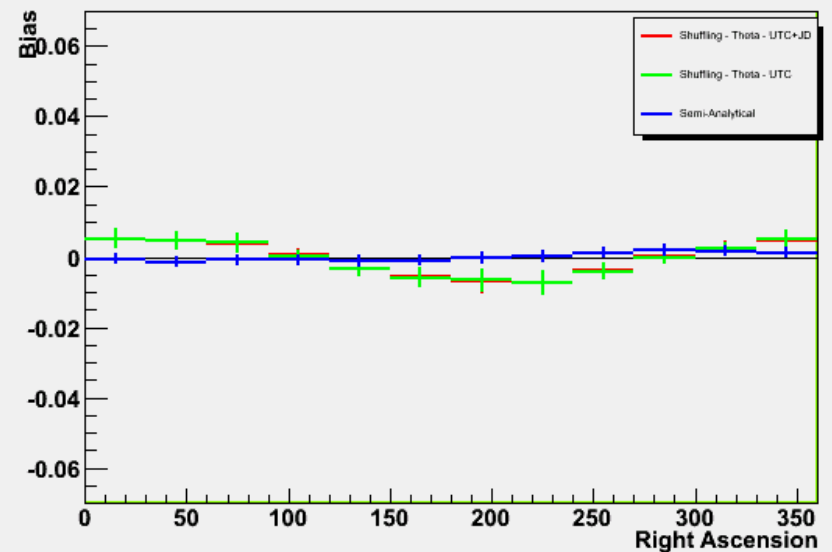
Bias: Declination



Bias - Right Ascension

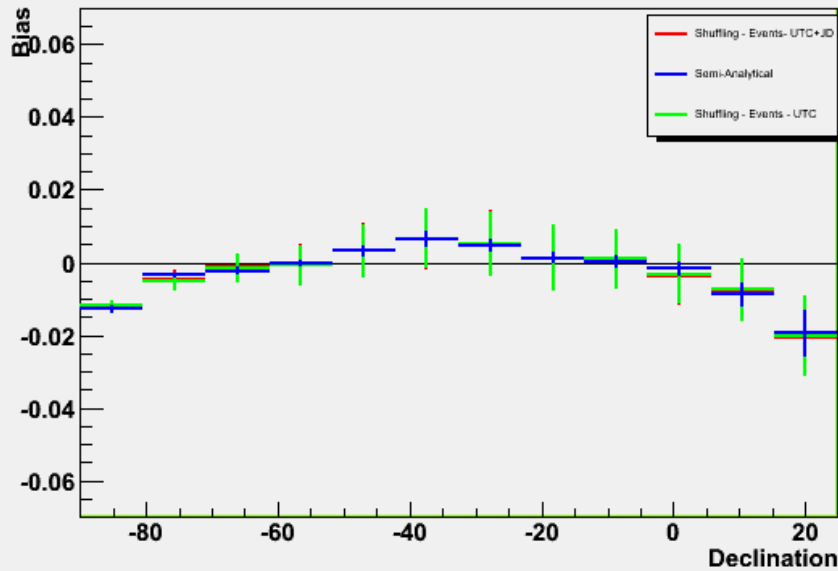


Bias - Right Ascension

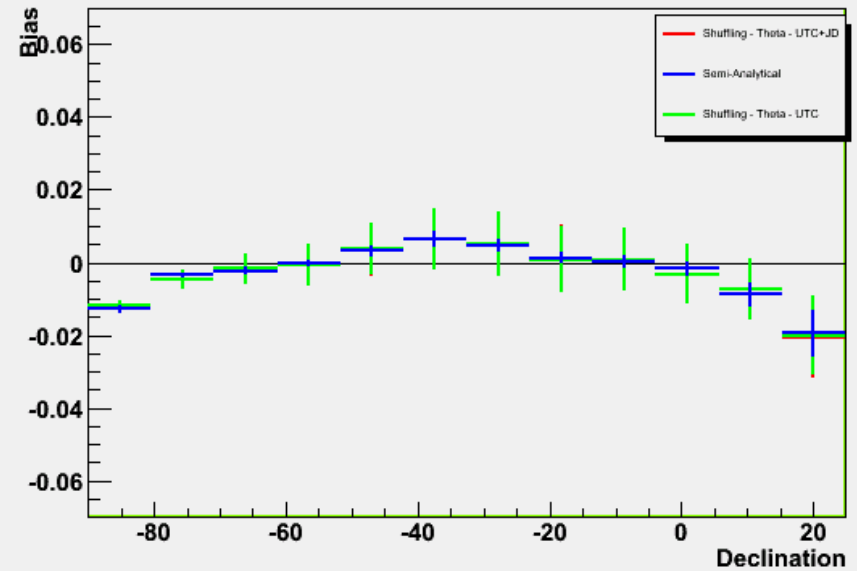


DIPOLO, $E > 1$ EeV, AMP 20%, (0,-45)

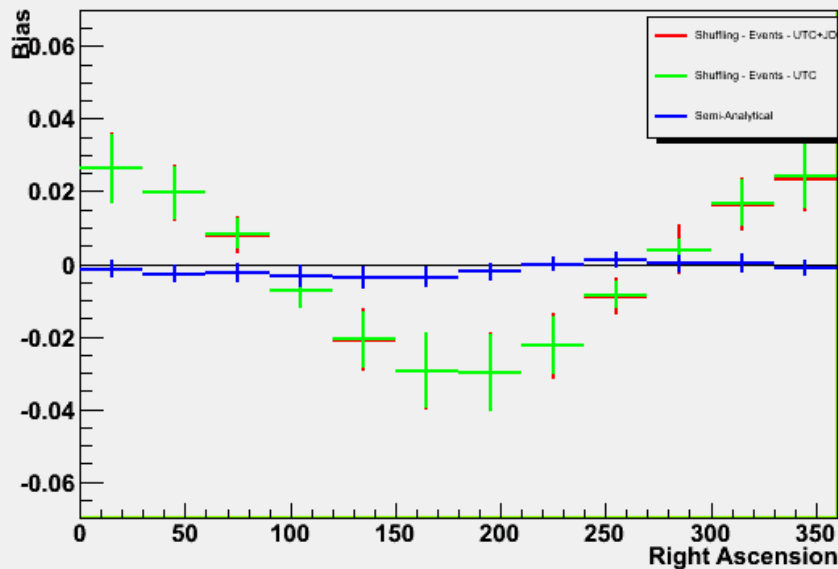
Bias: Declination



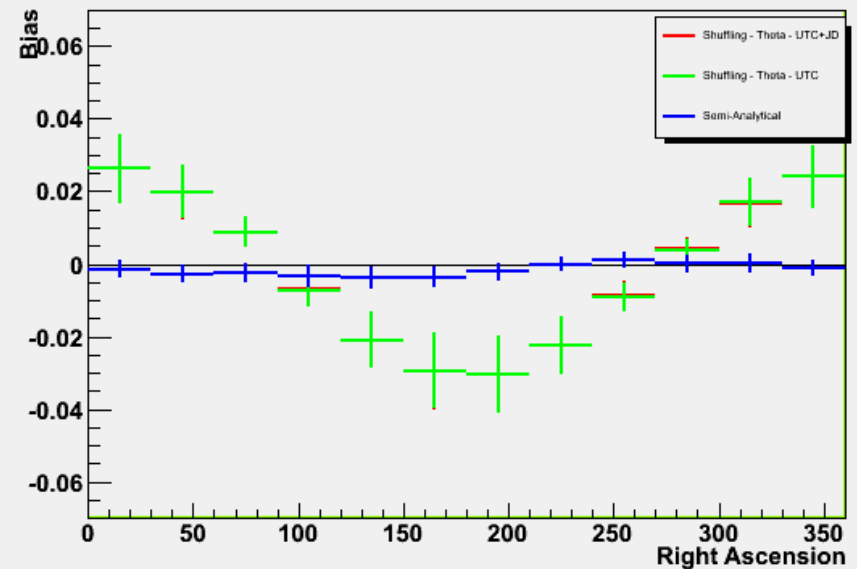
Bias: Declination



Bias - Right Ascension

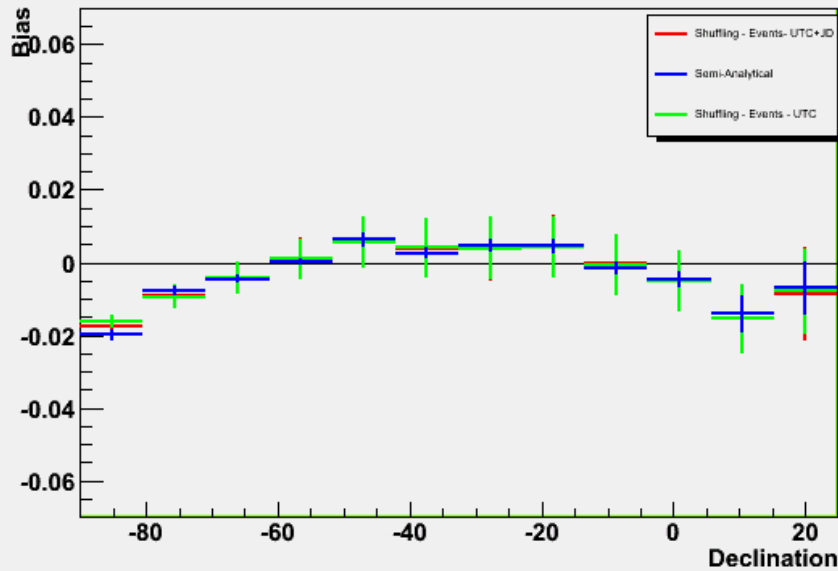


Bias - Right Ascension

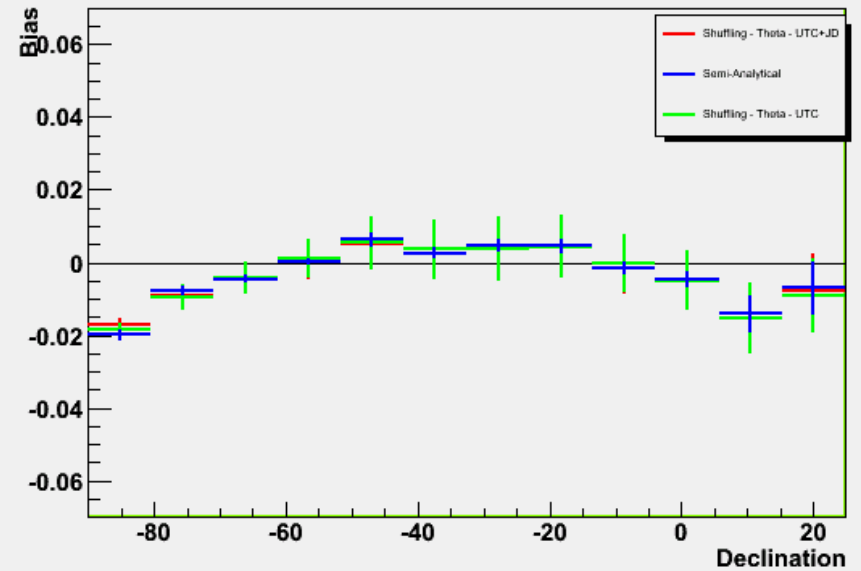


DIPOLO, $E < 2$ EeV, AMP 20%, (0,-45)

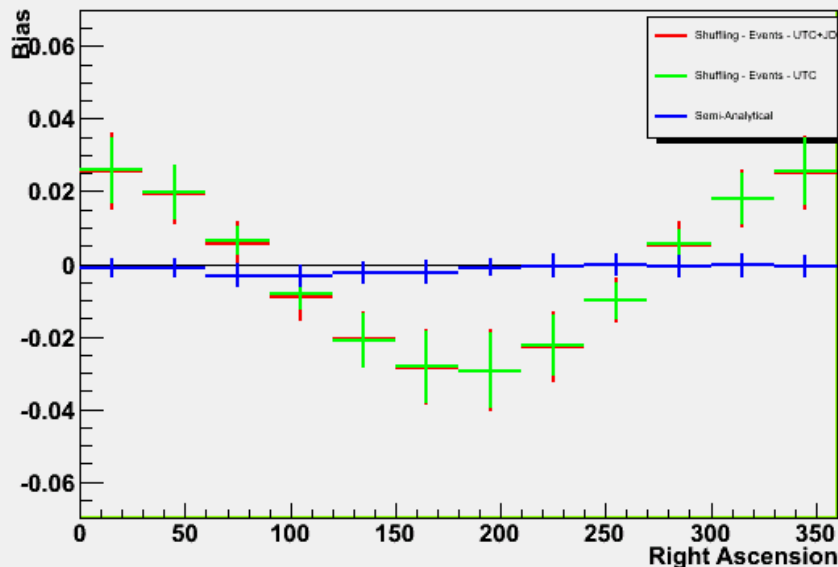
Bias: Declination



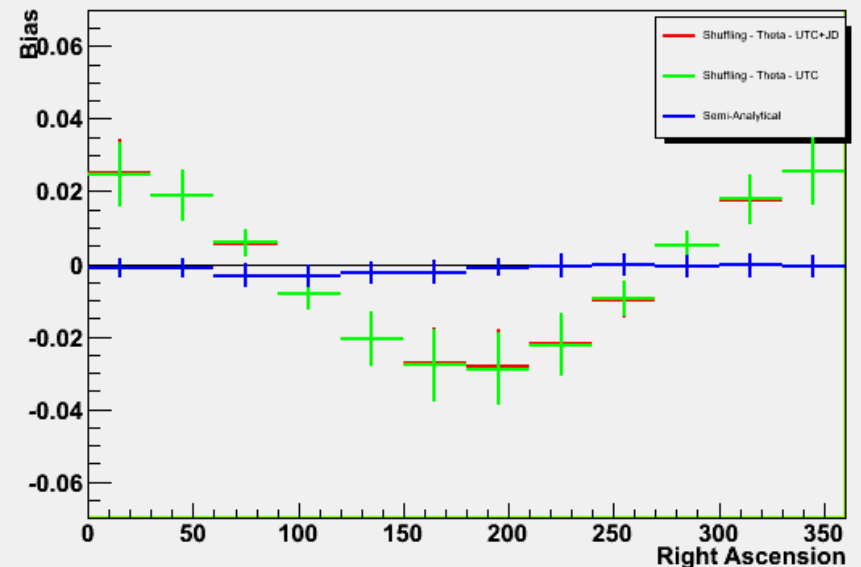
Bias: Declination



Bias - Right Ascension

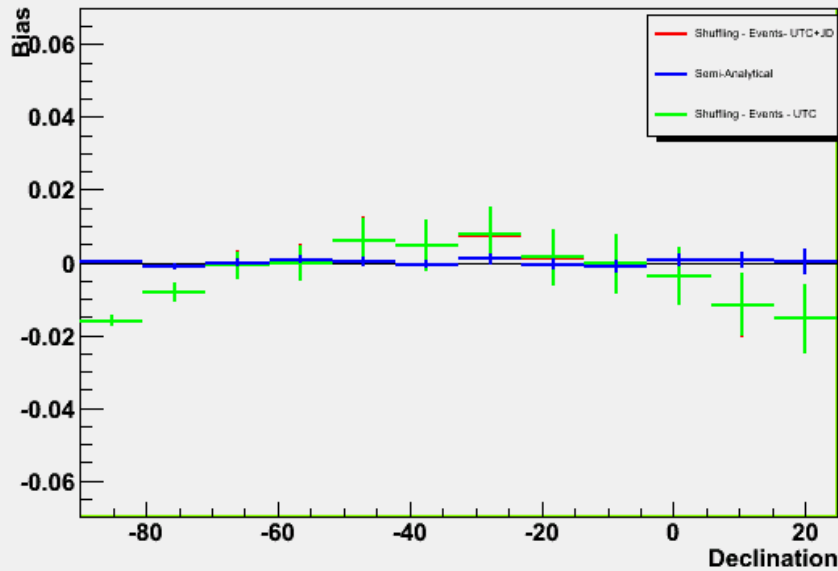


Bias - Right Ascension

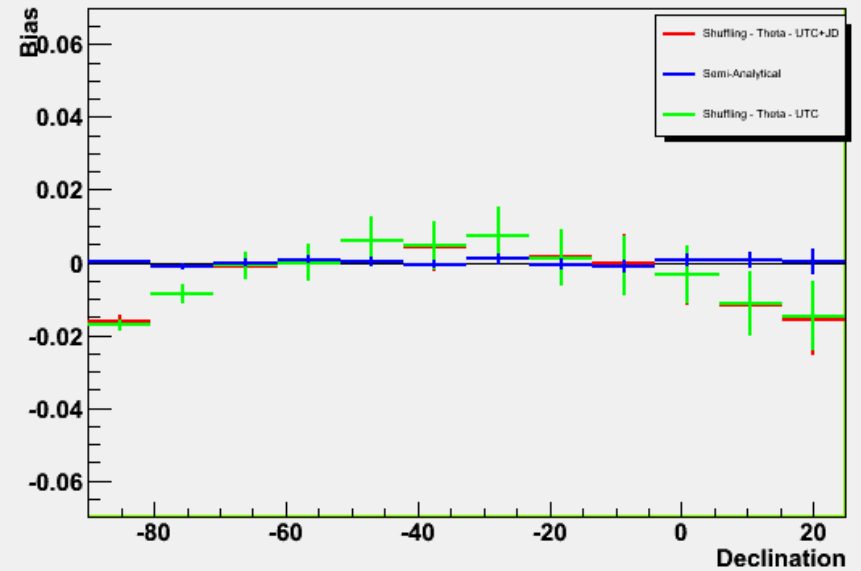


DIPOLO, $E > 5$ EeV, AMP 20%, (0,-45)

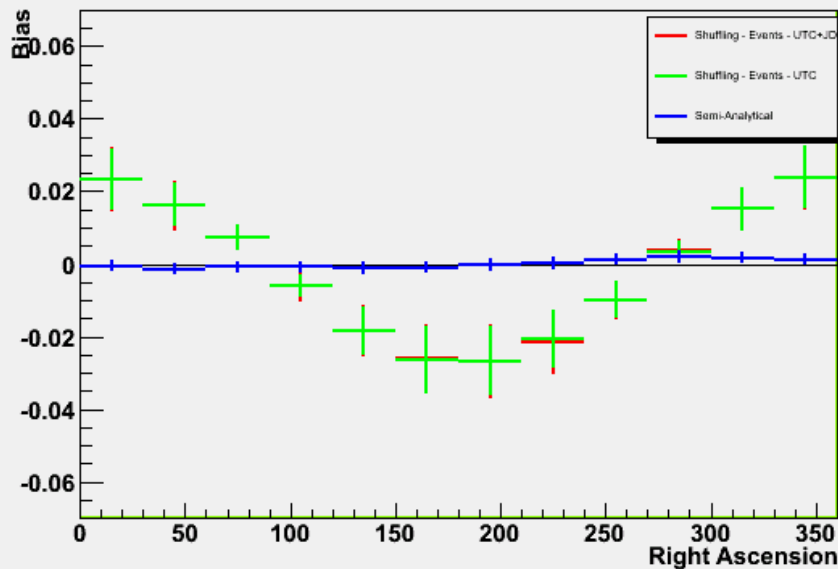
Bias: Declination



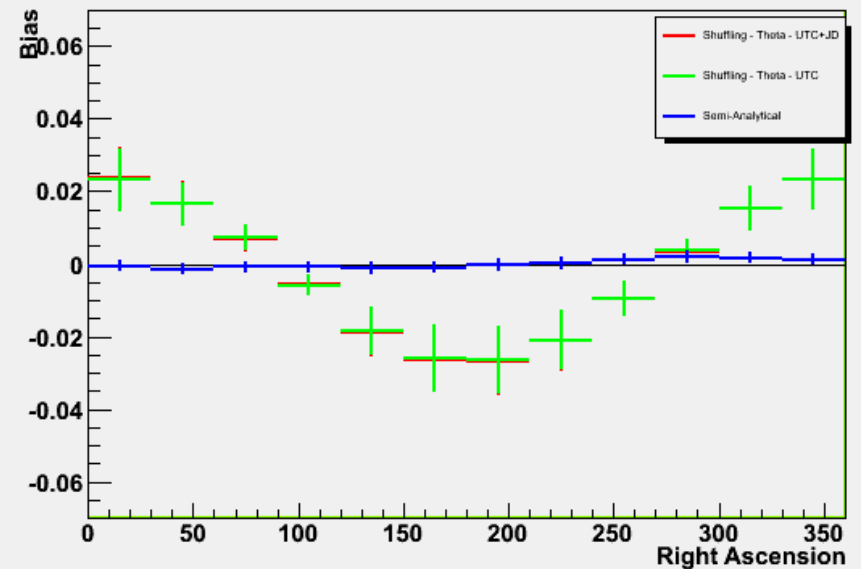
Bias: Declination



Bias - Right Ascension



Bias - Right Ascension



RMS: Dipolo

	Shuffling				SA				
Nside	Theta - UTC+JD	Theta - UTC	Events - UTC+JD	Events - UTC	SA	Energy Cut	Dec	RA	Amplitude
128	0.0143389	0.0144872	0.0178167	0.0143831	0.00660305	>1	0	0	0.05
128	0.0130795	0.013178	0.0173404	0.0129794	0.00858677	<2	0	0	0.05
128	0.0110384	0.0111402	0.0151786	0.0110159	0.00562429	>5	0	0	0.05
128	0.0326472	0.0327588	0.0347544	0.032642	0.00612402	>1	0	0	0.2
128	0.0335542	0.033569	0.0364087	0.033338	0.00975771	<2	0	0	0.2
128	0.0325703	0.0324529	0.0337495	0.0325861	0.00562429	>5	0	0	0.2
128	0.00821927	0.0080913	0.01517	0.00808165	0.00668256	>1	0	-90	0.05
128	0.00943692	0.00960636	0.0184012	0.00943717	0.00891615	<2	0	-90	0.05
128	0.00945997	0.00942836	0.0142455	0.00906054	0.00796299	>1	0	-90	0.05
128	0.00923388	0.00949945	0.0175989	0.00905925	0.00882748	<2	0	-90	0.05
128	0.00803214	0.00804522	0.0119562	0.00814667	0.00562429	>5	0	-90	0.05
128	0.0121562	0.0119373	0.0146176	0.0121987	0.0109014	>1	0	-90	0.2
128	0.0123475	0.0127366	0.0187774	0.0122585	0.0107041	<2	0	-90	0.2
128	0.0127401	0.0127377	0.0160509	0.0126993	0.0117835	>5	0	-90	0.2
128	0.00990283	0.00990526	0.0133655	0.00991582	0.00603243	>1	0	-45	0.05
128	0.0119171	0.0121265	0.0185499	0.0120486	0.00797333	<2	0	-45	0.05
128	0.00903216	0.00904809	0.0131816	0.00919071	0.00562429	>5	0	-45	0.05
128	0.0260817	0.0260695	0.0284407	0.0261164	0.00873664	>1	0	-45	0.2
128	0.0258738	0.0259522	0.0302039	0.0265177	0.0104916	<2	0	-45	0.2
128	0.0239264	0.0237145	0.0250451	0.0237954	0.00562429	>5	0	-45	0.2

CONCLUSÕES

- No caso isotrópico, o semi-analítico mostrou-se ligeiramente melhor que o shuffling, introduzindo menores erros.
- No caso do dipolo, o shuffling não conseguiu minimizar os efeitos do dipolo na geração do mapa de cobertura. Apesar da existência de viés no semi-analítico em alguns casos, seu erro foi menor que o do shuffling, de modo geral.
- Outra vantagem do semi-analítico sobre o shuffling, é que o tempo computacional requerido é menor.

REFERÊNCIAS BIBLIOGRÁFICAS

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- **D'Orfeuil, B. R. Recherche de sources et d'anisotropies dans le rayonnement cosmique d'ultra-haute énergie au sein de la collaboration AUGER.**