$D_0 - \varphi_0$ Beamline Study

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What is the $D_0 - \varphi_0$ Beamline?

In CDF coordinates

$$D(Z_0,\phi_0)=x_0\cdot\sin(\phi_0)+x_{slope}\cdot\sin(\phi_0)\cdot Z_0-y_0\cdot\cos(\phi_0)-y_{slope}\cdot\cos(\phi_0)\cdot Z_0$$

Define

$$\vec{x}=(x_0,y_0,x_{slope},y_{slope})$$

$$\vec{g}=(\sin(\phi_0),-\cos(\phi_0),\sin(\phi_0)\cdot Z_0,-\cos(\phi_0)\cdot Z_0)$$

Then minimize

$$\chi^2=\sum_{i=1}^{N}\left(\frac{(D_i-\vec{x}\cdot\vec{g})}{\sigma_i}\right)^2$$

to get

$$\vec{x}=V\cdot\vec{b}$$

where

$$V^{-1}_{l,m}=\sum_{i=1}^{N}\left(\frac{g_l\cdot g_m}{\sigma_i^2}\right)$$

$$\vec{b}=\sum_{i=1}^{N}\left(\frac{g_l\cdot D_i}{\sigma_i^2}\right)$$

What have we done?

- So far looked only at SVX beamline
- $D_0 - \varphi_0$ algorithm cuts
  - Default, good quality track cuts
    - $p_T > 1.0$ Gev
    - #Si axial hits ≥ 4
    - $|d0| < 3.0$ cm
    - tighten χ^2 cut until 60% of tracks remain
  - Modified one by one for two recent runs
    - Run 156460, w/constant SVT beamline
    - Run 155919, w/varying SVT beamline
- Preliminary look at algorithm in Monte Carlo

Run 156460: constant SVT beam

Run 156460 (constant SVT beamline)

#events=36,379
L=388 nb^{-1}

Beamline	x_0 (cm)	y_0 (cm)	dx ($\times10^{-6}$rad)	dy ($\times10^{-6}$rad)	σ_{x0} ($\times10^{-6}$)	σ_{y0} ($\times10^{-6}$)	σ_{dx} ($\times10^{-8}$)	σ_{dy} ($\times10^{-8}$)	#trk/ev
vxprim DB	−0.205005	0.403707	538.957	230.5	11.4827	11.3592	50.2943	50.7187	−−−−
$D_0-\varphi_0$ DB	−0.20500	0.40371	539.0	230.5	0.0000	0.0000	0.0000	0.0000	−−−−
$D_0-\varphi_0$	−0.205000	0.403703	539.055	230.107	11.3341	11.2364	49.6724	50.0379	8
−stand alone	−0.205010	0.403724	537.879	228.875	12.0805	12.1078	52.2478	53.2362	6
$p_T>0.5$	−0.204830	0.403658	540.590	229.721	9.2060	9.1142	40.1166	40.3629	15
$p_T>0.6$	−0.204903	0.403693	540.188	230.452	9.6604	9.5737	42.1350	42.4780	13
$p_T>0.8$	−0.204920	0.403686	539.822	229.845	10.1655	10.0800	44.2813	44.6497	10
$p_T>1.2$	−0.205130	0.403706	538.988	229.597	11.9211	11.8288	52.1752	52.5910	7
$p_T>1.5$	−0.205014	0.403713	538.088	228.484	12.8375	12.7412	56.0583	56.5508	5
$\lvert d_0\rvert \le 1.0$	−0.205001	0.403702	539.055	230.077	11.3337	11.2358	49.6718	50.0330	8
$\lvert d_0\rvert \le 10.0$	−0.205000	0.403703	539.063	230.116	11.3340	11.2364	49.6722	50.0385	8
#SiAxHits ≥ 3	−0.204963	0.403700	539.562	230.081	11.0124	10.9248	48.1908	48.4841	8
#SiAxHits ≥ 5	−0.205006	0.403707	539.030	230.058	11.4828	11.3592	50.2931	50.7163	7
f=0.4	−0.205008	0.403715	539.035	230.300	11.4184	11.3145	50.0752	50.4340	5
f=0.5	−0.205000	0.403703	539.055	230.107	11.3341	11.2364	49.6724	50.0379	7
f=0.7	−0.204988	0.403695	538.867	230.019	11.2834	11.1854	49.4178	49.7786	9
f=0.8	−0.204981	0.403681	539.113	229.925	11.2385	11.1429	46.3654	49.5519	11

- Biggest difference in p_T cuts
  - Much larger #tracks/event w/lower p_T
- Other quantities don't change much

Run 155919: varying SVT beam

Run 155919 (varying SVT beamline)

#events=33,525
L=389 nb^{-1}

Beamline	x_0 (cm)	y_0 (cm)	dx ($\times 10^{-6}$rad)	dy ($\times 10^{-6}$rad)	σ_{x0} ($\times 10^{-6}$)	σ_{y0} ($\times 10^{-6}$)	σ_{dx} ($\times 10^{-8}$)	σ_{dy} ($\times 10^{-8}$)	#trk/ev
vxprim DB	−0.205519	0.402371	481.15	236.446	11.4328	11.0818	50.7828	50.1226	−−−−
$D_0-\varphi_0$ DB	−0.20552	0.40237	481.2	236.400	0.0000	0.0000	0.0000	0.0000	−−−−
$D_0-\varphi_0$	−0.205464	0.402365	481.728	235.506	11.9497	11.6246	53.0720	52.2941	8
−stand alone	−0.205506	0.402354	479.417	234.256	12.6855	12.5302	55.7264	55.7056	6
$p_T>0.5$	−0.205428	0.402282	483.853	235.714	9.6004	9.3349	42.4547	41.7929	15
$p_T>0.6$	−0.205457	0.402314	482.758	236.291	10.1734	9.9022	45.0722	44.4476	13
$p_T>0.8$	−0.205490	0.402312	482.362	235.505	10.7260	10.4384	47.4614	46.7514	10
$p_T>1.2$	−0.205490	0.402347	481.093	235.062	12.5860	12.2391	55.8165	54.9867	7
$p_T>1.5$	−0.205520	0.402342	480.199	234.395	13.5634	13.1773	60.0584	59.0374	5
$\lvert d_0\rvert \le 1.0$	−0.205466	0.402364	481.741	235.433	11.9499	11.6246	53.0693	52.2928	8
$\lvert d_0\rvert \le 10.0$	−0.205464	0.402365	481.728	235.506	11.9497	11.6246	53.0720	52.2941	8
#SiAxHits ≥ 3	−0.205513	0.402314	482.046	234.683	11.2791	10.9880	49.8696	49.0650	8
#SiAxHits ≥ 5	−0.205476	0.402366	481.563	235.691	12.1192	11.7575	53.8138	53.1020	8
f=0.4	−0.205461	0.402363	481.774	235.519	11.9604	11.6361	53.1212	52.3512	5
f=0.5	−0.205461	0.402363	481.774	235.519	11.9604	11.6361	53.1212	52.3512	7
f=0.7	−0.205466	0.402365	481.669	235.483	11.9439	11.6180	53.0461	52.2634	9
f=0.8	−0.205465	0.402364	481.597	235.433	11.9382	11.6121	53.0235	52.2389	11

- Again biggest difference in p_T cuts
- Hard to draw conclusions from varying case
  - try MC.....

Di−jet MC: beam at (0,0,0,0)

#events=20,000

Di−jet MC (beam @ (0,0,0,0))

Beamline		x_0 ($\times 10^{-6}$cm)	y_0 ($\times 10^{-6}$cm)	dx ($\times 10^{-6}$rad)	dy ($\times 10^{-6}$rad)	σ_{x0} ($\times 10^{-6}$)	σ_{y0} ($\times 10^{-6}$)	σ_{dx} ($\times 10^{-8}$)	σ_{dy} ($\times 10^{-8}$)	#trk/ev
$D_0-\varphi_0$ "good" qual.		10.8572	−15.8783	−0.827171	−0.698416	21.0566	21.0329	29.4533	29.4517	3
+standard DB		147.979	−364.112	−0.235748	−0.685496	16.3554	17.3012	23.1703	24.4427	6
$p_T>0.4$										
$p_T>0.5$										
$p_T>0.8$										
$p_T>1.2$										
$p_T>1.5$										
$p_T>2.0$										
#SiAxHits ≥ 3										
#SiAxHits ≥ 5										
#CtAx,St ≥ 20,20										
#CtAx,St ≥ 30,30										
#events = 1000		13.3495	10.4180	1.19124	3.96426	91.4769	91.6763	125.722	128.748	4

- "good" quality
  - defTracks, p_T > 1.0GeV, #Si axial ≥ 4
    #COT ax,st ≥ 25, $|d_0|$ ≤ 1.0 cm, f = 0.6
  - Many empty columns remaining!!

Summary

- Monte Carlo needs further study
- Beamline in reasonable agreement w/vxprim
- more next week...