MERIT beam optics

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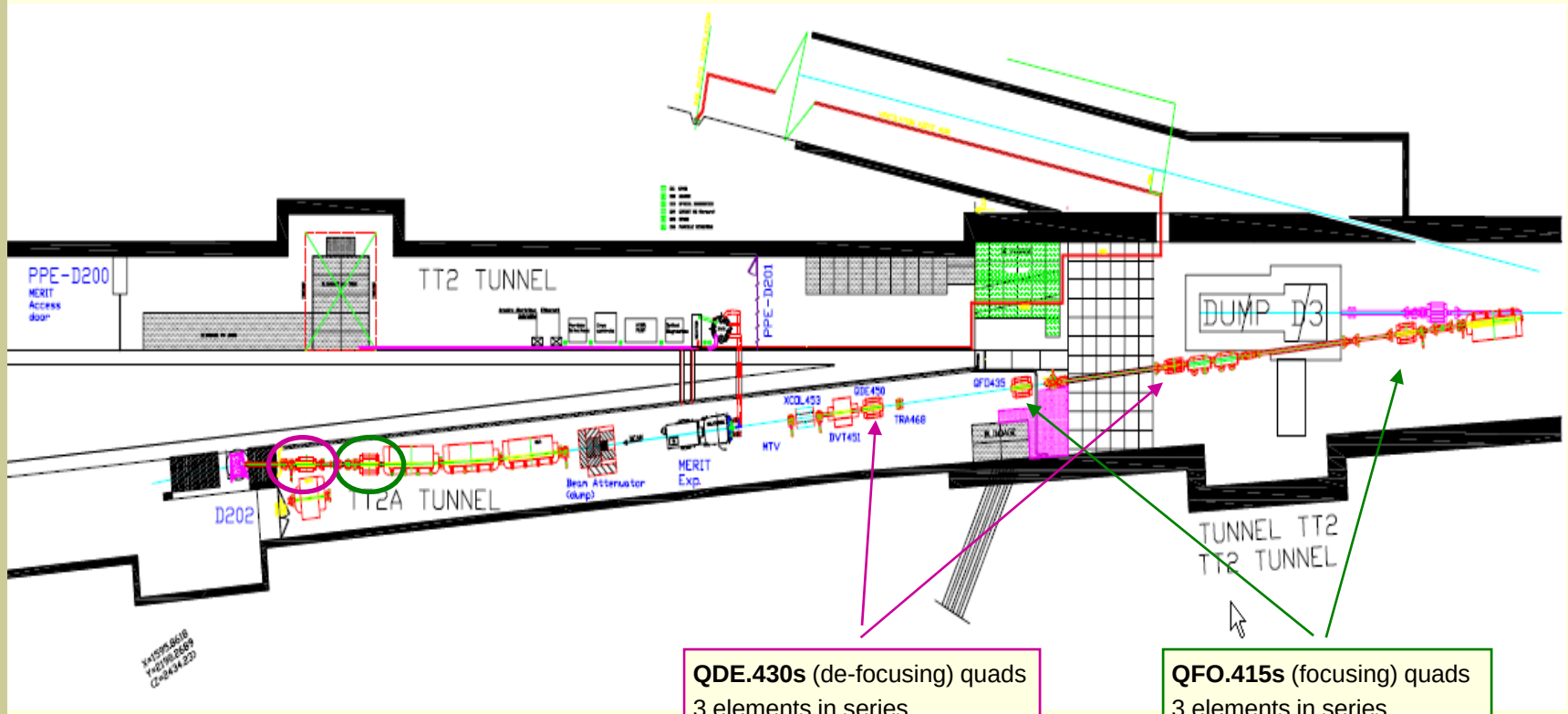
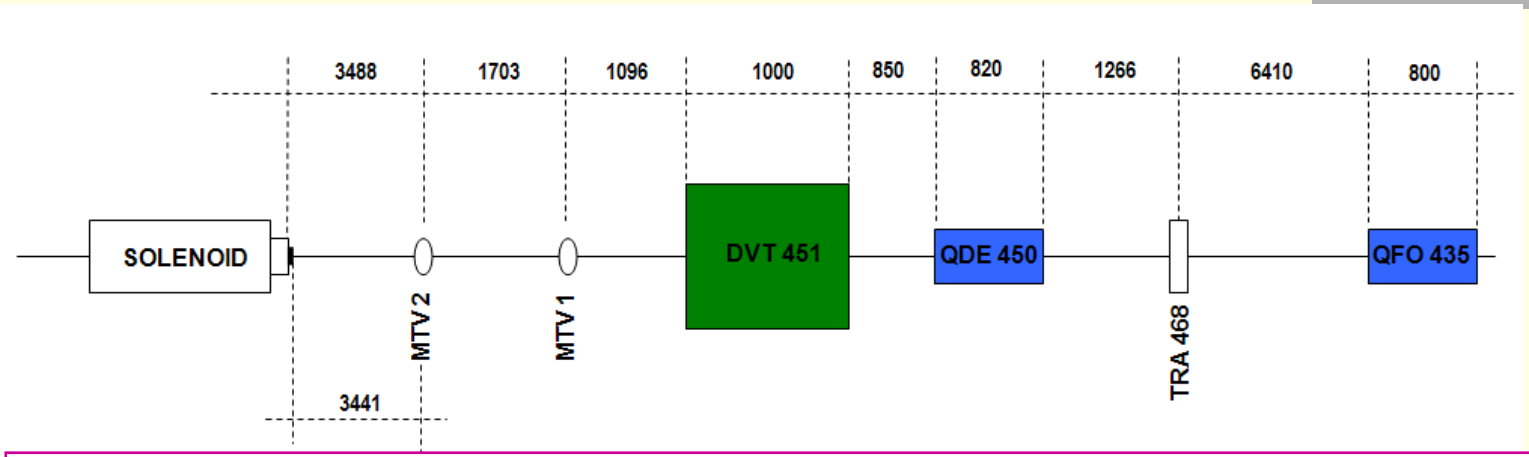
MERIT Elements – Layout



QDE.430s (de-focusing) quads
3 elements in series

QFO.415s (focusing) quads
3 elements in series

Survey data after the MERIT run – 18.12.2007



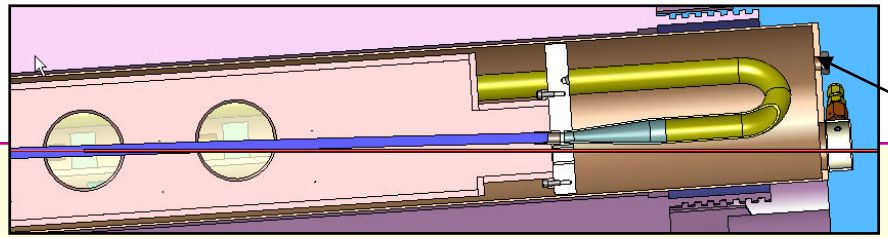
FTN start 304.69540

Data from GEODE database, registered on 15 June 2007

Element	Position	x	y	z	Distance	Rel. Distance	Center	TT2/FTN
FTNQFO.435	E	1636.84951	2179.54532	2434.22735	48.21100		48.61100	353.30640
	S	1636.11207	2179.85546	2434.22734	49.01100	0.80000		
FTNTRA.468	E/S	1634.82593	2180.39636	2434.22734	50.40625	1.39525		
FTNQDE.450	E	1629.01792	2182.83899	2434.22733	56.70700	6.30075	57.11700	361.81240
	S	1682.26050	2183.15688	2434.22733	57.52700	0.82000		
FTNDVT.451	E	1627.44810	2183.49920	2434.22732	58.41000	0.88300	58.91000	363.60540
	S	1626.52630	2183.88687	2434.22732	59.41000	1.00000		
FTNXCO.453	E	1625.49113	2184.32222	2434.22732	60.53300	1.12300	61.03300	365.72840
	S	1624.56933	2184.70990	2434.22732	61.53300	1.00000		

Measurements - 18.12.2007

Distance	TT2/FTN	Center
48.211	352.9064	48.611
49.011	353.7064	
55.421	360.1164	55.421
56.687	361.3824	57.097
57.507	362.2024	
58.357	363.0524	58.857
59.357	364.0524	

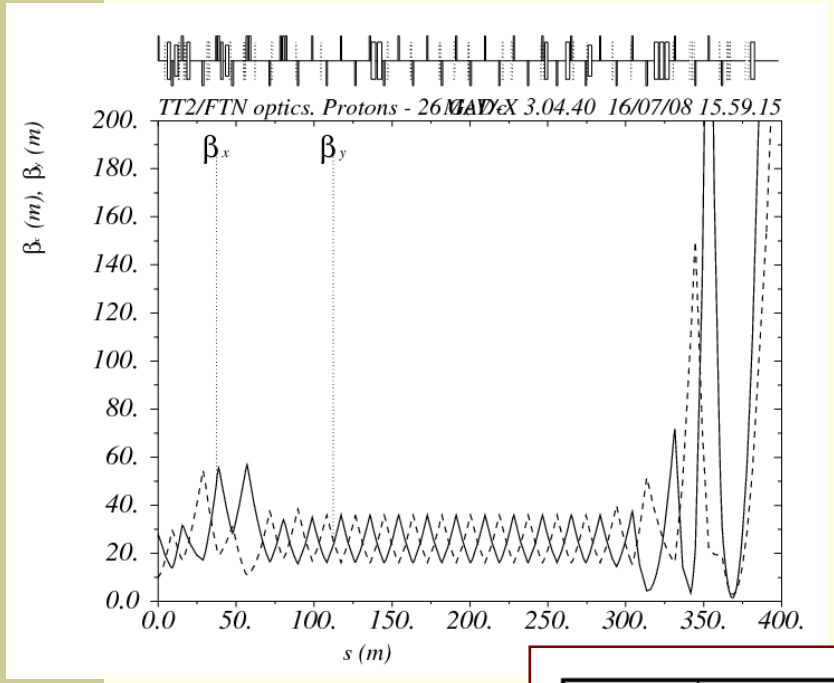


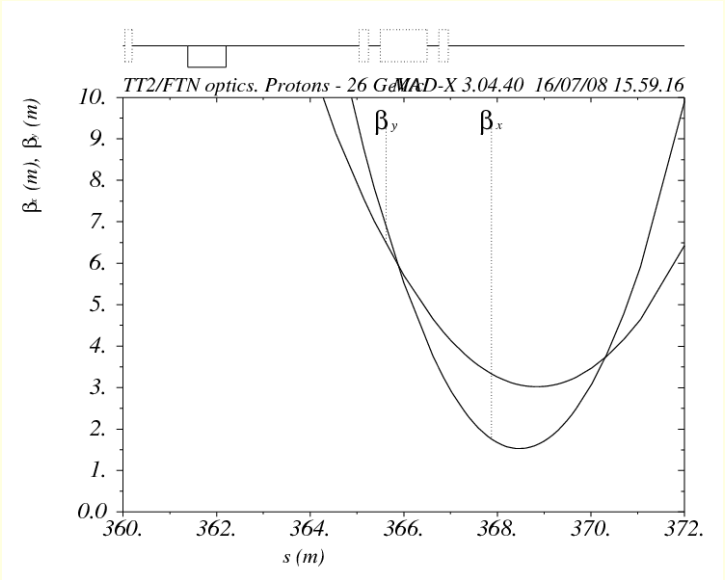
MTV1	60.453	365.1484
MTV2	62.156	366.8514
HGTAU	65.644	370.3394
HGTAR	66.367	**371.0624**

Upstream face: **-72.3cm**

Beam optics

- Fit parameters: QFO, QDO strengths and locations (within limits)

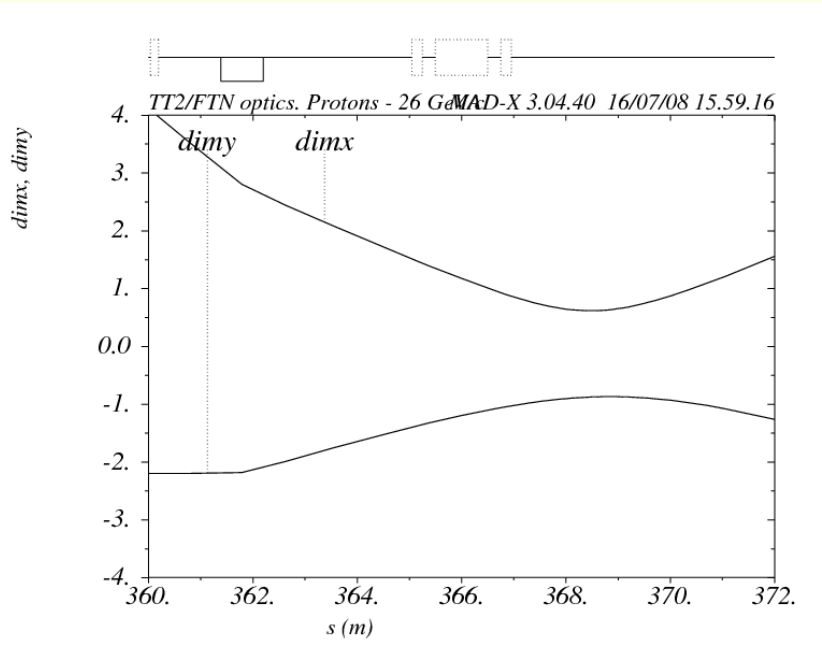




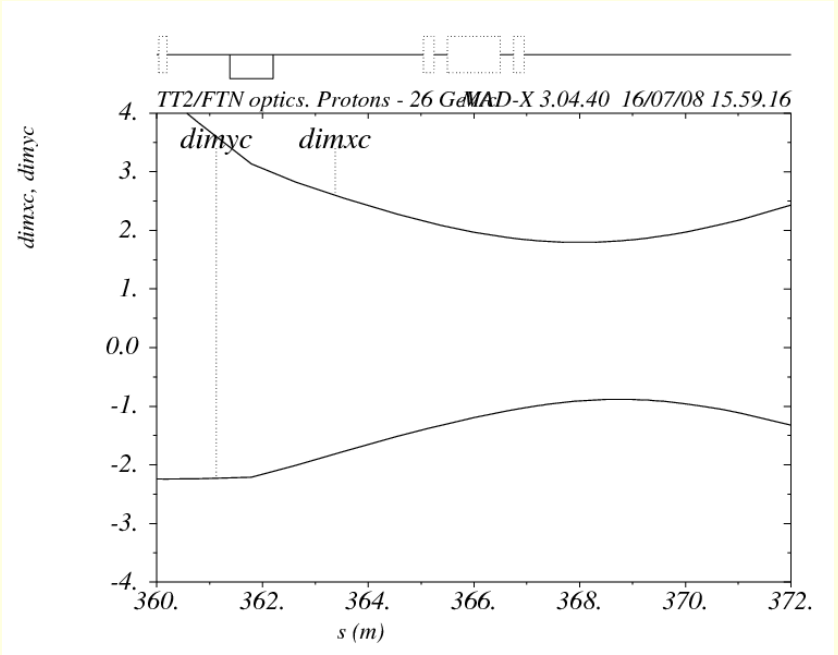
Element	S_line	Beta_x	Alfa_x	Delta_x	Beta_y	Alfa_y	Delta_y
	[m]	[m]	[]	[m]	[m]	[]	[m]
MTV.454	365.1484	8.7535	2.1732	1.5415	7.5513	1.2242	-0.0419
MTV.484	366.8514	3.2477	1.0598	1.6209	4.3414	0.6607	0.0294
HG-WUP	370.3394	3.8082	-1.2205	1.7834	3.7581	-0.4934	0.1756
HG-TARG	371.0624	5.9148	-1.6932	1.8171	4.6446	-0.7327	0.2058
HG-WDO	373.6914	19.3362	-3.4119	1.9397	10.7838	-1.6025	0.3160

Beam envelope (1-sigma) - ε=0.25 (mm.mrad), Dp=0.1%

- Without dispersion term



- With dispersion term



- σ(x) = 2.2mm , σ(y) = 0.86 mm,
- 164 J/gr@30TP

Beam optics – summary

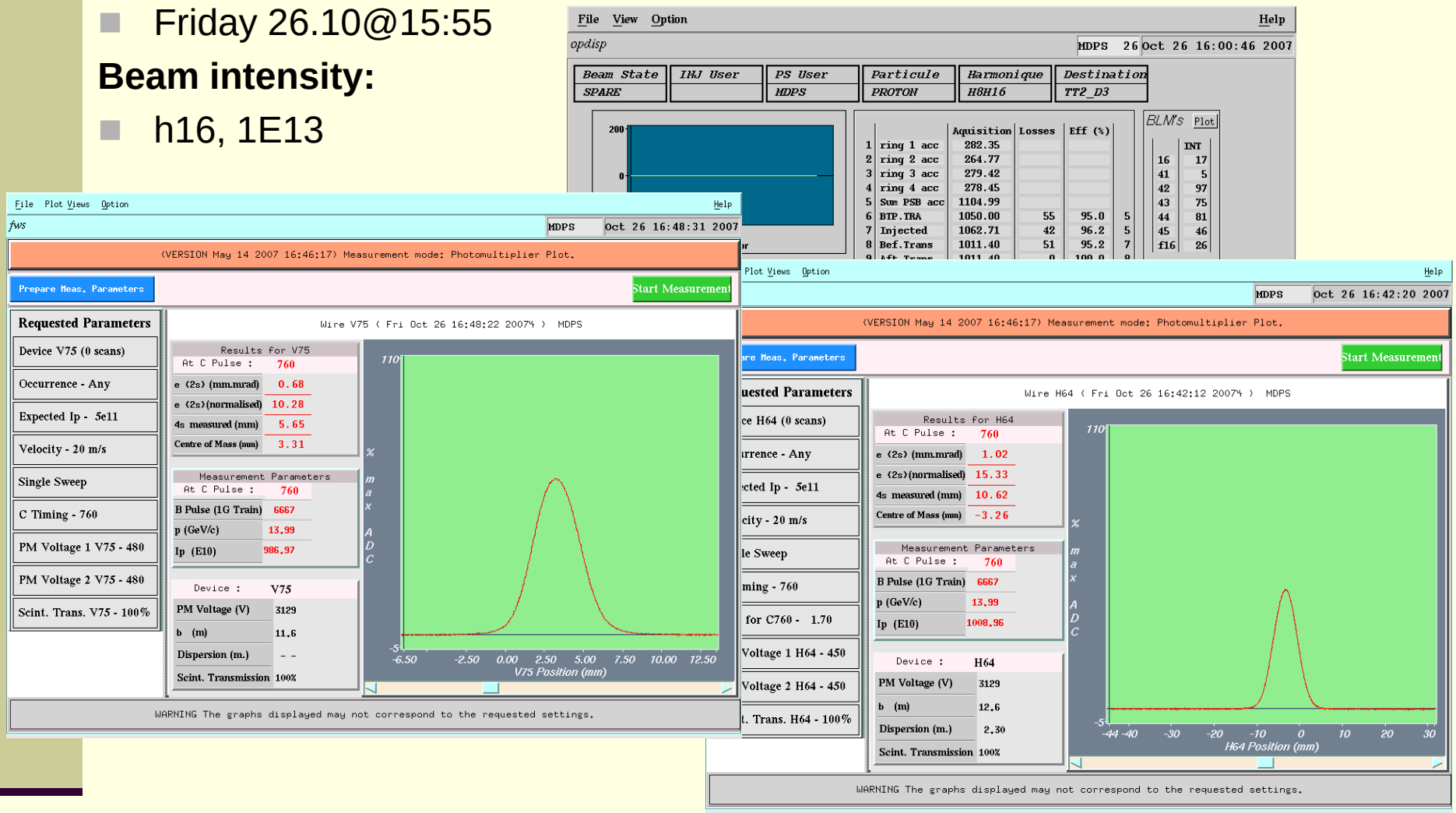
- Optics solution found within the overall constrains
- Lack of survey before the data-taken introduced an error to the beam focus position
  - Beam waist advanced by ~1m upstream of solenoid
- Beam spot estimate depends on emittance measurement
  - We did not insist of having systematic measurement of the beam emittance during the run
  - Only five measurements done

Beam Emittance measurement – 14 GeV/c

- Friday 26.10@15:55

Beam intensity:

- h16, 1E13

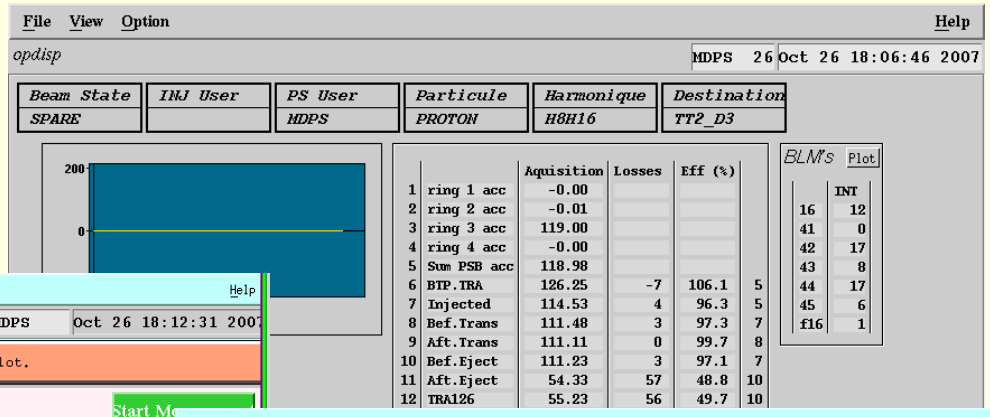


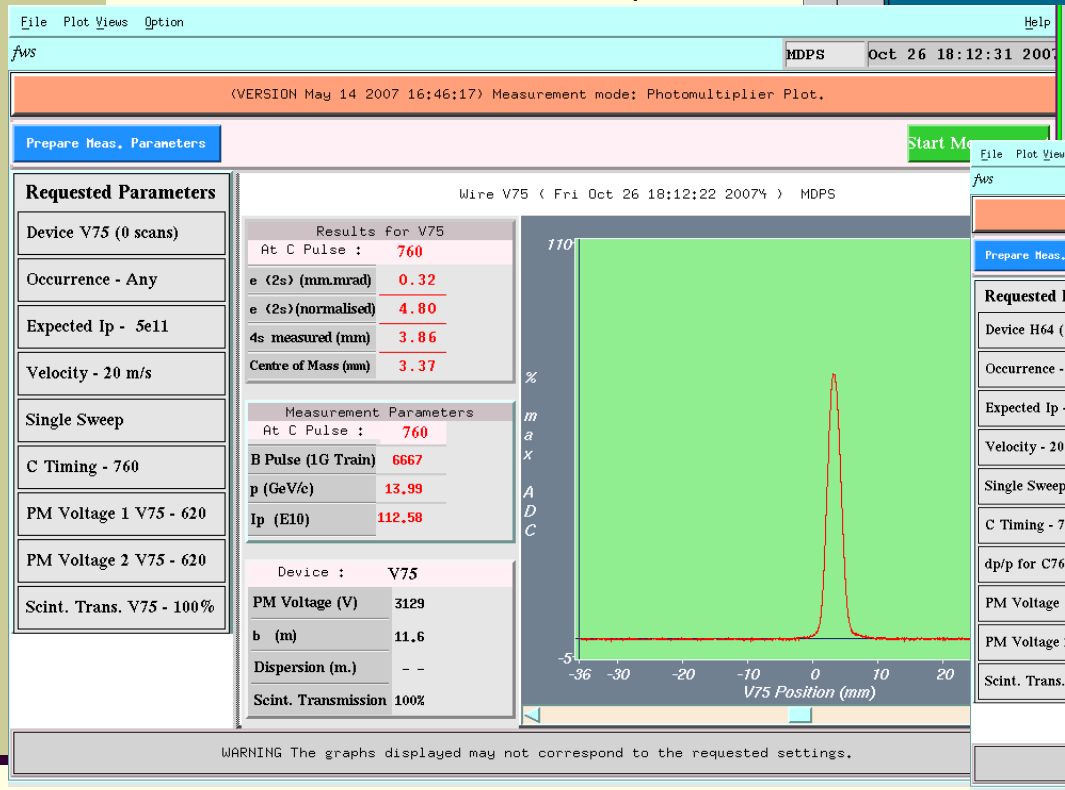
Beam Emittance measurement – 14 GeV/c

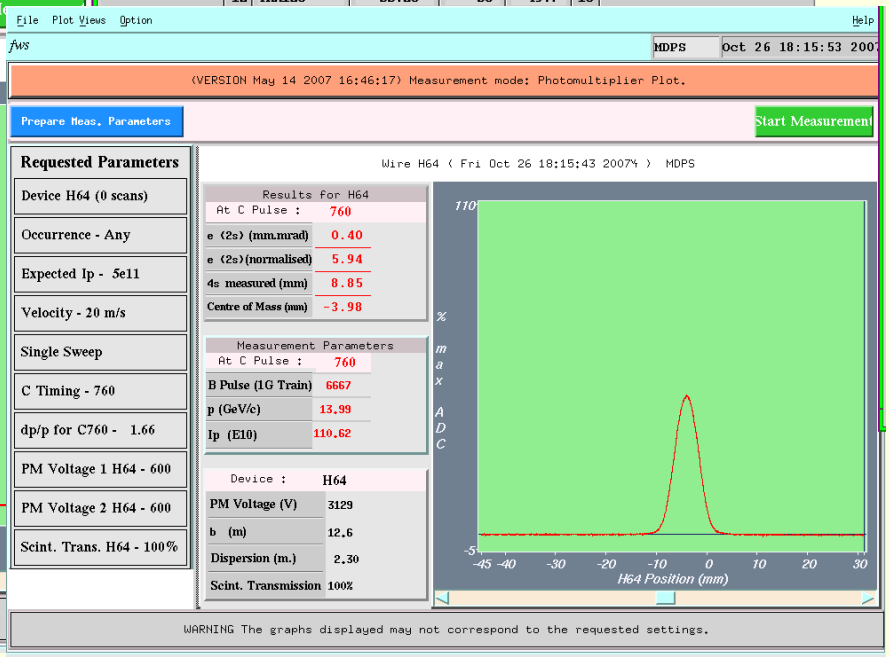
- Friday 26.10@17:37

Beam intensity:

- 2.5E11/bunch
- 2 extracted bunches,





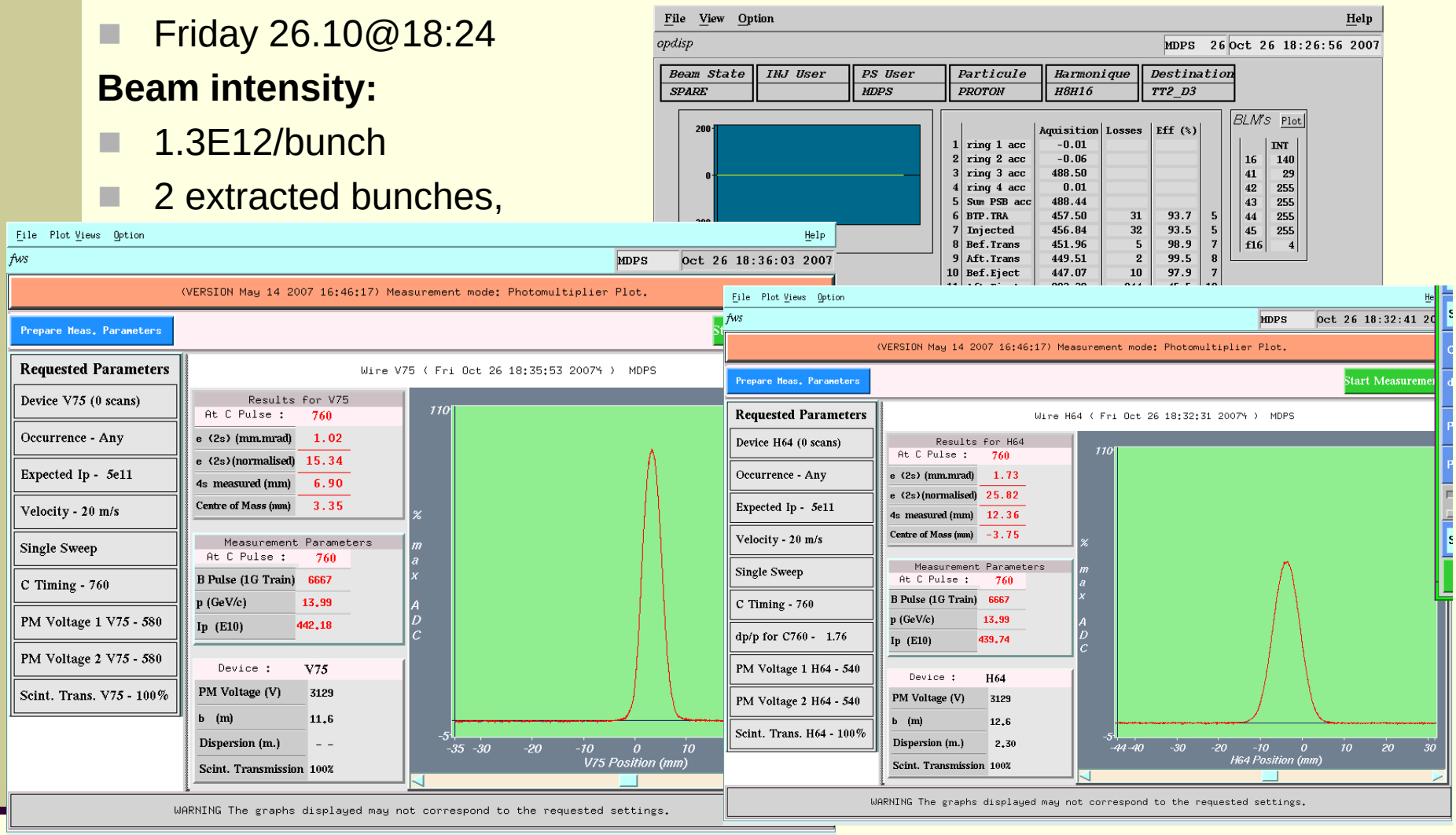


Beam Emittance measurement – 14 GeV/c

- Friday 26.10@18:24

Beam intensity:

- 1.3E12/bunch
- 2 extracted bunches,

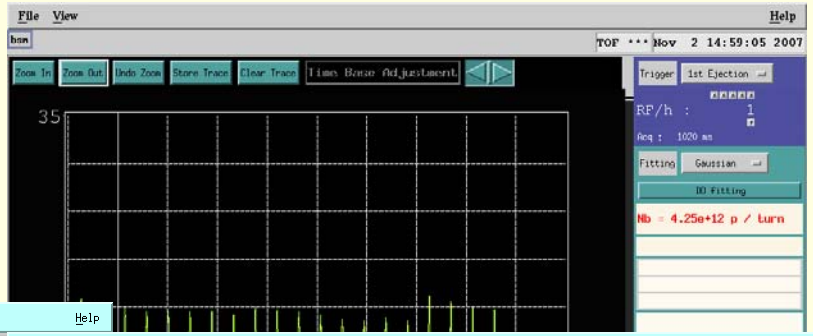


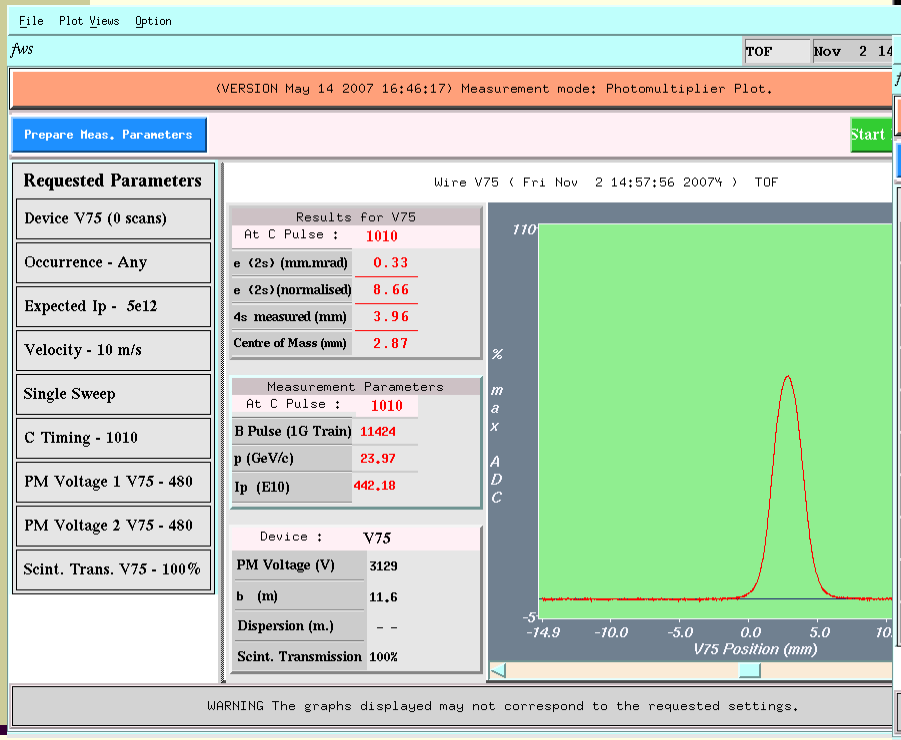
Beam Emittance measurement – 24 GeV/c

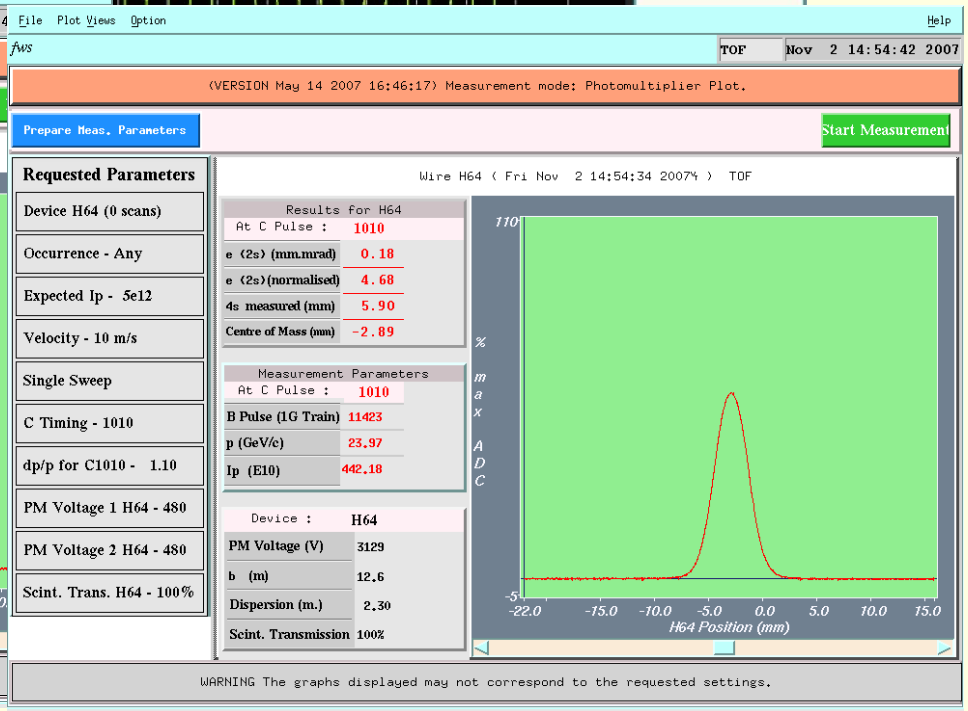
- Friday 02.11@14:55PM

Beam intensity:

- 2.5E11/bunch
- 16 bunches





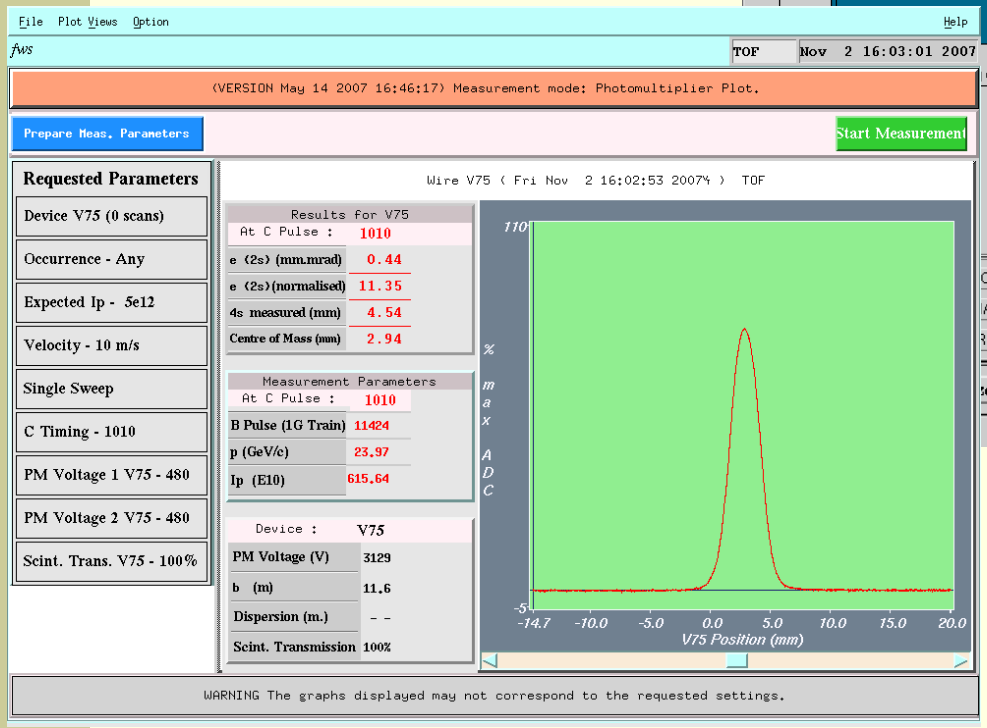


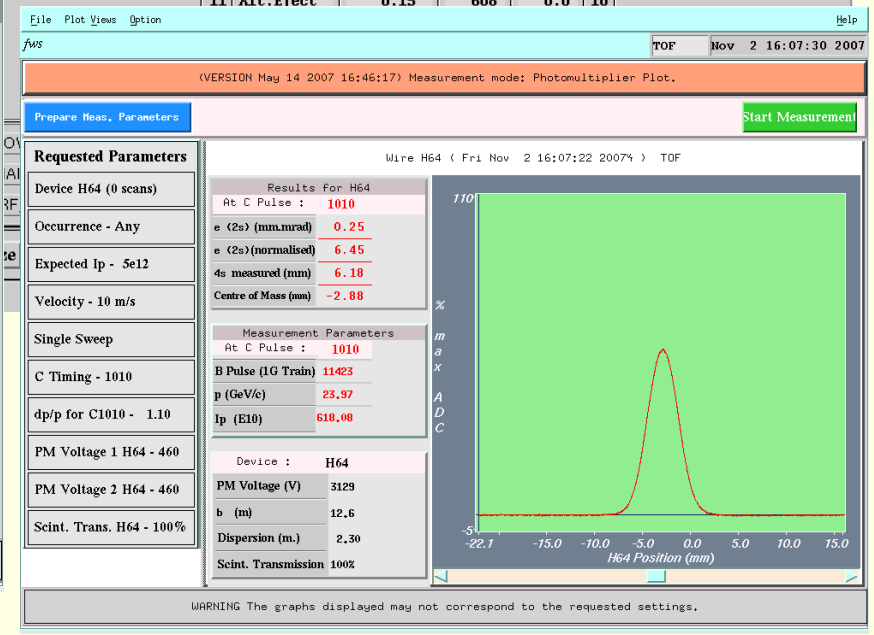
Beam Emittance measurement – 24 GeV/c

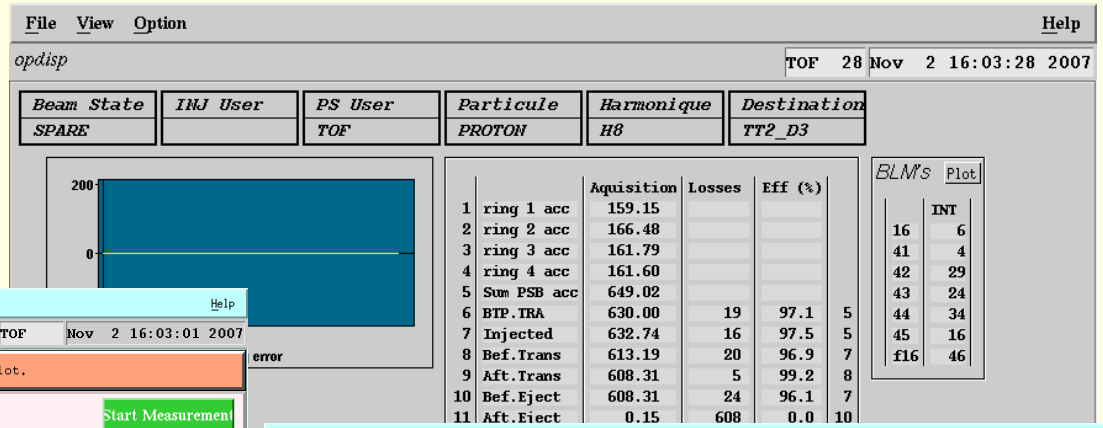
- Friday 02.11@16:02PM

Beam intensity:

- 16 bunches,
- 6E12 protons





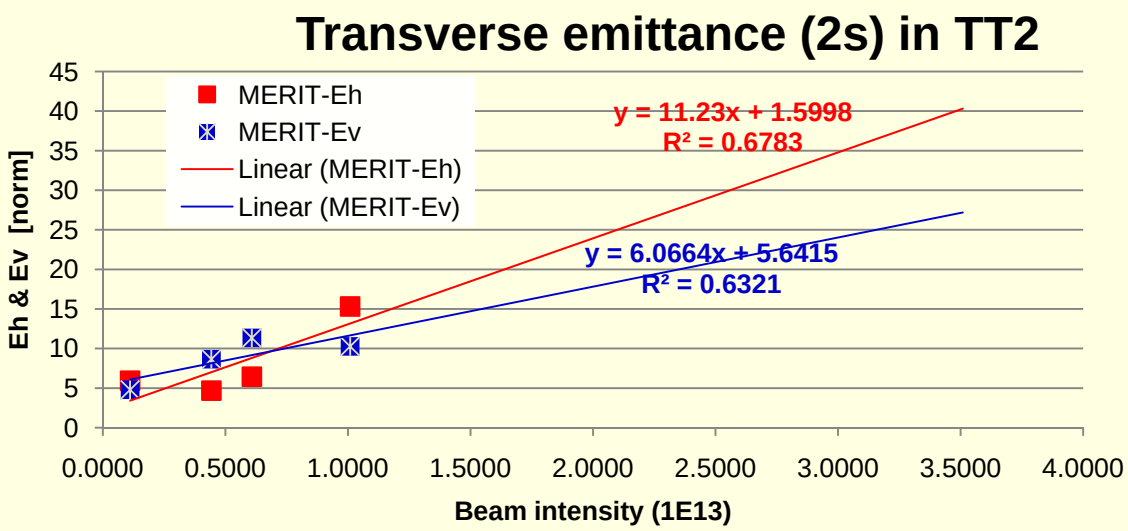


Emittance measurement

- Use the data to extrapolate at higher intensities

Intensity [e13]	Pbeam [GeV]	Eh(2s) [mm.mrad]	Eh(2s) [norm]	Ev(2s) [mm.mrad]	Ev(2s) [norm]
MERIT -run					
1.0090	14	1.02	15.33	0.68	10.28
0.1112	14	0.4	5.94	0.32	4.8
0.4428	14	0.18	4.68	0.33	8.66
0.6080	24	0.25	6.45	0.44	11.35
0.4471	24	1.73	25.82	1.02	15.34

	Eh(2s) [norm]	Eh(2s) [mm.mrad]	Ev(2s) [norm]	Ev(2s) [mm.mrad]
24 GeV	35.2898	1.3678	23.8392	0.9242
14 GeV	35.2898	2.3764	23.8392	1.5893



Estimated beam spot and density

- Use the extrapolated emittances to estimate the beam spot and energy density at target

- Example : 24 GeV, 30 TP

24 GeV	Delta_p=	1.1 [0.1%]	
	Eh_x(2s)@30TP=	1.3678 [pi. mm.mrad]	0.34195
	Eh_y(2s)@30TP=	0.9242 [pi. mm.mrad]	0.23105
	Beam density (1s)=	**122.37 [J/gr for 30TP]**	

Element	S_line	Beta_x	Alfa_x	Delta_x	Beta_y	Alfa_y	Delta_y	Size_x(1s)	Size_y(1s)
	[m]	[m]	[]	[m]	[m]	[]	[m]	[mm]	[mm]
MTV.454	365.1484	8.7535	2.1732	1.5415	7.5513	1.2242	-0.0419	2.4225	1.3210
MTV.484	366.8514	3.2477	1.0598	1.6209	4.3414	0.6607	0.0294	2.0711	1.0016
HG-WUP	370.3394	3.8082	-1.2205	1.7834	3.7581	-0.4934	0.1756	2.2695	0.9338
HG-TARG	**371.0624**	**5.9148**	**-1.6932**	**1.8171**	**4.6446**	**-0.7327**	**0.2058**	**2.4531**	**1.0383**
HG-WDO	373.6914	19.3362	-3.4119	1.9397	10.7838	-1.6025	0.3160	3.3413	1.5822