

LEIR Injection line studies

F.Roncarolo – APC meeting 31-08-2006

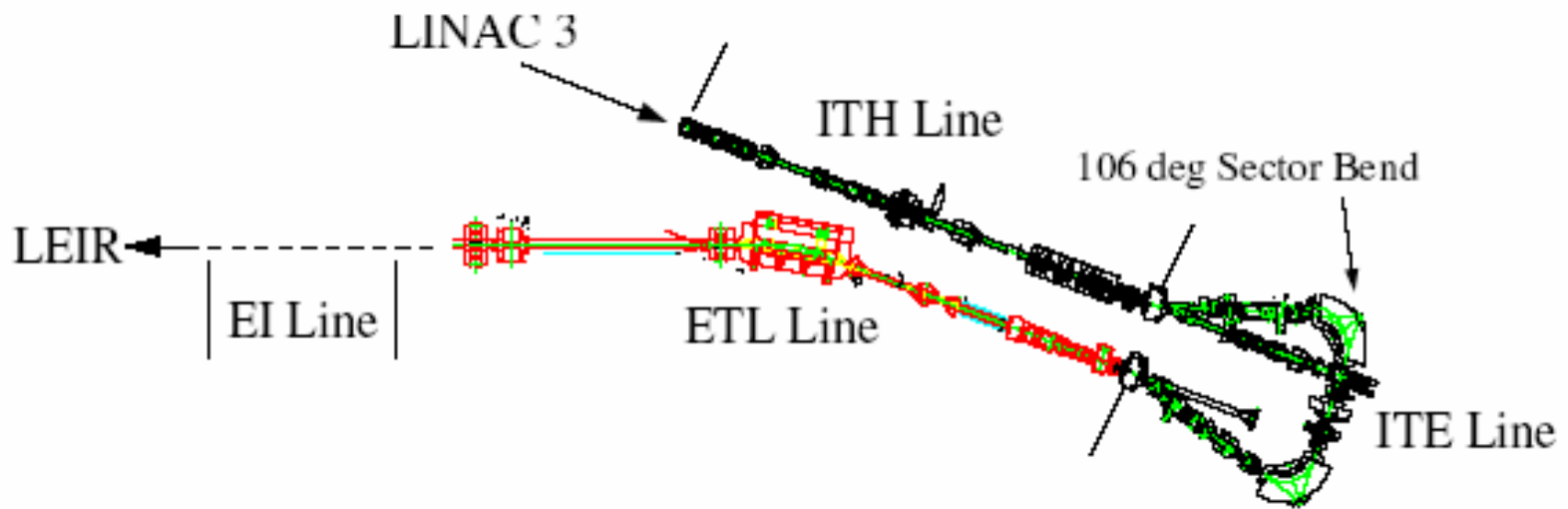
Acknowledgments:

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All the LEIR commissioning team

Injection Line Layout

- Ions transfer from Linac3 to LEIR
 - O^{4+} or Pb^{54+} at 4.2 MeV/nucleon



Matching Constraints

- Total **length** of the consider line: 110 m
- **Matching** using **MAD** according to the following constraints:
 - Matching of **Twiss parameters** from **Linac3** (beginning of ITH line)
 - **Symmetric** Twiss parameters along **ITE line**
 - $\alpha_x, \alpha_y = 0$ at the loop center
 - $\beta_x, \beta_y < 25$ m and -10 m $< D_x < 10$ m along **ETL line**
 - $D_x \approx 0$ and $\beta_x = \beta_y = 2$ m at **LEIR injection** in order to enhance the multi-turn injection efficiency

ITH Line (from Linac3)

NAME	S	BETX	ALFX	MUX	DX	BETY	ALFY	MUY	DY
IT	0.000	10.200	0.975	0.000	0.871	20.000	-2.300	0.000	0.000
IT.DD10	0.956	8.511	0.792	0.016	0.851	24.682	-2.601	0.007	0.000
IT.D10	0.956	8.511	0.792	0.016	0.851	24.682	-2.601	0.007	0.000
IT.DQ08	6.398	5.552	-0.249	0.162	0.737	62.305	-4.312	0.029	0.000
IT.Q0810	6.653	6.274	-2.678	0.169	0.768	58.354	19.287	0.030	0.000
IT.DQ09	7.198	9.580	-3.387	0.180	0.916	39.229	15.803	0.031	0.000
IT.Q09	7.453	9.729	2.835	0.184	0.910	37.447	-8.438	0.033	0.000
IT.DQ09	7.998	6.915	2.329	0.195	0.736	47.216	-9.488	0.035	0.000
IT.Q0810	8.253	6.424	-0.339	0.201	0.690	47.294	9.196	0.035	0.000
IT.DD11	11.036	9.657	-0.823	0.258	0.573	10.125	4.162	0.056	0.000
IT.D11	11.036	9.657	-0.823	0.258	0.573	10.125	4.162	0.056	0.000
IT.DMS11	11.446	10.361	-0.894	0.265	0.556	7.016	3.420	0.064	0.000
IT.MS11	11.446	10.361	-0.894	0.265	0.556	7.016	3.420	0.064	0.000
IT.DD21	15.396	20.130	-1.579	0.309	0.389	8.231	-3.727	0.477	0.000
IT.D21	15.396	20.130	-1.579	0.309	0.389	8.231	-3.727	0.477	0.000
IT.DQ11	15.990	22.069	-1.683	0.313	0.364	13.302	-4.803	0.486	0.000
IT.Q1113	16.293	20.337	7.155	0.316	0.329	18.399	-12.722	0.489	0.000
IT.DQ12	16.597	16.224	6.375	0.318	0.271	26.951	-15.412	0.491	0.000
IT.Q12	16.900	16.769	-8.336	0.321	0.250	28.633	10.381	0.493	0.000
IT.DQ13	17.196	22.072	-9.580	0.324	0.263	22.821	9.257	0.494	0.000
IT.Q1113	17.499	25.086	0.059	0.326	0.259	20.107	0.073	0.497	0.000
IT.DMS15	18.577	25.006	0.016	0.333	0.186	20.008	0.019	0.505	0.000
IT.MS15	18.577	25.006	0.016	0.333	0.186	20.008	0.019	0.505	0.000
IT.DIE	18.964	25.000	0.000	0.335	0.160	20.000	0.000	0.508	0.000
IT	18.964	25.000	0.000	0.335	0.160	20.000	0.000	0.508	0.000

ITE Line (Loop)

NAME	S	BETX	ALFX	MUX	DX	BETY	ALFY	MUY	DY
IEOPT	18.964	25.000	0.000	0.335	0.160	20.000	0.000	0.508	0.000
IE.B1	19.446	25.009	-0.019	0.338	0.062	18.701	2.607	0.512	0.000
IE.DQ1	21.016	25.167	-0.082	0.348	-0.485	11.542	1.952	0.529	0.000
IE.Q1	21.271	22.097	11.601	0.350	-0.541	12.042	-3.996	0.533	0.000
IE.DQ2	22.716	1.382	2.734	0.392	-0.665	26.533	-6.032	0.546	0.000
IE.Q2	22.971	0.474	0.989	0.444	-0.735	25.852	8.575	0.547	0.000
IE.DB2	23.408	0.407	-0.835	0.679	-0.939	18.904	7.314	0.550	0.000
IE.B2_1	24.888	2.060	1.473	0.834	0.935	5.786	2.561	0.573	0.000
IE.DTV1	25.728	0.671	0.180	0.961	2.798	2.405	1.464	0.609	0.000
IE.MTV1	25.728	0.671	0.180	0.961	2.798	2.405	1.464	0.609	0.000
IE.DQ3	25.965	0.672	-0.185	1.018	3.323	1.785	1.154	0.628	0.000
IE.Q3H	26.128	0.703	0.000	1.056	3.514	1.603	0.000	0.643	0.000
IE.Q3H	26.291	0.672	0.185	1.093	3.359	1.785	-1.154	0.659	0.000
IE.DB3	27.368	2.060	-1.473	1.277	1.198	5.786	-2.561	0.713	0.000
IE.B2_2	28.848	0.407	0.835	1.433	-0.856	18.904	-7.314	0.736	0.000
IE.DB2	29.286	0.474	-0.989	1.668	-0.817	25.852	-8.575	0.739	0.000
IE.Q2	29.541	1.382	-2.734	1.720	-0.852	26.533	6.032	0.741	0.000
IE.DQ2	30.986	22.097	-11.601	1.762	-1.382	12.042	3.996	0.754	0.000
IE.Q1	31.241	25.167	0.082	1.764	-1.385	11.542	-1.952	0.757	0.000
IE.DQ1	32.811	25.009	0.019	1.774	-0.849	18.701	-2.607	0.774	0.000
IE.B1	33.292	25.000	0.000	1.777	-0.754	20.000	0.000	0.778	0.000
IE.DB1I	33.050	25.002	0.010	1.775	-0.768	20.003	0.012	0.776	0.000
IEOPT	33.050	25.002	0.010	1.775	-0.768	20.003	0.012	0.776	0.000

ETL Line

NAME	S	BETX	ALFX	MUX	DX	BETY	ALFY	MUY	DY
ETIOPT	33.050	25.002	0.010	1.775	-0.768	20.003	0.012	0.776	0.000
ET.DDH1	33.889	25.014	-0.024	1.780	-0.718	20.018	-0.030	0.783	0.000
ET.DH1	33.889	25.014	-0.024	1.780	-0.718	20.018	-0.030	0.783	0.000
ET.DMTV1	34.502	25.059	-0.048	1.784	-0.681	20.073	-0.060	0.788	0.000
ET.MTV1	34.502	25.059	-0.048	1.784	-0.681	20.073	-0.060	0.788	0.000
ET.DUHV1	35.252	25.154	-0.078	1.789	-0.635	20.192	-0.098	0.794	0.000
ET.UHV1	35.252	25.154	-0.078	1.789	-0.635	20.192	-0.098	0.794	0.000
ET.DST1	36.221	25.343	-0.117	1.795	-0.577	20.429	-0.146	0.801	0.000
ET.ST1	36.221	25.343	-0.117	1.795	-0.577	20.429	-0.146	0.801	0.000
ET.DB1	41.038	27.400	-0.310	1.824	-0.286	23.000	-0.387	0.837	0.000
ET.B11	43.389	29.042	-0.402	1.837	-0.539	22.524	0.578	0.853	0.000
ET.DQ1	43.910	29.472	-0.423	1.840	-0.684	21.938	0.547	0.857	0.000
ET.Q11	44.295	30.010	-0.979	1.842	-0.794	21.375	0.911	0.860	0.000
ET.DBV1	49.213	41.217	-1.300	1.865	-2.235	14.482	0.490	0.905	0.000
ET.BV1	49.771	42.684	-1.329	1.867	-2.398	13.962	0.442	0.911	-0.003
ET.DQ2	50.200	43.835	-1.357	1.868	-2.524	13.599	0.406	0.916	-0.007
ET.Q21	50.585	43.404	2.465	1.870	-2.593	13.756	-0.819	0.921	-0.011
ET.DUHV2	51.870	37.337	2.255	1.875	-2.680	16.062	-0.975	0.935	-0.024
ET.UHV2	51.870	37.337	2.255	1.875	-2.680	16.062	-0.975	0.935	-0.024
ET.DMSE1	54.513	26.555	1.824	1.888	-2.859	22.066	-1.296	0.957	-0.051
ET.MSE1	54.513	26.555	1.824	1.888	-2.859	22.066	-1.296	0.957	-0.051
ET.DMTV2	58.391	14.859	1.192	1.919	-3.121	33.942	-1.767	0.980	-0.091
ET.MTV2	58.391	14.859	1.192	1.919	-3.121	33.942	-1.767	0.980	-0.091
ET.DQ3	61.200	9.445	0.734	1.958	-3.311	44.831	-2.108	0.991	-0.120
ET.Q31	61.585	9.348	-0.479	1.964	-3.418	44.294	3.480	0.992	-0.121
ET.DQ4	70.201	27.366	-1.612	2.055	-7.615	6.302	0.930	1.079	-0.079
ET.Q41	70.586	26.783	3.094	2.057	-7.547	6.030	-0.206	1.089	-0.080
ET.DMTV3	72.393	16.888	2.380	2.070	-6.034	7.339	-0.518	1.133	-0.096
ET.MTV3	72.393	16.888	2.380	2.070	-6.034	7.339	-0.518	1.133	-0.096
ET.DMSE2	74.514	8.566	1.543	2.099	-4.259	10.315	-0.885	1.172	-0.115
ET.MSE2	74.514	8.566	1.543	2.099	-4.259	10.315	-0.885	1.172	-0.115
ET.DUHV3	75.237	6.541	1.258	2.114	-3.654	11.685	-1.010	1.182	-0.122
ET.UHV3	75.237	6.541	1.258	2.114	-3.654	11.685	-1.010	1.182	-0.122
ET.DQ5	81.701	6.774	-1.294	2.402	1.755	31.964	-2.127	1.237	-0.180
ET.Q51	82.086	8.471	-3.238	2.411	2.155	30.930	4.739	1.238	-0.176
ET.DQ6	84.701	34.676	-6.783	2.435	5.450	11.329	2.756	1.261	-0.097
ET.Q61	85.086	35.821	3.927	2.437	5.612	10.524	-0.585	1.266	-0.091
ET.DMTV4	85.694	31.218	3.649	2.440	5.353	11.282	-0.663	1.275	-0.090
ET.MTV4	85.694	31.218	3.649	2.440	5.353	11.282	-0.663	1.275	-0.090
ET.DUHV4	86.580	25.109	3.242	2.445	4.975	12.557	-0.776	1.287	-0.088
ET.UHV4	86.580	25.109	3.242	2.445	4.975	12.557	-0.776	1.287	-0.088
ET.DST2	90.856	5.765	1.282	2.502	3.153	21.522	-1.321	1.329	-0.080
ET.ST2	90.856	5.765	1.282	2.502	3.153	21.522	-1.321	1.329	-0.080
ET.DBV2	91.377	4.554	1.043	2.519	2.931	22.933	-1.387	1.333	-0.079
ET.BV2	91.935	3.532	0.788	2.541	2.693	24.521	-1.459	1.337	-0.075
ET.DMSE3	92.422	2.874	0.564	2.565	2.485	25.972	-1.521	1.340	-0.069
ET.MSE3	92.422	2.874	0.564	2.565	2.485	25.972	-1.521	1.340	-0.069
ET.DB2	94.123	2.281	-0.216	2.681	1.759	31.512	-1.738	1.349	-0.050
ET.B21	94.735	2.647	-0.497	2.720	1.569	32.081	2.199	1.352	-0.042
ETIOPT	94.735	2.647	-0.497	2.720	1.569	32.081	2.199	1.352	-0.042

EI Line (to LEIR)

NAME	S	BETX	ALFX	MUX	DX	BETY	ALFY	MUY	DY
EIOPTF	94.735	2.647	-0.497	2.720	1.569	32.081	2.199	1.352	-0.042
EI.DQ1	96.230	5.183	-1.200	2.787	1.373	25.915	1.927	1.360	-0.016
EI.Q1	96.692	6.091	-0.732	2.800	1.277	25.468	-0.943	1.363	-0.009
EI.DB1	97.115	6.756	-0.838	2.810	1.159	26.280	-0.975	1.366	-0.002
EI.B1	98.296	9.038	-1.131	2.834	1.028	25.963	1.230	1.373	0.016
EI.DBV1F	98.725	10.056	-1.239	2.841	1.051	24.925	1.188	1.376	0.023
EI.BV1F	99.075	10.954	-1.327	2.846	1.070	24.105	1.154	1.378	0.028
EI.DTV1F	99.400	11.843	-1.409	2.851	1.087	23.365	1.123	1.380	0.033
EI.MTV1	99.400	11.843	-1.409	2.851	1.087	23.365	1.123	1.380	0.033
EI.DQ2F	101.159	17.578	-1.852	2.870	1.181	19.714	0.953	1.393	0.059
EI.Q2	101.621	17.199	2.641	2.874	1.136	21.224	-4.350	1.397	0.070
EI.DQ3F	103.659	8.361	1.696	2.902	0.631	42.852	-6.263	1.408	0.134
EI.Q3	104.121	8.575	-2.192	2.911	0.580	39.557	12.883	1.409	0.134
EI.DQ4F	105.159	13.856	-2.895	2.926	0.607	17.360	8.501	1.416	0.102
EI.Q4	105.621	14.051	2.498	2.931	0.566	12.758	2.039	1.421	0.096
EI.DBV2F	106.415	10.409	2.089	2.941	0.406	9.775	1.718	1.432	0.101
EI.BV2F	106.765	9.010	1.909	2.947	0.335	8.621	1.577	1.438	0.103
EI.DTV2F	107.016	8.084	1.779	2.952	0.284	7.855	1.475	1.443	0.104
EI.MTV2	107.016	8.084	1.779	2.952	0.284	7.855	1.475	1.443	0.104
EI.DSMF	107.767	5.703	1.392	2.969	0.132	5.868	1.172	1.461	0.109
EI.SMF	108.596	3.899	0.974	2.997	0.040	3.905	0.976	1.488	0.110
ER.DSEF	109.828	2.258	0.358	3.066	0.009	2.259	0.360	1.557	0.112
ER.SEF	110.548	2.000	0.000	3.121	0.000	2.000	0.000	1.612	0.114
EIOPTF	110.548	2.000	0.000	3.121	0.000	2.000	0.000	1.612	0.114
INJEPTF	110.548	2.000	0.000	3.121	0.000	2.000	0.000	1.612	0.114

QUAD scans in ITH Line

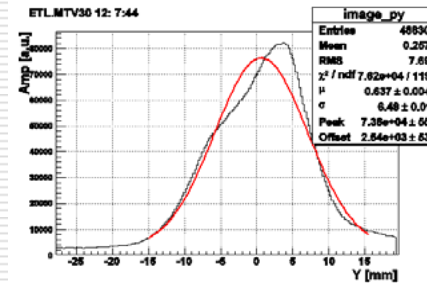
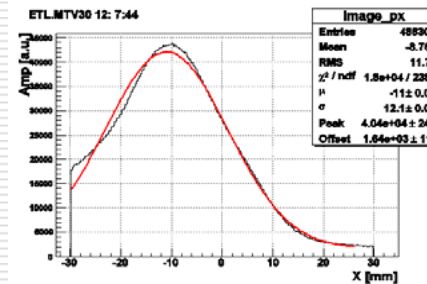
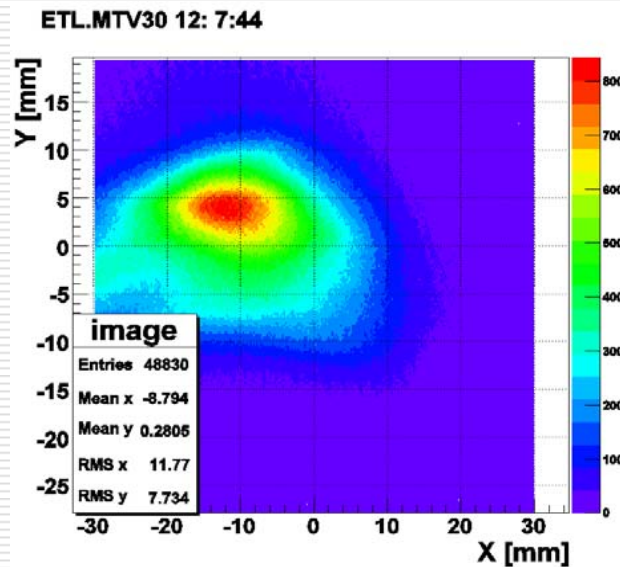
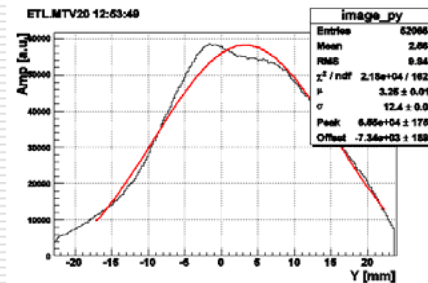
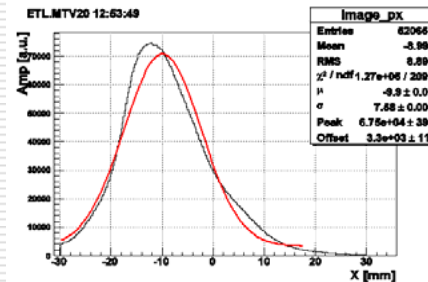
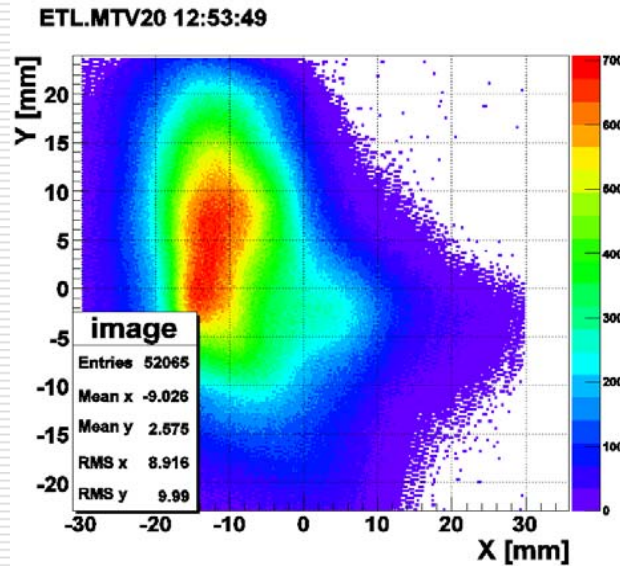
- The **Twiss parameters at the beginning of the line** (i.e. at the exit of Linac3) are inferred from **quadrupole scans + beam size** observation at SEM grid(s) in the first part of ITH
- Measurements done at different stages of the commissioning with O⁴⁺ and Pb⁵⁴⁺ ions
- **Final/optimal values:** (Richard&Ludovic)

	α_x	β_x [m]	α_y	β_y [m]	ϵ_x [μm]	ϵ_y [μm]
O ⁴⁺	2.2	38	-2.8	22	1.5	2
Pb ⁵⁴⁺	0.4	13	2.1	18	1.9	2.1

Trajectory measurements - method

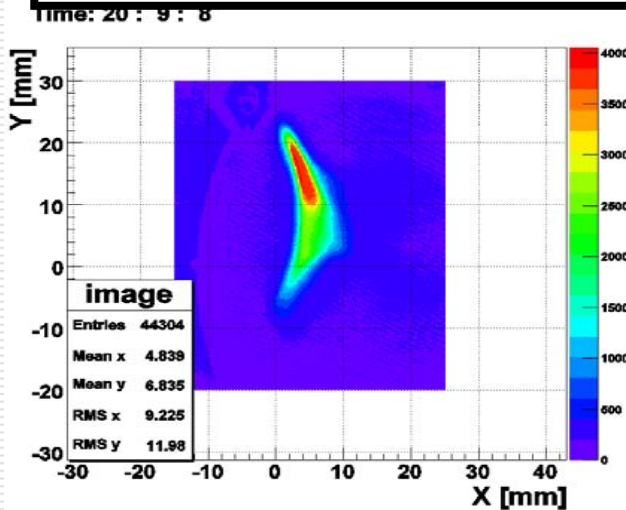
- Method to **verify** the **optics**
 - **Kick** (1-plane at a time) with the most upstream corrector
 - **Observe trajectory** $X(i)$, $Y(i)$ with all the available downstream profile monitors
 - **Compare observation** with MAD **prediction** $X_m(i)$, $Y_m(i)$
- If needed...
 - **minimize the difference** measurement-model varying possible uncertain parameters in order to improve the model
 - **Re-match** according to new model

Beam profile examples

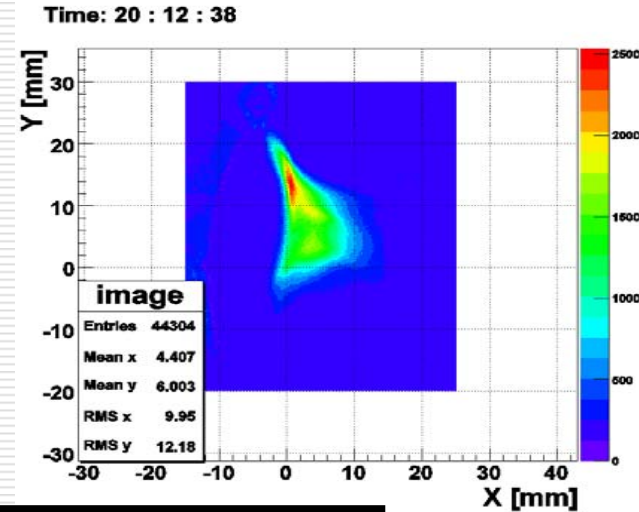


Images at EI.MTV20

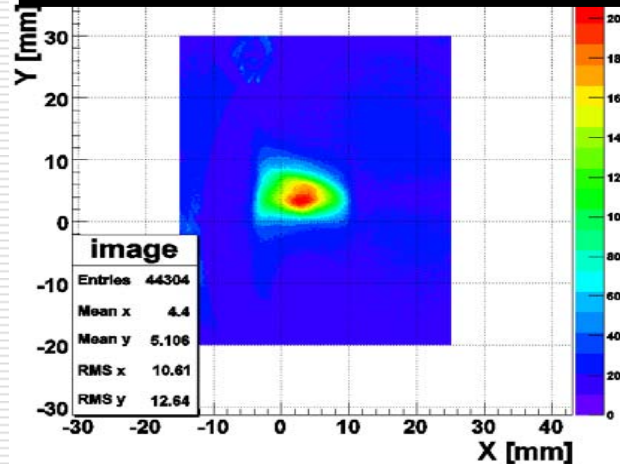
Phases: -30 deg w.r.t. to nominal



Phases: Nominal (160/190)



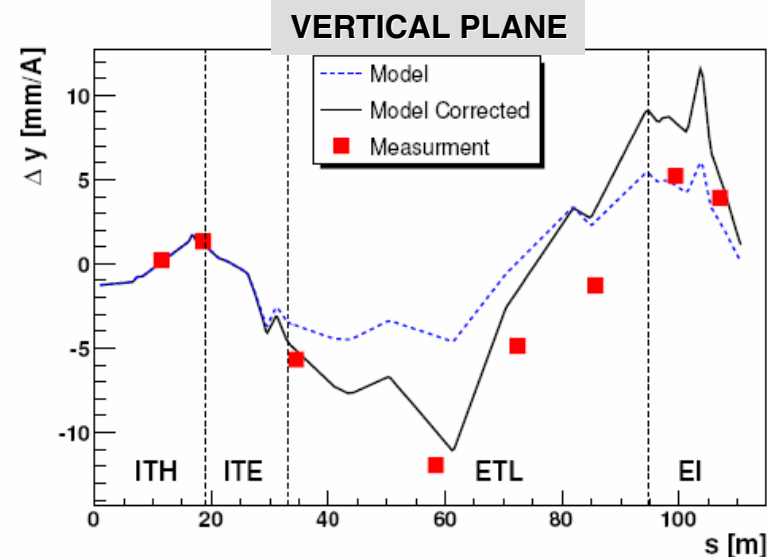
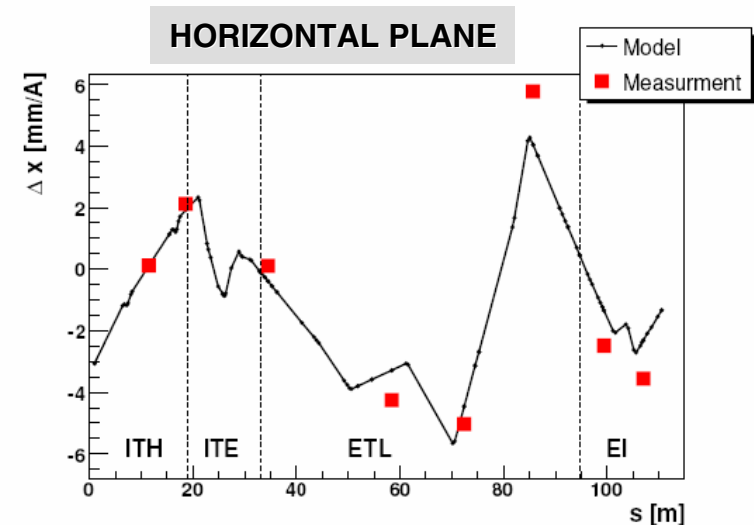
Phases: +30 deg w.r.t. to nominal



Wrong energy?

Trajectory measurements with O4+

- First measurements were performed with O4+
- The **horizontal trajectory** measurements **well predicted** by the model in all the measurements
- **Poor agreement** between measurements and **initial model in vertical plane**
 - additional vertical defocusing at exit of ITE loop
- Will explain in the next transparencies the **"corrected" model**

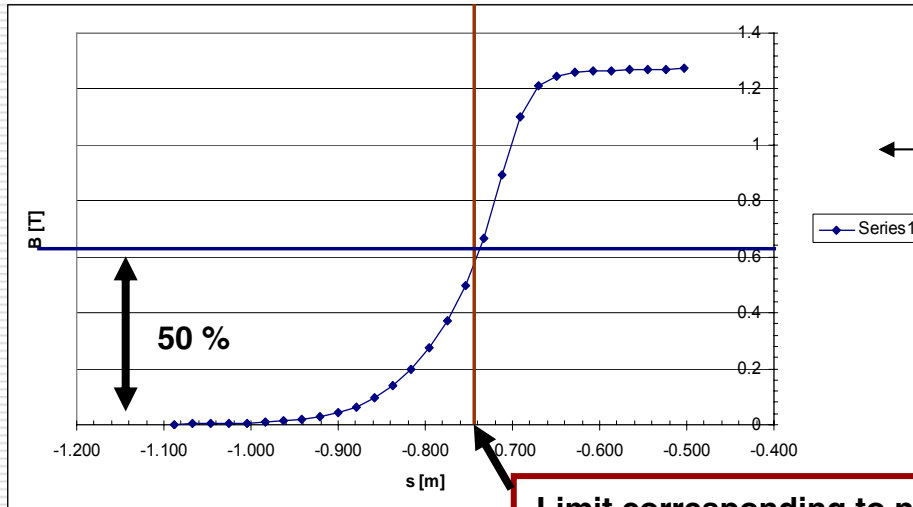


MAD model for SBENDs

- **Candidates** for explaining **poor agreement** measurements-model:
 - Sector bending magnets, in particular the two **106deg SBENDs in the ITE line (Loop)**
 - **Gradient** and **fringe field** effects
 - **Magnetic measurements:**
 - Used to estimate the field properties and implement the new model
- Other candidates
 - 2 **bending dipoles** in **ETL** line and 1 in the **EI** line

Magnetic Measurements SBENDS

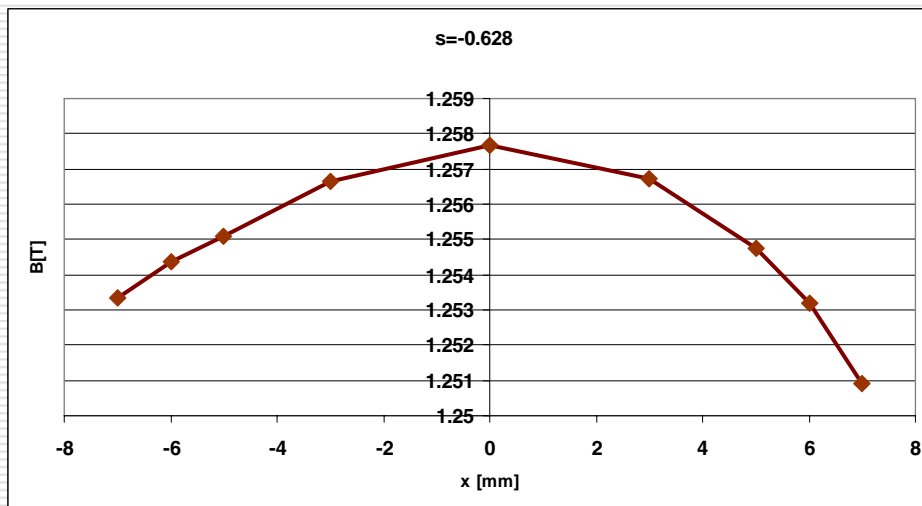
- From ITE 106deg SBEND mapping at $I < I_{\text{saturation}}$



B at $x=0$
in the end field region

Original model \rightarrow linear decay of fringe field

Limit corresponding to nominal magnetic length



B at s in the core region as
function of x

Original model \rightarrow Pure dipole field

Trajectory measurements-Improved model

- From magnetic measurements

$$FINT = \int_{-\infty}^0 \frac{B_y(s)[B_0 - B_y(s)]}{2 \cdot \text{HGAP} \cdot B_0^2} ds = 0.47$$

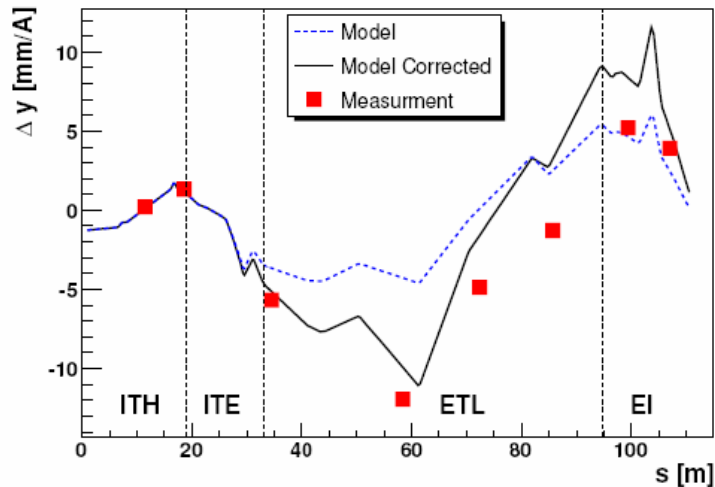
was 0.35 in initial model

$$K1 = \frac{1}{B_0 \rho} \left. \frac{\partial B_0}{\partial x} \right|_{\text{core}} = 0.02 [m^{-2}]$$

was 0 in initial model

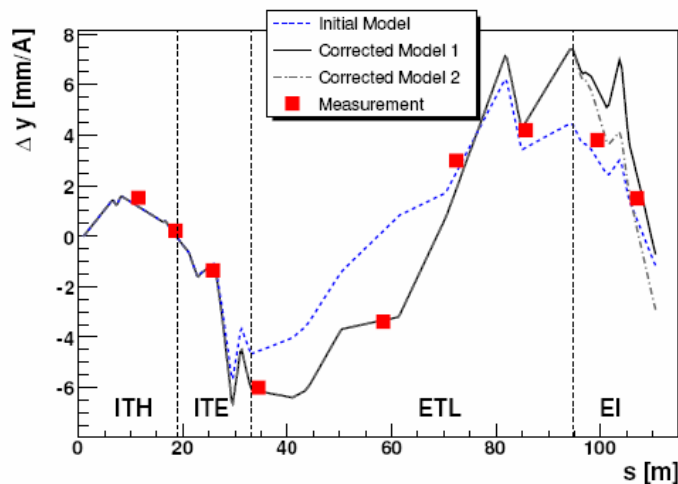
- From minimization trajectory meas-model
 - $K1=0.03 \text{ m}^{-2}$ for O4+
 - $K1=0.025 \text{ m}^{-2}$ for Pb54+
 - The difference may come from the different saturation level at which the magnets are operated with the two different ion species $\leftarrow \Delta(B\rho) \sim 4\%$

Trajectory Measurements – Results



O4+

ITE SBENDS model corrected
 $K1 = 0.03 \text{ m}^{-2}$, better agreement
with meas. But still some
uncertainty along ETL line



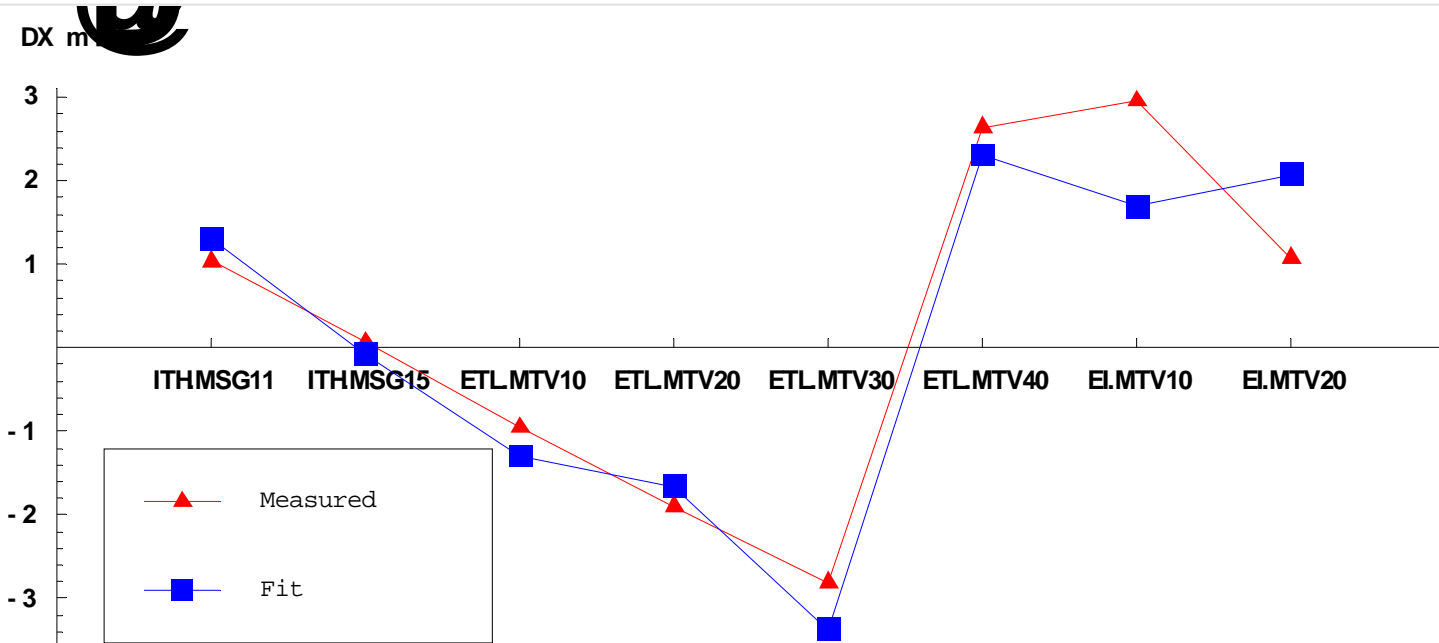
Pb54+

Two “corrected models”

1- $K1 = 0.025 \text{ m}^{-2}$ for ITE
SBENDS

2- $K1 = 0.025 \text{ m}^{-2}$ for ITE
SBENDS and $K1 = -0.025 \text{ m}^{-2}$
to ETL.BHN20 and EI.BHN10
-further studies needed

Dispersion Measurements



- Measurements at the **beginning** of commissioning with **O4+**
 - **Non-zero initial dispersion**
 - **Good transport** along the line when comparing to model
- Later measurements with **Pb54+** gave **negligible dispersion** at **beginning** and **good transport**

Working Sets – 04+ 15/12/05

File Edit View References Commands Control Help

Dec 15 10:03:15 LEI - TSTOPTIC

POW-V	Status	CCV	AQN	Unit
ITH.QDN08	0n	98.97	99.02	Amp.
ITH.QFN09	0n	143.75	143.83	Amp.
ITH.QDN10	0n	98.97	99.02	Amp.
ITH.QFN11S	0n	-3.67	-3.67	Amp.
ITH.QDN12	0n	9.16	9.16	Amp.
ITH.QFN21S	0n	-4.32	-4.32	Amp.
ITH.QDN22	0n	7.85	7.85	Amp.

POW-V	Status	CCV	AQN	Unit
ITH.DHZ10	0n	0.00	0.00	Amp.
ITH.DVT10	0n	-2.00	-2.01	Amp.
ITH.DHZ11	0n	0.00	0.00	Amp.
ITH.DVT11	0n	5.00	5.02	Amp.
ITH.DHZ21	0n	0.00	0.00	Amp.
ITH.DVT21	0n	-1.70	-1.70	Amp.

SCRAP	Status	Move	AQN
ITH.SLH11AP	At-Rest	100.000	100.000
ITH.SLH11P0	At-Rest	-0.900	-0.900
ITH.SLV11AP	At-Rest	100.000	100.000
ITH.SLV11P0	At-Rest	-39.900	0.000

open Knob... Open LogView... Properties...

File Edit View References Commands Control Help

Dec 15 10:04:08 LEI - TSTOPTIC WorkingSet view

POW-V	Status	CCV	AQN	Unit
ETL.BHN20-INJ	0n	202.45	202.41	Amp.

GFAS	Enable	Delay	Ampl.	Unit
ETL.GSBHN10	Enabled	40.00	-289.29	Amp

PowDF7000	Mode	Status	CCV	Mean	Units
ETL.DHN10-INJ	0n	OK	0.30	0.36	Amp
ETL.BHN10	0n	OK	0.00	0.00	Amp
ETL.QNN10-INJ	0n	OK	1.85	2.12	Amp
ETL.QNN20-INJ	0n	OK	8.52	8.65	Amp
ETL.QNN30-INJ	0n	OK	12.44	12.67	Amp
ETL.QNN40-INJ	0n	OK	16.39	16.46	Amp
ETL.QNN50-INJ	0n	OK	24.25	24.63	Amp
ETL.QNN60-INJ	0n	OK	32.85	32.80	Amp
ETL.BVN10-INJ	0n	OK	19.00	18.97	Amp
ETL.BVN20-INJ	0n	OK	9.52	9.59	Amp

SAMPAQ	Cursor	Interval	Unit	Aqn at C	Mean C+I	Unit
ETL.SDBHN10-C	0.000	0.000	ms	-11.523	-11.523	A

LTIM	Pulse	Delay	Train
EDX.TSF2-ICTRL	Enable	20	1KHz
EDX.TSF3-ICTRL	Enable	20	1KHz

open Knob... Open LogView... Properties...

File Edit View References Commands Control Help

Dec 15 10:03:42 LEI - TSTOPTIC WorkingSet view

POW-V	Status	CCV	AQN	Unit
ITE.QFN01	0n	147.69	147.50	Amp.
ITE.QDN02	0n	164.05	163.98	Amp.
ITE.QFN03	0n	135.39	135.41	Amp.
ITE.QDN04	0n	164.05	164.10	Amp.
ITE.QFN05	0n	135.39	135.41	Amp.

POW-V	Status	CCV	AQN	Unit
ITE.BHN10	0n	778.00	777.89	Amp.
ITE.BHN20	0n	998.00	997.93	Amp.
ITE.BHN30	0n	998.00	997.96	Amp.
ITE.BHN40-IN-LEI	0n	799.00	799.93	Amp.
ITE.BHN40-IN-LIN	0n	784.00	799.93	Amp.

open Knob... Open LogView... Properties...

File Edit View References Commands Control Help

Dec 15 10:04:48 LEI - TSTOPTIC WorkingSet view

POW-V	Status	CCV	AQN	Unit
EI.BHN10	0n	168.40	168.41	Amp.
EI.BVN10	0n	35.30	35.30	Amp.
EI.BVN20	0n	93.10	92.99	Amp.
ER.SMH11	0n	1068.50	1065.28	Amp.

POW-V	Status	CCV	AQN	Unit
EI.QFN10	0n	2.00	2.02	Amp.
EI.QFN20	0n	8.92	8.93	Amp.
EI.QDN30	0n	47.41	47.39	Amp.
EI.QFN40	0n	34.04	34.10	Amp.

open Knob... Open LogView... Properties...

Working Sets Pb54+ - 07/03/06

File Edit View References Commands Control Help

Mar 07 19:07:26 LEI - EARLY

NORMAL view

POW-V	Status	CCV	AQN	Unit
ITH.QDN08	0n	110.44	110.50	Amp.
ITH.QFN09	0n	179.84	179.85	Amp.
ITH.QDN10	0n	110.44	110.50	Amp.
ITH.QFN11S	0n	-3.47	-3.47	Amp.
ITH.QDN12	0n	8.31	8.31	Amp.

POW-V	Status	CCV	AQN	Unit
ITH.DHZ10	0n	1.00	1.00	Amp.
ITH.DVT10	0n	-3.50	-3.51	Amp.
ITH.DHZ11	0n	-5.00	-5.01	Amp.
ITH.DVT11	0n	-2.00	-2.02	Amp.
ITH.DHZ21	0n	0.00	0.00	Amp.
ITH.DVT21	0n	-1.00	-1.00	Amp.

open Knob... Open LogView... Properties...

File Edit View References Commands Control Help

Mar 07 19:07:55 LEI - EARLY

NORMAL view

POW-V	Status	CCV	AQN	Unit
ITE.QFN01	0n	142.56	142.37	Amp.
ITE.QDN02	0n	155.49	155.43	Amp.
ITE.QFN03	0n	130.25	130.27	Amp.
ITE.QDN04	0n	155.49	155.56	Amp.
ITE.QFN05	0n	142.56	142.61	Amp.

POW-V	Status	CCV	AQN	Unit
ITE.BHN10	0n	750.00	750.26	Amp.
ITE.BHN20	0n	940.00	940.00	Amp.
ITE.BHN30	0n	940.00	940.16	Amp.
ITE.BHN40-IN-LEI	0n	770.00	771.38	Amp.
ITE.BHN40-IN-LIN	0n	480.00	771.38	Amp.

open Knob... Open LogView... Properties...

File Edit View References Commands Control Help

Mar 07 19:08:23 LEI - EARLY

NORMAL view

POW-V	Status	CCV	AQN	Unit
ETL.BHN20-INJ	0n	193.00	192.95	Amp.

GFAS	Enable	Delay	Ampl.	Unit
ETL.GSBHN10	Enabled	108.00	69.09	Amp.

PowDF7000	Mode	Control	CCV	Mean	Units
ETL.DHN10-INJ	0n	Remote	0.00	0.00	Amp.
ETL.BHN10	0n	Remote	0.00	0.00	Amp.
ETL.QNN10-INJ	0n	Remote	1.47	1.46	Amp.
ETL.QNN20-INJ	0n	Remote	7.20	7.23	Amp.
ETL.QNN30-INJ	0n	Remote	10.33	10.34	Amp.
ETL.QNN40-INJ	0n	Remote	14.25	14.26	Amp.
ETL.QNN50-INJ	0n	Remote	18.07	18.09	Amp.
ETL.QNN60-INJ	0n	Remote	25.32	25.37	Amp.
ETL.BVN10-INJ	0n	Remote	9.00	9.03	Amp.
ETL.BVN20-INJ	0n	Remote	9.00	9.02	Amp.

SAMPAQ	Cursor	Interval	Unit	Aqn at C	Mean C+I	Unit
ETL.SDBHN10-C	100.000	0.000	ms	46.021	46.021	A

LTIM	Pulse	Delay	Train
EIX.TSF2-ICTRL	Enable	30	1KHz
EIX.TSF3-ICTRL	Enable	30	1KHz

open Knob... Open LogView... Properties...

File Edit View References Commands Control Help

Mar 07 19:08:40 LEI - EARLY

NORMAL view

POW-V	Status	CCV	AQN	Unit
EI.BHN10	0n	159.50	159.42	Amp.
EI.BVN10	0n	26.20	26.20	Amp.
EI.BVN20	0n	82.40	82.33	Amp.
ER.SMH11	0n	1020.00	996.29	Amp.

POW-V	Status	CCV	AQN	Unit
EI.QFN10	0n	3.78	3.78	Amp.
EI.QFN20	0n	8.92	8.92	Amp.
EI.QDN30	0n	44.83	44.83	Amp.
EI.QFN40	0n	36.69	36.71	Amp.

open Knob... Open LogView... Properties...

Values from matching, Pb54+ - 07/03/2006

Element	Leq	K1 [m-2] (MAD)	KL [m-1]	I [A]
IT.Q0810	0.255	-1.538	-0.392	-110.444
IT.Q09	0.255	2.504	0.639	179.814
IT.Q1113	0.303	1.382	0.419	3.769
IT.Q12	0.303	-3.003	-0.910	-8.189
IE.Q1	0.255	1.985	0.506	142.561
IE.Q2	0.255	-2.165	-0.552	-155.492
IE.Q3H	0.326	3.748	1.222	130.254
ET.Q1I	0.385	-0.046	-0.018	-1.473
ET.Q2I	0.385	0.226	0.087	7.207
ET.Q3I	0.385	-0.324	-0.125	-10.333
ET.Q4I	0.385	0.447	0.172	14.255
ET.Q5I	0.385	-0.567	-0.218	-18.082
ET.Q6I	0.385	0.794	0.306	25.321
EI.Q1	0.462	0.236	0.109	3.783
EI.Q2	0.462	0.557	0.257	8.927
EI.Q3	0.462	-0.986	-0.456	-44.834
EI.Q4	0.462	0.807	0.373	36.695

Problems/Remarks -for future reference...

GENERAL REMARKS

- When using **profile monitors** to extrapolate beam size and position it can be **misleading** just to read the display information, **off-line analysis** is often needed
- **Periodic verification** of **Twiss parameters** at the **beginning** of the line should be periodically verified to be sure to have the best matching

SPECIFIC REMARKS

- After 1 month shot-down in Jan06 we took some time to have the beam transported after the ETL line
 - The quadrupole **ETL.QN60** had the **wrong polarity** (not understood why)
- The tuning of the **second triplet in ITH** line is very "delicate" and the good transport along the ITE loop is very sensible to it

Conclusions and Outlook

- First beam **transported** along the line in a relatively straight forward way
- **Validation** and understanding of the **line optics** allowed to prepare an **improved model** and enhance the **injection efficiency**
- A **residual uncertainty** about the model in the last part of the transfer line remains
 - It could be due to **additional quadrupole effects** on the ETL and EI bending dipole
 - **More studies/measurements needed**
- there was no time to perform conclusive **quadrupole scans** and “3profile” measurements to **infer optics and emittances**