Tracking Studies - TOOLS

- D1 tripping: recent check of linear tracking results with MAD-X
- Insertion IR1 – Aperture Model

Tracking Results for D1 Tripping
(normal conducting D1 of IR1 and IR5)

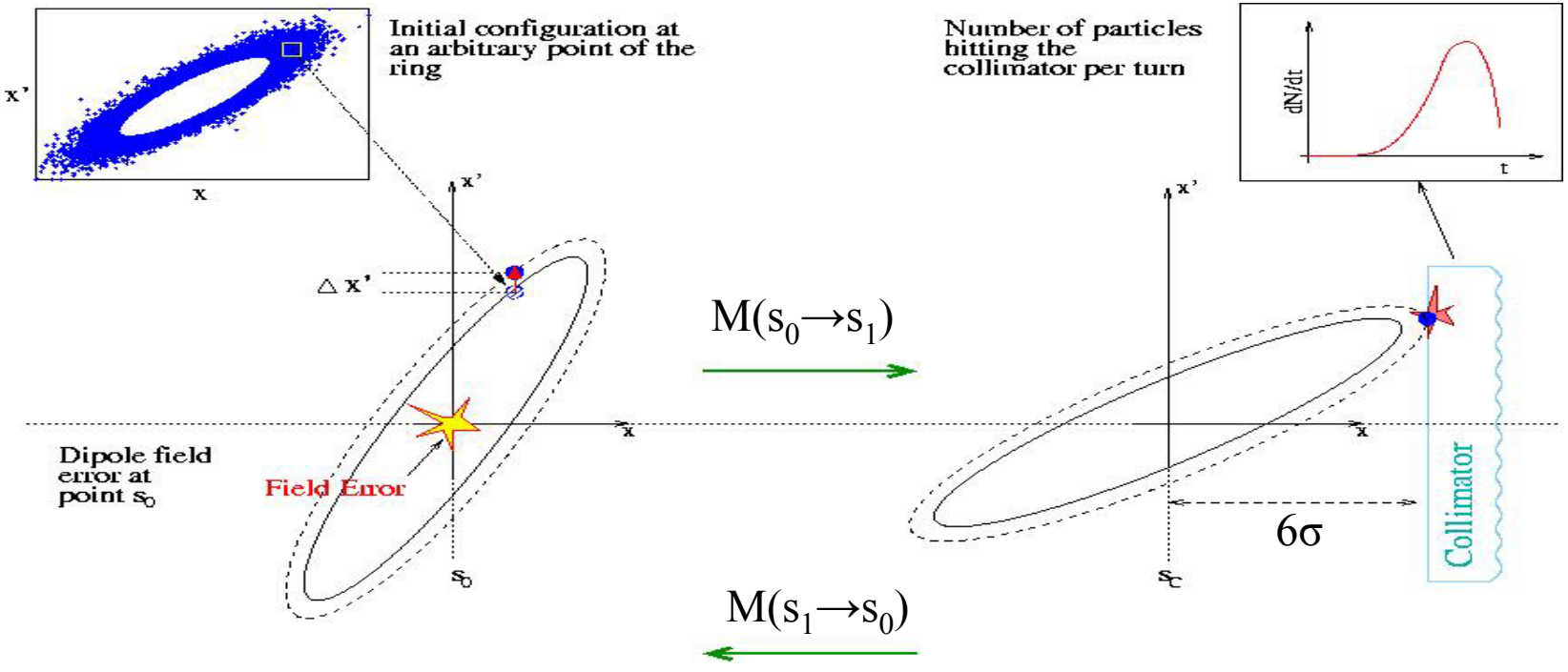
- Time constants for beam loss rates in IR7 obtained so far with linear trackings.
- Only collimators in IR7 were taken into account

Remaining Questions:

- What about non-linearities? Have they to be taken into account for these studies?
- What about other collimators and absorbers close to the beam (IR3, TCL, TCDQ).

→ MAD-X

Linear Tracking …

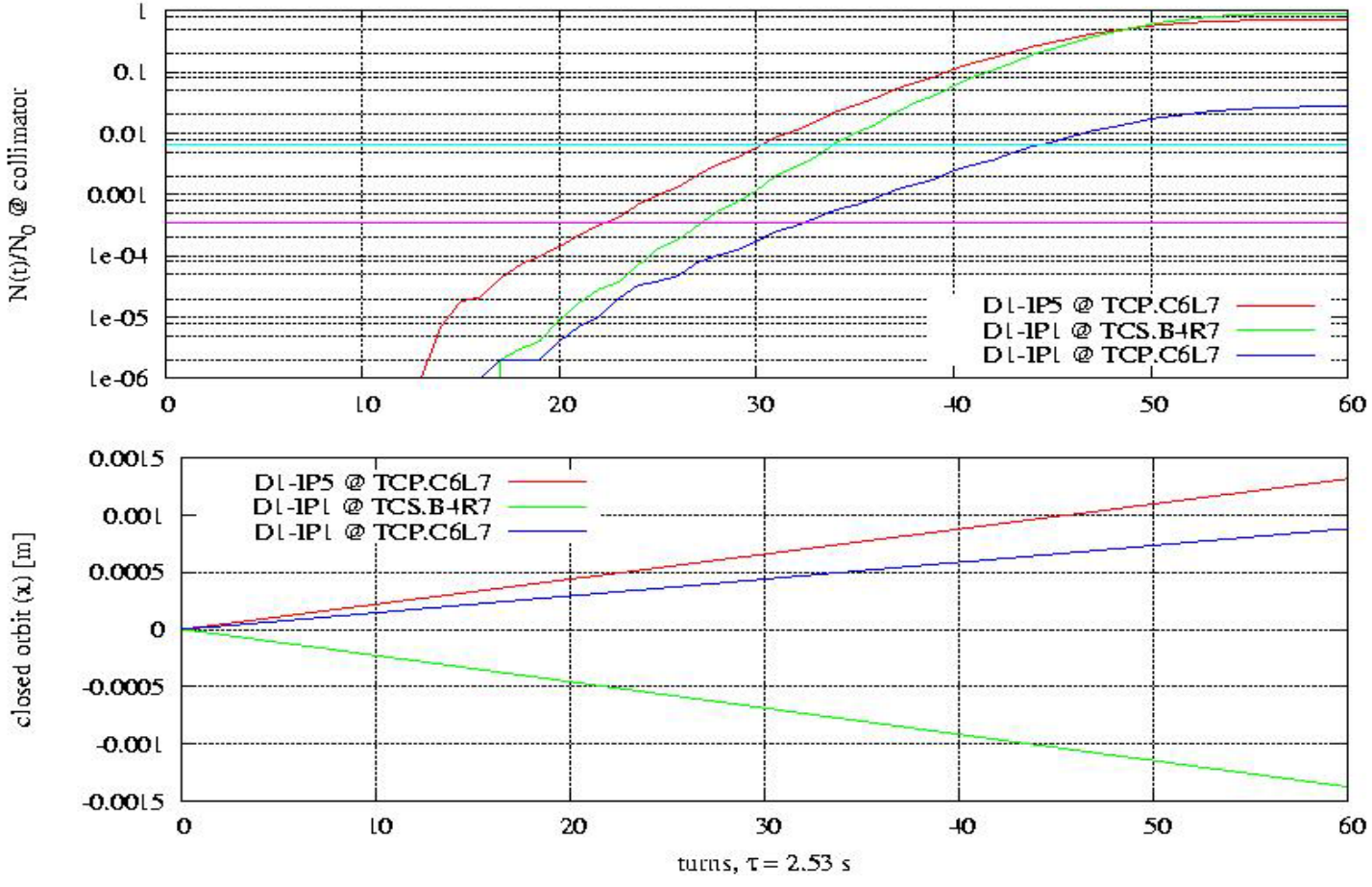


- $B(t)=B_0 \cdot e^{-t/\tau}$ $\tau=2.53s$
- Gaussian bunches: $N=10^6$, $p=7TeV/c$, sequence: V6.4, $Q_x=64.31$

Results with Linear Tracking

	T		$10^{-5}\cdot N_0$	$3.5\cdot10^{-4}\cdot N_0$	$6.7\cdot10^{-3}\cdot N_0$
D1 of	[s]	@	[turns]	[turns]	[turns]
IP1	2.53	TCS.B4R7	20	27	33
	1.5	TCS.B4R7	11	17	20
	5	TCS.B4R7*	34	52	64
IP5	2.53	TCP.C6L7	14	22	30
	1.5	TCP.C6L7	8	13	18
	5	TCP.C6L7	27	43	57

Results with Linear Tracking

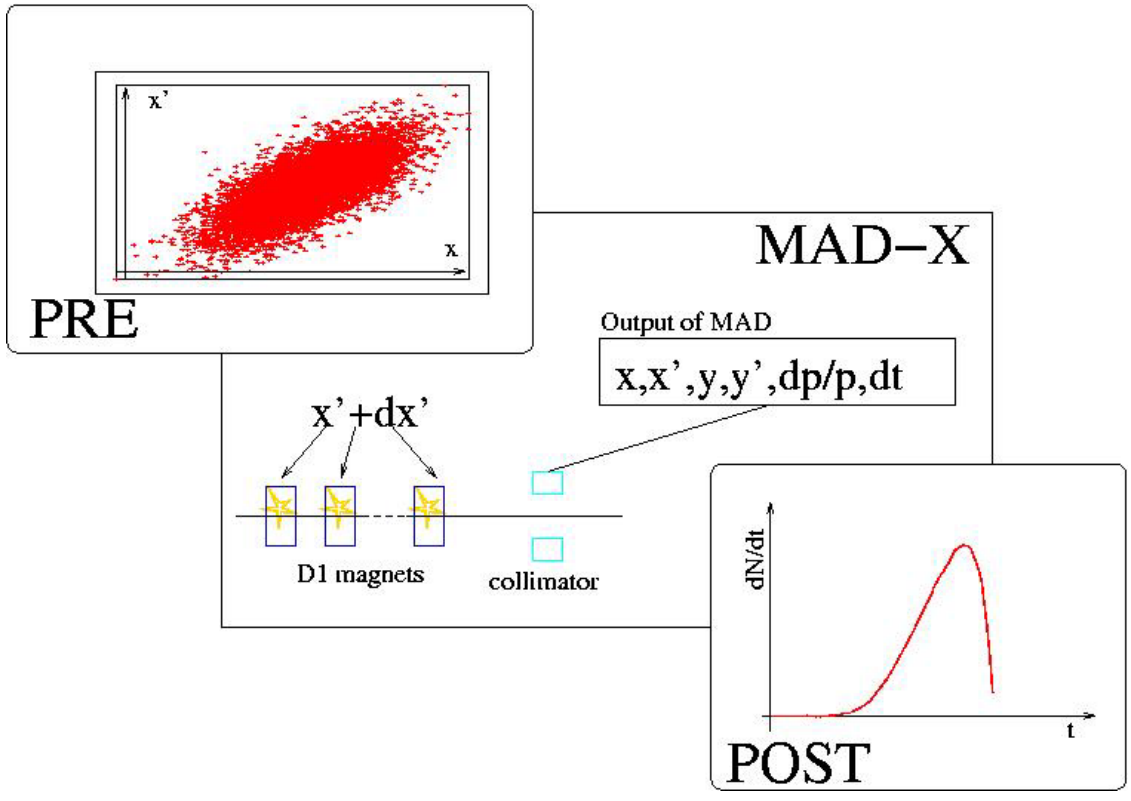


... and MAD-X

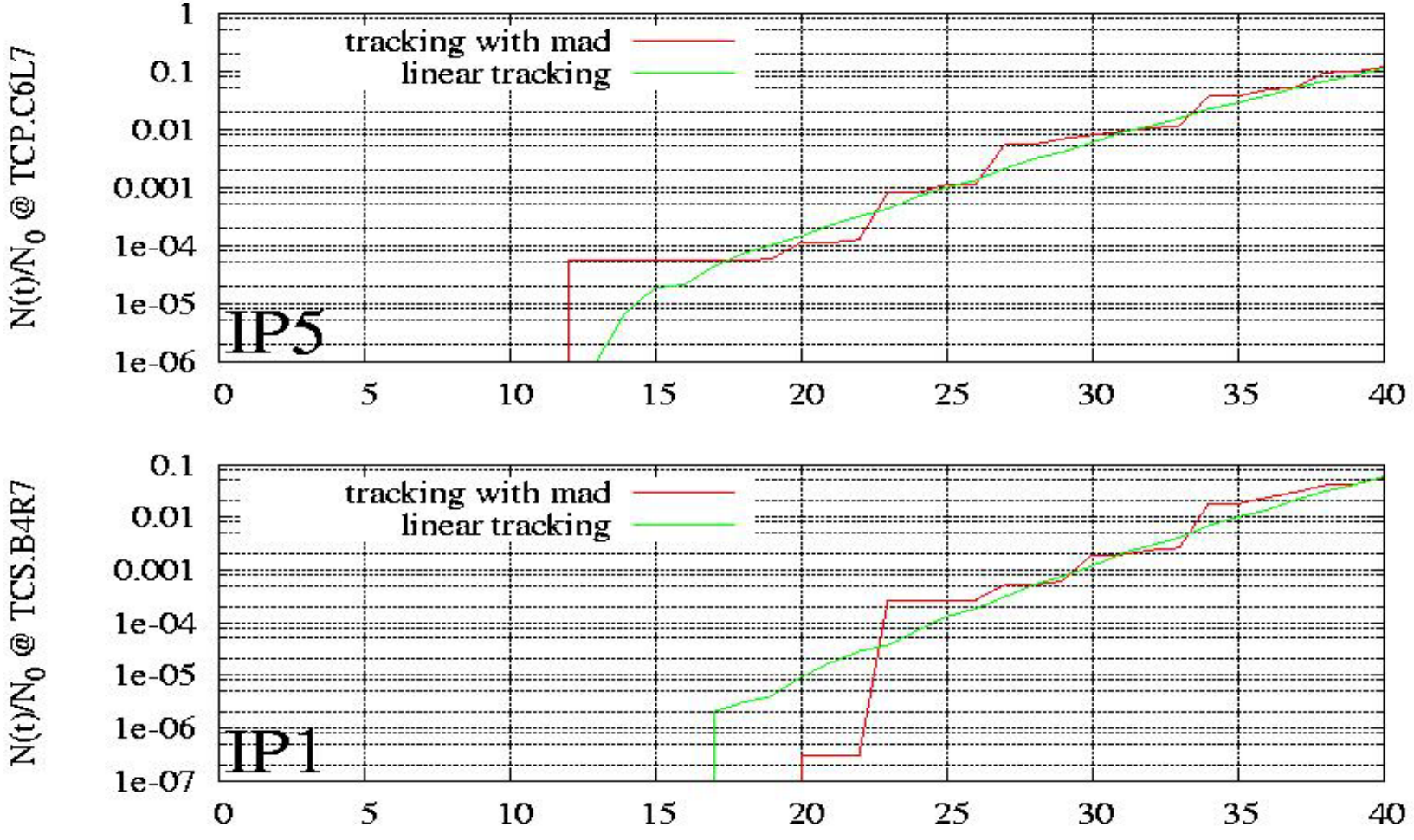
- No full aperture model in the LHC sequence → " observation points": collimators in IR7 and IR3, TCL, TCDQ.
- Dipole fields and MAD: own MAD-X table, particle identities.
- Pre-processing, post-processing
- Just cross check: simulations were run with maximum 10^4 particles

Tracking with MAD-X

- **Pre-processing** for initial particle coordinates
- **Post-processing** to calculate loss rates



Comparison of Results …



Conclusions – Check with MAD-X

- The results of the **linear tracking** look **reasonable**.
- The **fast linear tracking** program might be used **for other studies** too.
- A **tracking with MAD-X** has been set up **for decaying magnet fields**, which might be useful **for other simulations**.
- Resulting time constants: start of beam loss after 5 to 15 turns for D1@IP5, 10 to 20 turns for D1@IP1

Details on Apertures in IR1

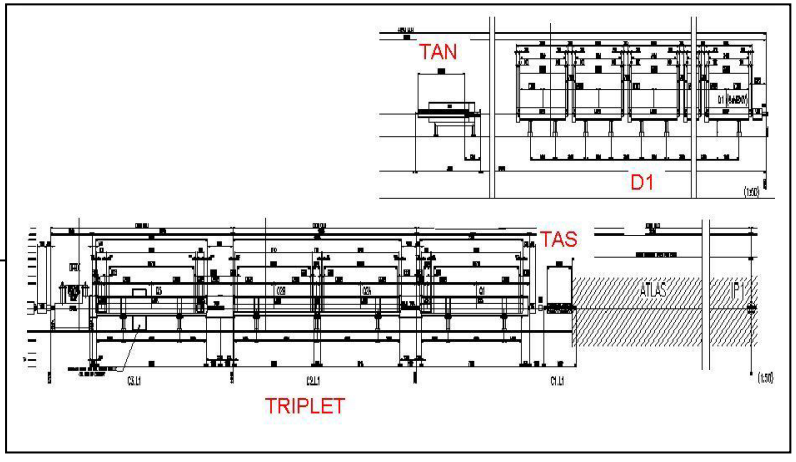
- What for:
  - In general: full aperture model of LHC needed for tracking studies
    - Simulations of failure scenarios
    - Equipment specifications (BLMs, …)
  - IR1 and IR5: aperture bottleneck at triplet: possible protection masks/tertiary collimators
- Complete data on apertures of TAN-IP1-TAN now available

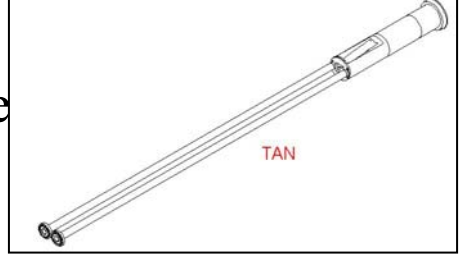
Apertures in IR1 …

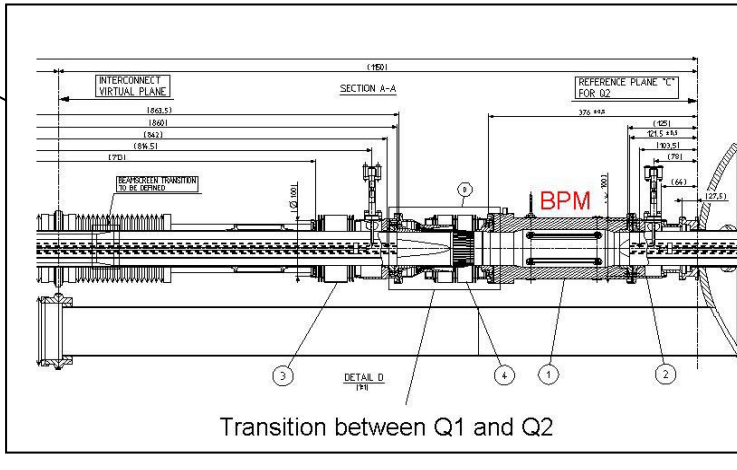
File Edit View Insert Format Tools Data Window Help

F135 =

	A	B	C	D	E	
111	cone_B	99.95175	32	32	cone	r1<r2
112	cone_A	99.95175	32	32	cone	r1>r2
113	cone_B	99.95775	30.1	30.1	cone	
114	trans_A	99.95775	30.1	30.1	cone, trans:pipe_screen	r1=r2, k>0
115	trans_B	100.05275	24.1	29		
116	beamscreen_A	100.05275	24.1	29	beamscreen	LHCscreen
117	Q2_begin	100.49975	24.1	29	beamscreen	LHCscreen
118	MQXB.B2L1	103.6	24.1	29	beamscreen	LHCscreen
119	DRIFT_191	106.5795	24.1	29	beamscreen	LHCscreen
120	MCBX.2L1	106.809	24.1	29	beamscreen	LHCscreen
121	DRIFT_192	107.0795	24.1	29	beamscreen	LHCscreen
122	MQXB.A2L1	110.1	24.1	29	beamscreen	LHCscreen
123	Q2_end	113.04775	24.1	29	beamscreen	
124	beamscreen_B	113.16925	24.1	29	beamscreen	
125	trans-A	113.16925	24.1	29	pipe, trans:screen_pipe	r1=r2, k<0
126	trans-B	113.18725	30.1	30.1	pipe, trans:screen_pipe	
127	pipe_A	113.18725	30.1	30.1	pipe	
128	pipe_B	113.19725	30.1	30.1	pipe	
129	cone_A	113.19725	30.1	30.1	pipe	these cones are out of lack of int
130	cone_B	113.21325	34.4	34.4	pipe	these cones are
131	pipe_BPM_A	113.21325	34.4	34.4	pipe	
132	pipe_BPM_B	113.35725	34.4	34.4	pipe	



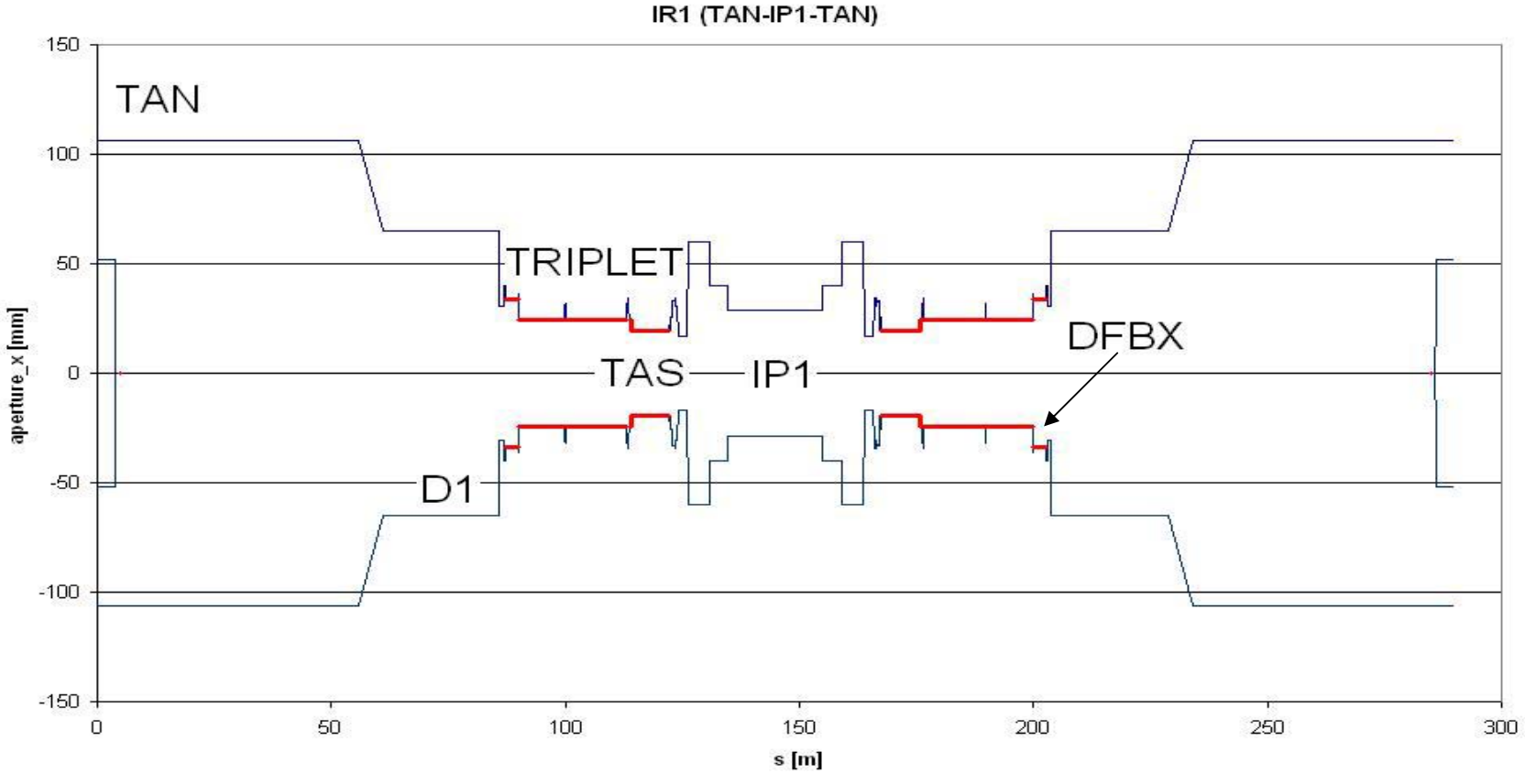




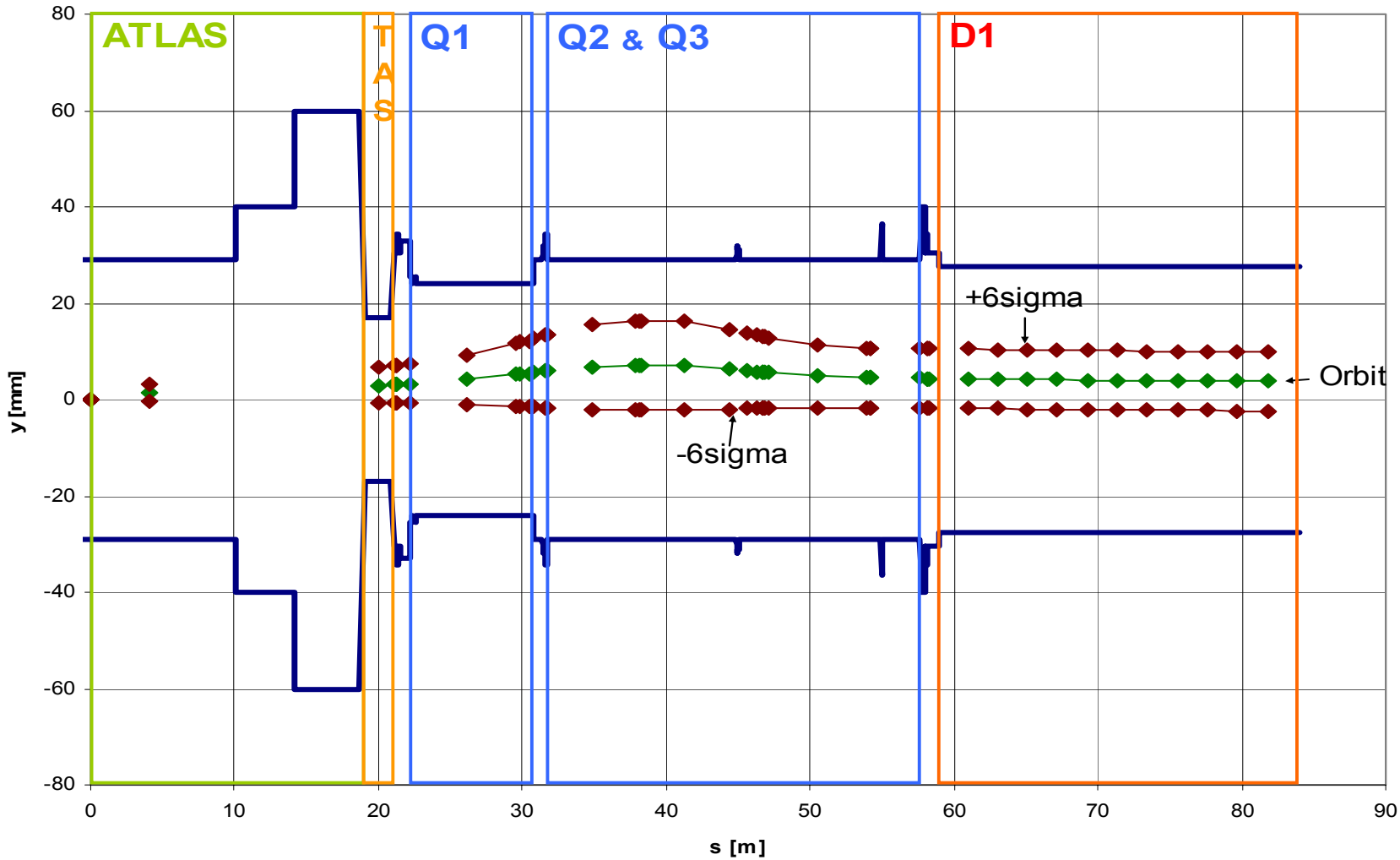
Transition between Q1 and Q2

The information from the Vacuum Group was gathered in a data file

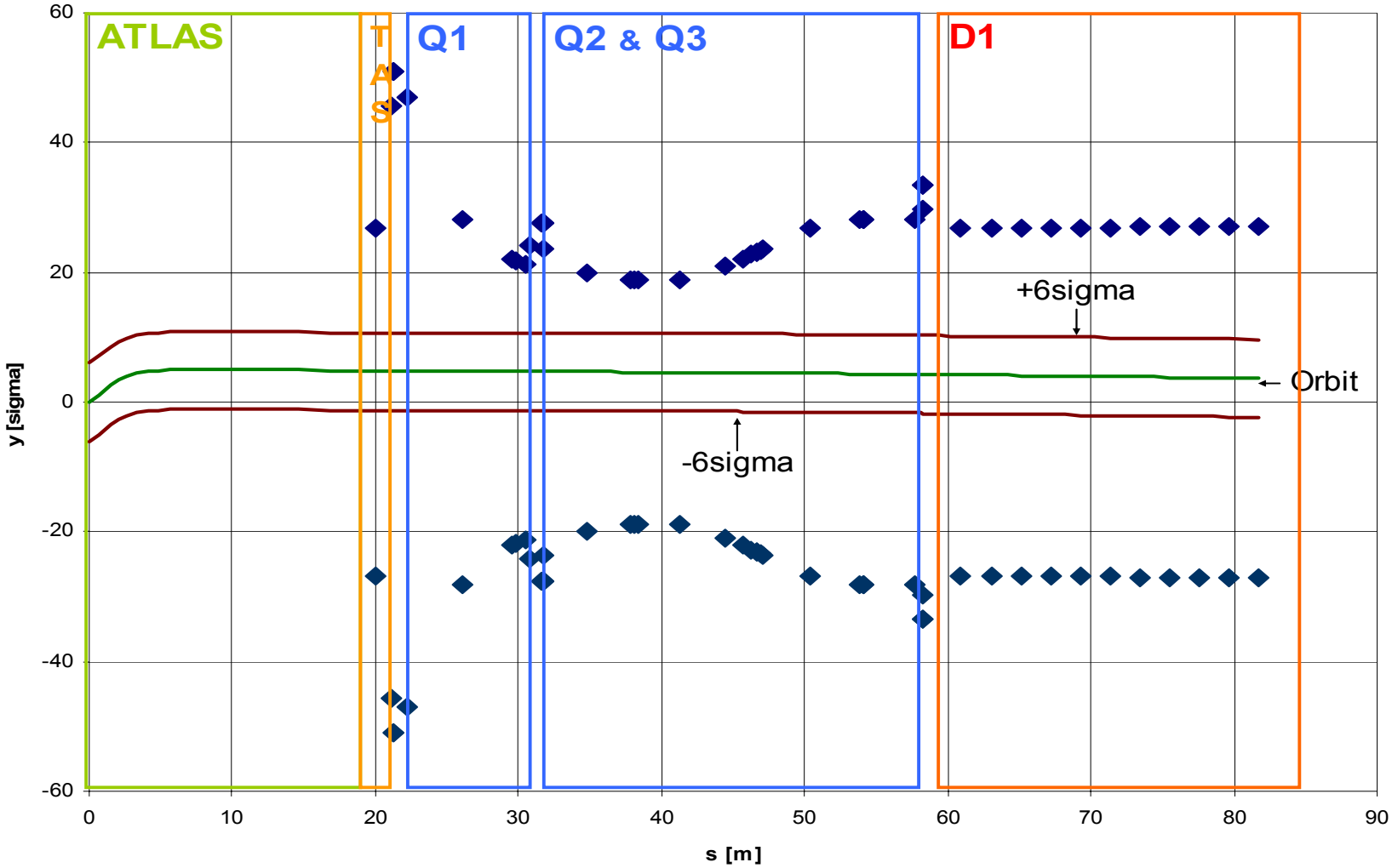
Apertures in IR1(horizontal plane)



Apertures in IR1: vertical plane, orbit, nominal crossing angle



Apertures in IR1: vertical plane, orbit, nominal crossing angle



Tracking with Apertures

- Apertures → MAD-sequence:
  - Magnets, collimators, absorbers,…: "easy", aperture is an element attribute
  - beam-pipes, cold-warm-transitions, interconnects: arbitrary "drifts" in MAD: → "Markers" have to be introduced
  - Simplified aperture model: in general markers every e.g. 2m with smallest aperture within this length
  - Possible additional markers for special locations (e.g. big angles of beam at interaction regions)

Conclusion

- Comprehensive data file on apertures for IR1 (TAN-IP1-TAN) is now available.
  - Not everything is defined yet. Some apertures are still being modified.
  - The data file is being checked by colleagues of the Vacuum Group. New information on apertures will be included.
- The file can be used as basis for the aperture data of IR5.