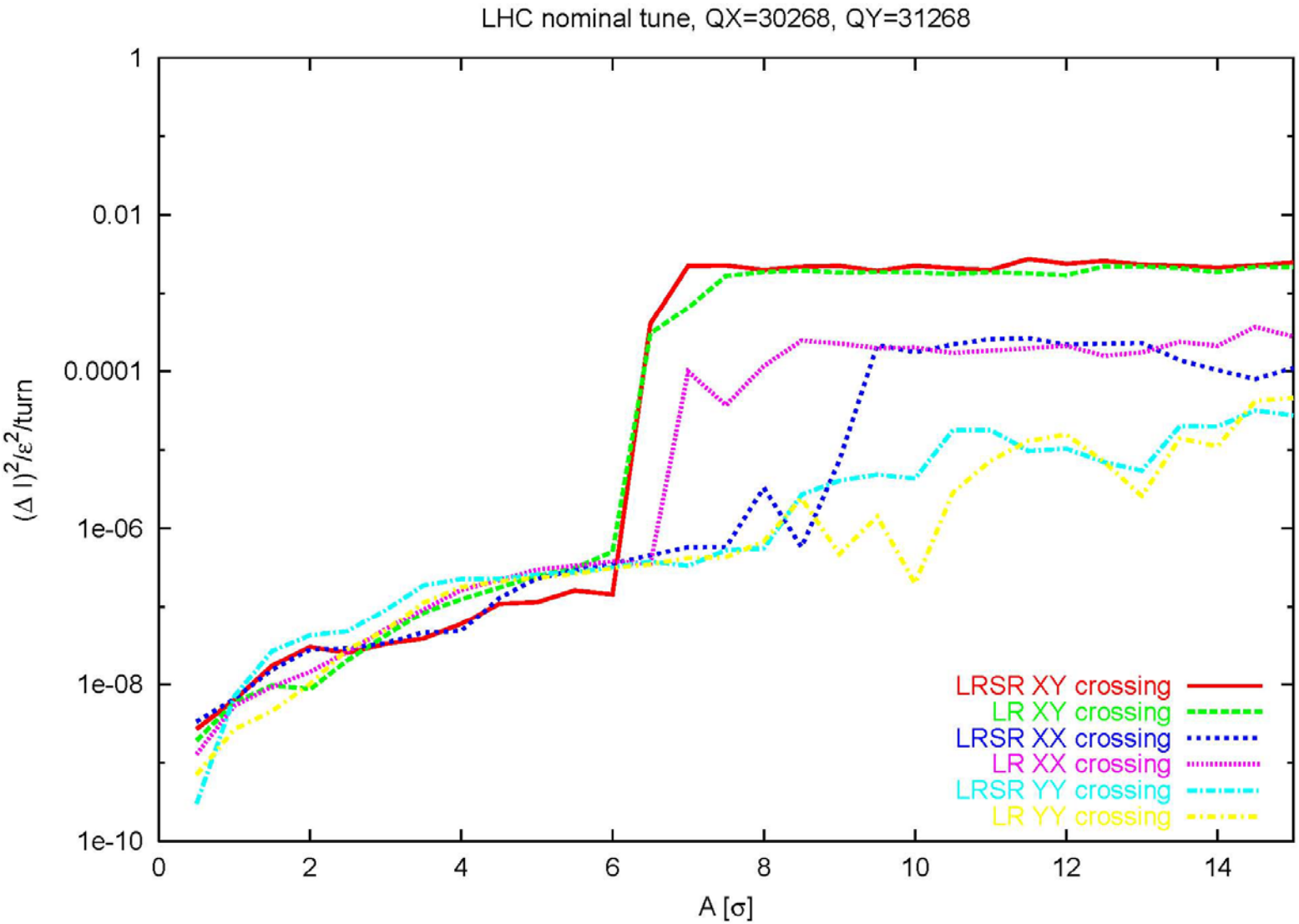
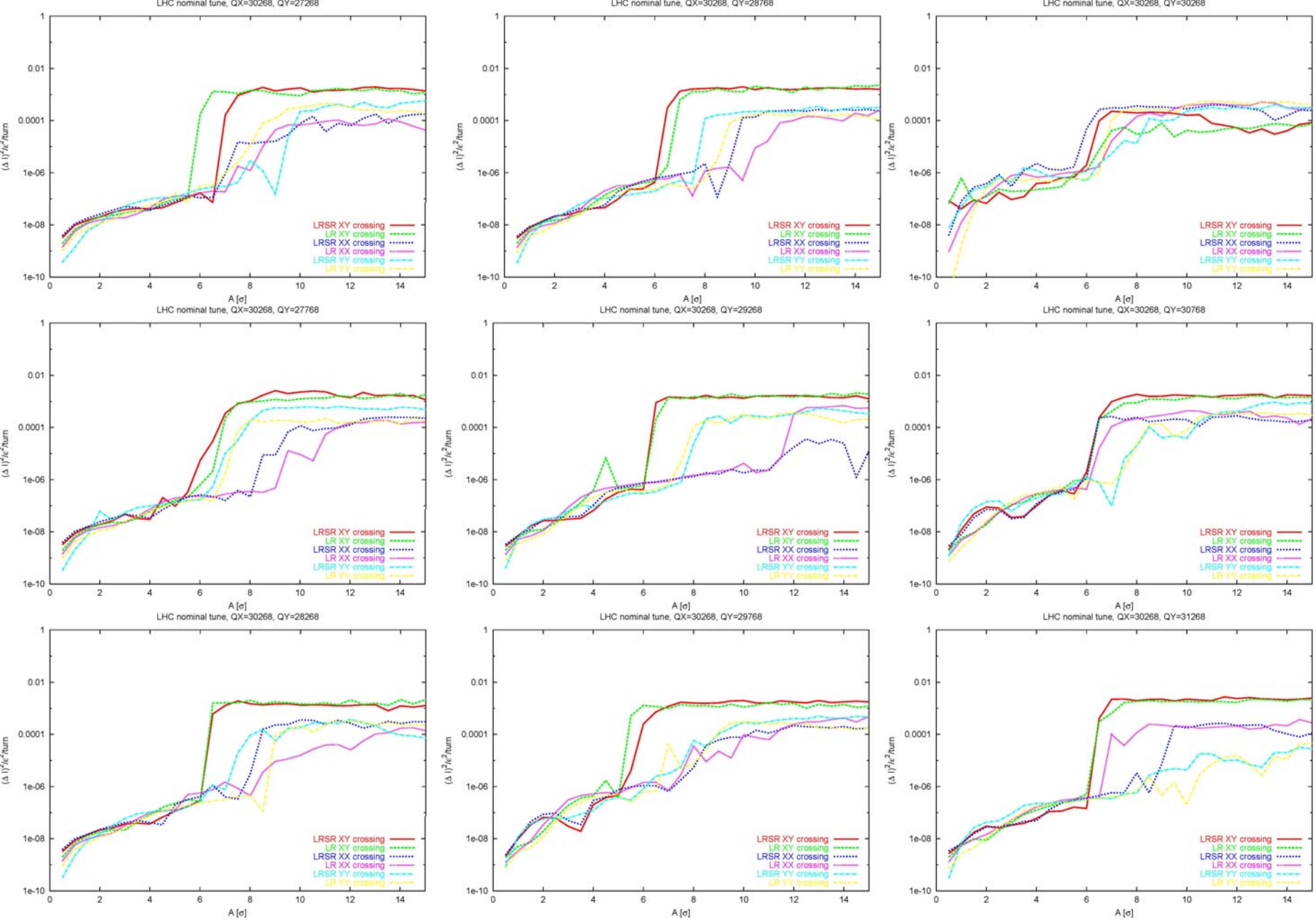
weak-strong beam-beam simulations for different crossing schemes in LHC

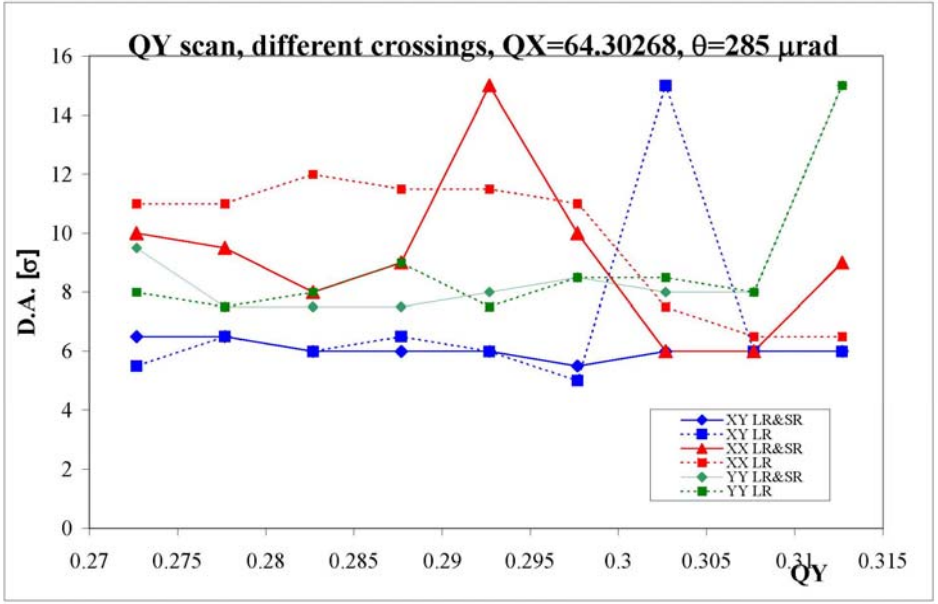
parameter	symbol	value
horizontal tune at A=0	Q_x	64.30268
vertical tune at A=0	Q_y	59.31268
bunch population	N_b	1.15×10^{11}
beta function at IP	$\beta^*_{x,y}$	0.55 m
relativistic gamma	γ	7461
normalized emittance (1s)	ε_N	3.75 μm
full crossing angle	θ	285 μrad
no. of IPs	N_{IP}	2
no. of parasitic crossings / IP	N_{par}	30
rms beam size at IP	$\sigma^*_{x,y}$	16.6 μm
rms beam divergence at IP	$\theta^*_{x,y}$	30.2×10^{-6} μrad

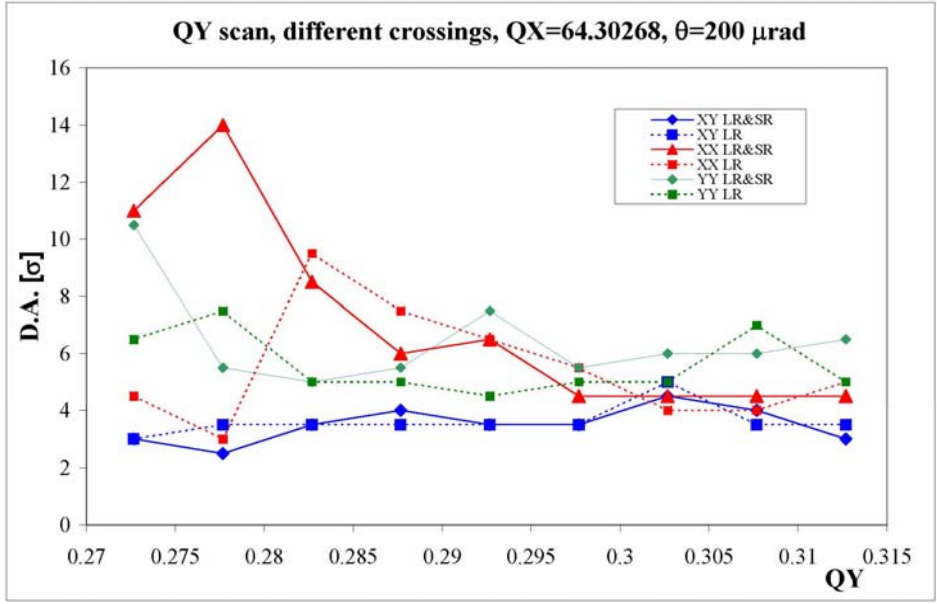


Simulated diffusion rate as a function of start amplitude for XX, XY and YY crossing with LR only and with the combined effect of LR and SR collisions, for the *same 0-amplitude tune* 0.30268, 0.31268; start amplitudes *x=y.*

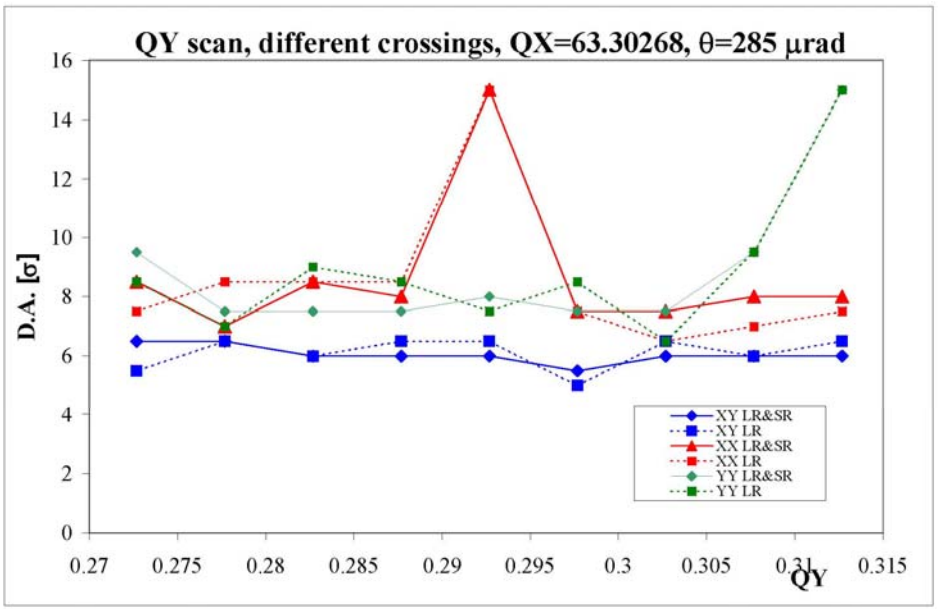


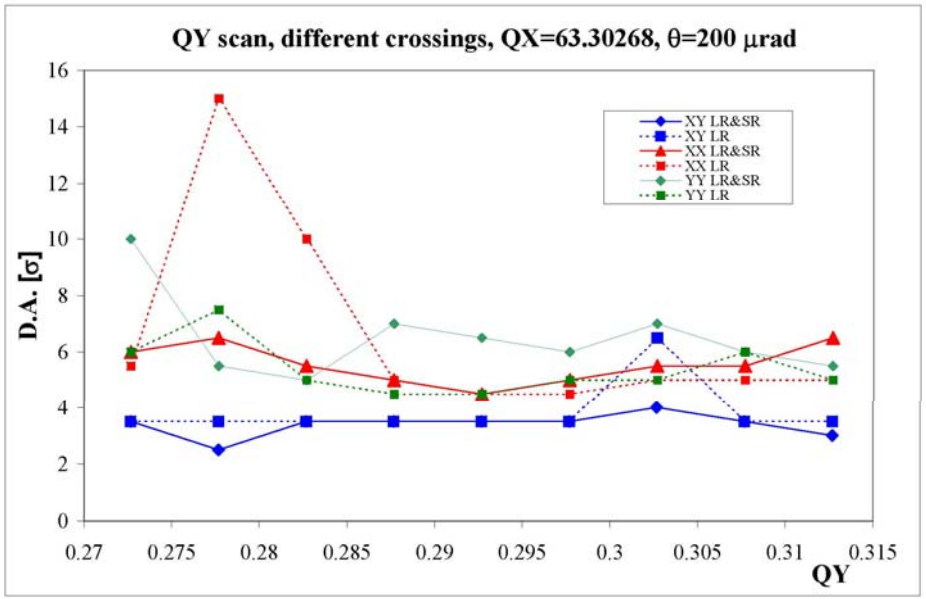
xx, yy, and xy crossing in LHC IPs 1 & 5 w & w/o HO @ different y tunes varied in steps of 0.005

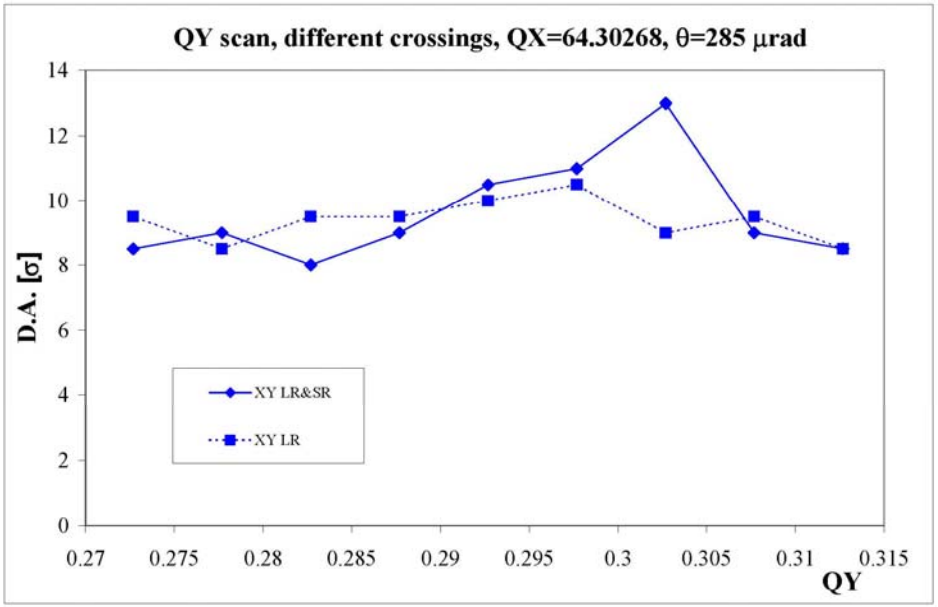


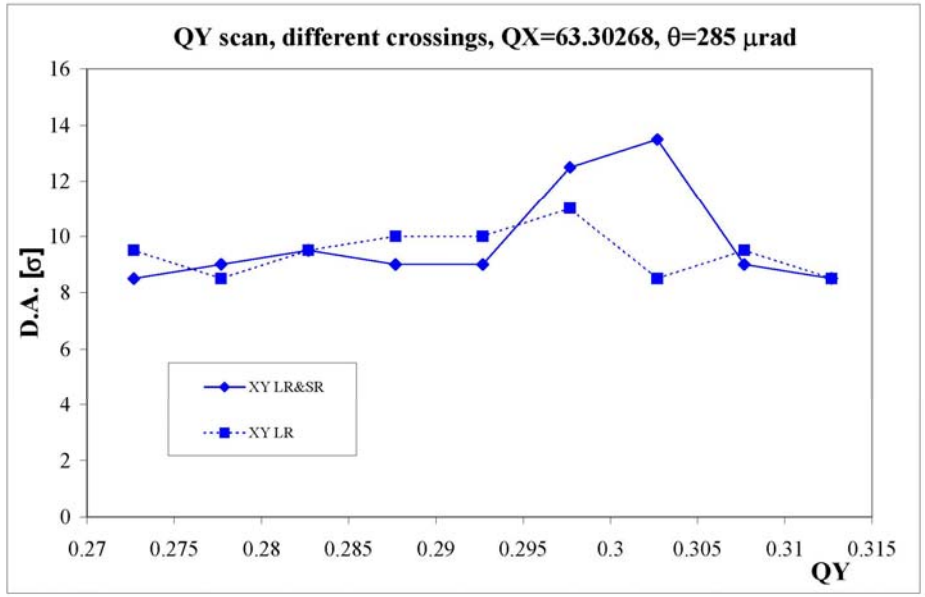


simulated LHC diffusive aperture for nominal & reduced crossing angle vs. Q_y, $x=y$

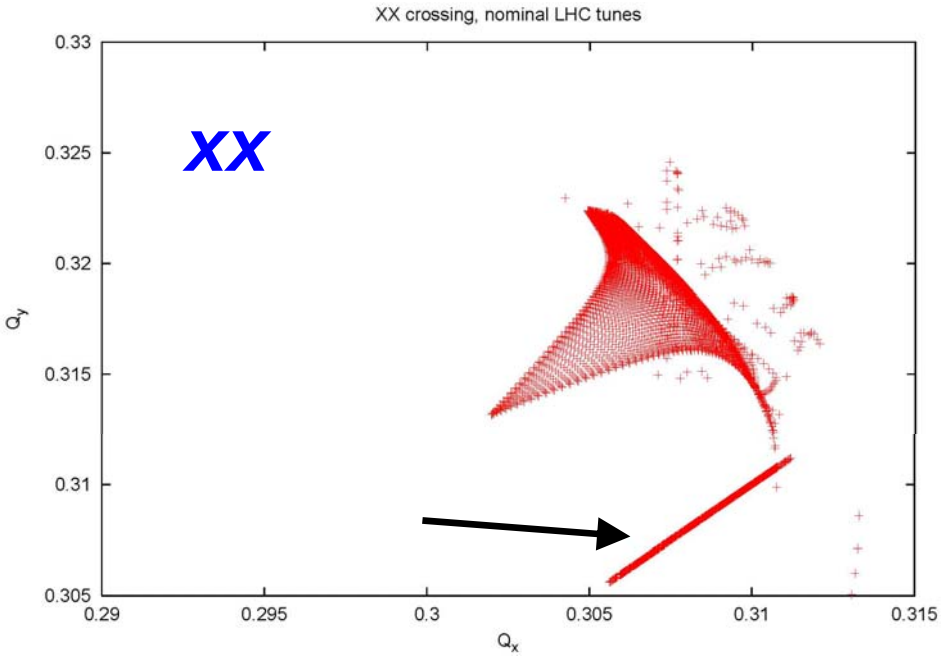


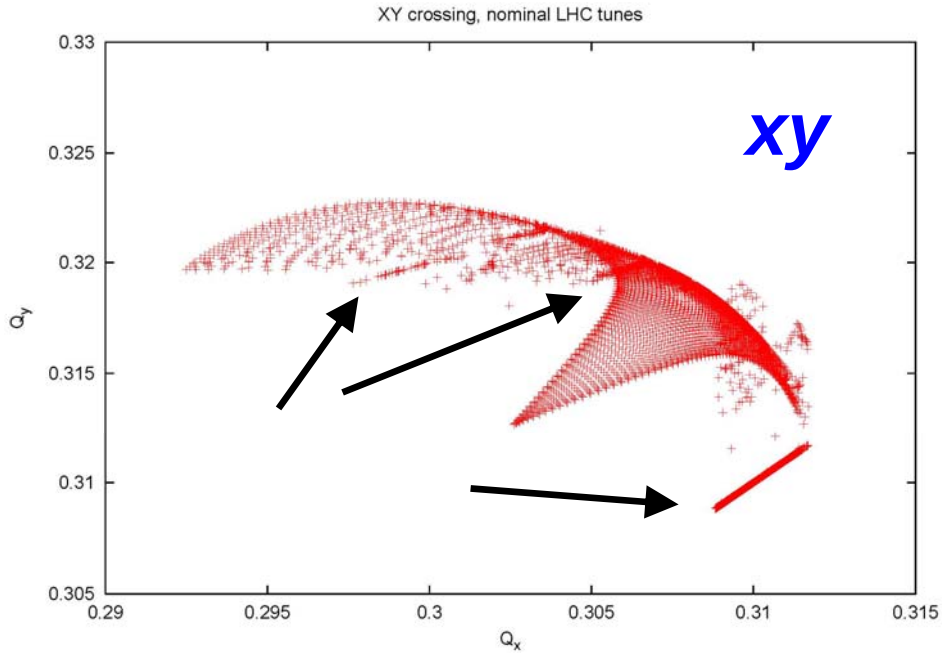




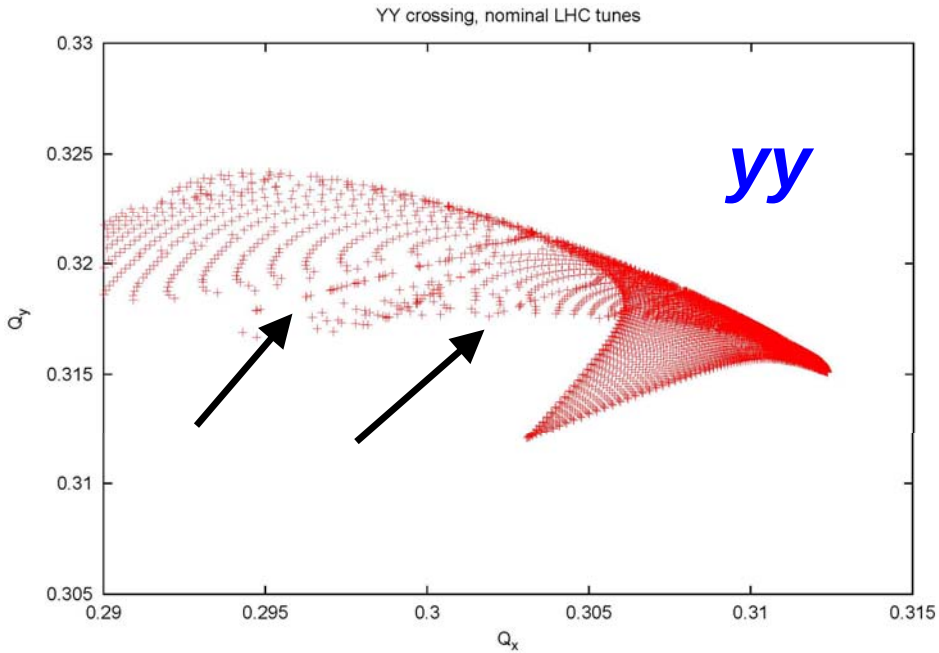


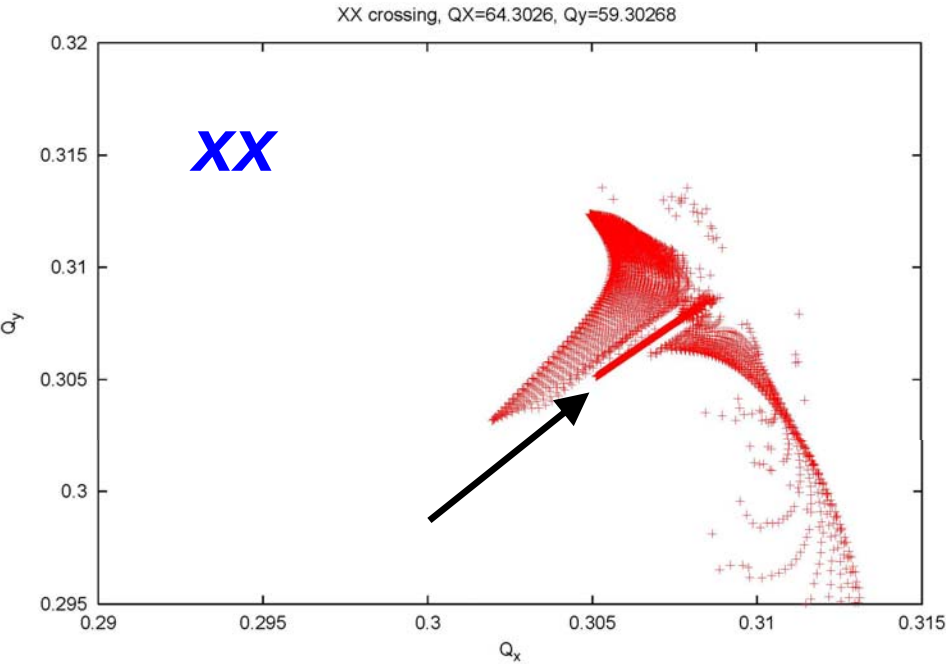
simulated LHC diffusive aperture for nominal & reduced crossing angle vs. Q_y, *y=0* (only x amplitude nonzero), in this case *xx* and *yy* crossing are always stable, and diffusive aperture found only for *xy* crossing

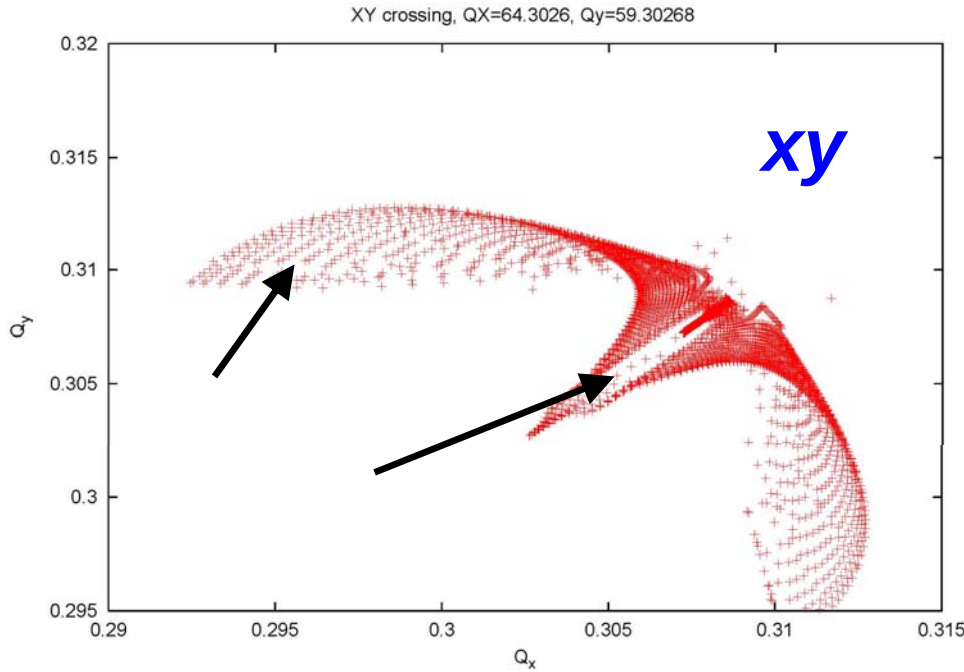




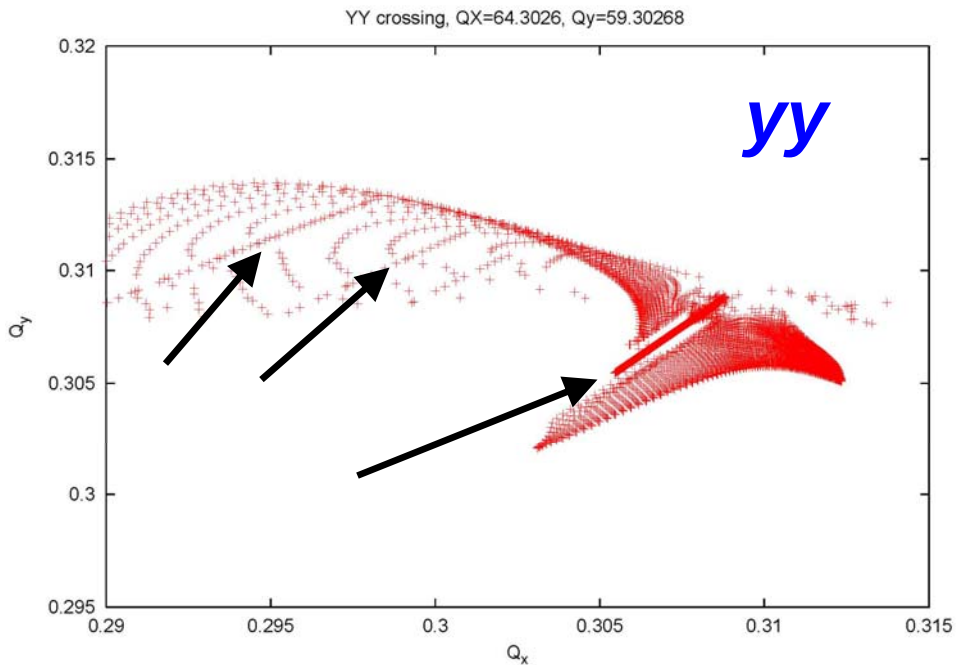
frequency maps for nominal LHC tunes







frequency maps for QY lower by 0.01 (~on coupling resonance)



thanks to Yannis Papaphilippou for his help in calculating frequency maps!

conclusion:
diffusive aperture larger for equal-plane crossing in all cases

possible explanation:
(1)different ‘folding’ since *xy* crossing cancels dodecapole and 20-pole terms;
&
(2) twice the number of resonances for *xy* crossing