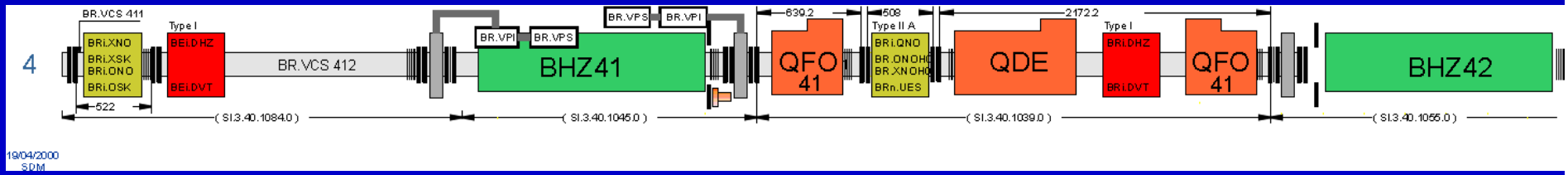
SPACE CHARGE MEASUREMENTS AT THE PSB

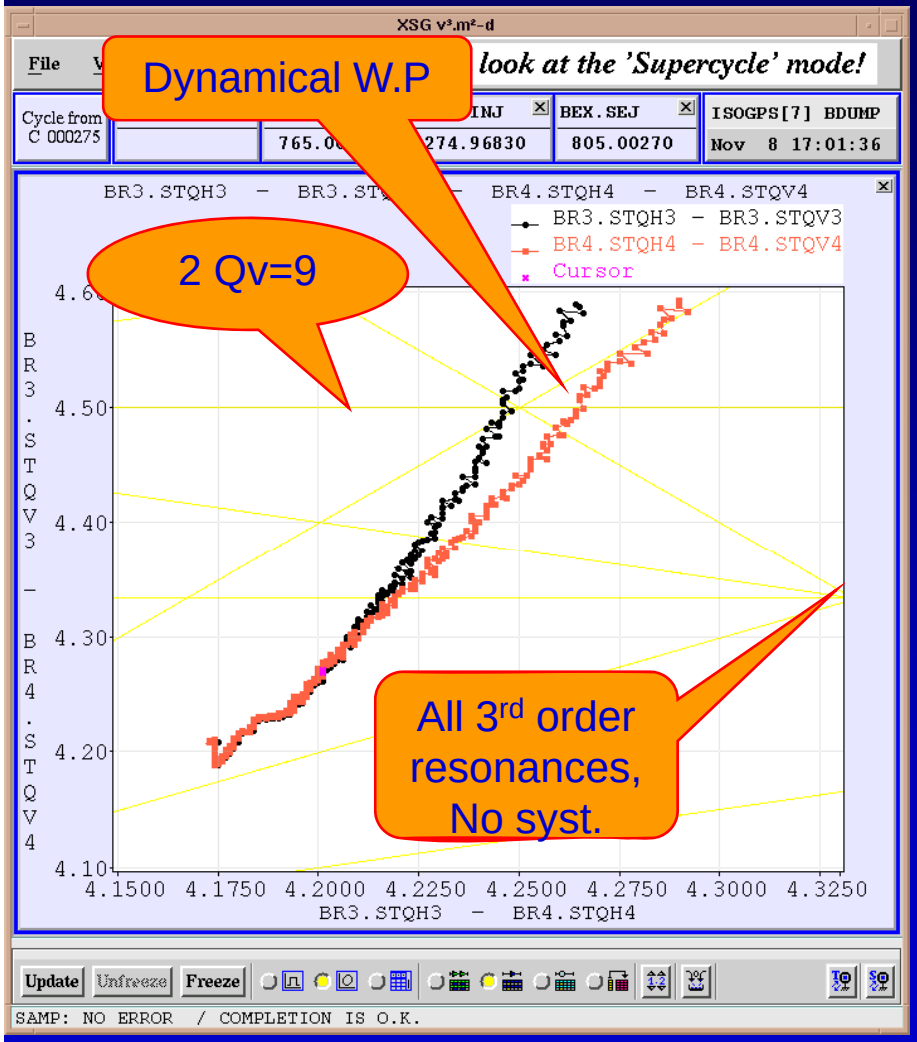
M. Chanel,CERN/AB/ABP

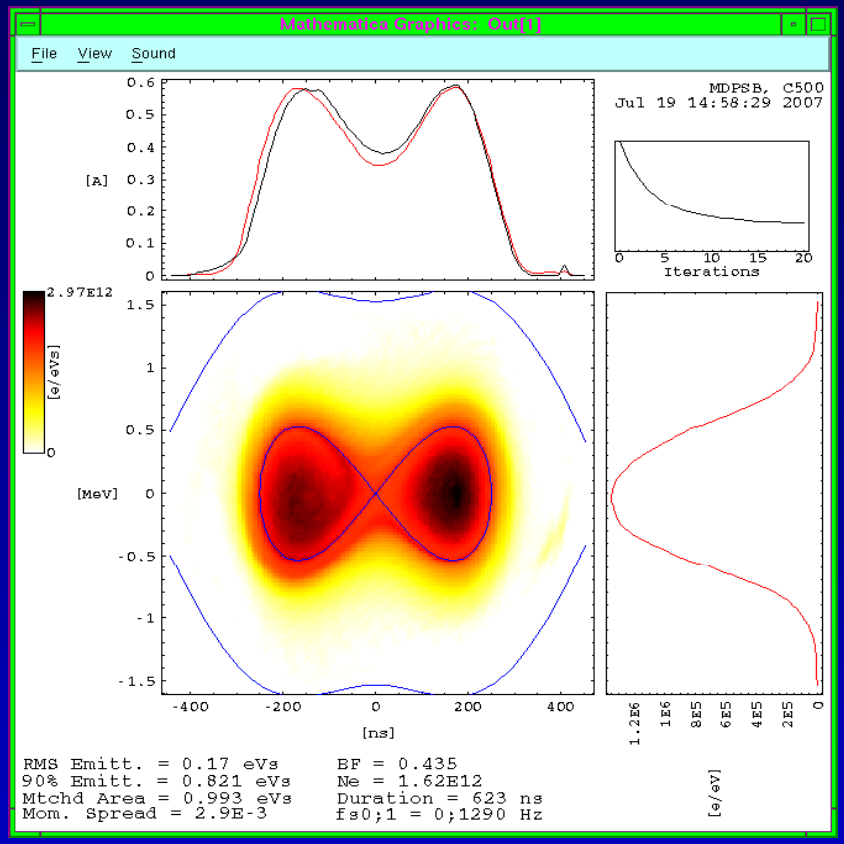
THE PSB

- Injector LINAC2, >160mA, 120μs
- 4 superposed rings, 50 π m length
- 16 periods, strong focusing, >π/2/period
- Horizontal multiturn injection
- Dynamical working point to absorb tune spreads and shifts: from (4.29,4.6) at injection to (4.17,4.23) after 200ms up to extraction
- Coherent tune shift ~-0.18, Laslett tune shift ~-0.5 with high N even with h1&2 to increase Bf.
- Acceptances about (180,120) π mmmrad



Tune diagram, Longitudinal





Tomoscope view of long. phase space with h1&2 at 8kV. Increase Bf to over 0.55

Performance

OPERATION DISPLAY

File View Option Help

opdisp MD3 10 Jul 25 19:37:14 2007

Beam State	PSB User	PS User	Particule	Harmonique	Destination	Energy
NORMAL	MD3		PROTON	H1	BDUMP	1400

Unit : 1e+10	1		2		3		4		Sum	
LTB.TRA55	2228		2236		2469		2251		9184	
BI.TRA10	2220	100%	2225	100%	2456	99%	2238	99%	9140	100%
BI.TRA20	2086	94%	2084	94%	2273	93%	2057	92%	8500	93%
INJECTION	1508	72%	1548	74%	1423	63%	1471	72%	5951	70%
CAPTURE	1106	73%	1167	75%	1056	74%	1064	72%	4393	74%
ACCELERATION	1033	93%	1079	92%	1002	95%	1010	95%	4124	94%
BT [illegible]	992	96%	983	91%	775	77%	965	96%	4 12	100%
BTP.TRA									-7	-0%
BTX [illegible]									0	
BTM [illegible]									8	
	0.0		13.0		13.0		14.0		13.0	
					Nb turns		Nb turns		ings	

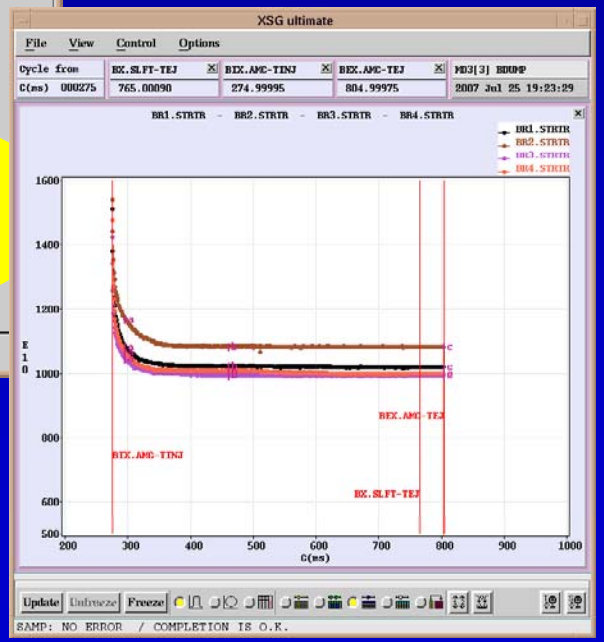
>10^{13}/Ring!

>4.1 10^{13}

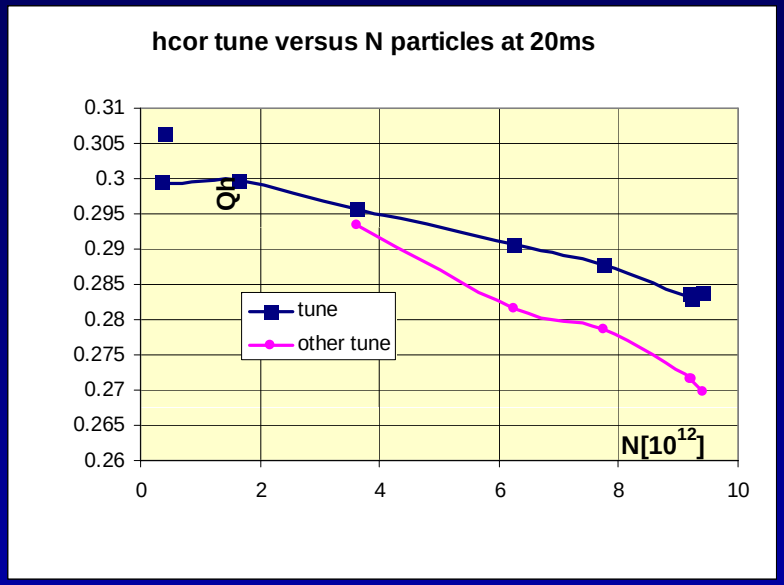
LINAC->PSB | INJ_RING_1 | INJ_RING_3 | RF_Cavities
INJ_COMMON | INJ_RING_2 | INJ_RING_4 | Magnetic

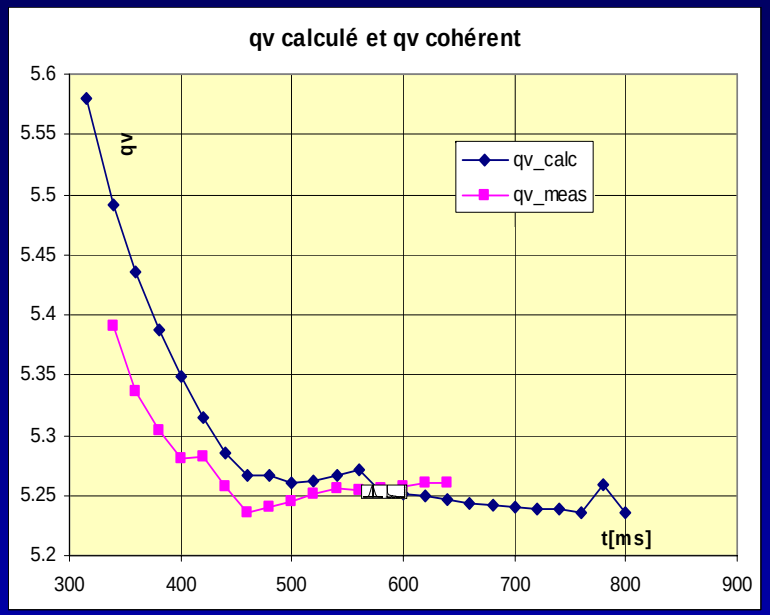
One Shot | Unfreeze | Freeze

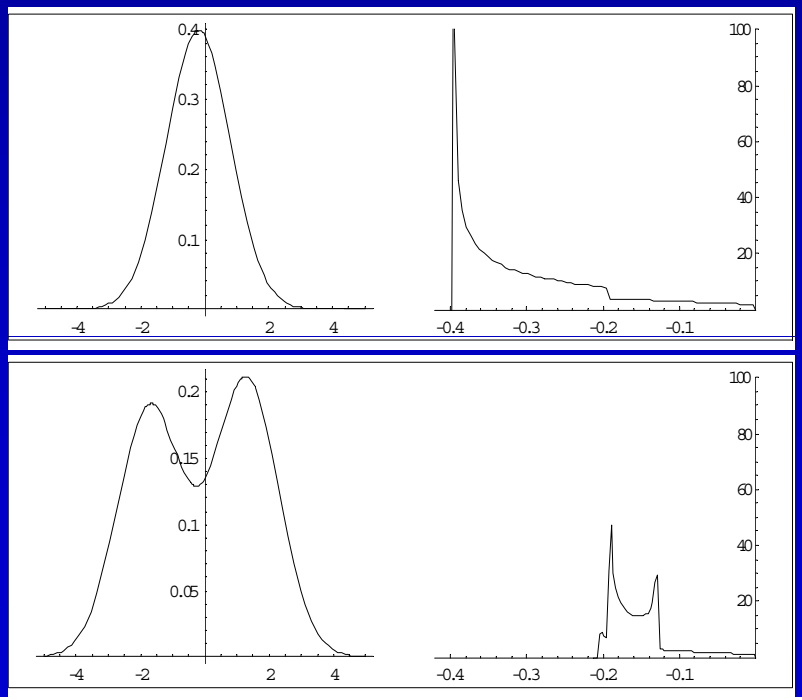
No message

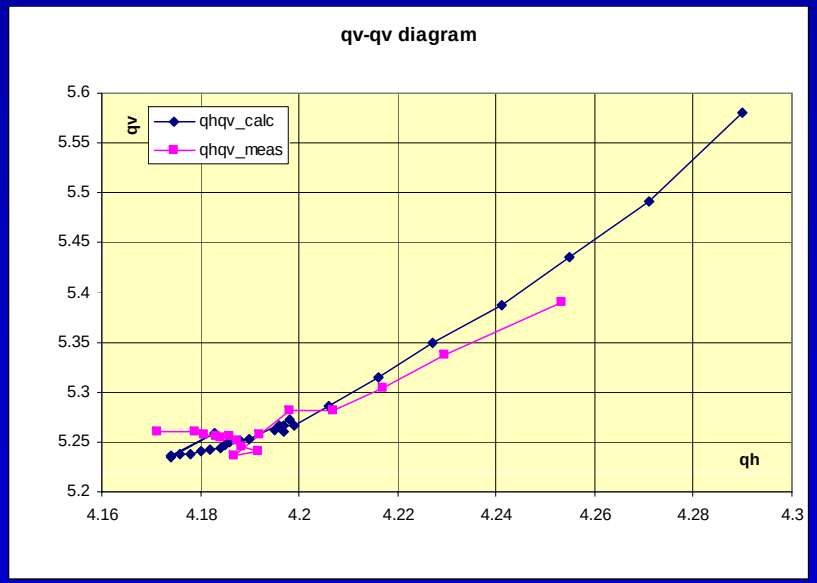


Coherent tunes



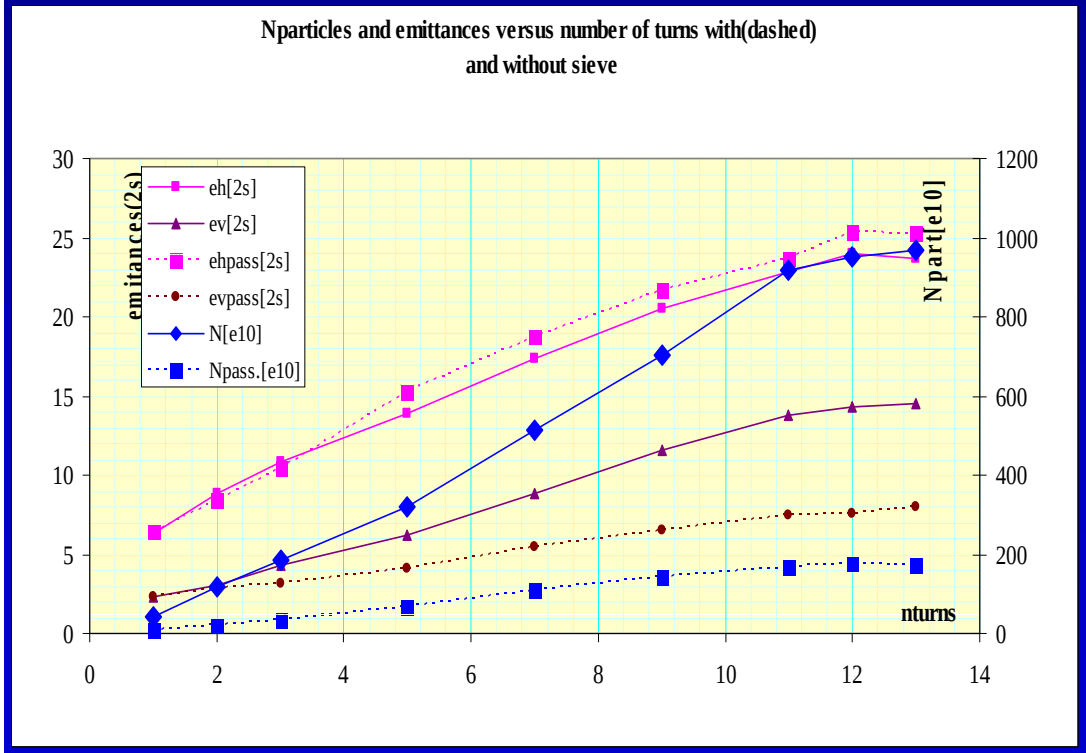


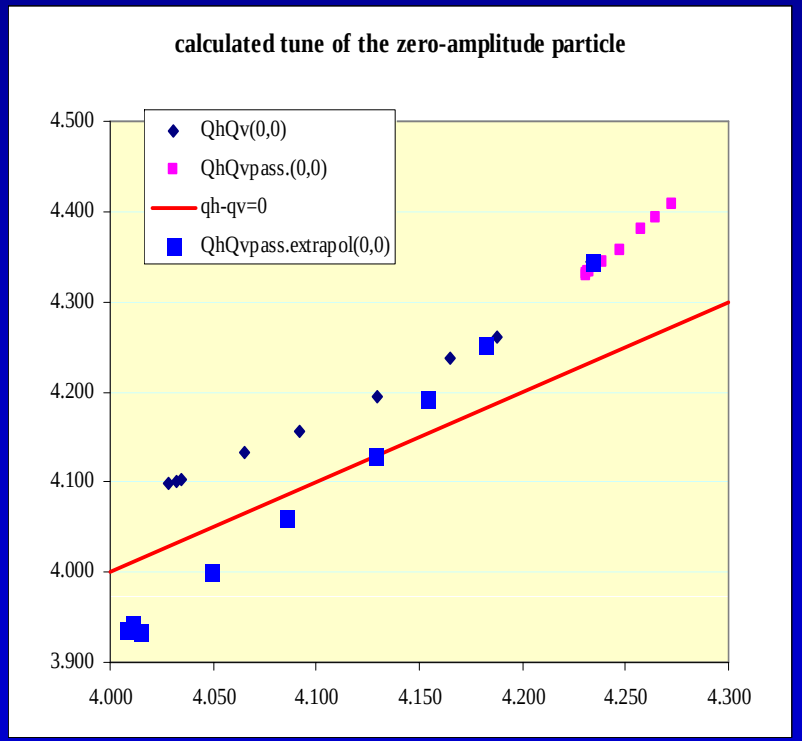




Emittances(1)

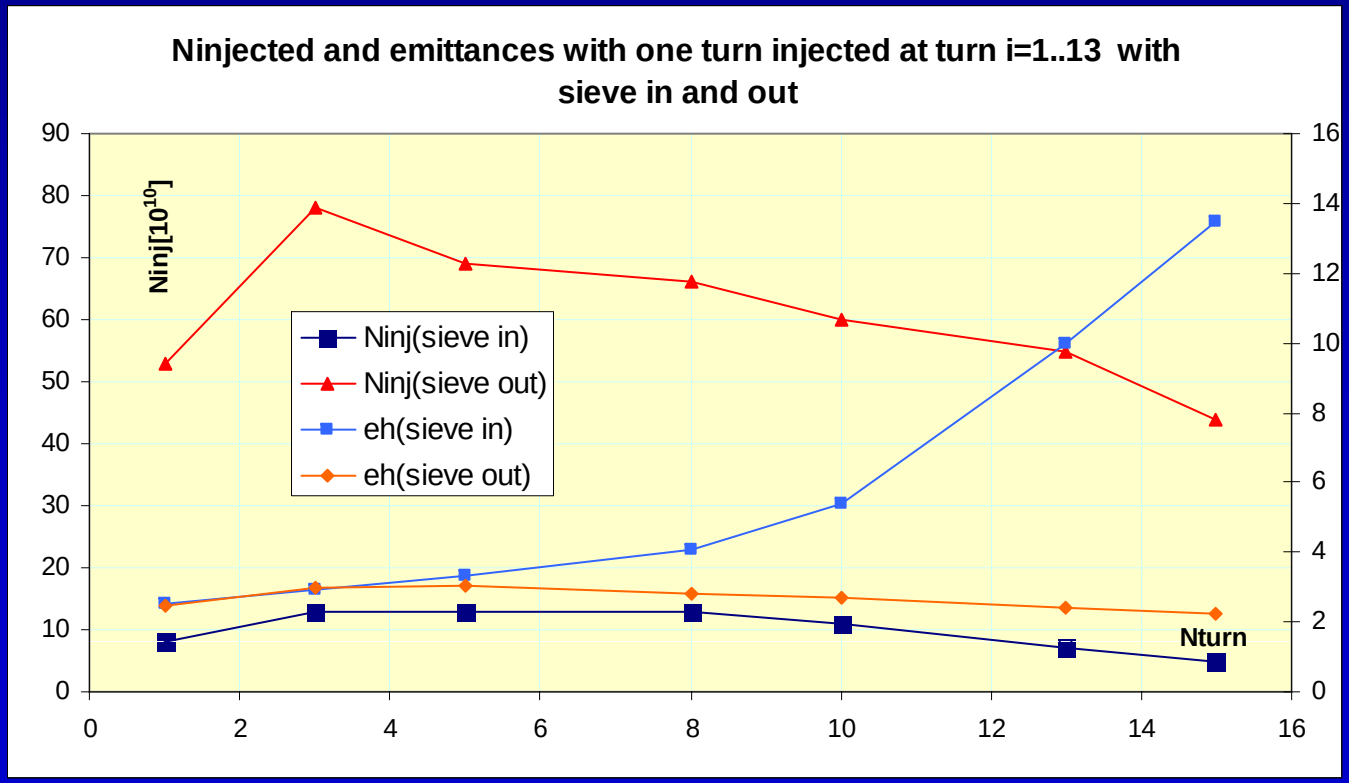
- Sieve reduces LINAC2 density by 5..6
- Measurements taken after acceleration, in ML
- Difference between normal/sieve is only important in V plane
- Calculated zero-ampl tune is made with some assumptions , the accelerated emittances and N!!!
- Extrapolated is dq sieve*N normal/Nsieve
- Probably qh-qv=0 is responsible for the vertical blow-up...and losses





Emittances(2)

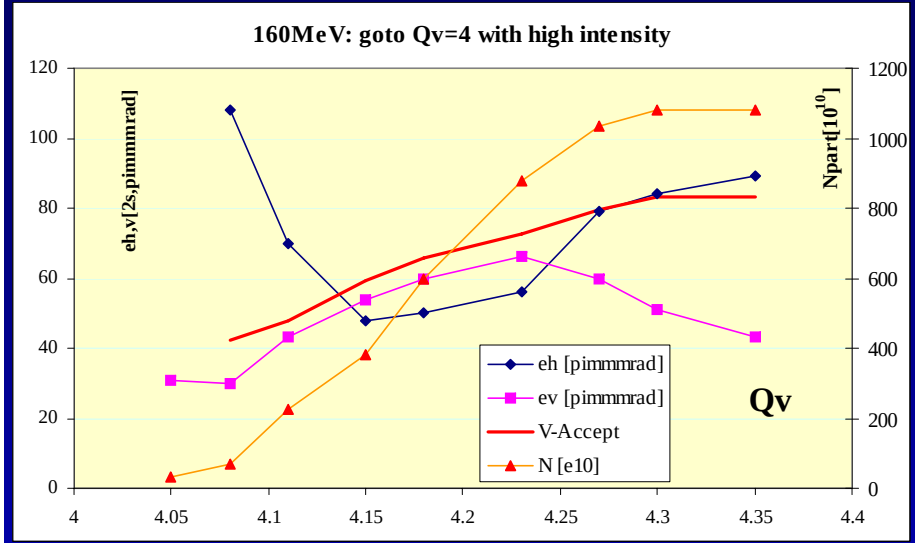
- One turn injected as turn 1 to 13
- Note the emittance with sieve “follows” the large amplitude oscillation for large N (filamentation present)
- Without sieve, there is no filamentation which indicates that the beam is a rigid body(density effect)
- The large oscillations without sieve continue for ms and are damped!!!

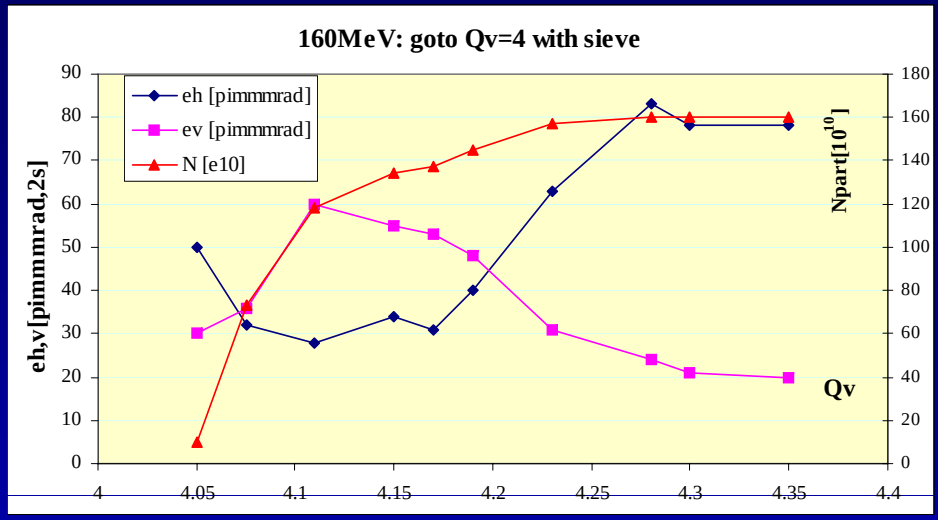


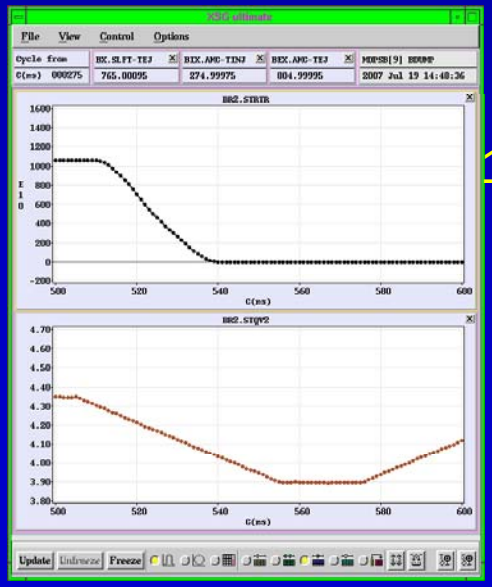
160 MeV


XSC ultimate
File
View
Control
Options
Cycle from
C(ms) 000275
BX.SLFT-TEJ
765.00125
BIX.AMC-TINJ
275.00005
BEX.AMC-TEJ
805.00020
MDPSB[8] BDUMP
2007 Jul 13 17:31:57
BR2.STRTR - BR.STKINENERGY
BR2.STRTR
BR.STKINENERGY
ε(2σ)
(93, 52) π
mmmrad
ε(2σ) (100, 47)
π mmmrad
E1 0 MeV
1600
1400
1200
1000
800
600
400
200
0
-200
200
300
400
500
600
700
800
900
1000
C(ms)
BEX.AMC-TEJ
BIX.AMC-TINJ
BX.SLFT-TEJ
Update
Unfreeze
Freeze

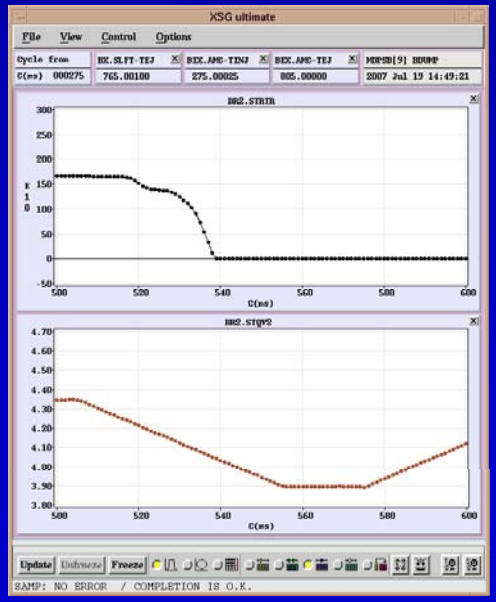
GOTO Qv=4





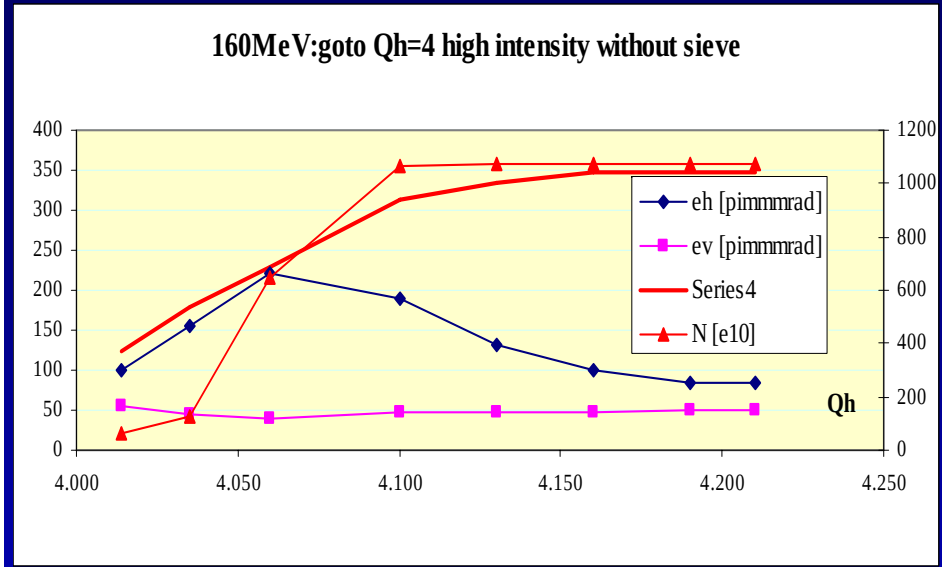


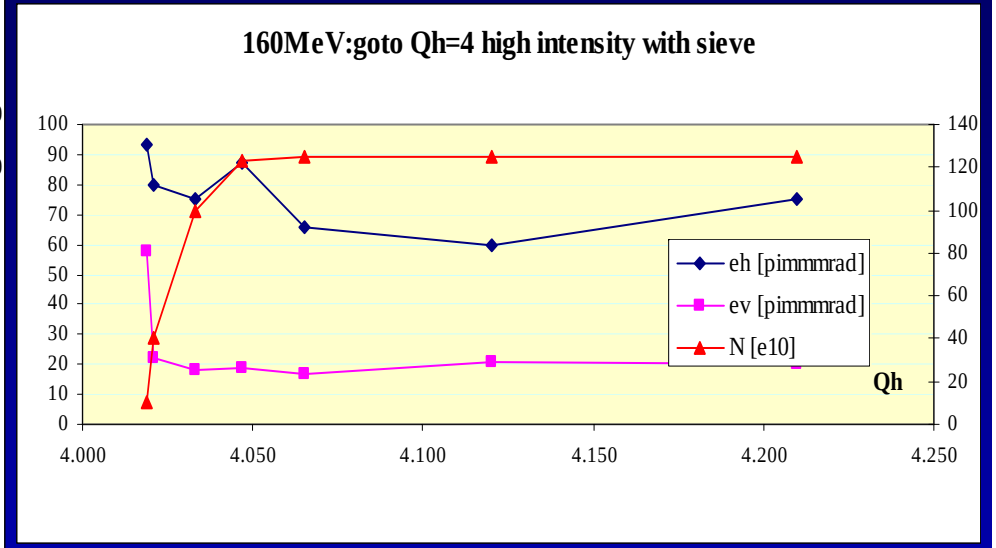
13 turns injected

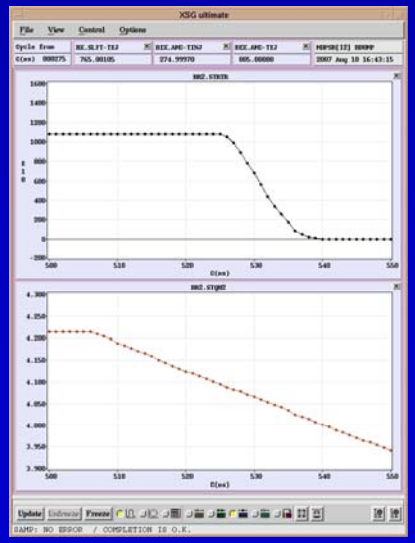


13 turns injected with sieve...

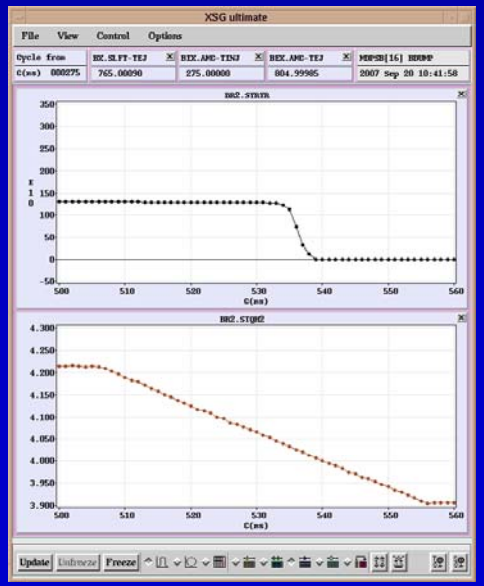
Goto Qh=4







13 turns injected



13 turns injected with sieve...

8kV RF h1&2 Δϕ=0 or π

- Need to increase the V tune to 4.56, instead of 4.34, when cavities are in phase. Peak density is increased by ~2
- More losses on ft than for out of phase h1&2

What's next ?

- Try to find the distributions, their evolution, correlations between H&V distributions