# "SIMPLE" BEAM BRIGHTNESS INCREASE BY A FACTOR 2 FROM PSB?
# => 3-BATCH INJECTION INSTEAD OF 2

## NOMINAL 25 ns IN PS

- 4b + 2b = 6b from PSB on h7 (~ 1.4E12 p/b) within ~ 2.5 μm
- Bunch length < ~ 190 ns (limited by PSB recombination kickers) in 327 ns RF bucket
- 6b × 3 = 18b on h21 at inj.
- Acceleration on h21
- 18b × 2 × 2 = 72b on h84 at ext.
- Cycle lasts 3.6 s and we have to wait 1.2 s at inj.
- The nominal 25 ns beam is not yet at the space charge limit
  - Where is the space charge limit?
  - Could also play with RF voltage and/or longitudinal profile to reduce SC => New limit?

## NEW 25 ns SCHEME?

- 3 × 4b = 12b from PSB on h14 (~ 0.7E12 p/b) within ~ 2.5 / 2 ~ 1.2 μm
- Bunch length ~ 100 ns? (not limited anymore by PSB recombination kicker) in 327 / 2 = 163.5 ns RF bucket => SC ~ 2 times more critical
- Acceleration on h14
- 12b × 2 × 3? = 72b on h84 at ext.
- Cycle lasts 4.8 s (+ 33%) and we have to wait 2.4 s at inj.
- If we want to have exactly the same cycle length we need to reduce the PSB cycle from 1.2 s to 0.6 s. Considered option? 0.9 s? POPS?
- If/when space charge limit reached => Increase PSB ext. energy between 1.4 and 2 GeV (Gain factor ~ 1.6 at max.)

# NEW 50 ns SCHEME?

- 3 × 4b = 12b from PSB on h14 (~ 0.35E12 p/b) within ~ 2.5 / 4 ~ 0.6 μm
- Bunch length ~ 100 ns? (not limited anymore by PSB recombination kicker) in 327 / 2 = 163.5 ns RF bucket => SC ~ 2 times more critical
- Acceleration on h14
- 12b × 3? = 36b on h84 at ext.
- Cycle lasts 4.8 s (+ 33%) and we have to wait 2.4 s at inj.
- If we want to have exactly the same cycle length we need to reduce the PSB cycle from 1.2 s to 0.6 s. Considered option? 0.9 s? POPS?
- If/when space charge limit reached => Increase PSB ext. energy between 1.4 and 2 GeV (Gain factor ~ 1.6 at max.)

# ISSUES?

- Bunch length at PS injection (assumed 1st to be ~ 100 ns, i.e. ~ 2 times smaller as h 2 times bigger): Can we increase it to try and reduce the SC effect? => Should be < 163.5 ns, but where is the limit (for capture losses etc.)? We could also play a little bit with the longitudinal profile to reduce SC
- 3-splitting at high energy: This might be an issue as I think we need 3 RF systems with h28, h56 and h84. I think we have h84 (40 MHz) and h28 (13.3 MHz). What about h56 (26.6 MHz)? Do we need to install a new RF cavity? => To be checked with RF
- PSB extraction energy: Might need to be increased but may be below 2 GeV => Could help to define which energy is needed

# THANKS

- GianluigiA, MassimoG, OliverB, RendeS
- RolandG's talk at the OMCM2011's workshop