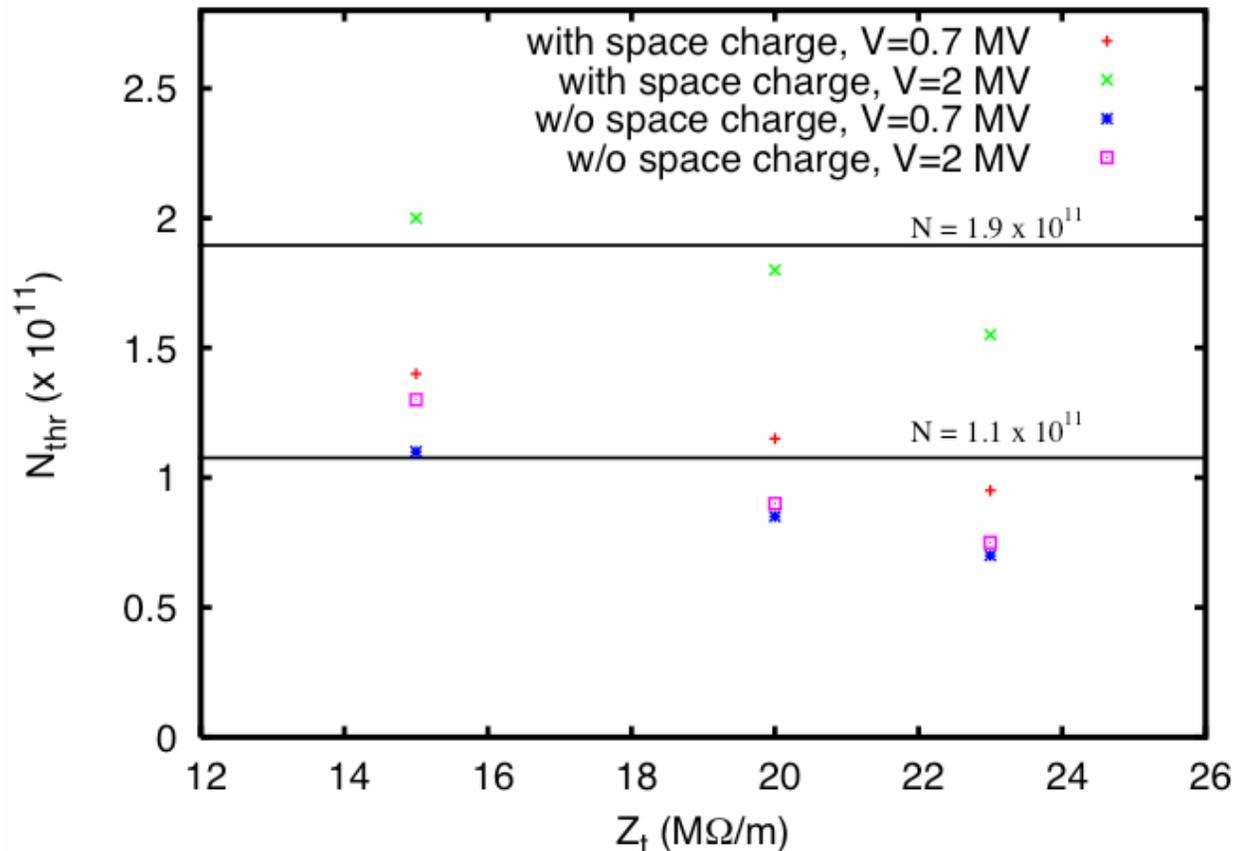


Higher injection energy in the SPS (Effects on TMCI)

G. Rumolo in RLC-LHC Meeting (11/11/2005)

- Parameters
- Study of **TMCI** threshold with **HEADTAIL** simulations
- Conclusions

Study of TMCI threshold at 26 GeV/c for different impedances and rf voltages. Neither of the two considered voltages was a matched value.



Main assumptions for this analysis:

- Nominal (LHC) beam parameters at injection:
 - Longitudinal emittance 0.35 eVs - unchanged
 - Normalised transverse emittances: $\sim 3.0 \mu\text{m}$
- Injection at $26, 40$ and $60 \text{ GeV}/c$
- Bunches are always **matched** to their buckets
- The chamber is assumed to be **flat** (dipole wakes weighed by Yokoya coefficients + quadrupole wakes)
- **Space charge** optionally included
- Broad band impedance with $R_s = 20 \text{ M}\Omega/\text{m}$,
 $\omega_r = 1.3 \text{ GHz}$, $Q = 1$

Main **implications** of the chosen set of parameters
(reference is the parameter set at 26 GeV/c):

- Longitudinal emittance **0.35 eVs**:
 - * Bunch length is kept constant (0.3m) and momentum spread $\delta p/p_0$ is scaled by $27.7/\gamma$ for 40 and 60 GeV/c
 - * Matched voltage, which scales like η/γ , is re-adjusted for each set of simulations
- Normalised transverse emittances: **$\sim 3.0 \mu\text{m}$** :
 - * Transverse beam sizes are scaled by $\sqrt{27.7/\gamma}$
so the net improvement on the space charge tune shift is like $(27.7/\gamma)^2$

N is the number of protons/bunch

	26 GeV/c	40 GeV/c	60 GeV/c
Threshold N without space charge ($\times 10^{11}$)	0.7	1.5	1.9
Threshold N with space charge ($\times 10^{11}$)	0.9	1.8	2.2

Without space charge, **the threshold increases like η** , which is confirmed by Elias' formula and by the fact that the threshold still stays at around 1.9 at 450 GeV/c

Conclusion

- The **threshold of TMCI significantly increases** raising the injection energy (but, when keeping the longitudinal emittance constant, like η and not like γ , as one might expect) and at 40 GeV/c it becomes higher than the threshold at 26 GeV/c including space charge.
- Higher injection energy in the SPS is certainly **beneficial** against TMCI!