The high harmonic (HH) RF system can be useful for:

- additional flexibility for beam parameters
- longitudinal beam stability
- bunch flattening (bunch-lengthening mode)
    - reduction of luminosity density
    - reduction of beam induced heating below 1.2 GHz
    - increase of peak luminosity
    - ions: increase of bucket (loss reduction), reduction of the IBS growth in transverse plane

From beam stability point of view the best frequency of the HH RF is 800 MHz, maximum required voltage is 8 MV.
However flat bunches will be tilted and longitudinal stability could be even
reduced in a double RF system with the full-detuning scheme for the 400 MHz RF, required for total beam intensities
above nominal.
Flat bunches can also be obtained in a single RF system by bunch shaping with phase modulation, but this flat shape may evolve with time to more Gaussian. Present bunch length (1.25 ns) seems to be close
to the optimum for the experiments, beam lifetime requirements and heating problems.
Effect of impedance of this RF system should be small, any potential loss of stability related to its impedance
will be compensated by increased Landau damping in a double RF system.
For the present LHC impedance, single bunch longitudinal stability should be OK up to HL-LHC intensities.
Need to be re-evaluated in case of LHC impedance increase. The situation is less clear for multi-bunch effects.

Actions from this meeting:

- Study transverse stability in a double RF system - ABP
- Look for possible solutions for tilted bunches in a double RF - RF
- Simulate (flat) bunch shape evolution in a single RF with IBS, RF noise, beam-beam... – ABP

Preliminary agenda of the next meeting (in March):

- Design of the 800 MHz RF system – R. Calaga
- Design of the 800 MHz RF system – M. Zobov
- Can we restore bunch flatness in the full-detuning scheme – P. Baudrenghien

E. Shaposhnikova
05 February 2013

Comments from S. Fartoukh (e-mail):

It is important to mention the bunch splitting , each bunch halved into two bunchlets spaced by 1.25 ns (but not OK for 400 MHz crab-cavities) or by 2.5 ns, basically the halving of the emittance after the 800 MHz splitting is re-lost after the 400 MHz recapture, i.e. the two final bunchlets spaced by 2.5 ns have each the same longitudinal emittance as the initial bunch but twice less the charge).

On the other hand, I am still not sure if we absolutely need the 800 MHz to do this bunch splitting, but perhaps if we can play independently with the phase of the existing 400Mhz RF cavities, we could do the job as well (in this case during the LHC ramp … which in some sense would be another way to blow up the longitudinal emittance ...)

Finally the interest, and pros and cons of such a beam need of course to be well established for the (HL-)LHC but there are already quite a few.