Electron flux and pressure dynamic in the LHC Vacuum Pilot Sector as function of beam parameters

E. Buratin[1,2], V. Baglin[1], B. Henrist[1], P. Chiggiato[1], A.Fasoli[2]

[1] *CERN, Geneva, Switzerland*

[2] *EPFL, Lausanne, Switzerland*

The Large Hadron Collider (LHC) is affected by a phenomenon, known as electron cloud (EC), which provokes beam instabilities, heat loads and pressure increases in the vacuum system. Along the ring, free electrons are generated by beam gas ionization, by beam losses and by photoelectron production at 6.5 TeV collision energy. During each bunch passage, these electrons are accelerated by the electro-magnetic field and imping on the vacuum pipe. An increase of the electron flux is also taking place when the secondary electron yield (SEY) of a material surface, i.e. the production of secondary electrons per impinging electron, is larger than one. The resulting EC build-up process can be sustained and amplified bunch by bunch, depending on the LHC beam structure (number of bunches, bunch population and bunch spacing). This process, called multipacting, generates a cloud.

The Vacuum Pilot Sector (VPS), installed in a dedicated room temperature part of the storage ring, provides a permanent monitoring of the electron flux and the pressure levels with pick-ups and Bayard-Alpert gauges. Several technical surfaces, such as ex situ NEG, amorphous carbon coating and copper, are simultaneously tested with this innovative system.

The main outcomes of this study show that the EC signals have: 1) a linear dependence with the number of bunches and with the bunch population in the multipacting regime, 2) a build-up threshold at a given bunch population, 3) a reduction due to beam conditioning. The comparison between different surfaces shows that amorphous carbon coating reduces drastically the EC build-up, thanks to its low SEY. Other detailed experimental observations are discussed in this paper.