About some issues in the measurements at the Injector on 30.10.2019

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The first zero crossing at TDS

The second zero crossing at TDS
The current from the *first/*second* zero crossing at TDS
\[ V(0) = 122.74 \text{ MV} \]

\[ V(\varphi) = \frac{V(0)}{\cos(\varphi)} \]

\[ y_{RF}(t, \varphi) = eV(\varphi)\cos(\omega t + \varphi) \]

\[ y_M(t, \varphi) = \Delta E(t) + eV(\varphi)\cos(\varphi) \]

There is a phase dependence of the energy and the curvatures disagree on the left plot. Do we have a phase shift?
\[ V(0) = 122.74 \text{ MV} \]
\[ V(\phi) = \frac{V(0)}{\cos(\phi)} \]

\[ y_{RF}(t, \phi) = eV(\phi)\cos(\omega t + \phi + \phi_0) \]

\[ y_M(t, \phi) = \Delta E(t) + y_{RF}(0, \phi) \]

\[ \Delta E_{LH}(\phi) = E_{LH}(\phi) - E_{LH}(0) \]

\[ \Delta E_{RF}(\phi) = y_{RF}(0, \phi) - y_{RF}(0, 0) \]

\[ V_0 = 122.76 \text{ MV} \]

\[ \phi_0 = -0.94 \text{ deg} - \text{systematic error?} \]
There is a weak phase dependence of the energy and the curvatures disagree on the left plot. Do we have a phase shift in AH1 as well?

\[
V(0) = 122.74 \text{ MV}
\]

\[
V_3(0) = 15.25 \text{ MV}
\]

\[
V_3(\varphi_3) = \frac{V_3(0)}{\cos(\varphi_3)}
\]

\[
\varphi_0 = -0.94 \text{ deg}
\]

\[
y_{RF}(t, \varphi) = eV(0)\cos(\varphi_0) + eV_3(\varphi_3)\cos(3\omega t + \varphi_3)
\]

\[
y_{RF}(0, \varphi) = \Delta E(t) + y_{RF}(0, \varphi)
\]

\[
\Delta E_{LH}(\varphi) = E_{LH}(\varphi) - E_{LH}(0)
\]

\[
\Delta E_{RF}(\varphi) = y_{RF}(0, \varphi) - y_{RF}(0, 0)
\]
$V(0) = 122.74 \, MV$

$V_3(0) = 15.25 \, MV$

$V_3(\varphi_3) = \frac{V_3(0)}{\cos(\varphi_3)}$

$\varphi_0 = -0.94 \, \text{deg}$

$y_{RF}(t, \varphi) = eV(0)\cos(\varphi_0) + eV_3(\varphi_3)\cos(3\omega t + \varphi_3 + \varphi_0)$

$y_M(t, \varphi) = \Delta E(t) + y_{RF}(0, \varphi)$

$\Delta E_{LH}(\varphi) = E_{LH}(\varphi) - E_{LH}(0)$

$\Delta E_{RF}(\varphi) = y_{RF}(0, \varphi) - y_{RF}(0, 0)$

$\varphi_0 = -1.04 \, \text{deg} - \text{systematic error?}$
Horizontal orbit change during A1 phase scan with the “constant” beam energy (S. Tomin).
Vertical orbit change during A1 phase scan with the “constant” beam energy (S. Tomin).
Summary

• The on-crest phase defined with “IntelliPhase” differs from the direct fit of TDS measurements to RF curvature. The systematic error is about 1 degree for A1 and 1 degree for AH1. We need an additional study to find the reason:
  • space-charge,
  • wakefields,
  • ...

• We need a model to explain the trajectory offset dependences from the phase in A1 for approx. “constant” energy
  • coupler kick,
  • RF focusing,
  • ...