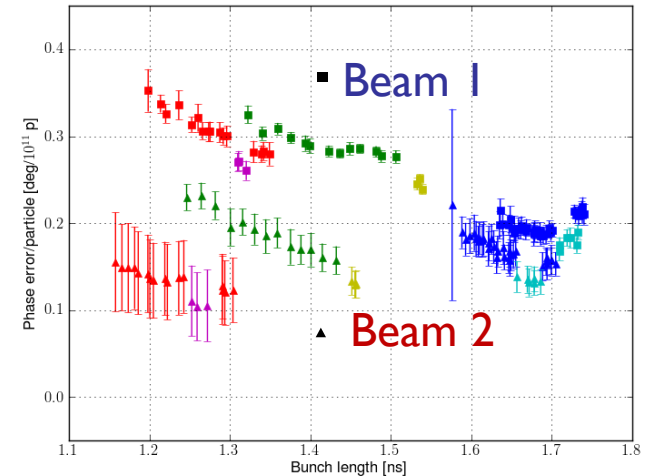
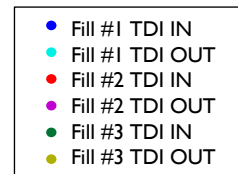


Phase Module calibration with beam and Longitudinal impedance measurements at 4 TeV

T. Argyropoulos, P. Baudrenghien , N. Biancacci, T. Bohl, J. F. Esteban Müller,
G. Papotti, T. Mastoridis, N. Mounet, B. Salvant, E. Shaposhnikova, H. Timko, +...

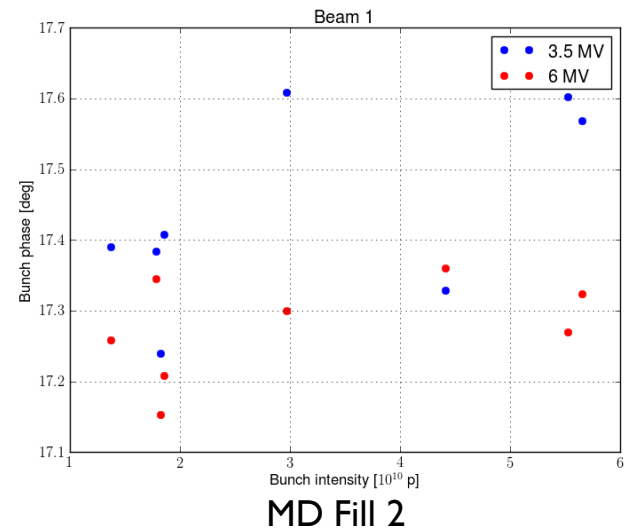
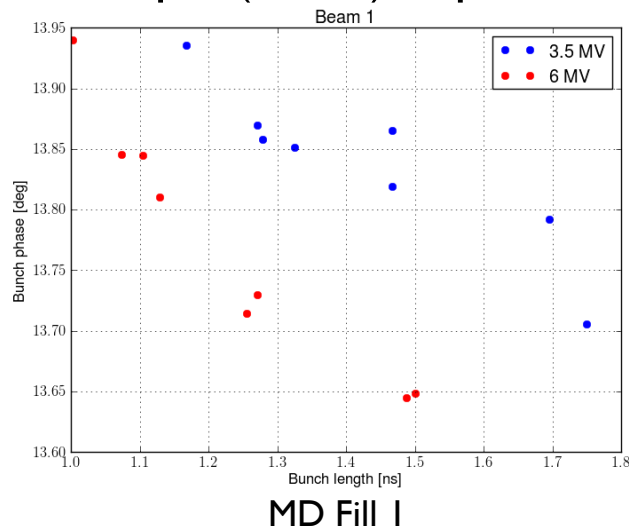
Introduction

- ▶ Different results from previous MD for Beam 1 and Beam 2 and also between different modules, even after some corrections
 - ▶ Calibration needed
- ▶ Only measurements at FB
 - ▶ Measurements at 4 TeV needed
- ▶ MD summary:
 1. 2 fills for phase module calibration at 450 GeV
 - ▶ 8 bunches of low intensity ($1 - 6 \times 10^{10}$ p)
 2. 1 fill with ramp for impedance measurements at 4 TeV
 - ▶ 3 bunches of high intensity ($0.5 - 1.6 \times 10^{11}$ p)
- ▶ Measurements done:
 - ▶ Synchronous phase
 - ▶ Peak Detected Schottky
 - ▶ Transverse tune shift
 - ▶ Beam profiles



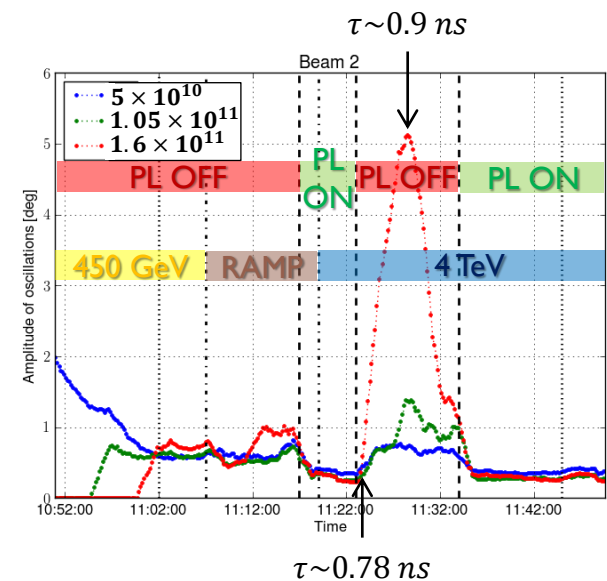
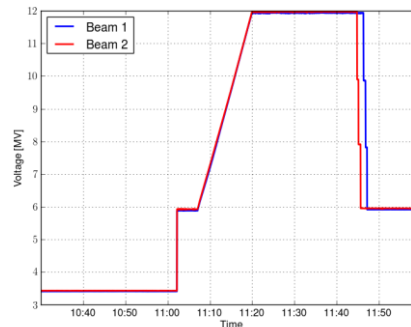
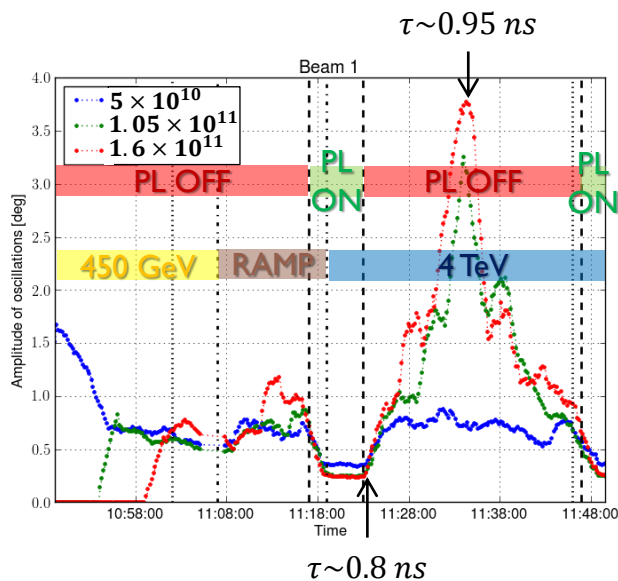
Phase Module Calibration

- ▶ 8 bunches low intensity ($1 - 6 \times 10^{10}$ p)
- ▶ Signal amplitude was increased to the level of high intensity used in previous measurements
- ▶ Voltage changed from 3.5 MV to 6 MV to disentangle the impedance contribution and the phase module effect
- ▶ Two fills at injection energy:
 1. Similar intensities ($3 - 5 \times 10^{10}$ p) and different bunch lengths (1-1.8 ns)
 2. Similar bunch lengths (1.5 -1.7 ns) and different intensities ($1 - 6 \times 10^{10}$ p)
- ▶ No simple (linear) dependence could be extracted so far



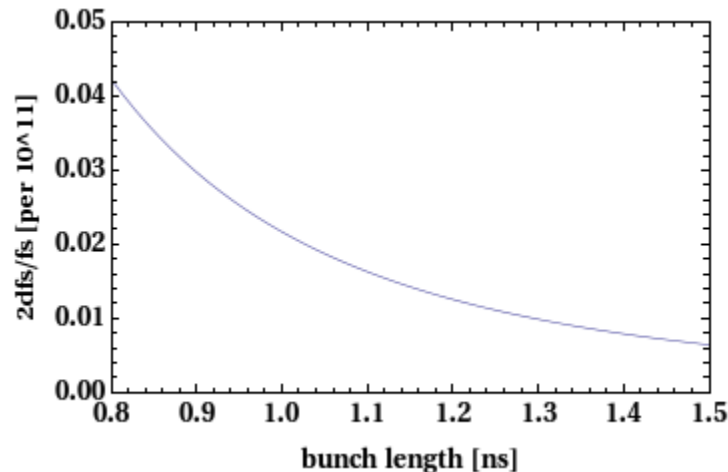
Longitudinal Impedance at 4 TeV

- ▶ Only 3 bunches due to limited time
 - ▶ Intensities in the range $0.5 - 1.6 \times 10^{11}$ p
 - ▶ Similar bunch lengths ~ 0.8 when arrived at 4 TeV
- ▶ Longitudinal impedance from synchronous phase shift not possible
 - ▶ More bunches and phase module calibration is needed
- ▶ Loss of Landau damping was observed when the phase loop was switched off for bunches with 1×10^{11} p and 0.8 ns bunch length



Peak Detected Schottky

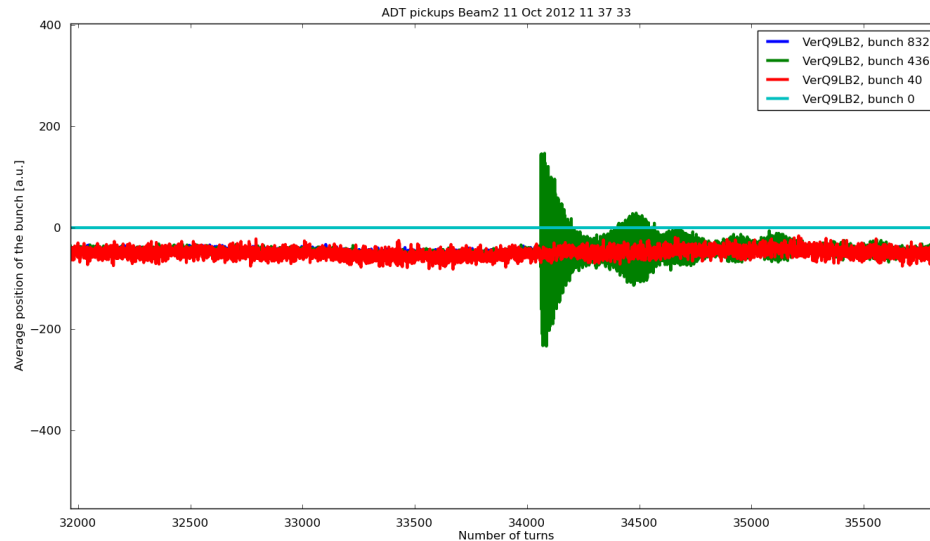
- ▶ Estimated quadrupole line frequency shift at 4 TeV for $\text{Im}Z/n=0.1$ and 0.9 ns bunch length ($V=12$ MV) is $< 1 \text{ Hz}/10^{11}$



- ▶ Measurement precision is around 0.2 Hz
- ▶ Very limited time → Only measurements for two bunches with different Peak Detected modules
- ▶ Analysis on-going

Transverse Tune Shift

- ▶ Measurements with the ADT pickups:
 - ▶ Injection oscillations
 - ▶ Kicks at 4 TeV



- ▶ Tune vs. intensity → To be analysed

Conclusions

- ▶ Synchronous phase measurements:
 - ▶ We observed a systematic error of ~ 0.2 deg in the measurements range
 - ▶ Modules behave different (opposite for Beam 1 and Beam 2)
 - ▶ If the impedance model is correct, the required precision is ~ 0.1 degrees or less
 - ▶ Relative measurements (TDI) and for larger phase shift (electron cloud) are correct
 - ▶ We will try calibrate the module and extract the best from the data