Bunch monitor signal integration (preliminary)

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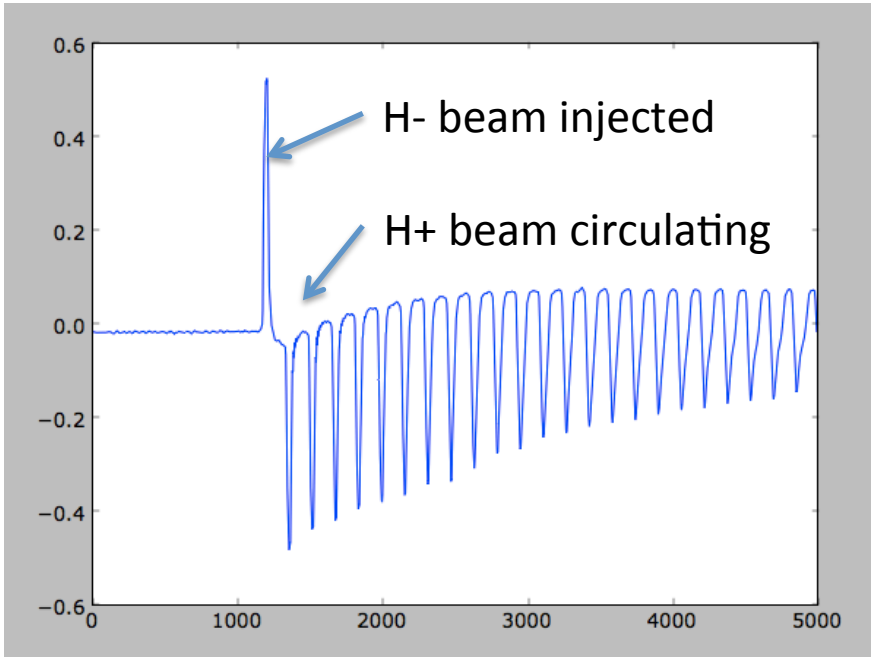
KURRI-FFAG meeting 19/12/13

Intro

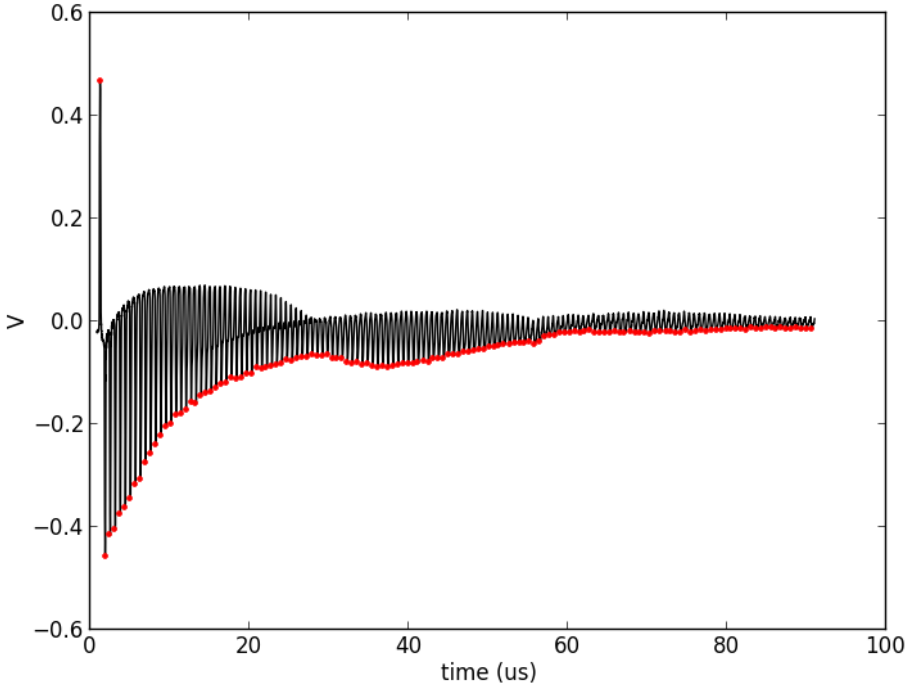
- Parallel bunch monitor (located after injection foil)
- Assume integral of each peak proportional to bunch charge.
- So far I have just looked at 2013/11/13/1/double*.csv

Figures from Suzie's presentation 13/11/13



Signal preprocessing (1)

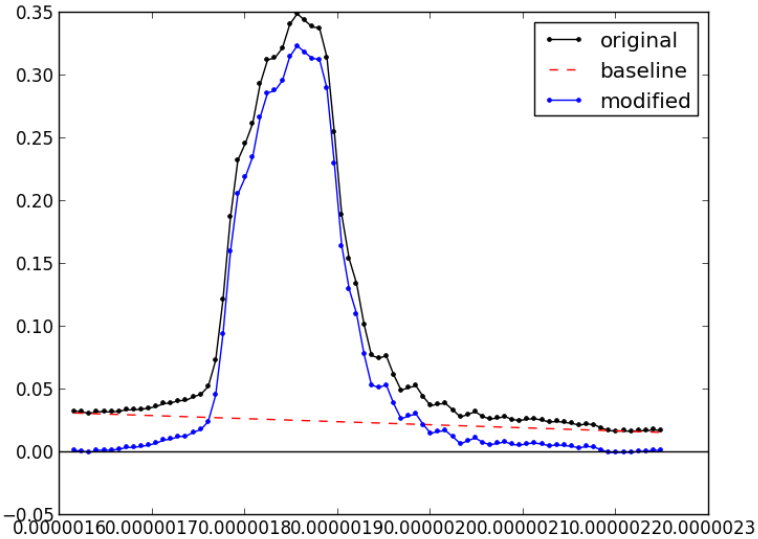
- Find set of peaks
- Example data plotted below: 2013/11/13/1/ double010.csv



Signal preprocessing (2)

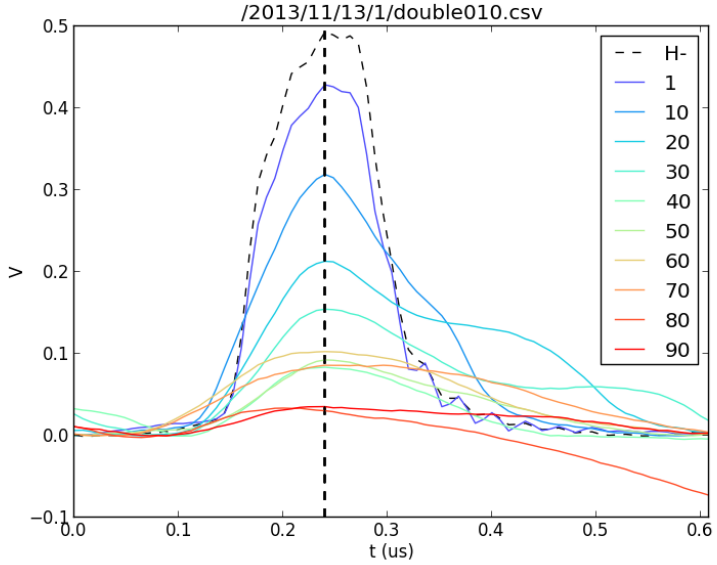
- For every peak, isolate the signal for that turn. Window used

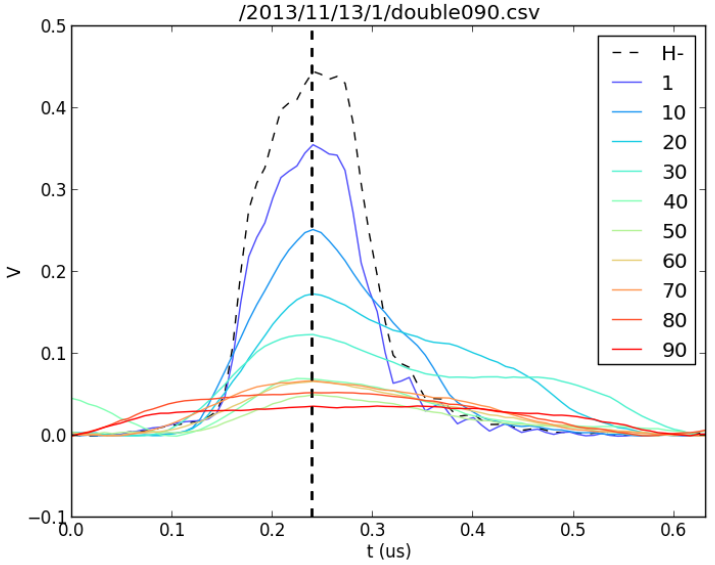
  $t_{peak} - 30ns < t < t_{peak} + 50$ ns
- Remove slow variation (slope) in signal by subtracting from each point a line that passes through the minima on both sides.
- (Flip so peaks are always positive in figures)



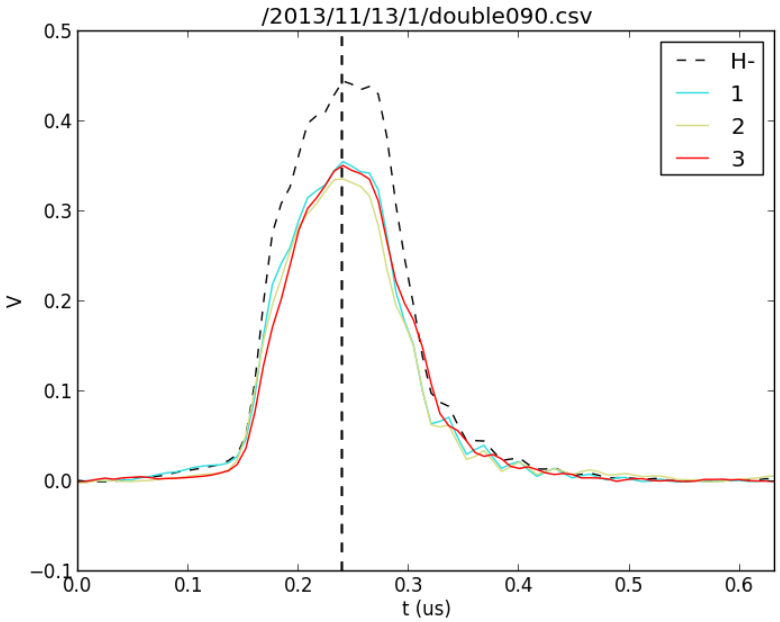
Signal evolution - overall

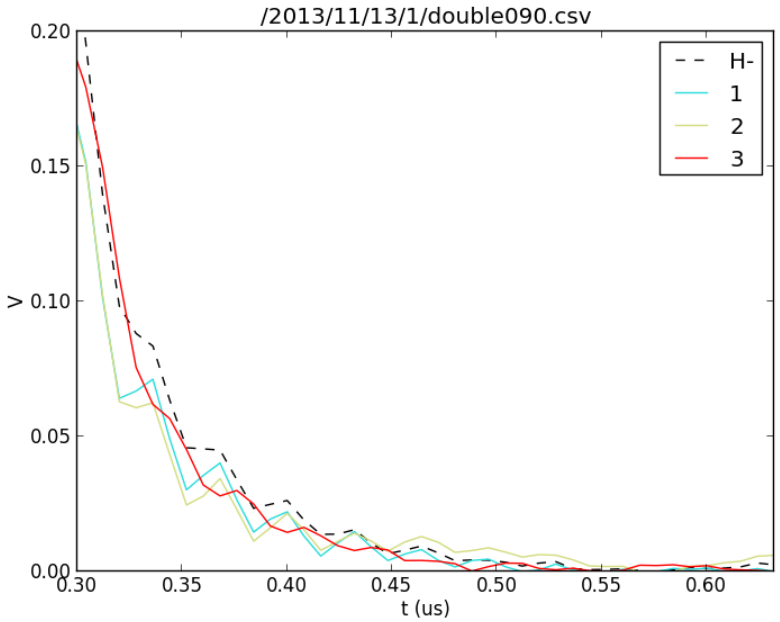
- H- peak similar shape to first proton bunch (bunch structure in first couple of turns)
- Asymmetric bunch broadening (shoulder in distribution by turn 20)
- Apparent partial recovery of signal between turns 40 - 60





First few turns





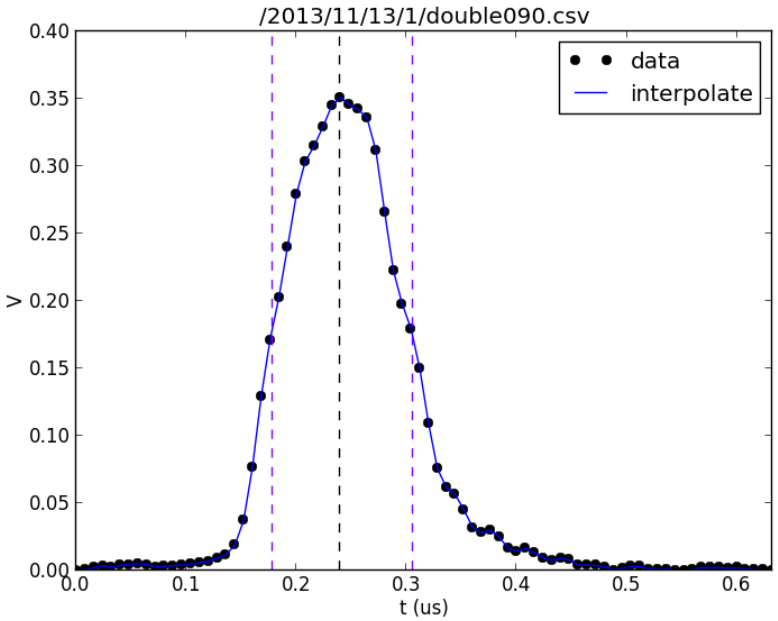
- Gap between peaks in bunch distribution is about 30 ns

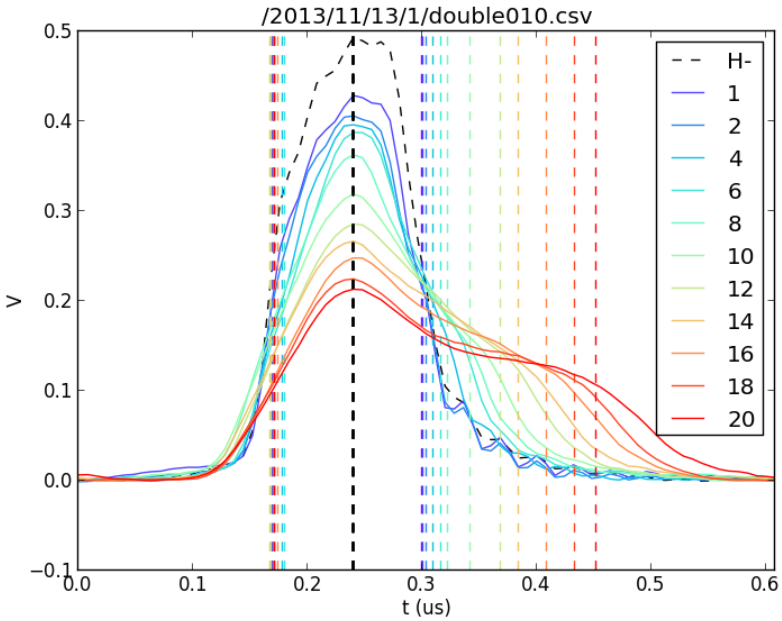
Area calculation methods.

- Linear interpolate data (f(t) from scipy.interpolate.interp1d)

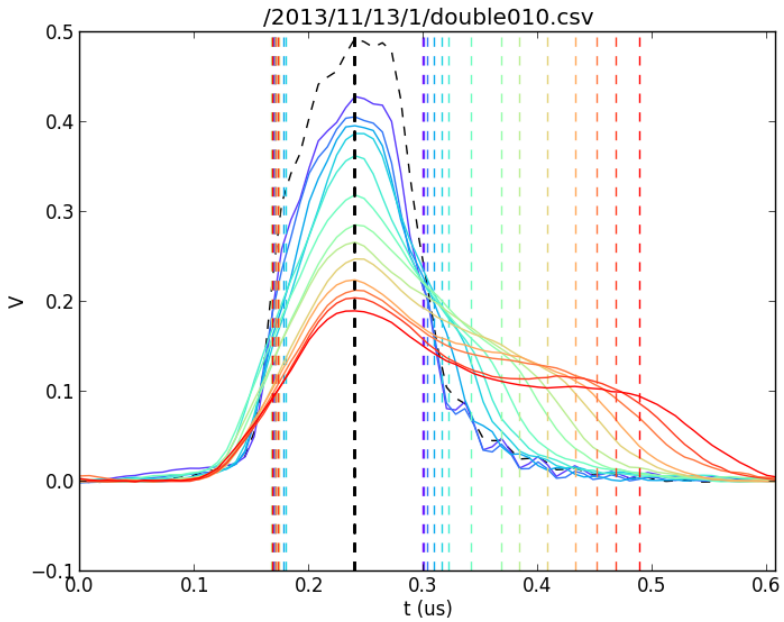
(1) Find f(t) = 0.5*V_peak. Calculate area using FWHM.

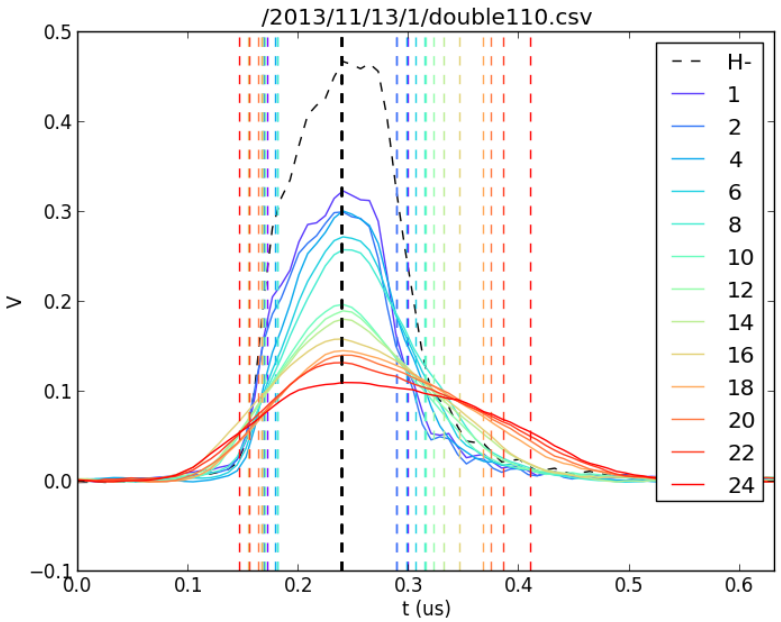
(2) Integrate f(t) by quadrature (scipy.integrate.quadrature).





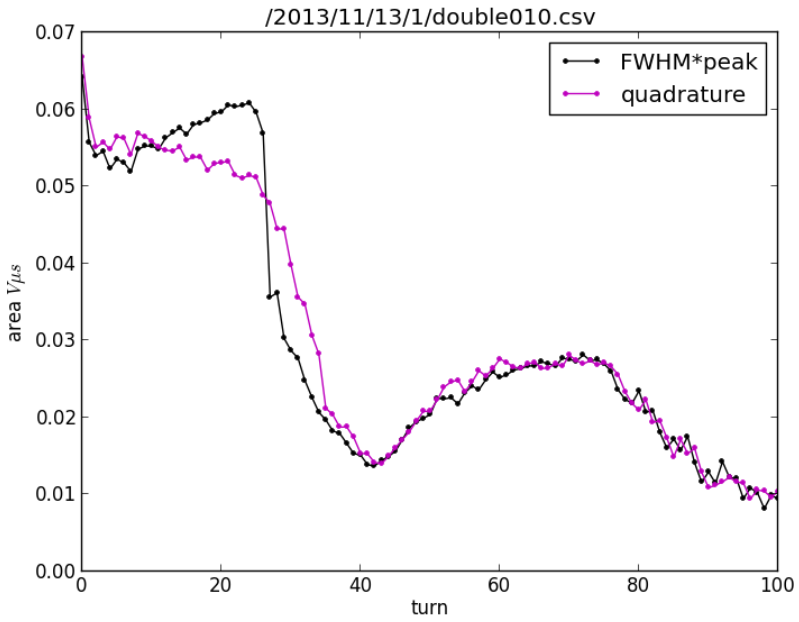
Two examples

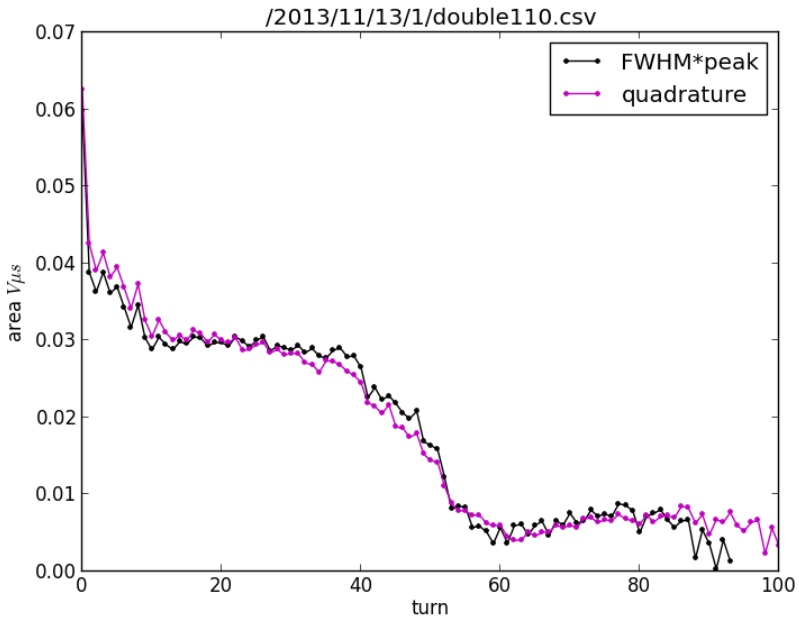




Turn-by-turn area examples

- Left figure: apparent area gain in first ~20 turns
- Right figure: Losses for first 10 turns before a plateau.

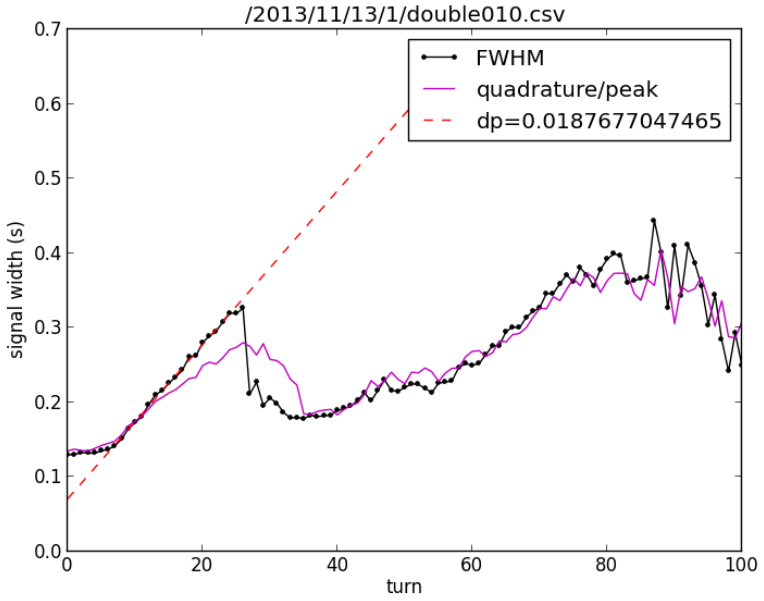


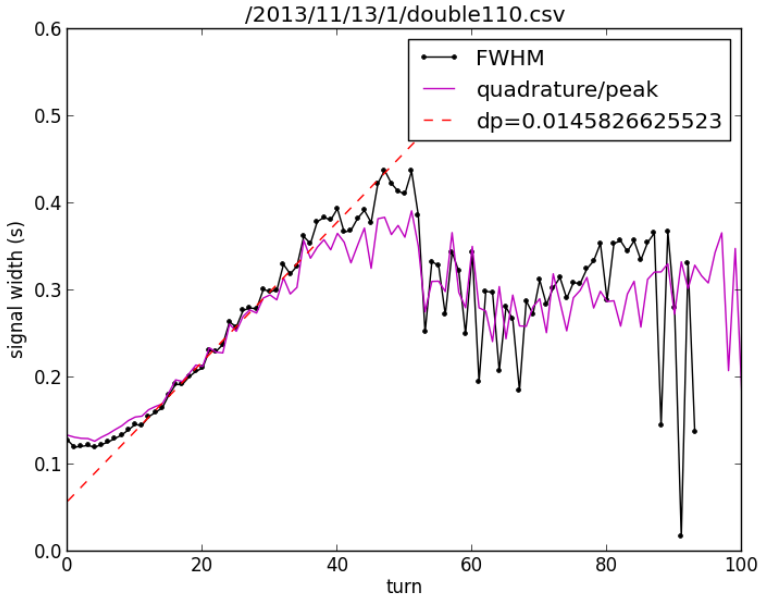


Debunch rate calculation

$$dp = \frac{slope}{\eta T_0}$$

- Fit width vs turns in linear region to obtain effective dp (here we assume dp is fixed).
- Phase slip η from Zgoubi model at injection momentum (~0.86).
- Head-meets-tail debunch time from dp calculation (left fig: 32 turns, right fig: 42 turns)





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