Orbit analysis

David Kelliher

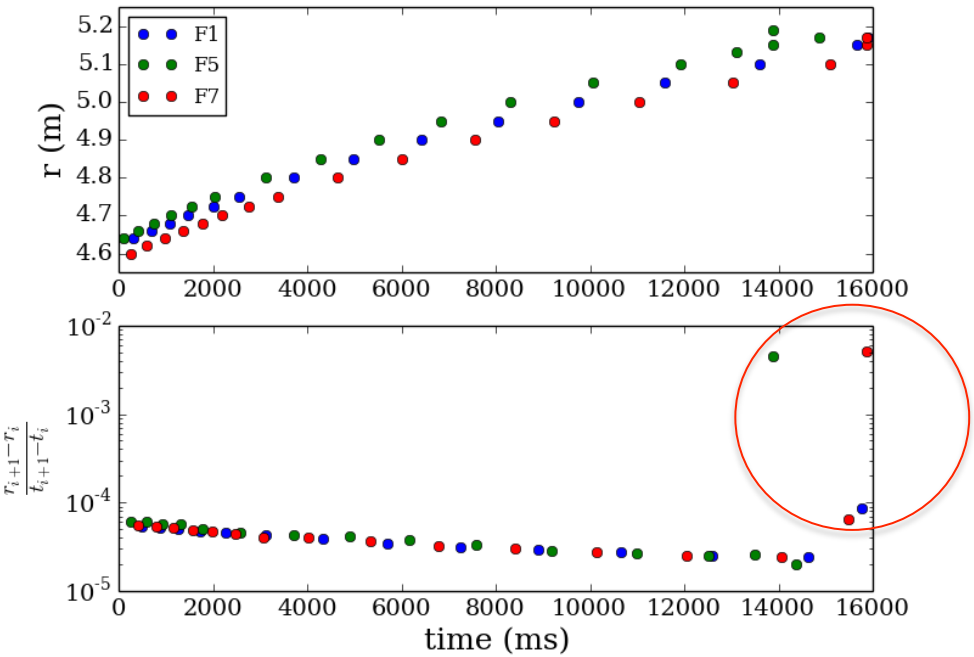
11/06/2015

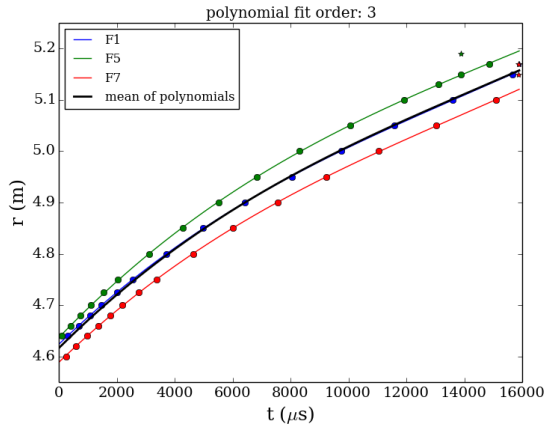
The data

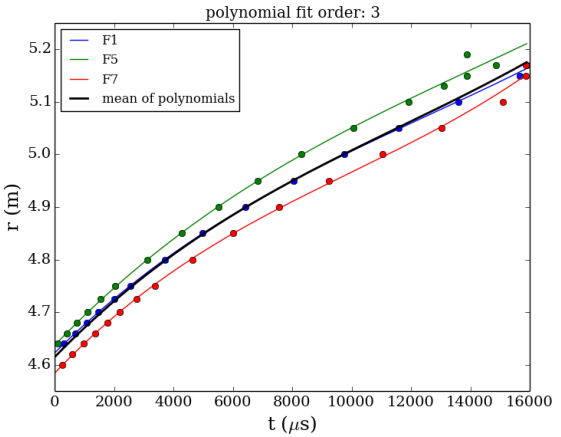
- “QinBin” data involved moving probe to a radial position and using the bunch monitor to find the time taken for the signal to be lost.
- As an estimate of noise level, measure the standard deviation of the data well after the loss time. The signal loss time is defined as the latest time point that is some multiple of σ_{noise}.
- Use data from 31/12/14 which covers the widest momentum range.

Outliers?

- Data points that introduces a large change in dr/dt will a cause rapid variation in effective k. Can we justify removing them from fit?

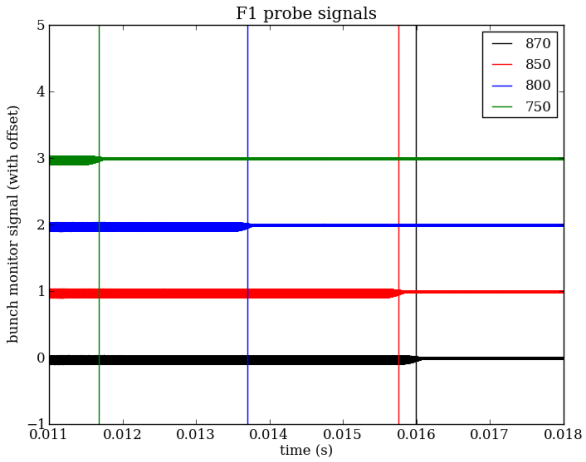


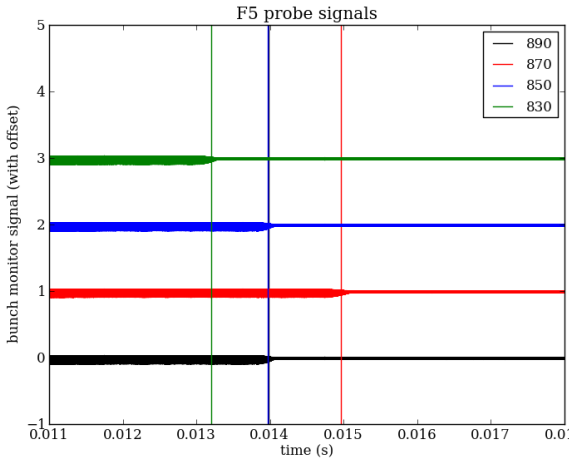


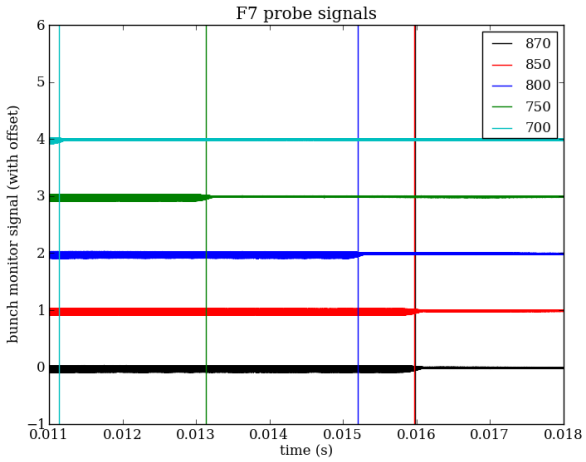


Double check the data

- Was the probe position recorded incorrectly? Is there an issue in the movement of the probe at these positions?

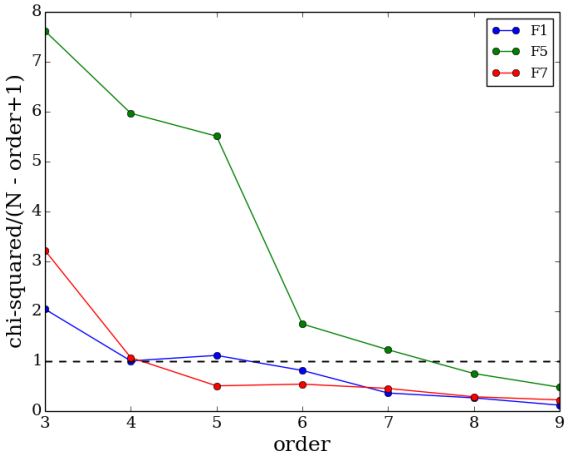


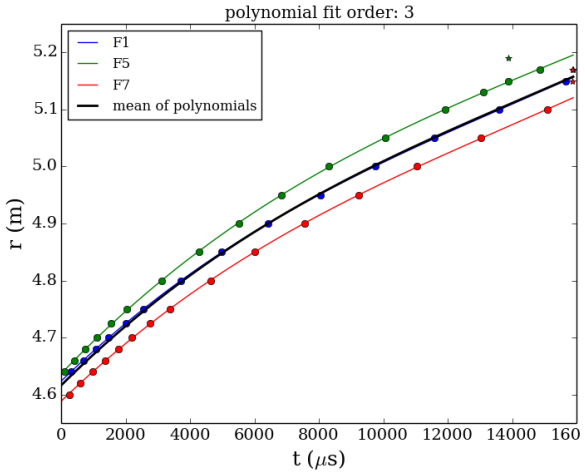


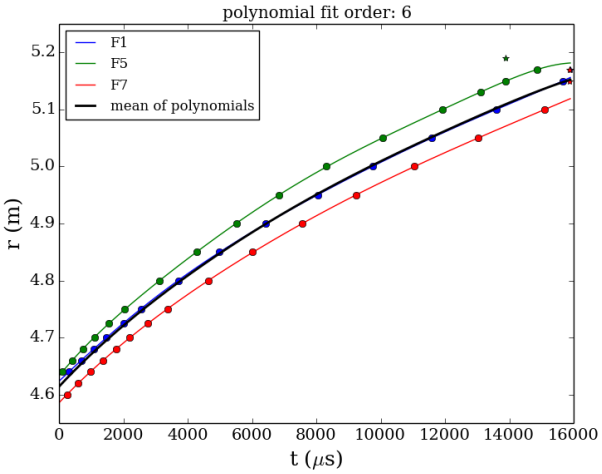


Choice of polynomial order

- Choose polynomial order based on chi-squared of fit. Assume +/- 1 mm uniform read off error of probe position. Outliers removed in this calculation.







Algorithm

- Start at t=t0 where E = 11 MeV, p = 144 MeV/c.
- For first guess at $k(t_i)$, assume γ=1.
- For rf, use polynomial function in .equ file directly.
- For R(t), dR/dt use polynomial obtained by fitting orbit data.

$$\frac{k(t)+1}{\gamma(t)^2} = \frac{1}{f(t)}\frac{df(t)}{dt} \Big/ \frac{1}{R(t)}\frac{dR(t)}{dt} + 1$$

p1

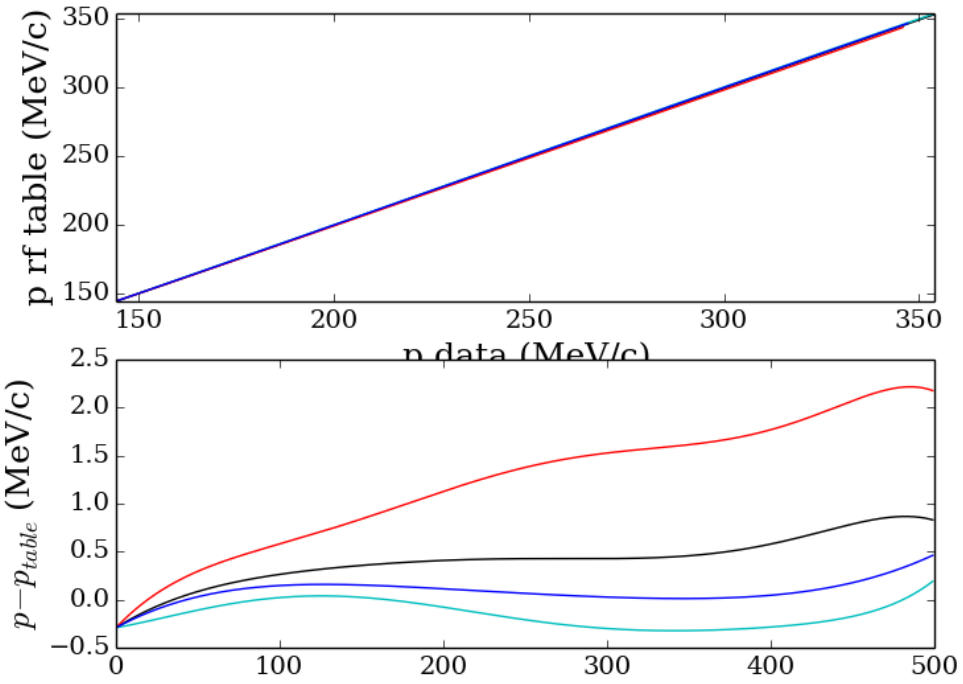
$$p(t) = p(t_0)e^{\int (k(t)+1)\frac{1}{R(t)}\frac{dR(t)}{dt}}$$

p2

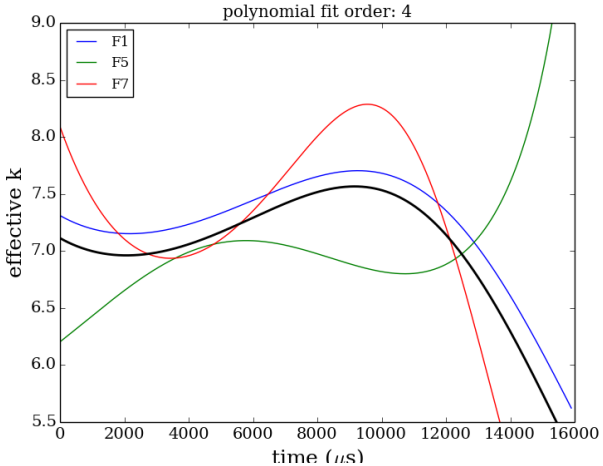
- Use Newton root finding method to find $k(t_i)$ that minimises |p1-p2|.
- Repeat for next time point using updated list of $k(t_i)$ values when calculating integral.

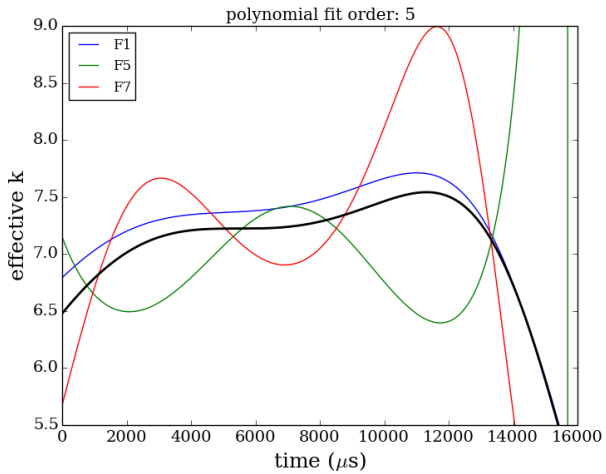
Momentum comparison

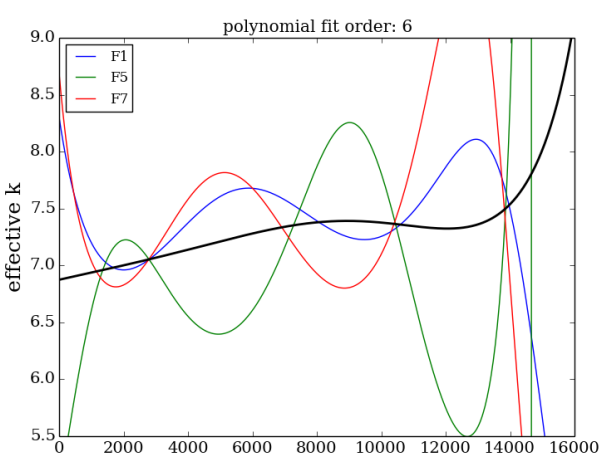
- |p1-p2| reduced practically to zero (~1e-12 MeV/c)
- Momentum agrees well with that in rf table ("SimulatedVariableK.dat").

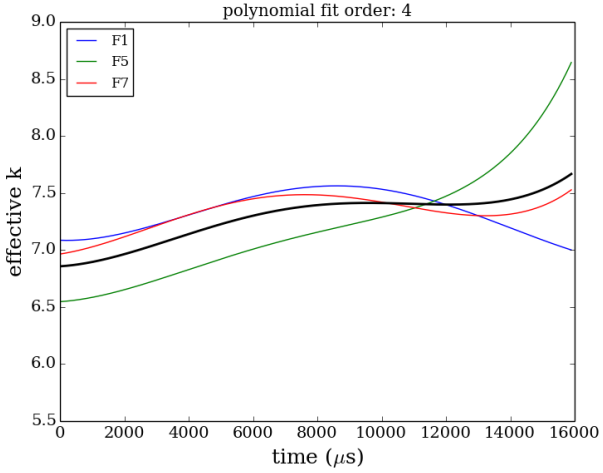


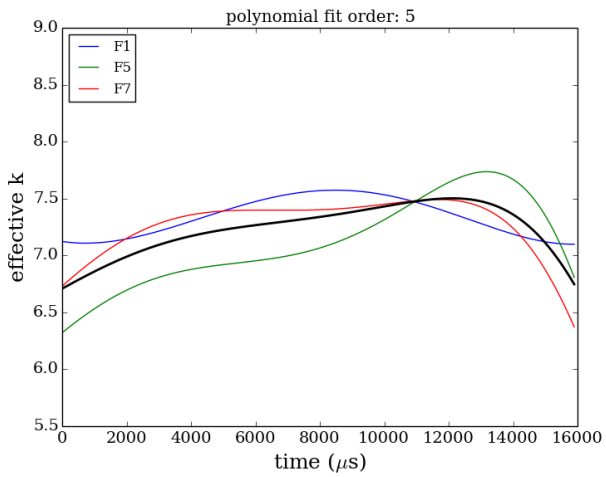
Effective k results

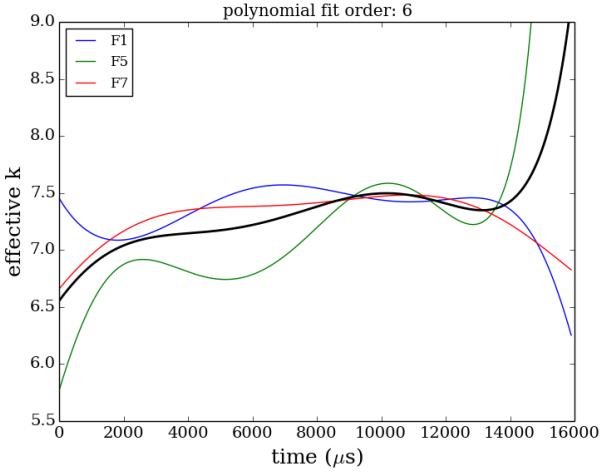












Questions

- What were the corrector settings in the case of 31/3/14?
- Why didn't we continue taking data beyond 70 MeV/c.