IDS-NF Plenary Meeting
EMMA Run 22–25 April

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Advanced Accelerator Group Meeting
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IDS-NF Plenary

- Change in baseline due to large θ_{13}
- Updates on various subsystems
- Discussion of baseline changes
- Cost review

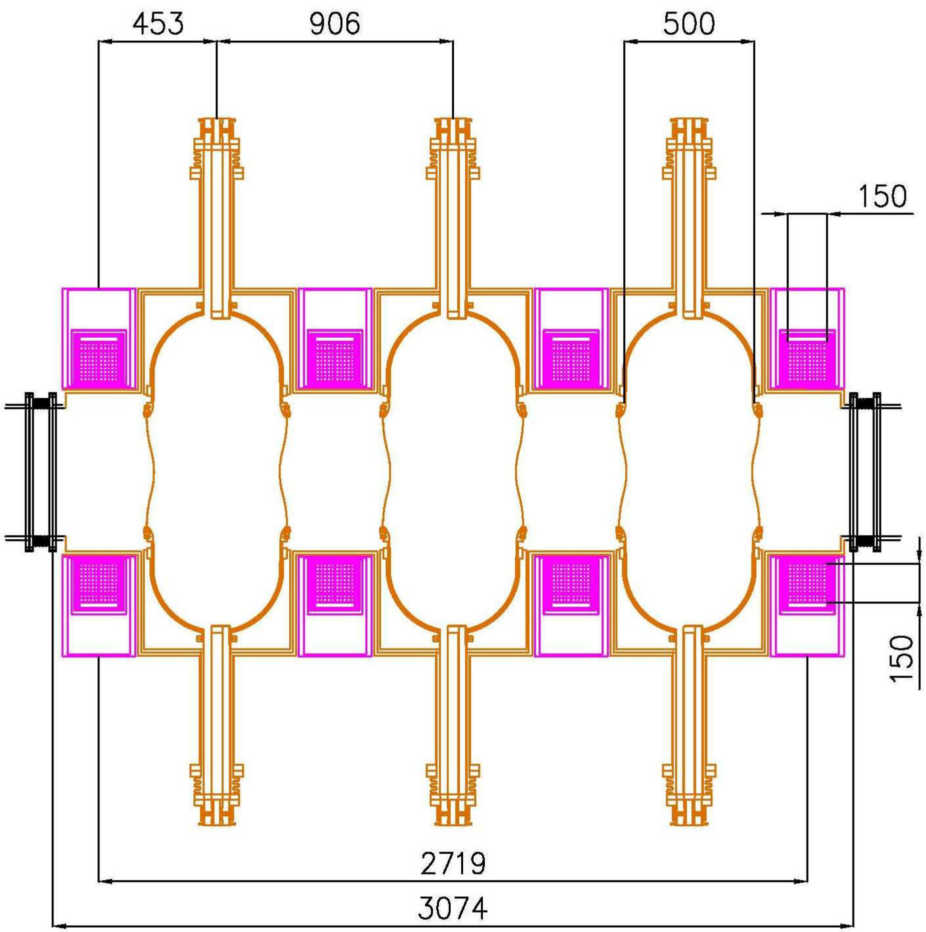
Large θ_{13}

- Daya Bay: $\sin^2 2\theta_{13} = 0.092 \pm 0.016 \pm 0.005$
- Original neutrino factory energy was 25 GeV
- Ideal muon energy about 10 GeV
  - Could go lower, but concern over detector thresholds
  - Accelerate only to 10 GeV
  - Consider RLA-only and Linac-RLA-FFAG Scenario
    - I did a first pass design: see no cost benefit
  - New decay ring

Updates on Subsystems

- Proton driver
  - Low emittance seems within reach
  - Some designs can live with fewer bunches (Fermilab)
- New target solenoid configuration
- Front end
  - Chicane in front end
    - Unclear whether a second absorber will be needed
  - Engineering couldn't fit everything in space allotted (cooling)

Updates on Subsystems



Cooling Cell Section 1

Updates on Subsystems

- Updated linac/RLA designs
- FFAG
  - Need to work on getting tracking right
  - Will publish FFAG even though it was dropped
- Decay ring
  - Have injection design, optimize timing and kicker location
  - Designing for lower energy

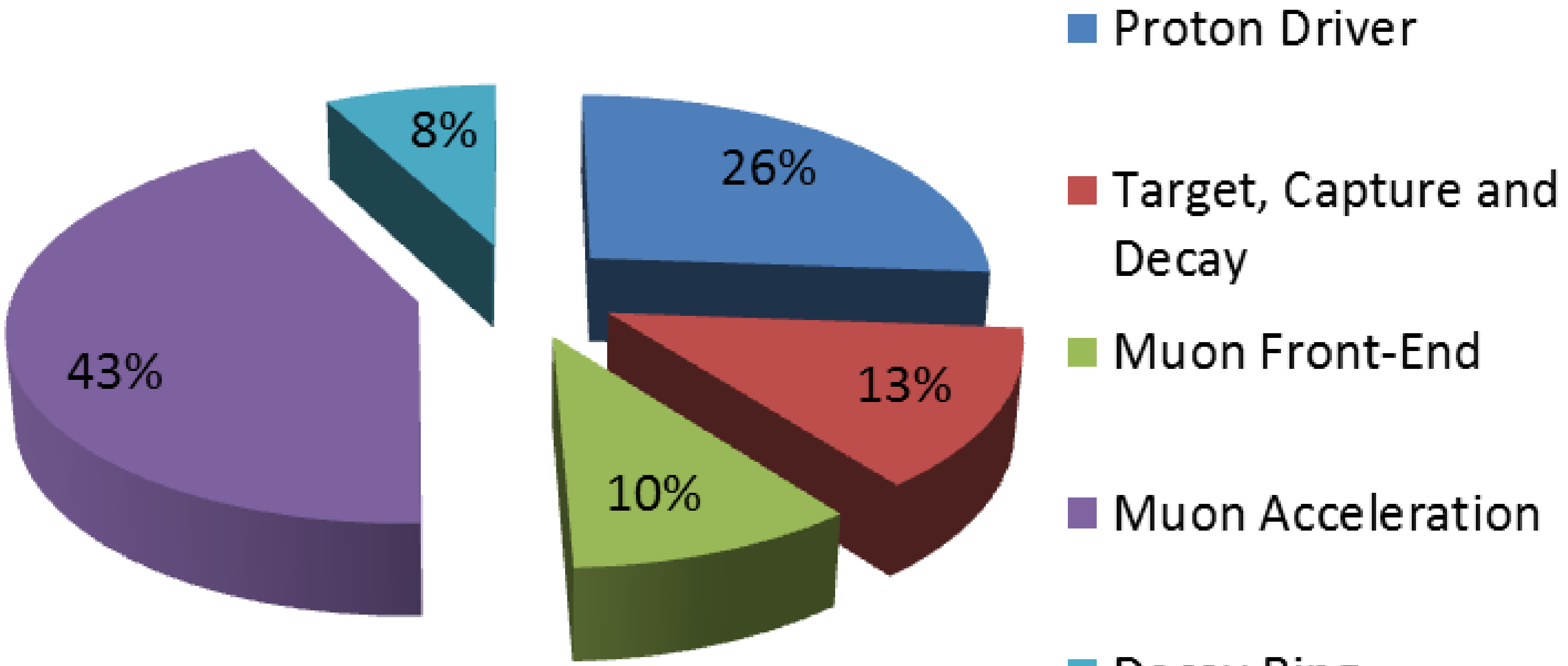
Baseline Changes

- Take a fixed point for the target solenoid config by Sep. 1
  - In paritcular, look at 15 T
- Front end
  - Look at consequences of engineering constraints
  - End June, review options for new baseline
    - Bucked coils
    - Shielded

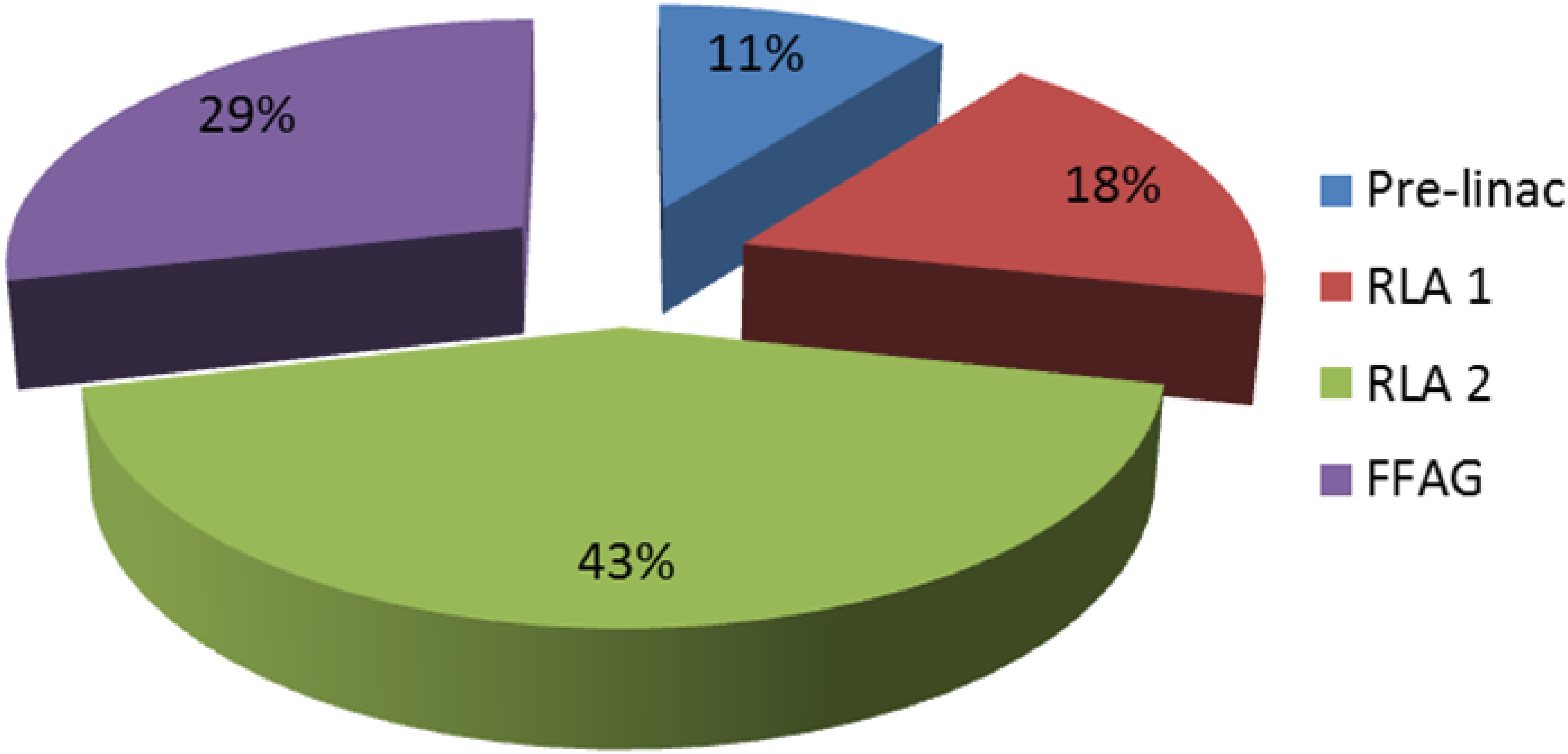
Cost Review

- Have most components for a full system cost
- Significantly more expensive than Study II!
- Key missing items
  - Not enough RF power in cooling (!)
  - Some magnets missing in RLAs

IDS-NF Cost Pie



IDS-NF Acceleration Cost Pie



- We now have EPICS readout of injection line BPMs

IDS-NF Acceleration Cost Pie

- Beam steered through magnet centers and center of BPM 4: could not find a septum setting where we observed beam at first EMMA BPM
  - Difficult to verify steering through last leg
  - Good injection with beam at +3 mm in BPM 4
  - Required mis-steering by bend and H corrector

IDS-NF Acceleration Cost Pie

- Clive Hill making drawings of septum at range extremes
- Little room to increase septum rotation angle
- Measured dispersion at YAG 1
  - Use to look for ALICE energy drift
- Problems with slit
  - Could give beam distribution, position, dispersion, etc.
  - Couldn't get any beam through
  - Problem is design: slit only goes to pipe center (almost)
  - Straightforward to extend additional 2 cm
    - Effort more of a cost issue than parts

IDS-NF Acceleration Cost Pie

- Wall current monitor
  - Two uses: trigger and measure current
    - Used for measure of injection efficiency, comparing with WCM in EMMA ring
  - Triggering problems
    - High freuqency noise generated by kicker pulses obscures signal
    - Alex mitigated by increasing signal amplitude (split off to fewer places)
    - Appears on raw IL BPM signal as well
    - One attempt to reduce noise had no effect
    - Does this affect accuracy of measured current?
      - Compare with kicker on and off

BPM Cards

- Some BPM cards fail to record data on some shots
- Attenutaion setting has some effect
- Tested one turn, almost all cards trigger
- For multiple turns, majority of cards fail to trigger
- Hope to have engineer who designed digital cards look at this during EMMA run (?)
- Make one extraction kicker available to help debug (change number of turns)

Significant Measurements This Run

- ToF and ring BPM data as a function of kicker timing (hopefully amplitude)
  - Goal: ToF as a function of transverse amplitude
- ToF and BPM data vs. displacement of one F quad on 0.1 mm steps
  - Goal: understand how best to get response matrix, and work out optimal displacement to use
  - Eventually use to get closed orbit correction
  - Will also tell us about the machine
  - Should be done for all magnets (D, F displacements, vertical correctors), several different energies
    - Important to get one right so we can take all this data quickly

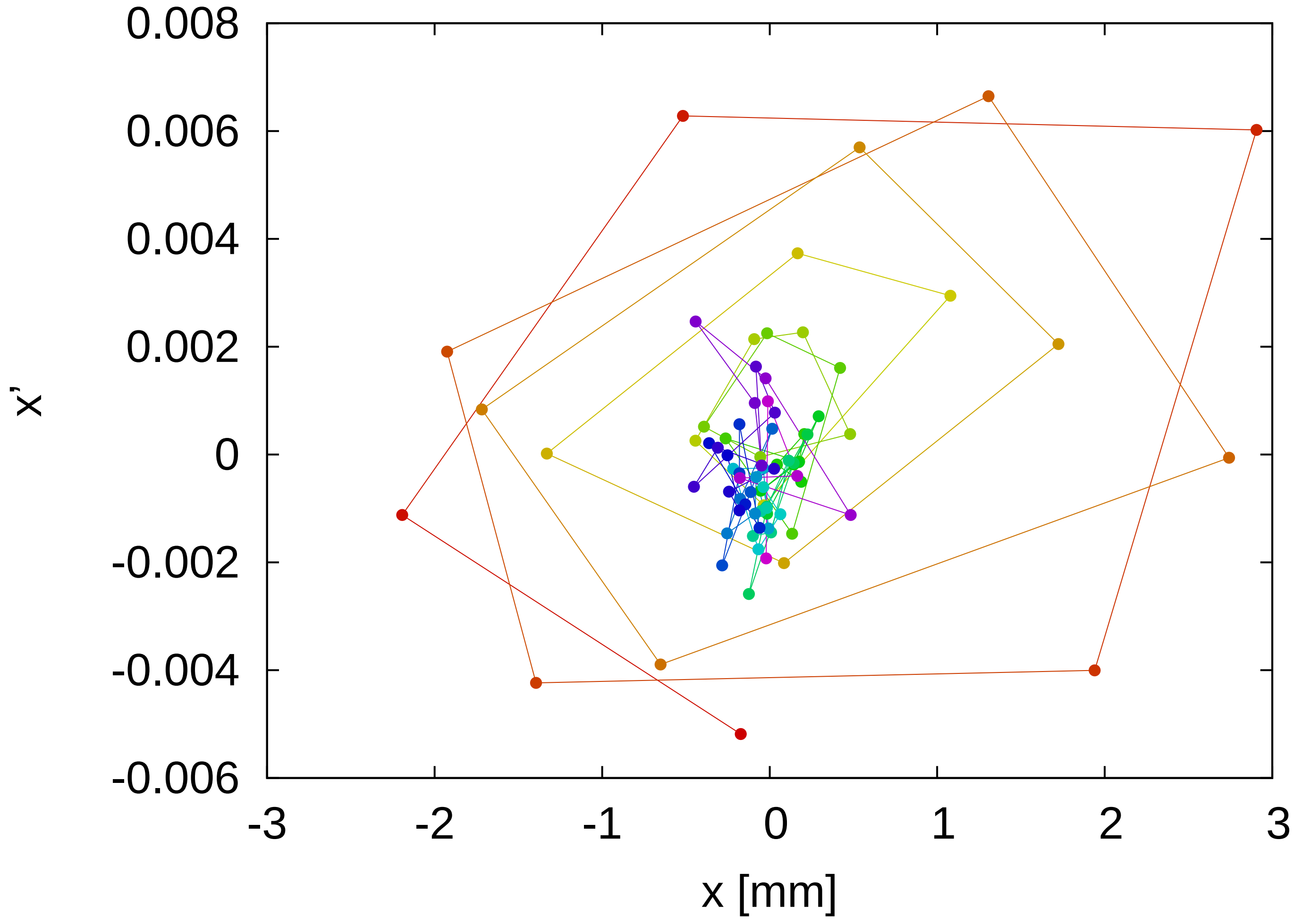
Wall Current Monitor in Ring

- Sorry, didn't finish plots, summarize in words
- Can clearly see bunch lengthening (?) in wall current monitor signal
  - Also seen in raw BPM signal, but much uglier and more difficult to identify
    - Appears to have some structure when seen in BPM signal?
- Accurate current measurements require integral of pulse
- For accurate ToF measurements, should unfold response function

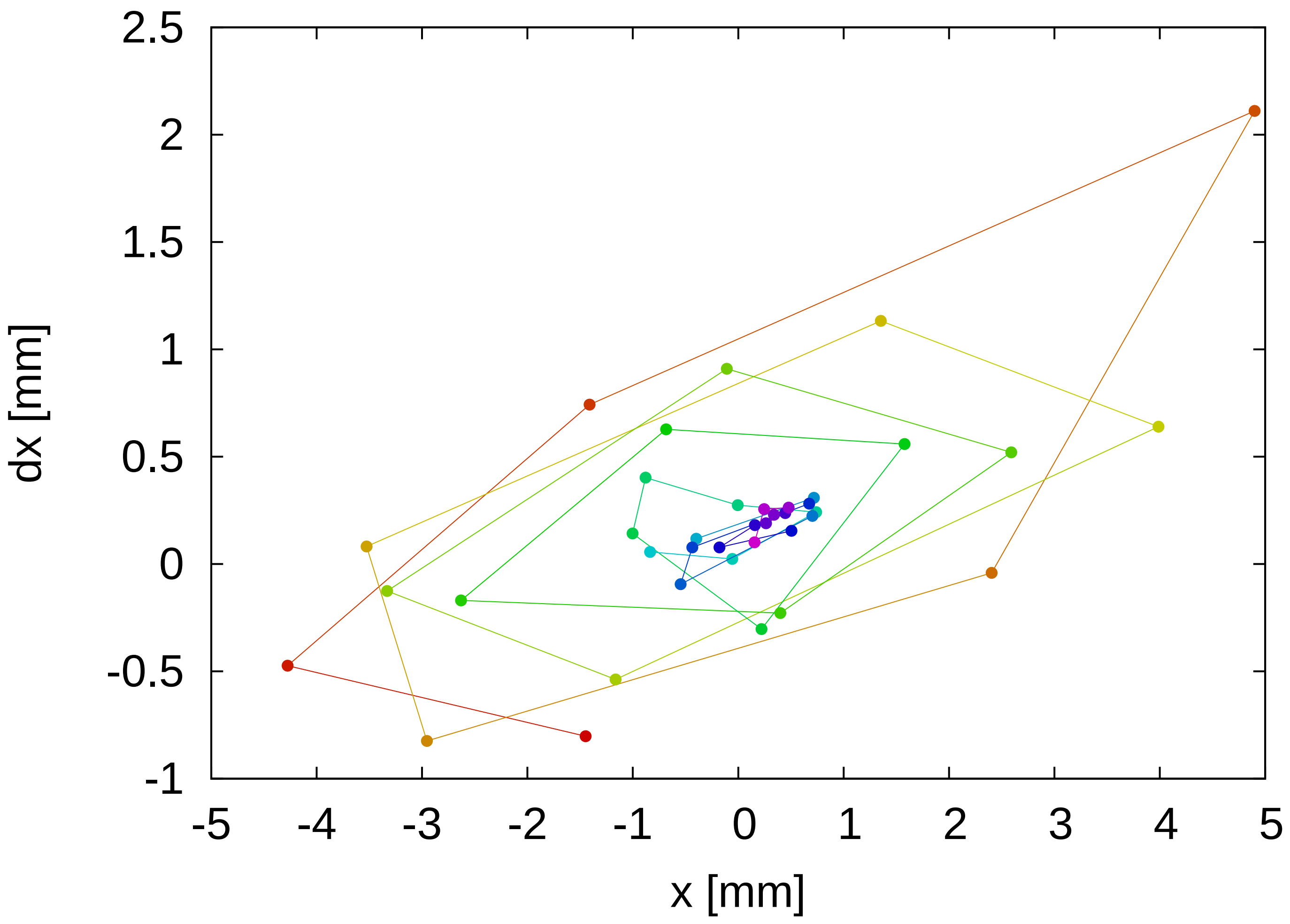
Poincare BPM Analysis (Unfinished)

- My goal: amplitude for different kicker settings
- Simplistic attempts didn't show a good correlation between amplitude and kicker setting. Try something more sophisticated.
- Plotted amplitude vs. turn number, saw large fluctuation up and down
- Goal: find common (for sets with one kicker setting) closed orbit and ellipse shape to compute amplitude
- Some bad BPM data makes this more challenging

Single Good Poincare Set



Single Outlier Poincare Set



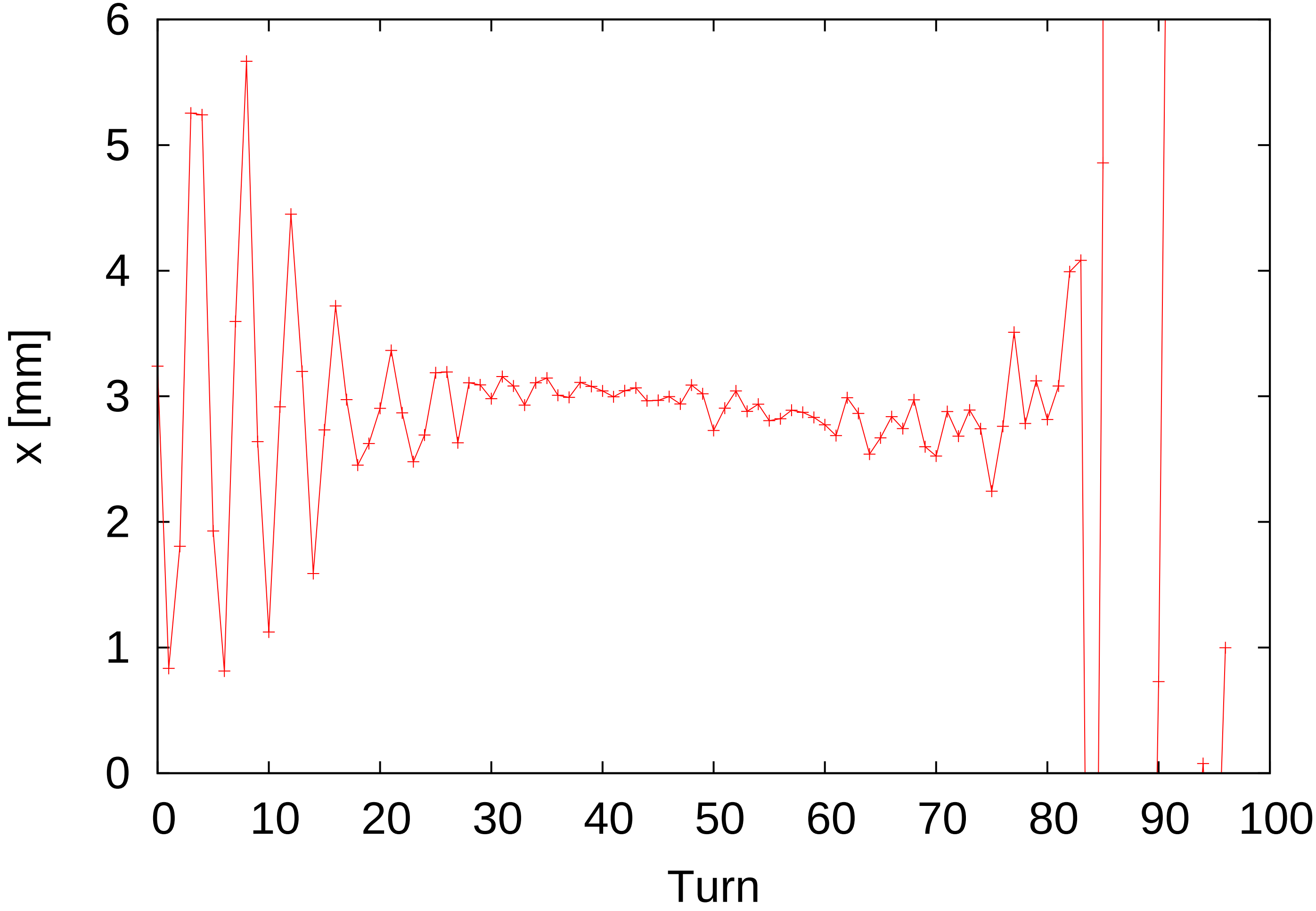
Single BPM Data

- Plot vs. turn number, three regions
  1. Betatron oscillation
  2. Decohered "closed orbit"
  3. Noise
- Closed orbit region has dependence on turn number
  - I typically linearly extrapolate this back to zero
  - Looking at Poincare data, this is clearly wrong

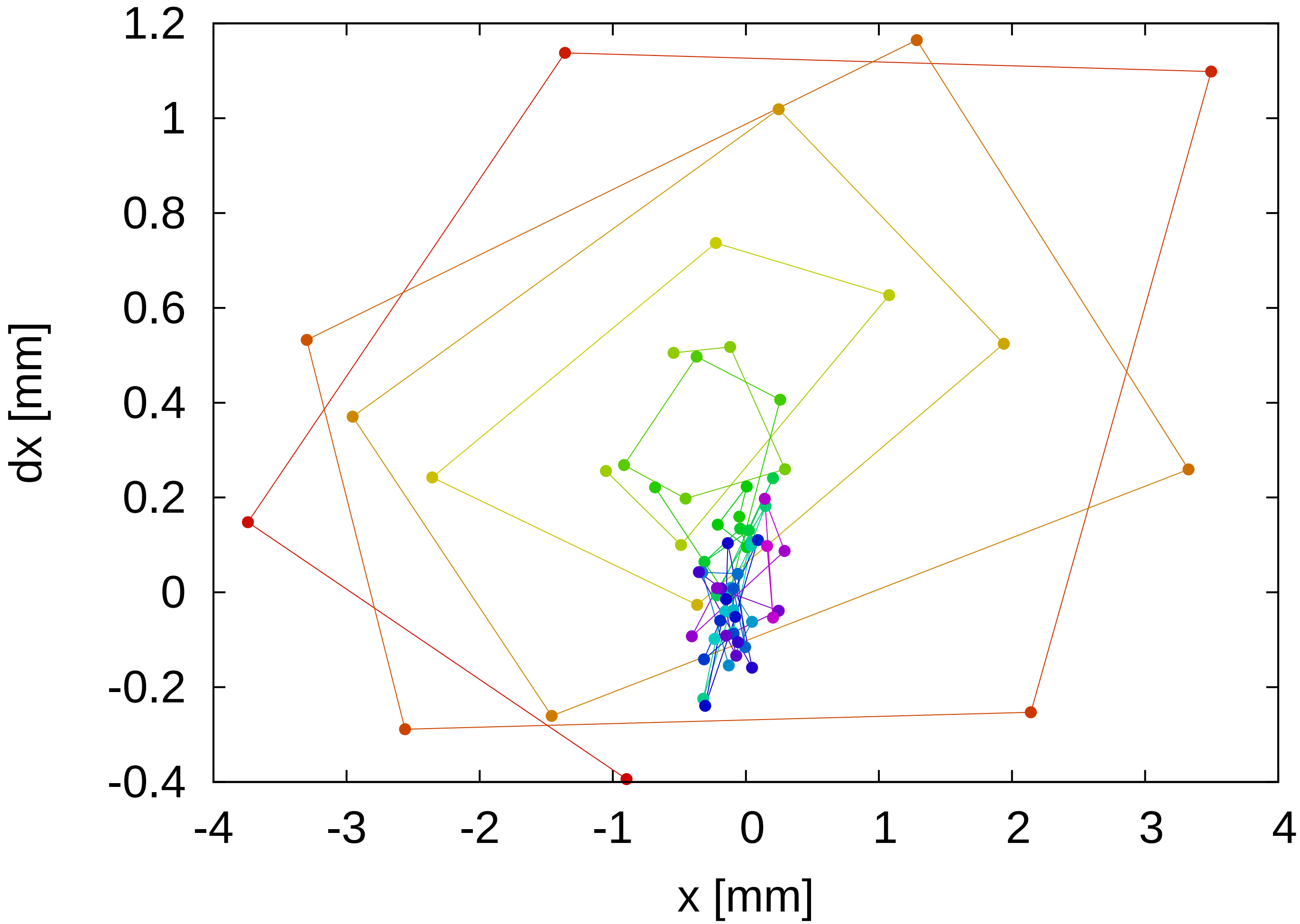
Single BPM Data

- Subsequent runs, try to detune RF cavities
  - See if beam loading is the cause
    - Look at current dependence?
  - Numerous other possible causes
    - Nonlinear BPM response
    - Selective truncation
    - Problems with the mapping (source is not a point!)

Single BPM Data



Single BPM Data



Poincare Analysis: Current Status

- For some sets, have passable amplitude vs. turn number
- Trying to make something that works for collection of sets
  - Outliers mess this up a bit
- Algorithm uses
  - Quadratic fit to close orbit
  - Fit beam ellipse
  - Goal function for amplitude that
    - Tries to be monotonically decreasing in betatron region
    - Zeros the amplitude in the closed orbit region

Poincare Analysis: Current Status