

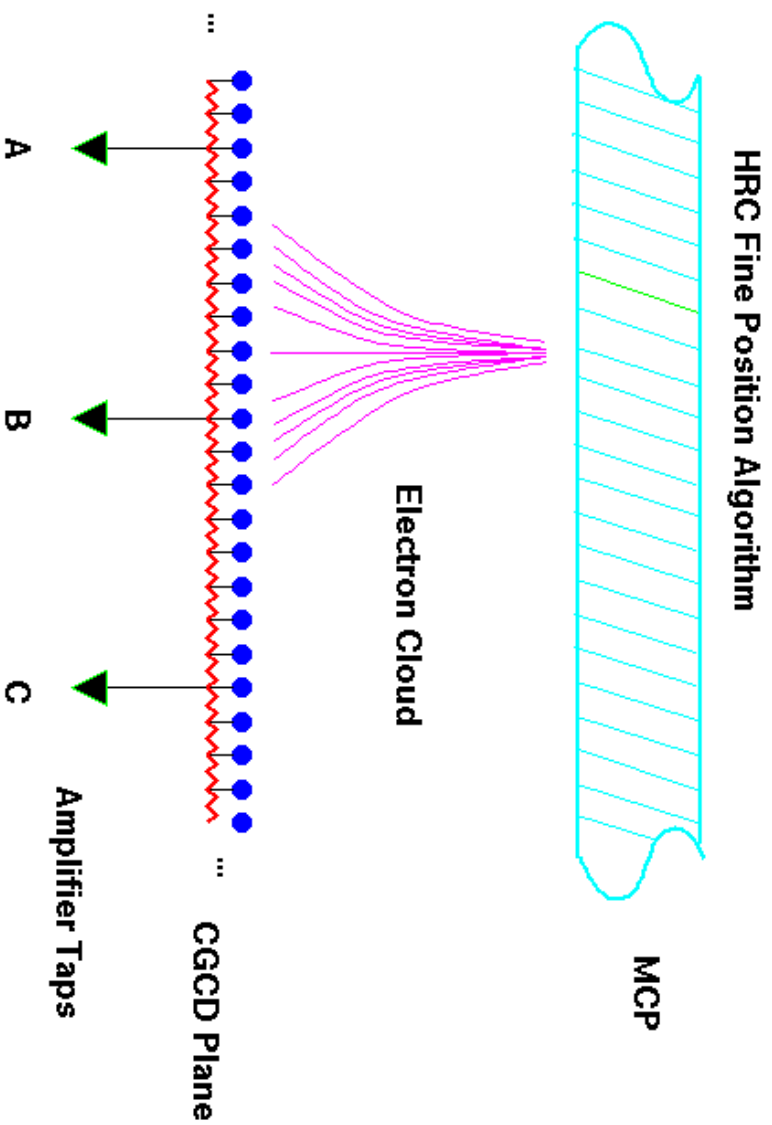
# **Amplifier Mis-match as a Possible Source of HRC Event Position Distortions**

Michael Juda

## Outline of Talk

1. Review of HRC event position determination
2. Evidence for mis-matched amplifier strings
3. Comparison to simulations
4. Future prospects

## Event Position Determination



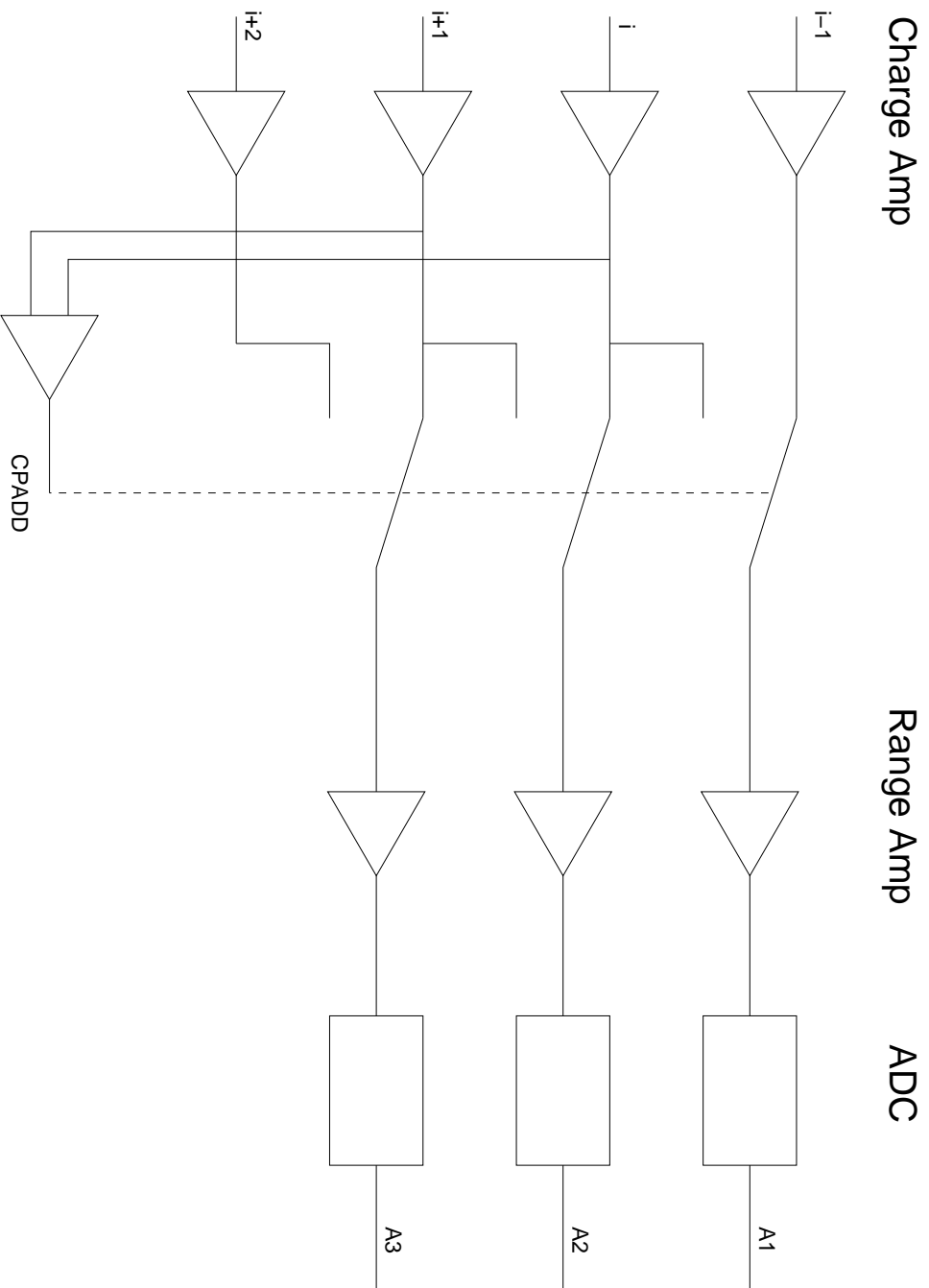
$$fp = \frac{C - A}{A + B + C}$$

Fine Position

$$\text{Degap: } a \times fp + b \times fp^2 + c \times fp^3 + d \times fp^4 + e \times fp^5$$

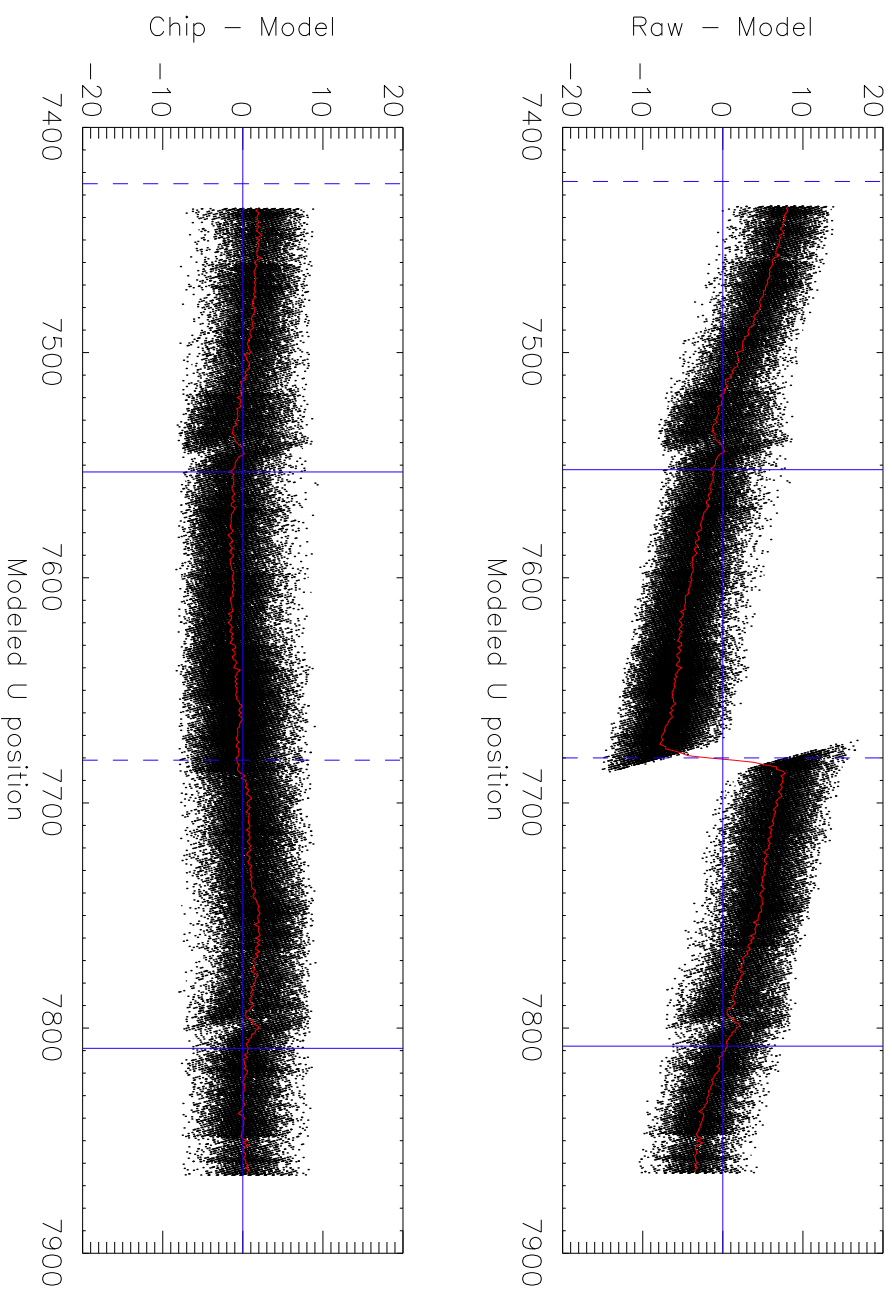
## Event Position Determination

Several “amplification” stages between CGCD and telemetered values



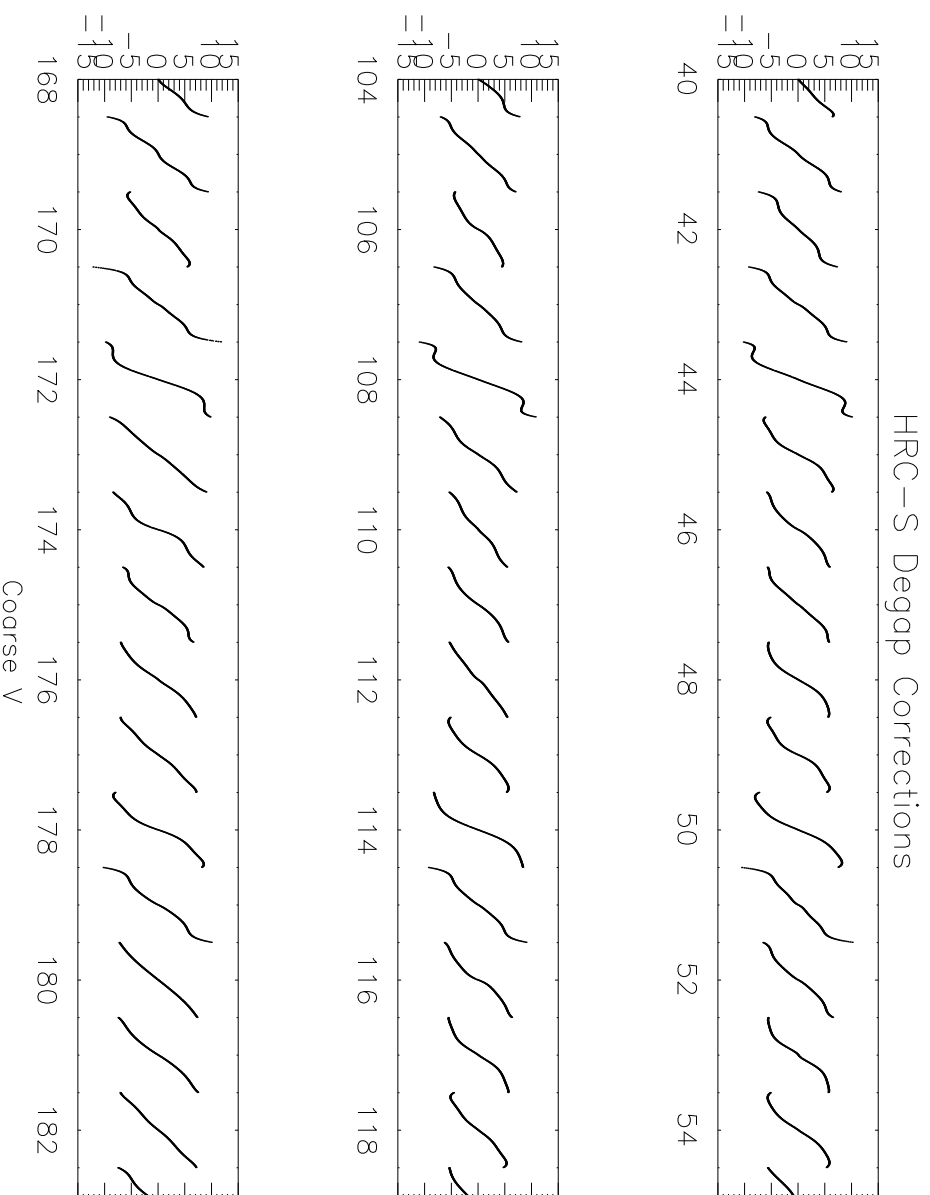
## Evidence for Mis-Match

$X_{fine} \neq 0$  for events located at the tap center



## Evidence for Mis-Match

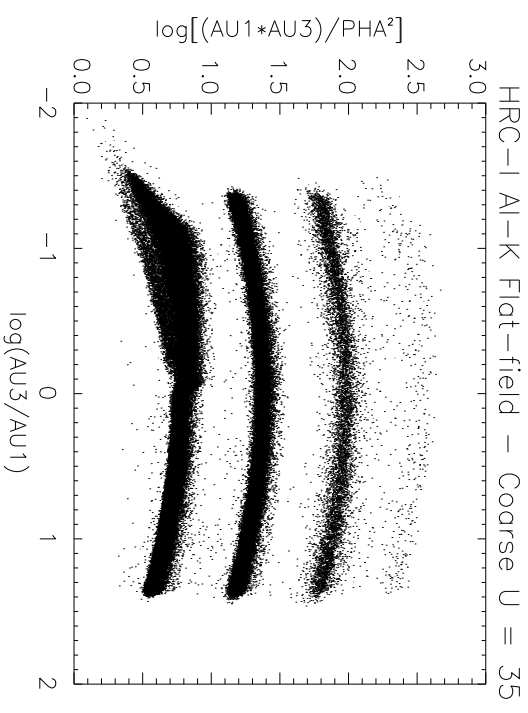
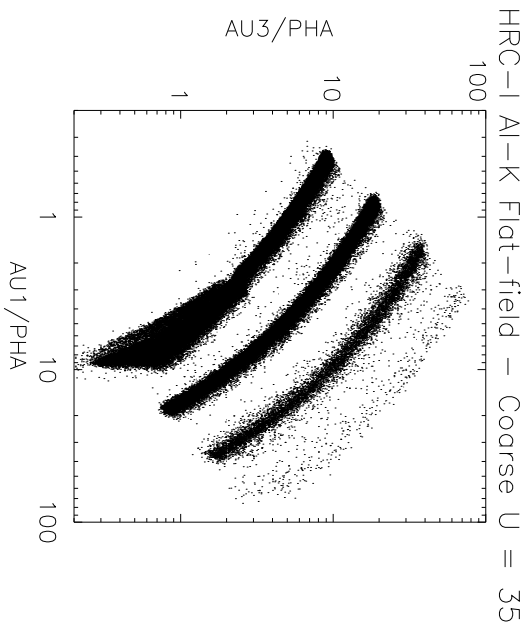
Systematic pattern in the HRC-S dispersion axis degapping corrections



## Evidence for Mis-Match

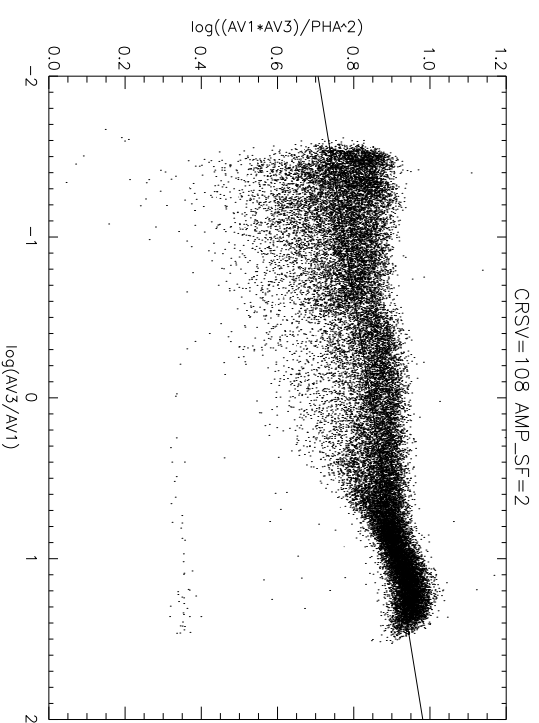
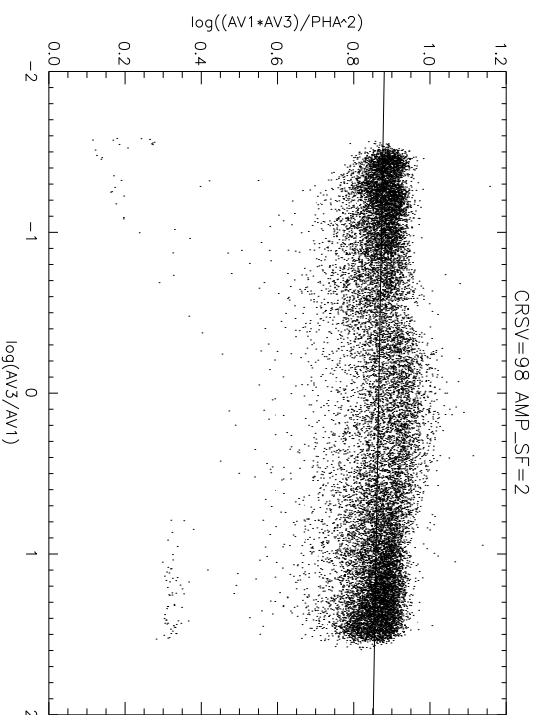
Best approach is to look at tap signals. Signal amplitudes depend on:

- Charge cloud size (PHA)
- Charge cloud shape
- Charge cloud position



## Evidence for Mis-Match

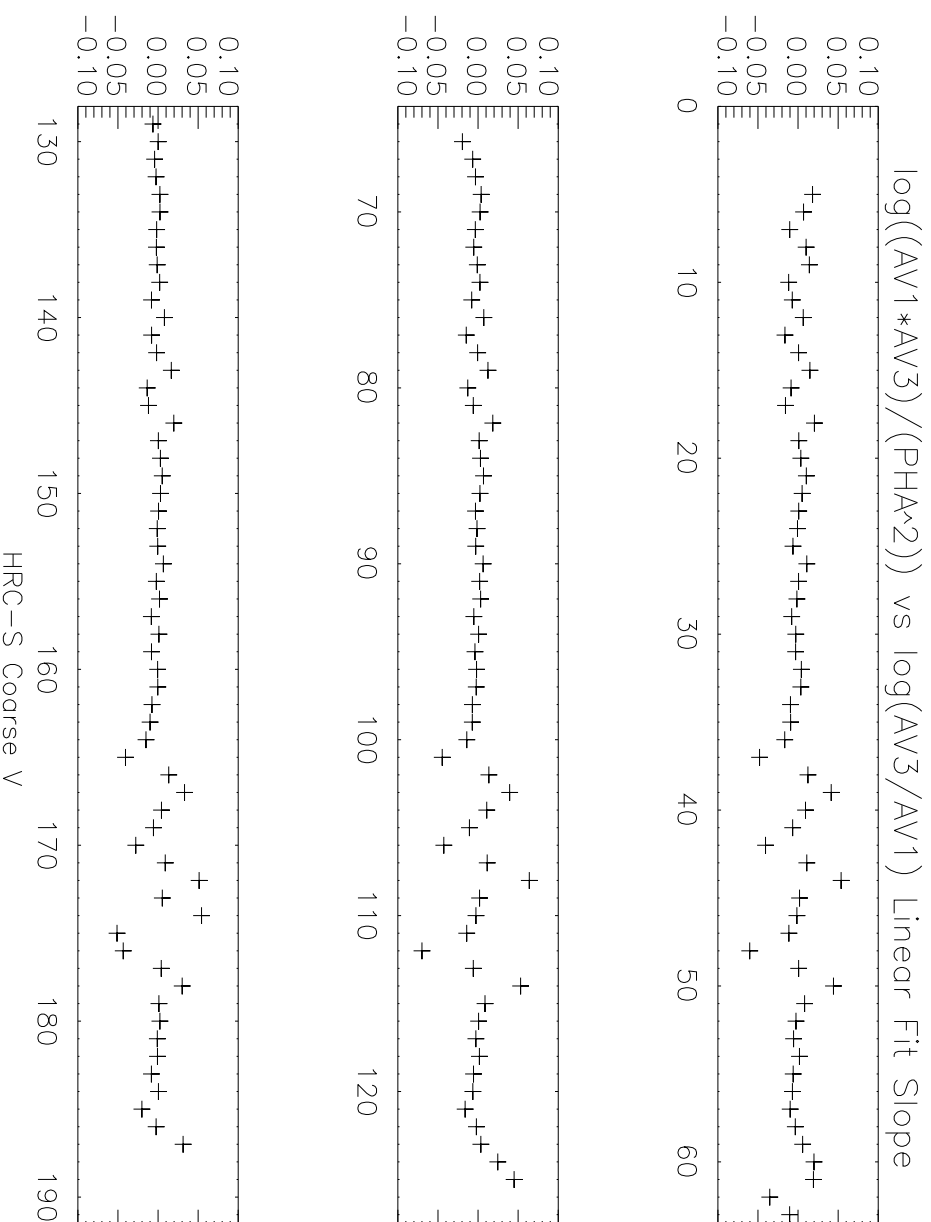
HRC-S dispersion axis shows some of the strongest evidence for mis-matches  
Asymmetry across the tap is the “smoking gun”





## Evidence for Mis-Match

Linear fits on the HRC-S dispersion axis show systematic variation in the asymmetry



## Comparison to Simulations

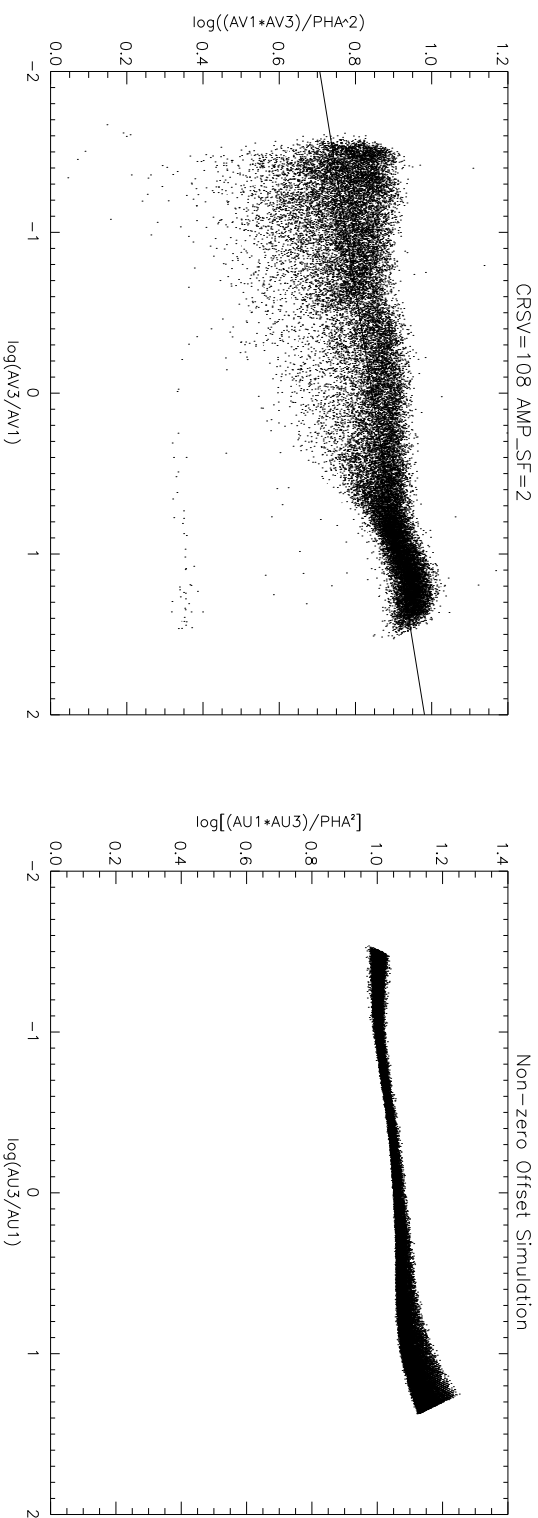
HRC event position hardware simulator

- Amount of charge parameterized with a Gaussian
- Charge spatial distributions parameterized as sum of Gaussian and Lorentzian
- Charge on individual CGCD wires calculated based on event position
- Charge at taps calculated by summing the resistive division of the wire charges
- Charge amplifier offsets and relative gains specified
- Candidate coarse position determined by coarse centering
- Final coarse position and selected tap values determined from comparison with candidate neighbor
- Tap signals scaled for range

## Comparison to Simulations

Simulations of the CGCD readout and processing electronics can be used to study effects of mis-matched gains or offsets

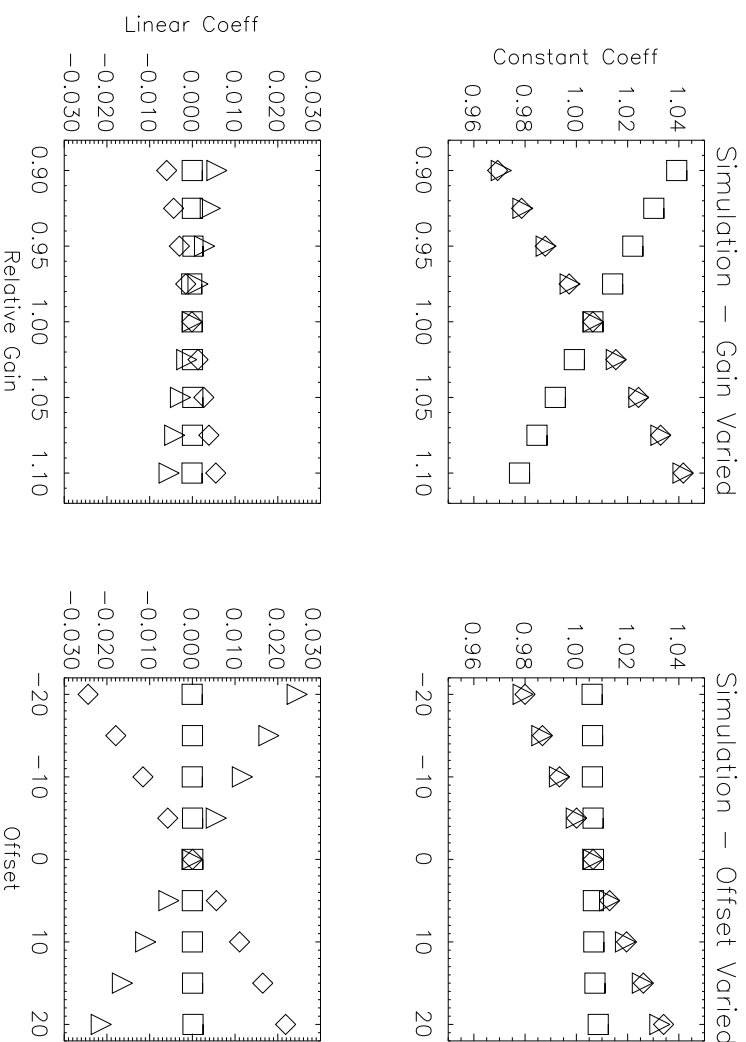
Observed HRC-S asymmetries may best be explained by non-zero offset differences



## Future Prospects

CIAO/CXCDS tool *hrc\_process\_events* has provisions for applying gain and offset corrections to the tap signals

Simulations can be used to characterize the effect of gains and offsets on tap signals



Lab tests with Flight-backup focal-plane and flight-like electronics will help to guide simulations and analysis of Flight-instrument data