A Method to Measure Droop from Flight Data

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Below is a simple method to estimate the “amount of droop” in the Si:As 24μm array on a pixel-by-pixel basis from acquired science data. First, to remind people what “droop” is: Droop is an un-usual observation where the counts (or readout) in one pixel is affected by counts in all other pixels on the array.

A simple model is to parameterise the measured counts \( DN_{m,i} \) in a single pixel \( i \) as:

\[
DN_{m,i} = DN_{t,i} + D_i, \tag{1}
\]

where \( DN_{t,i} \) are the “true, droopless” counts, and \( D_i \) is the additional factor (in \( DN \)) due to droop. Since the droop appears to be proportional to the total measured counts in all other pixels \( j \) on the array, I have parameterised the droop factor as follows:

\[
D_i = \beta \sum_{j \neq i}^N DN_{m,j}, \tag{2}
\]

where \( \beta \) is the constant of proportionality (NOT the formal droop coefficient), and \( N = 128 \times 128 \) pixels.

One immediately sees that equations (1) and (2) when combined, form an equation for a straight line with slope \( \beta \) and intercept \( DN_{t,i} \). The aim is to use an observing strategy that dithers around an extended source such as a galaxy in order to sample a large dynamic range in the total flux \( \sum_{j \neq i}^N DN_{m,j} \) falling on the array. One must also ensure that a portion of the pixels in the array don’t contain any flux from the source. In other words, one wants the measured counts in pixel \( i \) \( (DN_{m,i}) \) to be due to the true counts \( (DN_{t,i} \text{ - primarily only background and dark current}) \) and the “droop effect”.

With measures of \( DN_{m,i} \) and \( (\sum_{j \neq i}^N DN_{m,j}) \), one can fit for \( \beta \) and \( DN_{t,i} \) to determine the droop factor (eq. 2). For robustness, one can take the median of values for \( DN_{m,i} \) amongst the different dithers. This is to account for any spurious point sources that fall in that pixel. This process can be repeated for a large number of pixels (which of course, must all avoid contamination from the extended source).

\[\sum_{j \neq i}^N DN_{m,j} \]

Figure 1: Schematic for measuring droop