FORCAST Imaging Exposure Time

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FORCAST imaging data obtained during SOFIA observing cycles 1 and 2 have various integration times listed in the FITS header and deducing the on-source integration time from these FITS header cards can be confusing. This document outlines a simple way for an observer to figure out the total on-source integration time for a FORCAST imaging observation.

As with all mid-IR observations, FORCAST uses chops and nods to subtract the background emissions due to the sky, telescope, and instrument. Each FORCAST observation is stored in FITS format and contains four planes, corresponding to two nod positions and two chop positions per nod position. The keyword DETITIME in the FORCAST imaging FITS header is defined as integration time per nod position excluding the move and settle time.

Depending of the observing mode[†] we calculate the on-source integration time for LEVEL 2 or 3 pipeline processed merged file (*MRG*.fits) as follows:

For **C2N mode** where the source appears on all the planes of the input data the on-source integration time, t_{int}, is given by:

$$t_{int} = 4 \times \frac{DETITIME}{2}$$

$$= 2 \times DETITIME$$

where, the factor 4 accounts for the four image planes in the input data and DETITIME/2 is the integration time per plane of the input data.

For **C2N mode with large chop**[‡] the source appears on two planes of the input data and we get:

$$t_{int} = 2 \times \frac{DETITIME}{2}$$

$$= DETITIME$$

[†] For a detailed description of FORCAST observing mode refer to
http://www.sofia.usra.edu/Science/instruments/FORCAST_observations_modes.pdf
[‡] Chop amplitude $\gtrsim$ 180 arcsec.

Finally, in **C2NC2 mode** both the chop and nod are large, therefore the source appears on just one frame and hence:

$$t_{int} = \frac{DETITIME}{2}$$

If the pipeline processed products for the observation include a co-added (*COA*.fits) file then one needs to account for the number of input files, n, that goes into the co-added file. We can calculate n by counting the FITS header keywords PARENT3, PARENT4, etc.[§], which list the unique observation ids of the input files that are used to create a co-added image. Therefore, for a co-added file, the total on-source integration time, T_{int}, is given by:

$$T_{int} = n \times t_{int}$$

$$= n \times 2 \times DETITIME \qquad \textbf{C2N mode}$$

$$= n \times DETITIME \qquad \begin{array}{c}\textbf{C2N mode}\\\textbf{with large chop}\end{array}$$

$$= n \times \frac{DETITIME}{2} \qquad \textbf{C2NC2 mode}$$

[§] NOTE: Keywords PARENT1 and PARENT2 are reserved for input calibration file and should not be counted as number of input observations.