Simulated Datasets for the "Wide" Field of View Shaped Pupil Coronagraph

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Roman Coronagraph Instrument Information Sessions

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Available Tools

- PROPER (John Krist)
  - An optical propagation library available at http://proper-library.sourceforge.net
- Roman Phase C PROPER Prescription (John Krist)
  - PROPER model for the final CGI layout and coronagraph masks
  - Available at https://sourceforge.net/projects/cgisim/files/
- CGI Sim (John Krist)
  - Wrapper code for the Roman Phase C PROPER Prescription that defines many of the necessary parameters and generates an image
  - Most of the setup happens in cgisim.rcgisim.py, which is called by a wrapper function that contains the list of parameters
  - Includes examples
  - Available at https://sourceforge.net/projects/cgisim/files/
- EMCCD Detect (Bijan Nemati and Sam Miller)
  - Detector model that can be used for adding detector noise
  - Available at https://sourceforge.net/projects/cgisim/files/

Implementing a Time Series Simulation

- Overall process is to write a wrapper function that defines all of the parameters, then iteratively calls cgisim.rcgisim.py for each time step. (This process is not optimized for speed.)
- This wrapper function:
  - Specifies which coronagraph mode, coronagraph type, and bandpass to use
    (cgi_mode = 'excam', cor_type = 'spc-wide', bandpass = '4')
  - Specifies which polarization states are used
    (polaxis = 10 is the most realistic option, generating four incoherent images that are combined to form the final image)
  - Specifies the spectral type (star_spectrum) and V magnitude (star_vmag) of the star for each time step.
    The "star" column of the os9_info_cycle.txt files (available via* https://roman.ipac.caltech.edu/sims/Coronagraph_public_images.html*) identifies reference star observations with 0 and target star observations with 1.*
  - Specifies the deformable mirror pistons, dm1 and dm2,
    ('use_dm1':1, 'dm1_m':dm1, 'use_dm2':1, 'dm2_m':dm2),
    with DM drift implemented as

$$DM_{new}\left[x,y\right]=DM_{old}\left[x,y\right]\left(1+0.026\Delta_{temp,K}\right).$$

There are four DM solutions provided in the "examples" folder of Roman Phase C PROPER that can be used to generate the initial dark hole.

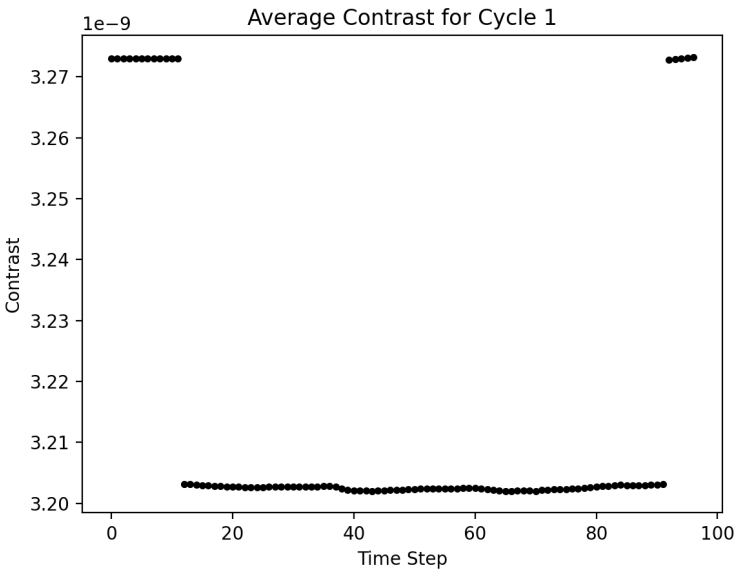
Implementing a Time Series Simulation

- The wrapper function also specifies which errors are included:
  - Optic fabrication and alignment errors
    ('use_errors' : 1)
  - Wavefront error changes from thermal drift
    ('zindex':np.arange(4,38), 'zval_m' *set to the values in columns 1-34 of the appropriate row of os9_inputs.txt, with the column numbers starting at 0*)
  - Pupil shear
    ('cgi_x_shift_m' and 'cgi_y_shift_m' *set to the values in columns 35 and 36, respectively, with the column numbers starting at 0)*

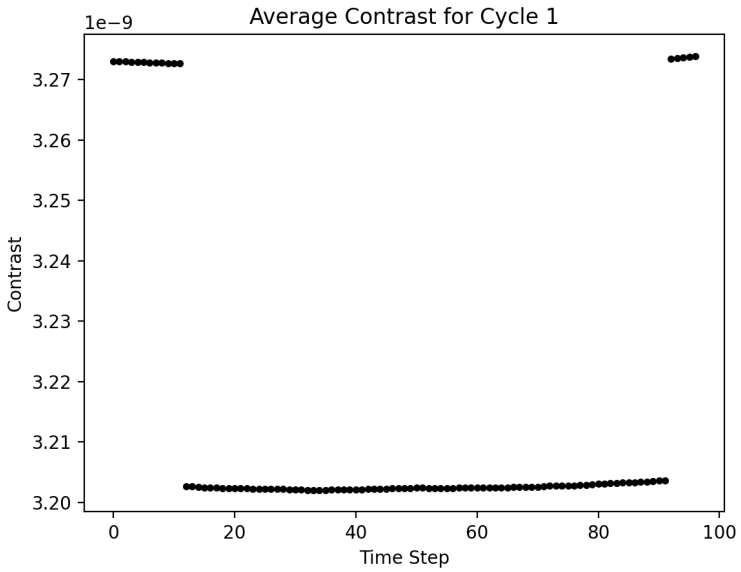
- Jitter can also be added, and this is a work in progress for the wide field of view shaped pupil coronagraph.

Example Results
(No jitter, no detector noise, no MUFs)

With DM Drift

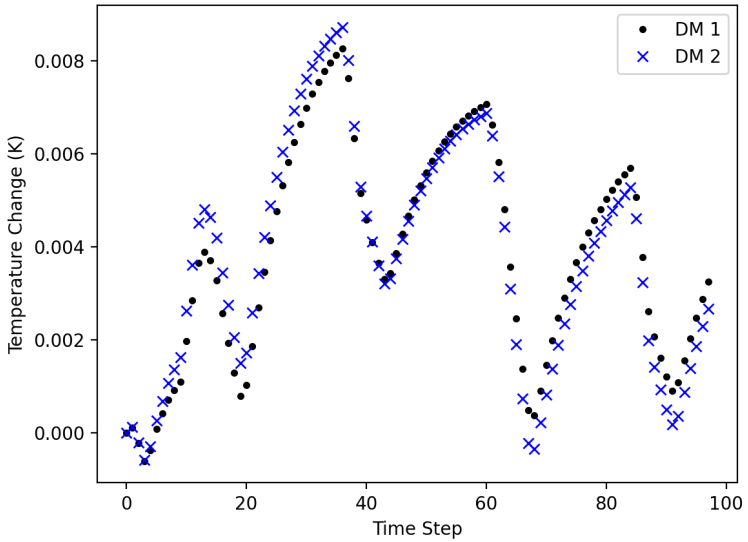


Without DM Drift

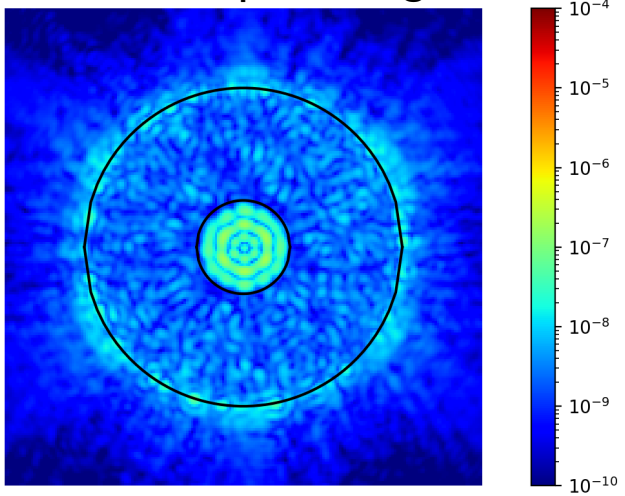


- The discontinuities in contrast occur when changing from the reference star to the target star or vice versa.
- Optic fabrication and alignment errors, wavefront errors due to thermal drift, and pupil shear are included.
- Jitter is a work in progress.
- Results to be posted to the IPAC website shortly (https://roman.ipac.caltech.edu).

Temperature Changes



Sample Image



Dark hole outline is superposed.