Lessons Learned from JWST APT on our IDS GTO Webb Medium Deep Fields (WMDF)

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Talk is on: `http://www.asu.edu/clas/hst/www/jwst/jwsttalks/jwst_apt17lessons.pdf`

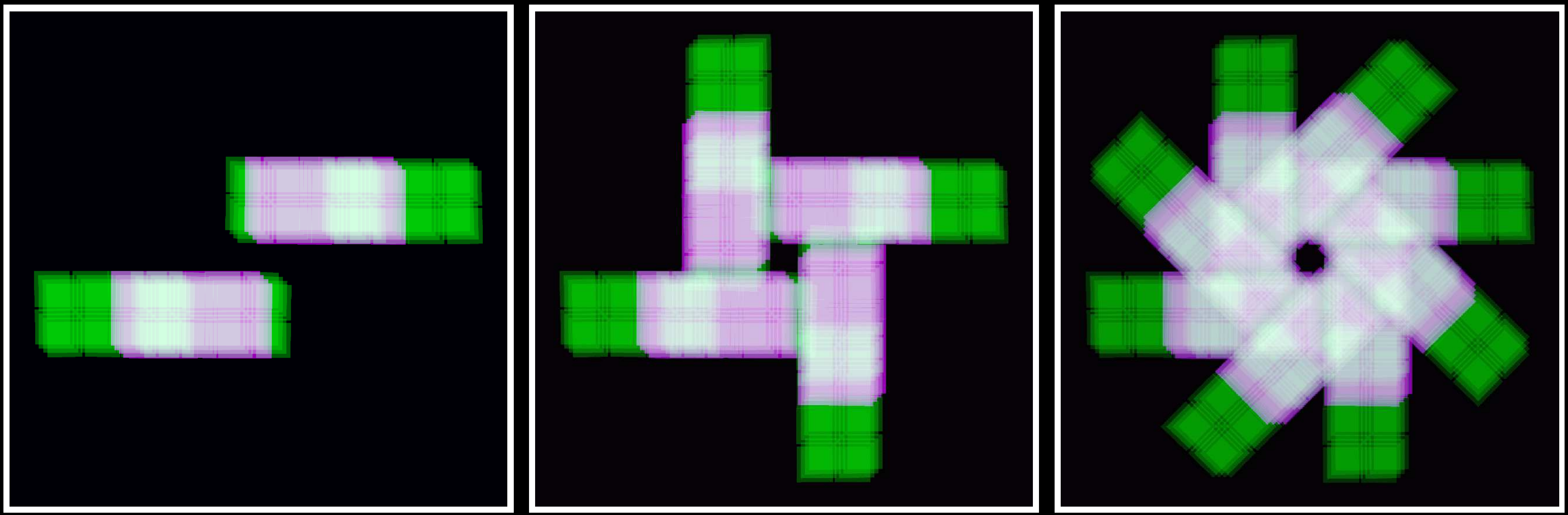
Historical note from the June 1992 STUC meeting in Sardinia:

- Giacconi was pounding his fist on the table, stating: "The HST observing efficiency cannot possibly exceed 35%"

- Since 1995, the HST observing efficiency has been at a steady $\gtrsim$45–50%!

Thanks to STScI for doing this all over — and much faster — for JWST!

JWST Exposure Maps in NEP Time Domain Field (TDF):



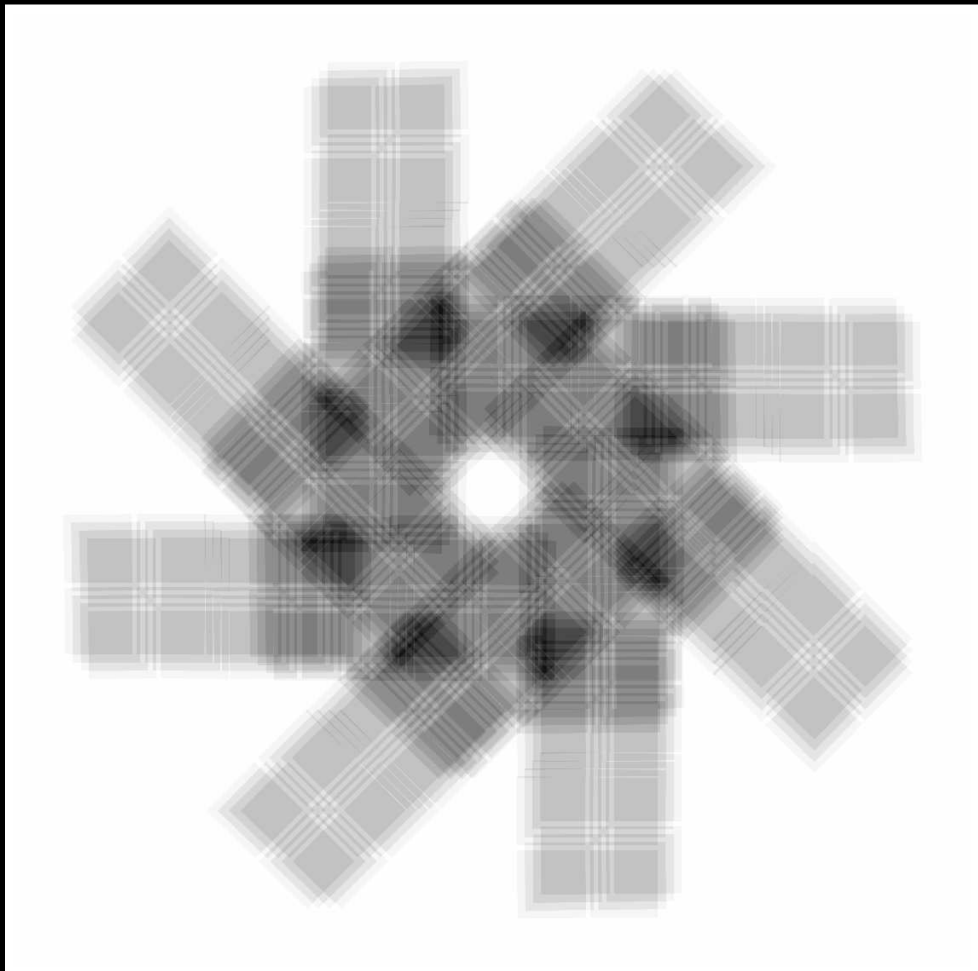
[LEFT]: Parallel NIRISS R150C+R150R grism spectra (purple) observed at ΔPA=0+180°, overlayed on primary NIRCam images (green).

[MIDDLE]: Same with ΔPA=90+270° added: This is our 50-hr GTO plan.

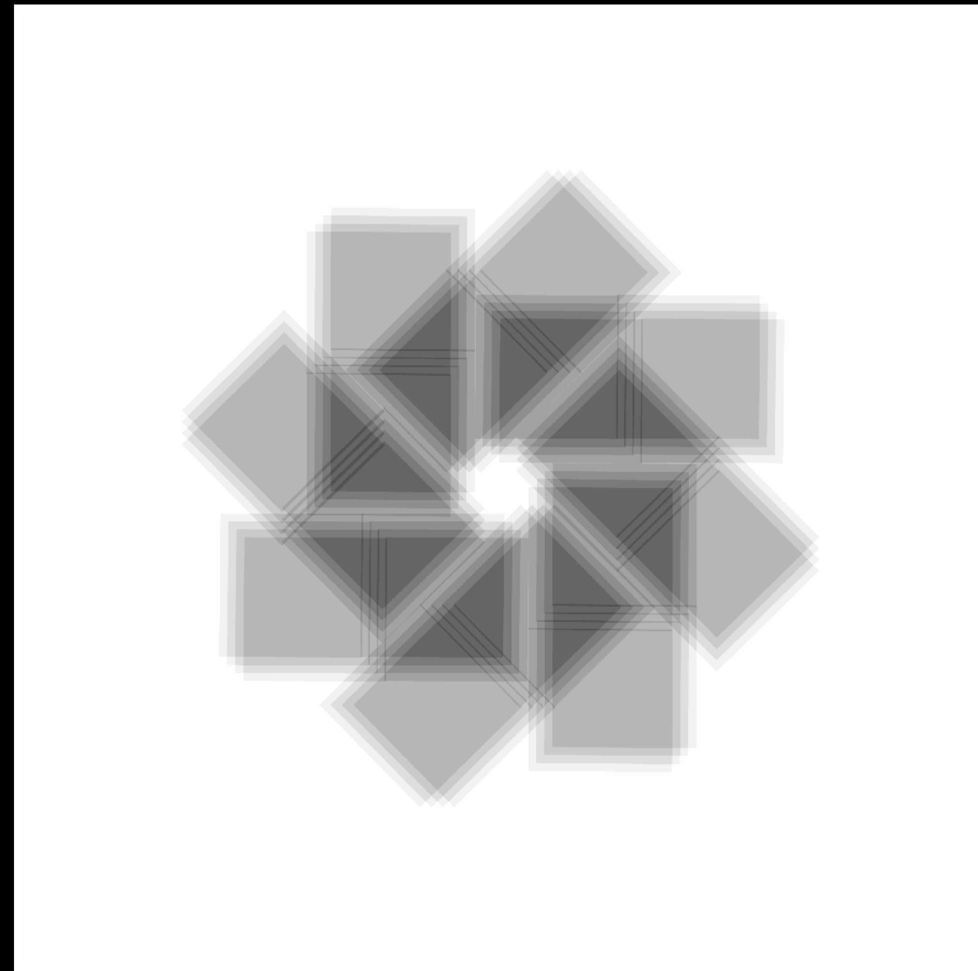
[RIGHT]: Anticipated GO-Community TDF extensions in JWST Cycle $\gtrsim$1.

White regions: NIRCam exposures overlap, reaching $\lesssim$0.75 mag deeper.

- GO's can repeat NIRCam primaries+NIRISS parallels as often as needed during JWST's 5–14 year lifetime at ANY PA!



NIRCam+NIRISS Windmills combined

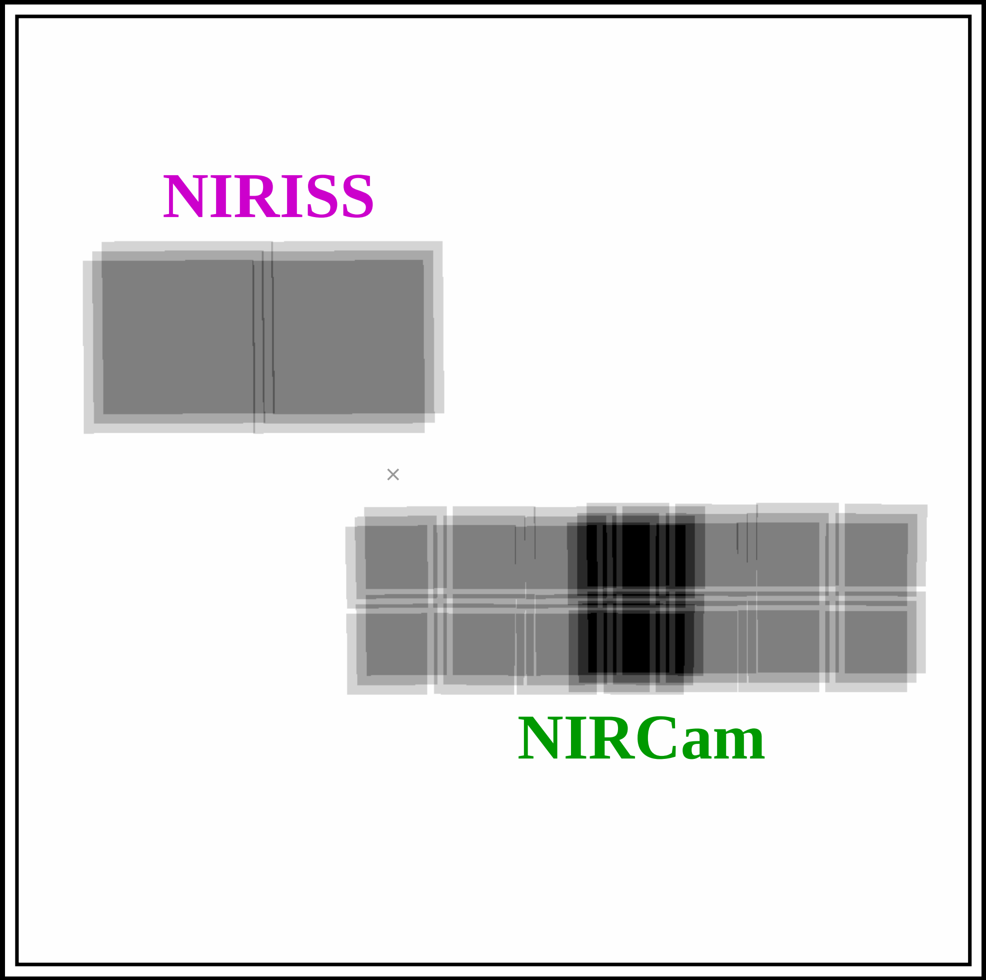


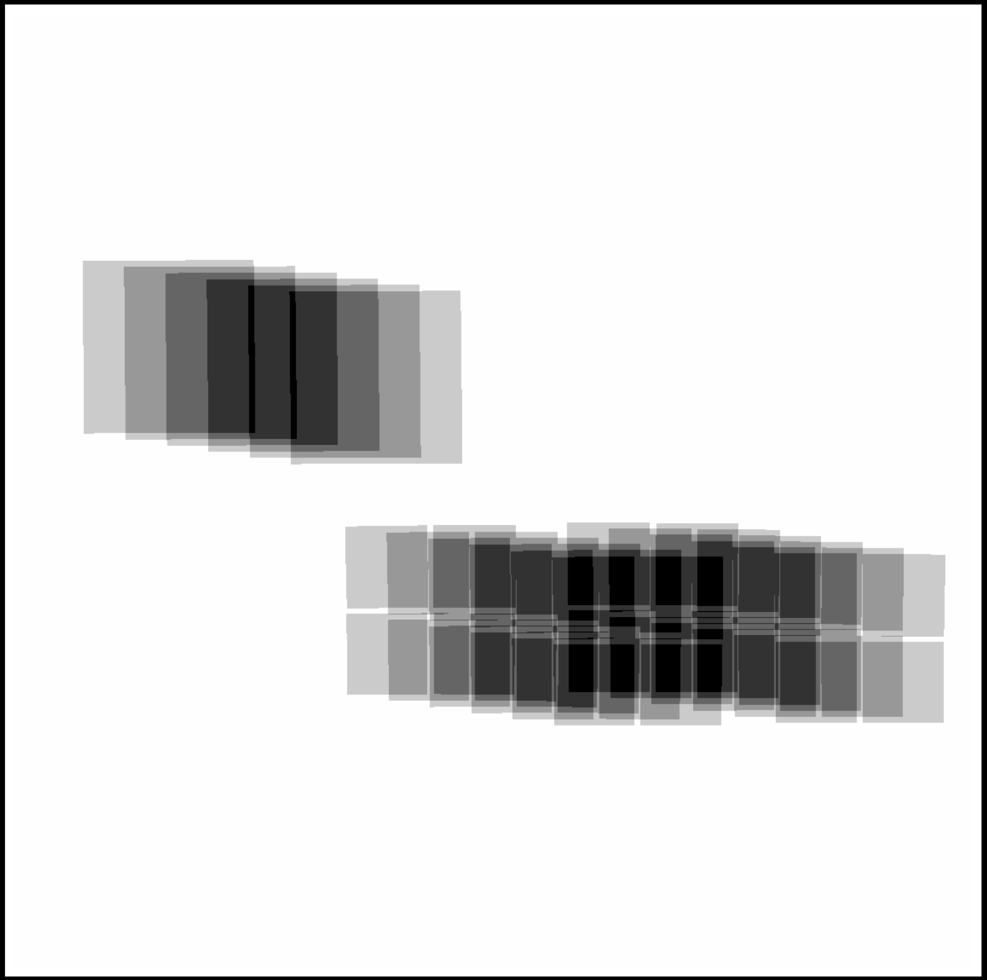
NIRISS-parallel Windmill alone

Exposure map of a community-driven GO extension of the JWST-Windmill adds, e.g., relative position angles ΔPA=45, 135, 225, and 315°.

Increases area by ∼60%, provides new epochs, and go $\lesssim$0.75 mag deeper.

- NIRISS parallel grism spectra increase the number of PA's grism angles to robustly disentangle overlapping object spectra to AB$\lesssim$27.5–28 mag.





[LEFT] Effective exposure time map for NIRISS and NIRCam

[RIGHT] Actual “Amsterdam Accordion” used to implement each JWST Windmill spoke in the NEP TDF.

APT 25.0.3 & 25.0.4 Lessons learned by our IDS GTO team:

- APT interface is intuitive for all who have used prior *HST* APTs !

Our approved 2002 proposal: do $\gtrsim$24 Medium Deep Fields ($\sim$48 HUDFs).

- We were told in 2002 to plan with $\sim$70% observatory efficiency.

- This is clearly not obtained for Webb Medium Deep Fields:

We get 50–60% on any program with 2–4 filters and $\gtrsim$2–3 dither-points.

- The resulting .times files show that:

— in APT 25.0.3 we obtained our 110 hr program with 60% efficiency;

— while APT 25.0.4 now yields a 124 hr program with 54% efficiency.

($i.e.$, we have to cut our samples, exp. times, or area by $\lesssim$15%).

- Constraints coded into APT do *not* fully capture reality, nor may they do so in the next version of APT.

— puts both GTO and GO teams at a disadvantage:

- Tremendous amount of effort for zero return (if targets are removed) or severely diminished returns (reduced depth);

• Reduced robustness of detections *negatively affecting follow-up*;

• Poor sampling of PSF when trying to compensate for lost depth; loss of credibility, when unable to deliver on promised quality of data products.

• Software appears relatively "simple"/overly modular;

— no memory of previous/next visit in an observing program;

— unnecessary mechanism moves and overheads;

— long instrument set-up times (incl. script compilation times).

• Interface between APT and Aladdin could be improved to show actual detector footprints in user specifiable subset of instruments and in user specifiable colors for each instrument.

• Setup of parallel instruments should *not* affect timings for primary instrument observations in *any* manner.

We certainly planned our APT's with enough room for parallels within each primary exposures.

• But the APT 25.1 of June 1 may still not contain all *parallel* O/H.

This may well require us to cut the parallels in all but our NEP field.

— ideally, all instrument (primary and parallel) configuration should be performed and completed during slew, settle, and guide star acquisition.

• The issues we had all revolved around having to compromise the scope of our science investigations due to the rising costs of overhead. Specifically:

1) It has been hard to plan observations in APT when the amount of overhead is a decreasing function of APT version.

2) Specifically, if you are doing a dither pattern/mosaic in multiple filters, you have to repeat each mosaic for each filter separately.

• Is the risk/cost of moving the filter-wheel really worth the extra overhead charged to our programs?

• Can cycling through all filters at each dither point be allowed in Cycle 1 to improve efficiency, and then follow the more conservative approach in Cycle $\gtrsim$2 if any filter-wheel wear has been noticed?

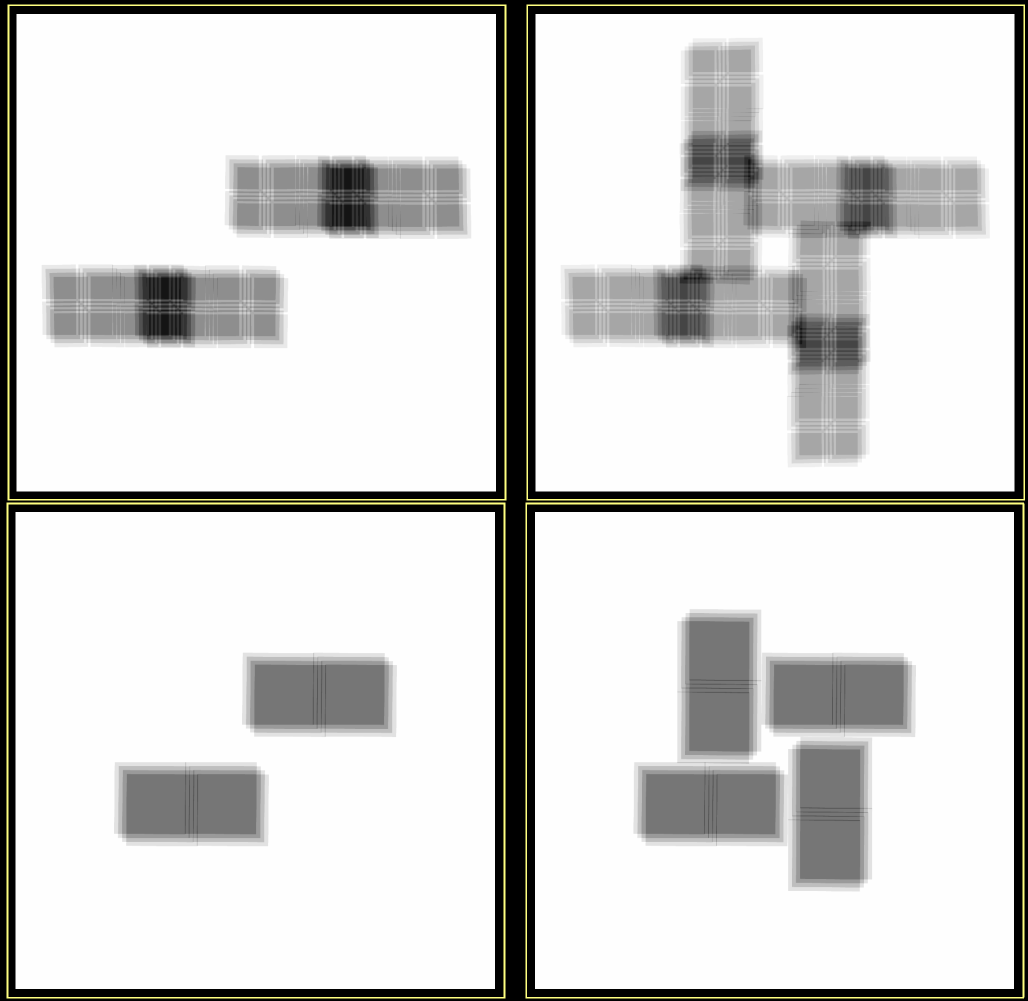
- In conclusion, our IDS GTO team feels that getting sufficiently deep PSF-sampled NIRCam imaging in 8 wide filters on each WMDF target has been sufficiently compromised that we need to reduce the number of fields.

- This directly affect our ability to conduct a proper WMDF area.

- It also compromises our WMDF depth that we had proposed and planned.

- Unless more efficient APT and scheduling S/W comes along, JWST is not very efficient for wider, shallower survey type science, and may end up becoming branded as "a follow-up" type telescope.

SPARE CHARTS



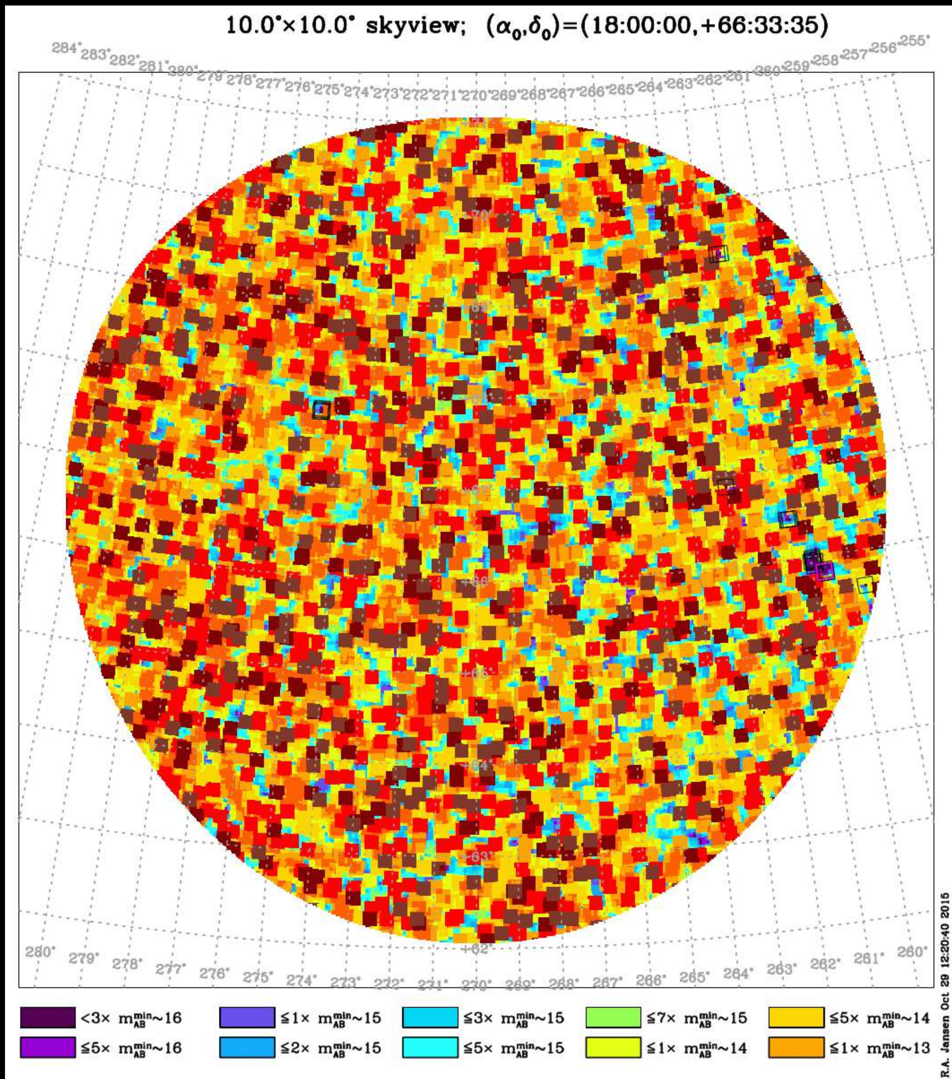
[TOP] Primary NIRCam JWST-Windmill at ΔPA=0° & 180°.

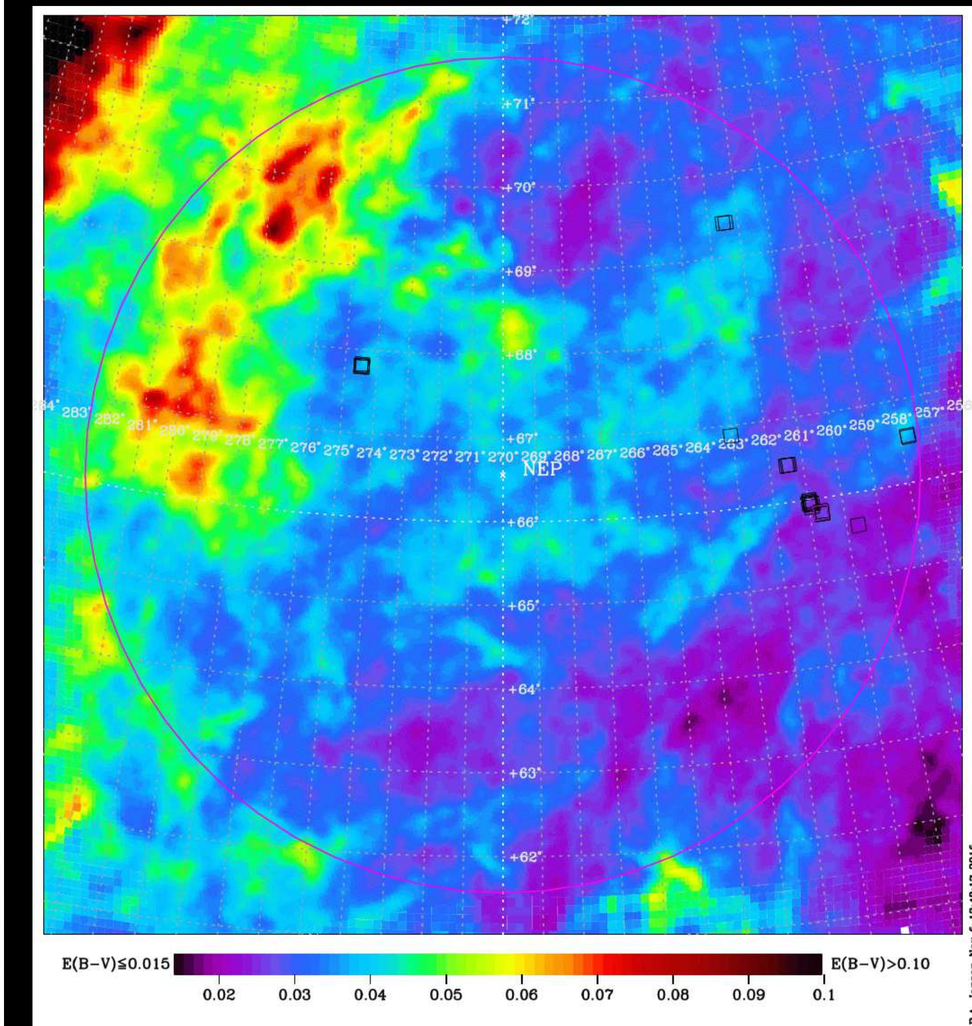
[BOTTOM] Parallel NIRISS grisms at the same relative PA's.

Two grisms (R150C+R150R) disentangle overlapping spectra to AB$\lesssim$28.

[RIGHT] Adding NIRCam+NIRISS at ΔPA=90° & 270° to the left.

Total NIRCam Area$\simeq$66 arcmin^2, with $\sim$20% of the area $\sim$2$\times$ deeper.

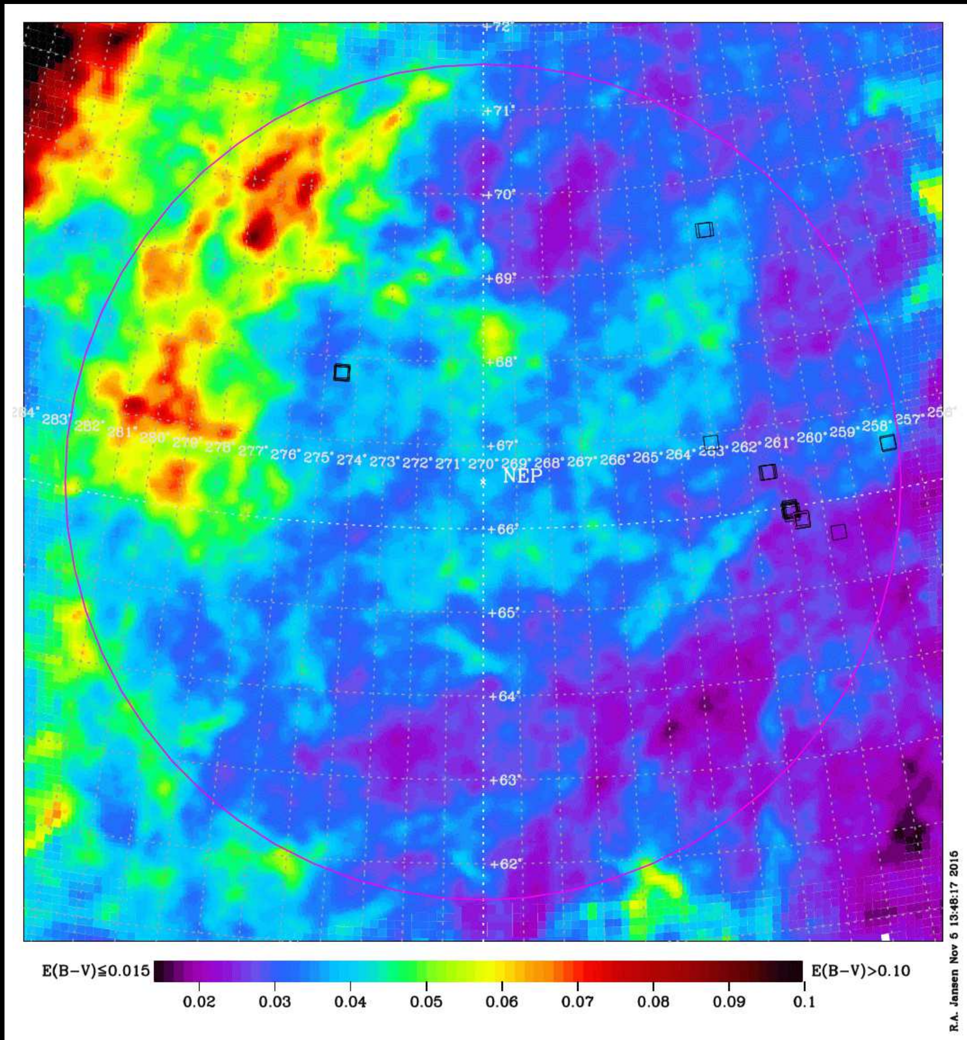


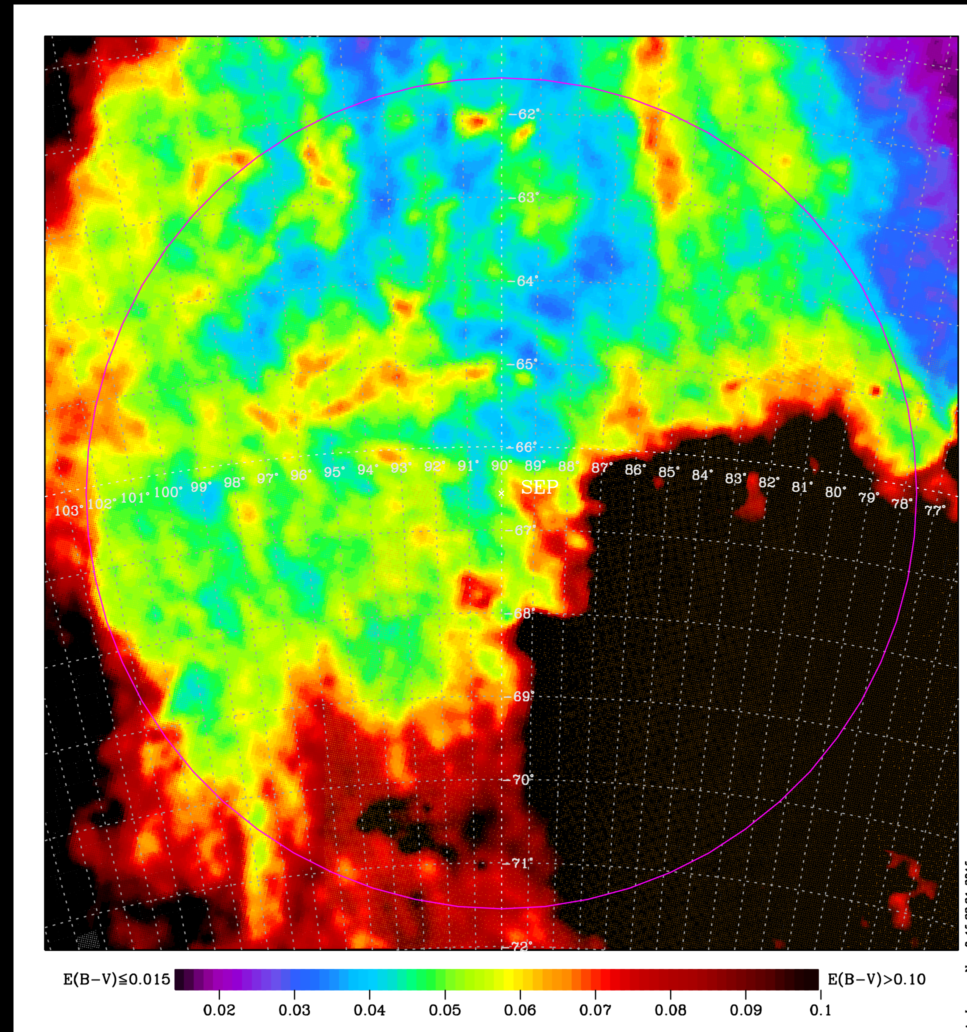


[LEFT]: *WISE* 4μm bright-object penalties in 10′ grid: Very few regions (purple) exist *without bright stars* (AB≲16) to minimize persistence.

[RIGHT]: *E(B−V)* map (Schlegel et al. 1998) in same NEP-region.

Cleanest 10×10′ region for JWST has modest extinction: *E(B−V)*≲0.028^m.

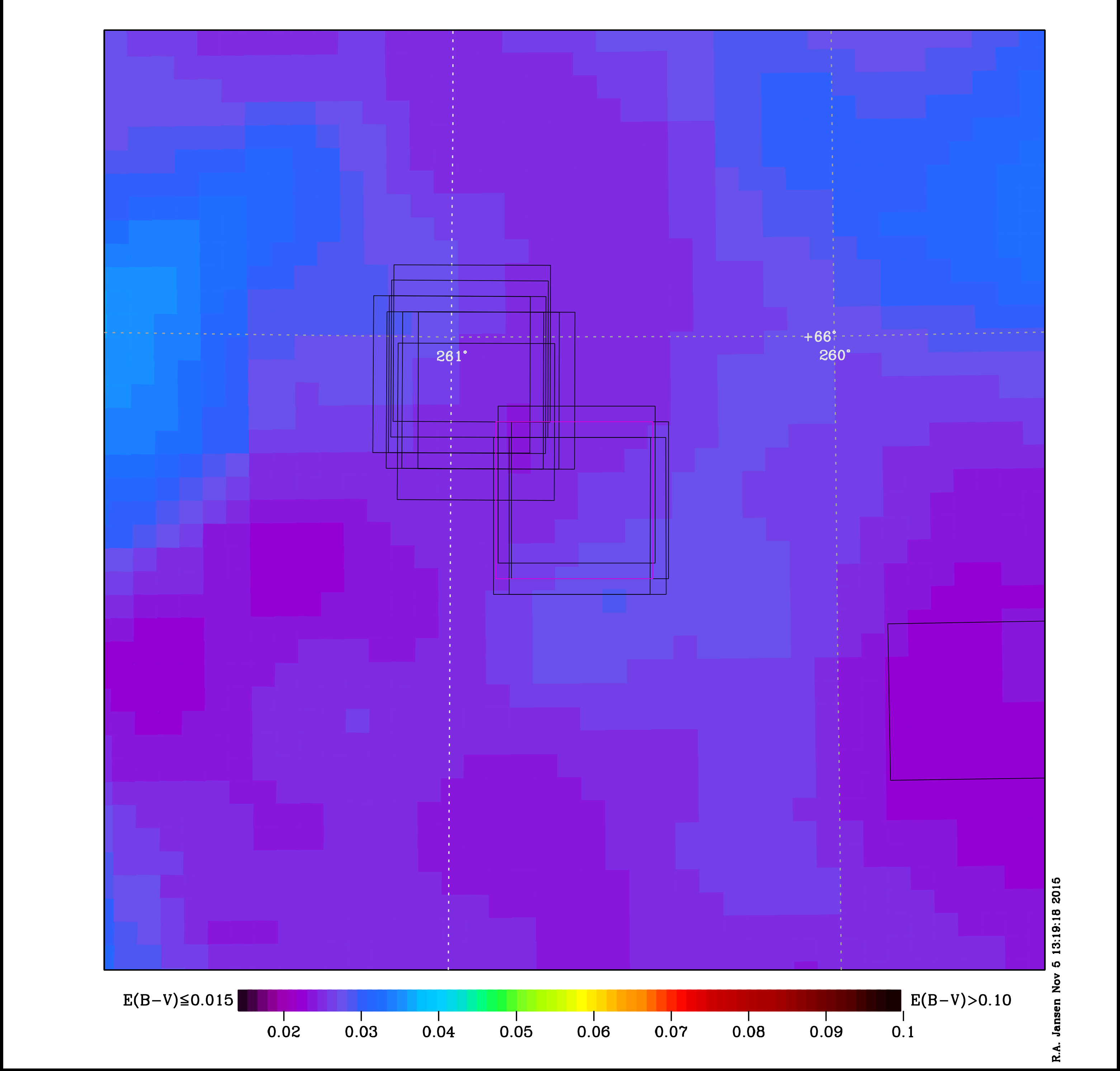




Comparison of *E(B−V)*-maps of NEP [Left] and SEP [Right].

- NEP contains clean $10\times10'$ region: no AB$\lesssim$16 stars, *E(B−V)*$\lesssim 0.028^m$.
- SEP contains *no* clean, bright-star free regions with r$\lesssim 5^\circ$ due to LMC.

Only NEP CVZ can be used for (*far*-extragalactic) time-domain science.



Enlargement of E(B–V) map of JWST NEP CVZ region.