



STScI | SPACE TELESCOPE
SCIENCE INSTITUTE

EXPANDING THE FRONTIERS OF SPACE ASTRONOMY

JWST's Pure Parallel Implementation

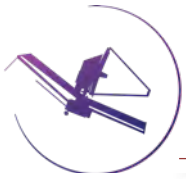
Macarena Garcia Marin

STScI's JWST Project Scientist

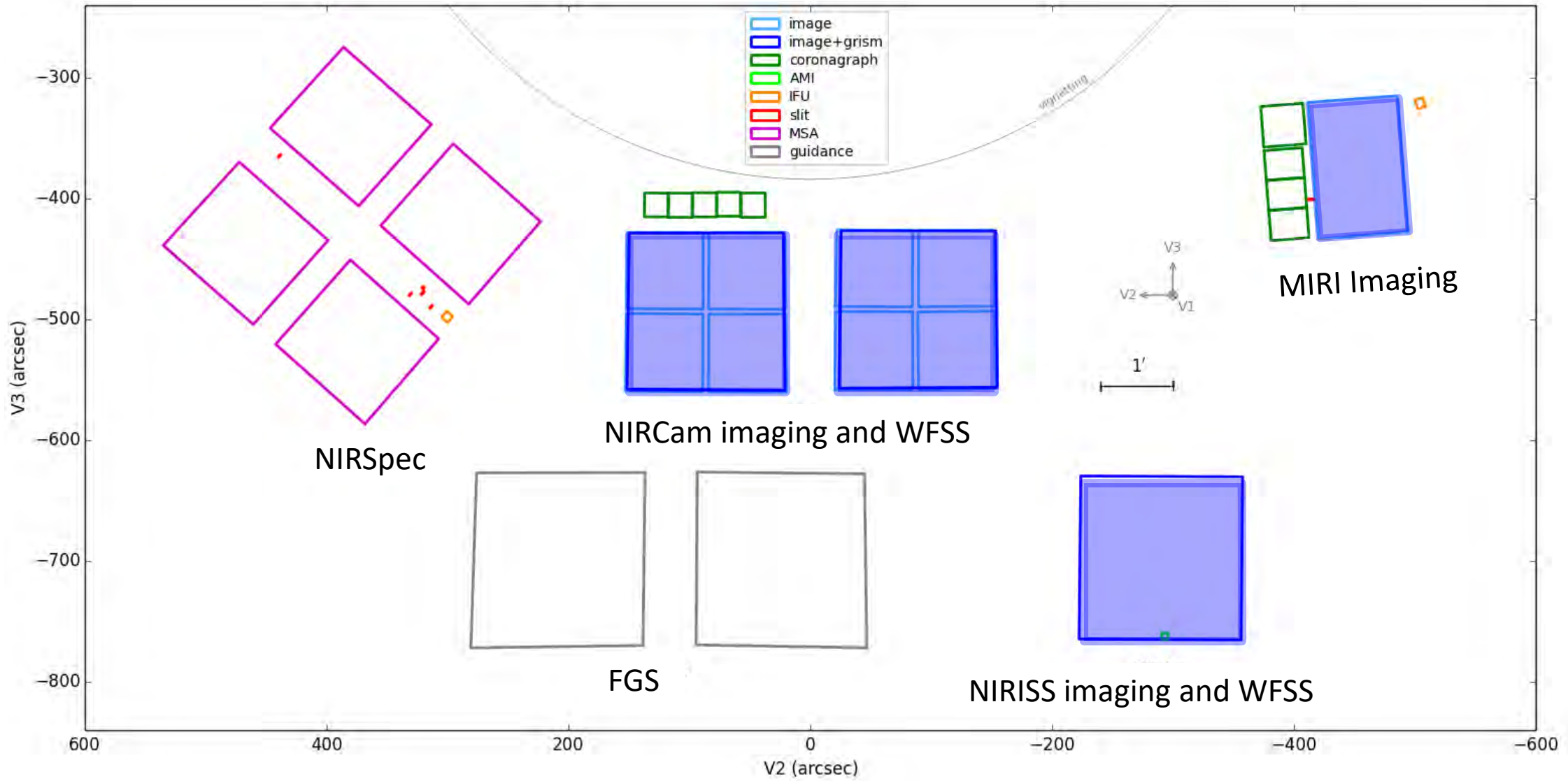


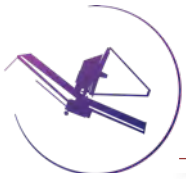
Introduction

- Pure Parallel Working Group established in summer 2024
 - Macarena Garcia Marin (chair)
 - Marco Sirianni
 - Jeff Valenti
 - Margaret Jordan
 - Neil Reid
 - John MacKenty
 - Marc Postman
 - Andrew Fox
- Tasked with:
 - Reviewing the current status of pure parallel programs implementation
 - Reviewing the completion degree of approved programs
 - Identifying main limitations on scheduling PP observations
 - Identifying areas of improvement and associated actions
 - Soliciting input from the PIs of Cycle 1 and 2 programs
 - Reporting findings to the JSTUC

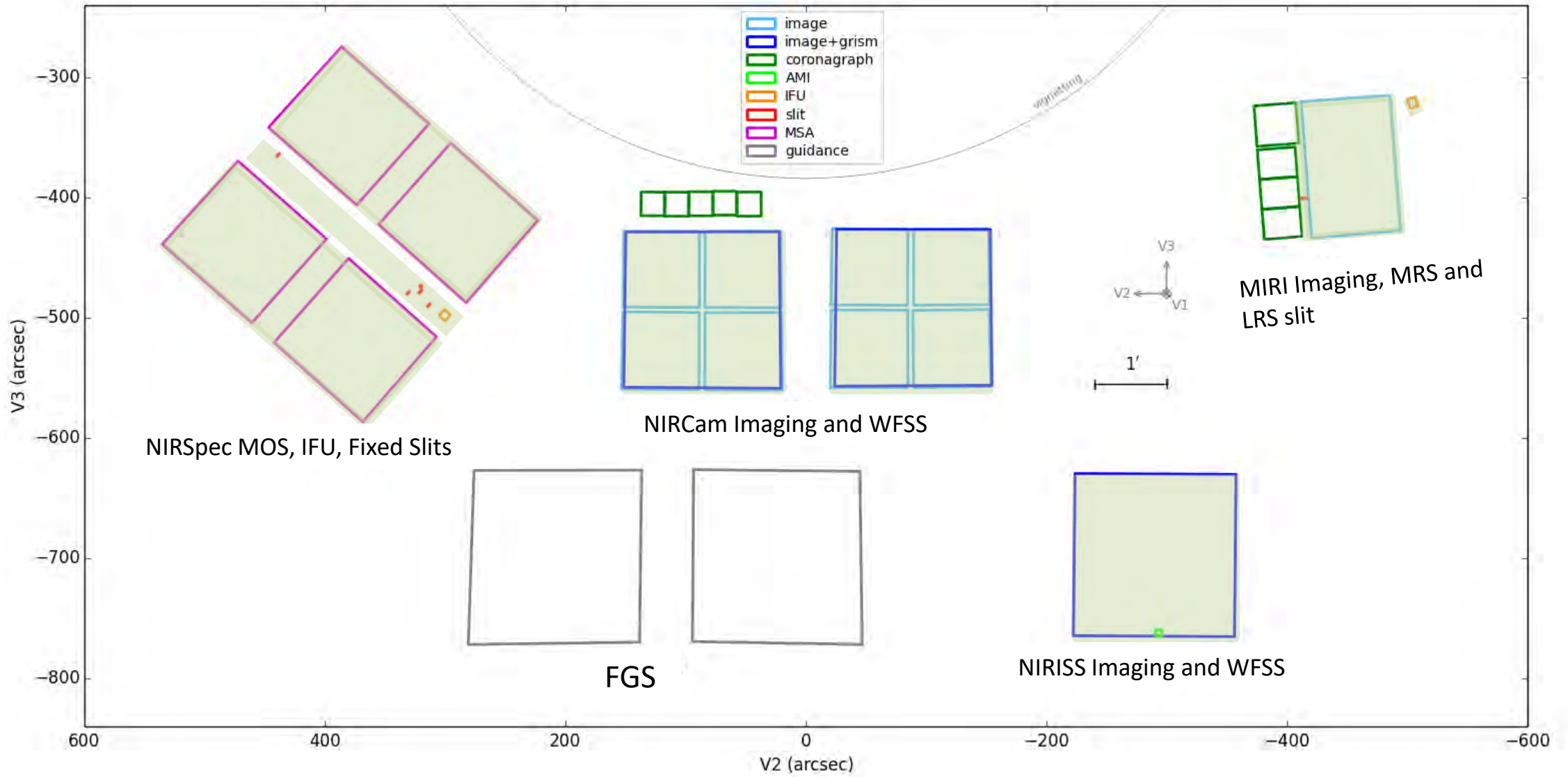


JWST Modes Offered for Pure Parallels





JWST Modes Allowed to Attach Pure Parallels



MIRI Imaging, MRS and LRS slit

NIRSspec MOS, IFU, Fixed Slits

NIRCcam Imaging and WFSS

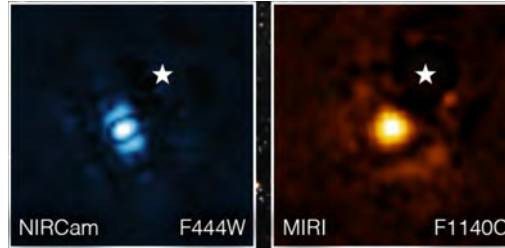
FGS

NIRISS Imaging and WFSS



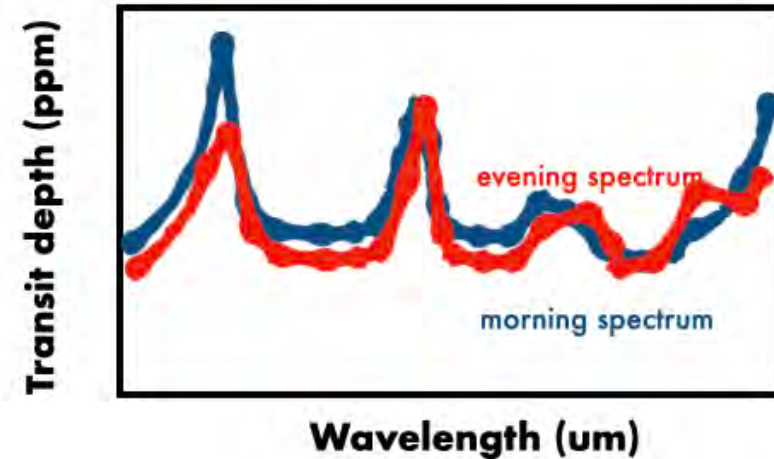
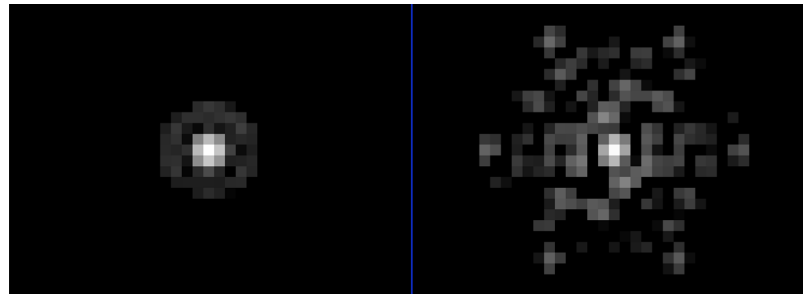
JWST Modes Not Allowed to Attach Pure Parallels

Coronagraphy (MIRI, NIRCams)



Time series observations (all instruments)

NIRISS AMI

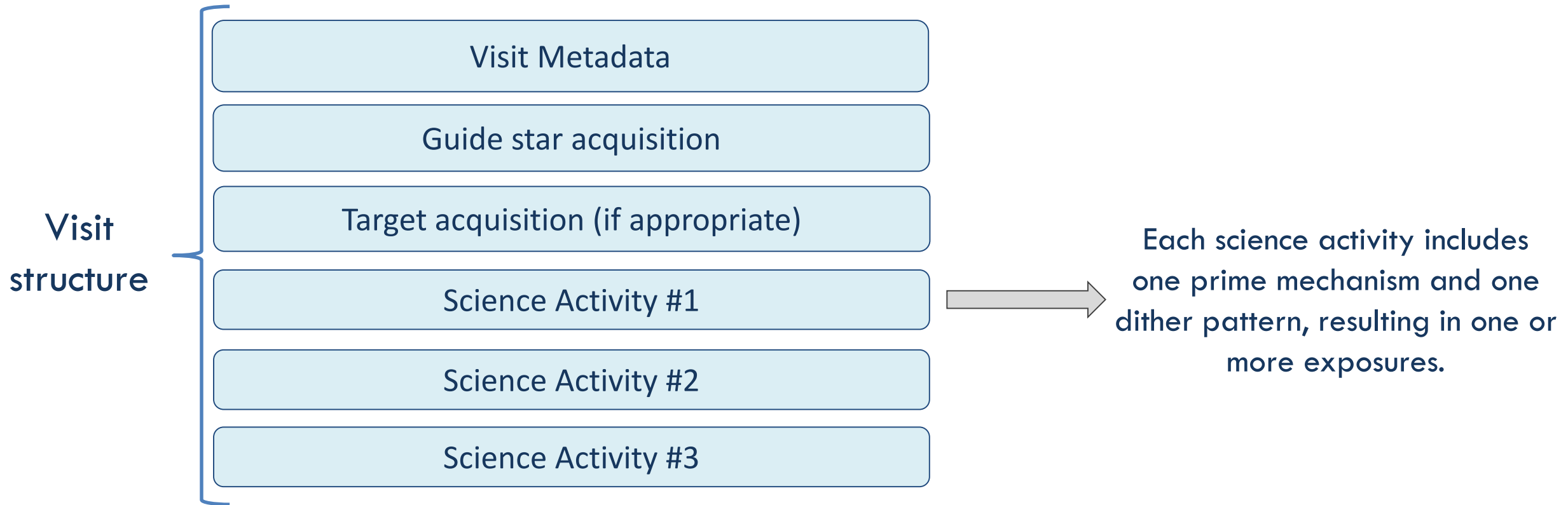


Impact on the primary science performance (e.g. cross-instrument EMI and pointing stability) is unknown.

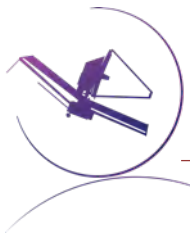


Visits Architecture

Visit: Minimum schedulable “unit”



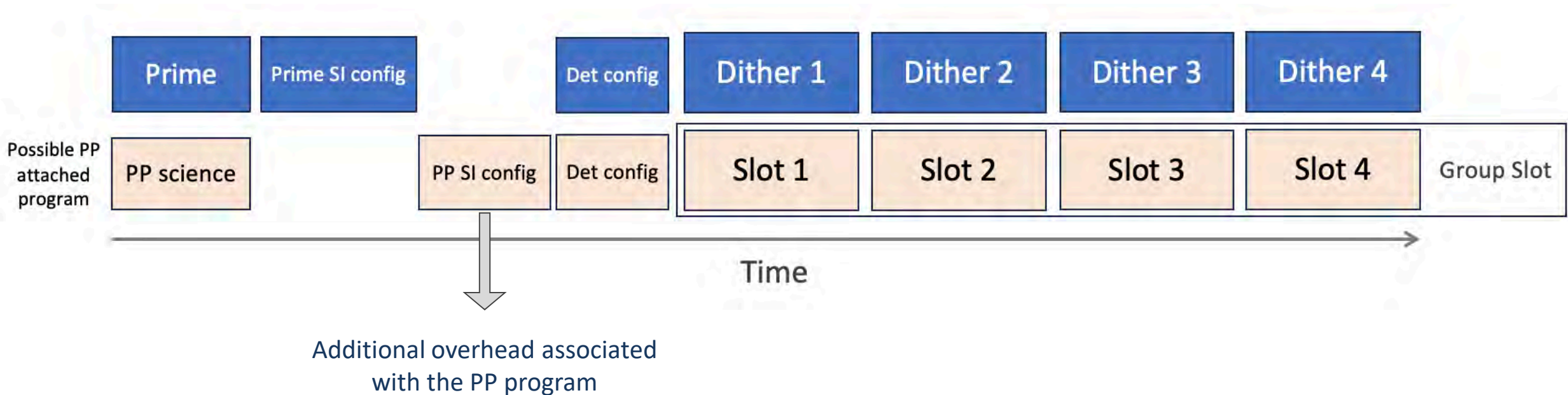
In this example, dither patterns with 3 filters map to 3 separate activities.



Prime and Parallel Instruments View: Slots and Group Slots

Slot: single exposure of a prime program (typically a single dither position)

Group slot: set of slots/exposures part of the same dither pattern (*).



(*) Observers tend to use the term “slot” for “group slot”



Pure Parallel Slot Assignment Process

LRP team builds plan for the cycle and makes a list of available slots



Instrument teams select calibration parallel slots



Calibration slots removed from list



To avoid conflicts, a pool of available slots is assigned to each PP program in APT



PP PIs assign slots to their programs

Working closely with STScI's Program Coordinators





Calibration Slots Assignment

Prime

SI config 1

Det config

Dither 1

Dither 2

Dither 3

Possible PP attached program:

PP science

SI config 1

Det config

Slot 1

Slot 2

Slot 3

Group Slot #1

PP Dark

SI config 1

Det config

Slot 1

A dark can extend across slots



Calibration Slots Assignment

Prime SI config 1

Det config Dither 1 Dither 2 Dither 3

Possible PP attached program:

PP science

SI config 1 Det config Slot 1 Slot 2 Slot 3 Group Slot #1

PP Dark

SI config 1 Det config Slot 1 A dark can extend across slots

Instrument teams assign calibration parallels (usually darks)

Prime SI config 1

Det config Dither 1 Dither 2 Dither 3

PP Dark

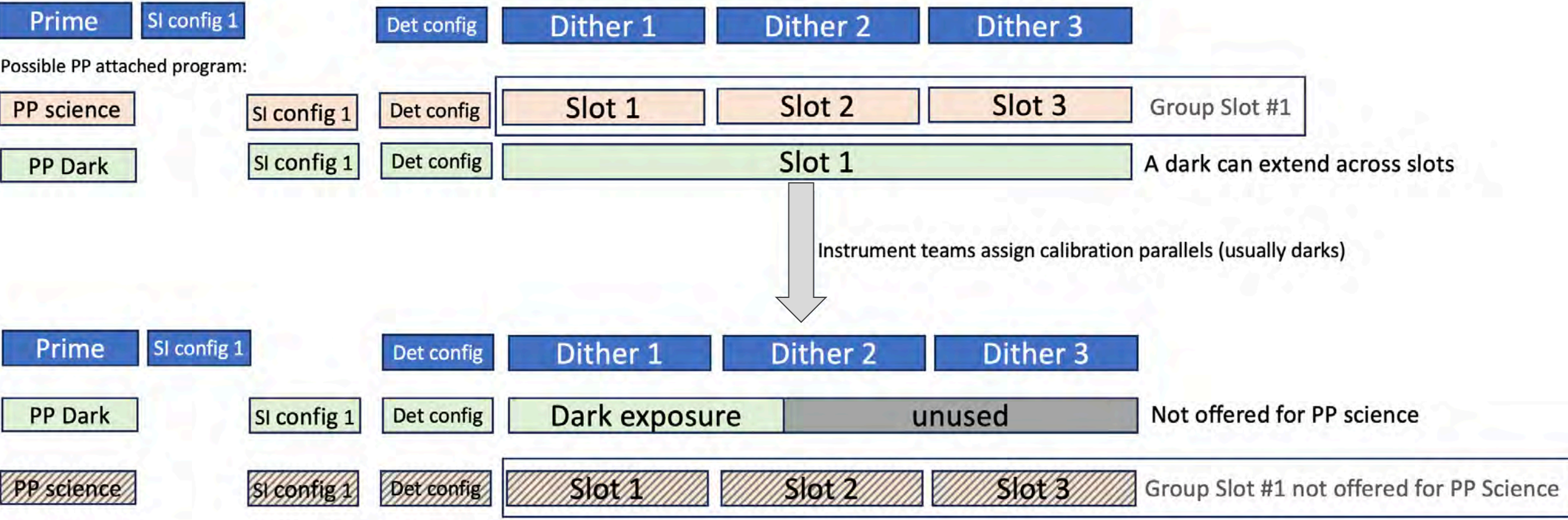
SI config 1 Det config Dark exposure unused Not offered for PP science

PP science

SI config 1 Det config Slot 1 Slot 2 Slot 3 Group Slot #1 not offered for PP Science



Calibration Slots Assignment



Darks are currently not executed as a 3rd parallel with a pure science parallel
The optimization of the calibration pure parallels assignment is under analysis

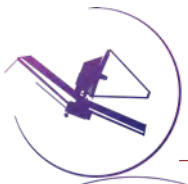


Pure Parallel Over JWST Cycles

Cycle	# Programs submitted	# Programs accepted	Oversubscription
1	8	3	~1:3
2	4	2 ^(*)	1:2
3	8	2	1:4
4	10	TBD	TBD

- Cycles 1 through 3 saw pure parallel proposals that only used NIRCam and NIRISS.
- In **Cycle 4** we have seen, for the first time, a program that **proposes to use MIRI as a pure parallel**.

(*) (1 of them divided into two)

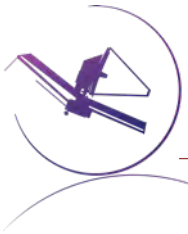


Pure Parallel Programs Status

Cycle	PID	Mode	Approved hours	Status
1	1571		Up to 591.0	COMPLETED
1	2211		Up to 38.0	COMPLETED, however, visit 48:1 was recently SKIPPED due to the prime 1266 visit 7:1 being SKIPPED. Schedulers waiting on the prime to be repeated so that the parallel visit can be repeated as well
1	2514		Up to 150.0	COMPLETED
2	3383		Up to 205.0	7 visits remaining to be executed; APT charged time: 192.0 hours
2	3990		Up to 600.0	25 visits remaining to be executed; APT charged time: 612.2 hours (*)
2	4681		Up to 410.0	21 visits remaining to be executed; APT charged time: 332.3 hours
3	5398		Up to 400.0	70 visits remaining to be executed; APT charged time: 53.7 hours
3	6434		Up to 600.0	260 visits remaining to be executed; APT charged time: 709.3 hours (*)

Pure Parallel Publication: Williams et al, 2024 arXiv:2419.01875

(*) to facilitate scheduling, these have APT charged time over the allocated hours. Not all hours will be observed



Main Limitations to Pure Parallels

- **Finding #1: Information on spectral configurations available for pure parallel not in JDox.**
 - We are compiling this information and plan to provide it in JDox
- ***Finding #2: Number of Mechanisms moves/Spectral Configurations is determined by the prime, which may limit the PP***
 - Observers have suggested to make each dither position one activity
 - This would require fundamental changes to the Telescope On-board Script Subsystem (OSS)
 - We don't recommend this approach:
 - significant **overhead increase** (i.e. impacting the prime program, against current policies)
 - **impact on the prime** observation has **not been evaluated**
 - **resource-consuming** (on-orbit testing plan, changes to OSS code, rewriting of OPGS rules, re-evaluation of the timing model, policies changes)
 - We also do not recommend prime programs to adjust their observations to accommodate PP.
 - Potential **impact on the science of the prime**, require **extensive coordination** and **increase workload** for the community and STScI staff
 - PP PIs are encouraged to design a primary/optimal program (plan A), and also plans B or even C, describing how to achieve/adjust the science with less spectral configurations.



Main Limitations to Pure Parallels

- ***Finding #3: Additional improvements in documentation (e.g. terms slot and slot group are confused).***
 - Recommend to update JDoX for clarity and consistency
- ***Finding #4: The assignment of STScI's instrument team's calibration pure parallels may not be optimized.***
 - Under investigation (e.g. ensure the length of darks are well matched to the used slots and group slot)
- ***Finding #5: Darks could be attached as a third instrument in parallel with a pure science parallel***
 - Under investigation by systems engineering.
- ***Finding #6: The S&OC could expand the list of modes that allow attachment of pure parallels***
 - Recommend to investigate the cost/benefit of testing the impact of attaching pure parallel observations to currently non-allowed modes.



In Summary

We have executed a detailed evaluation of the current status of JWST's Pure Parallel implementation

1. We intend to implement the JDox improvements in findings 1 and 3 by Cycle 5
2. We intend to evaluate the cost-benefit of testing the impact of attaching pure parallel observations to currently non-allowed modes
3. We'll report back to the JSTUC at a future meeting on progress with findings 4, 5 and 6
4. We'll re-evaluate pure parallel scientific productivity after Cycle 5