SPIRE Benchmarking Environment and Comparison Metrics

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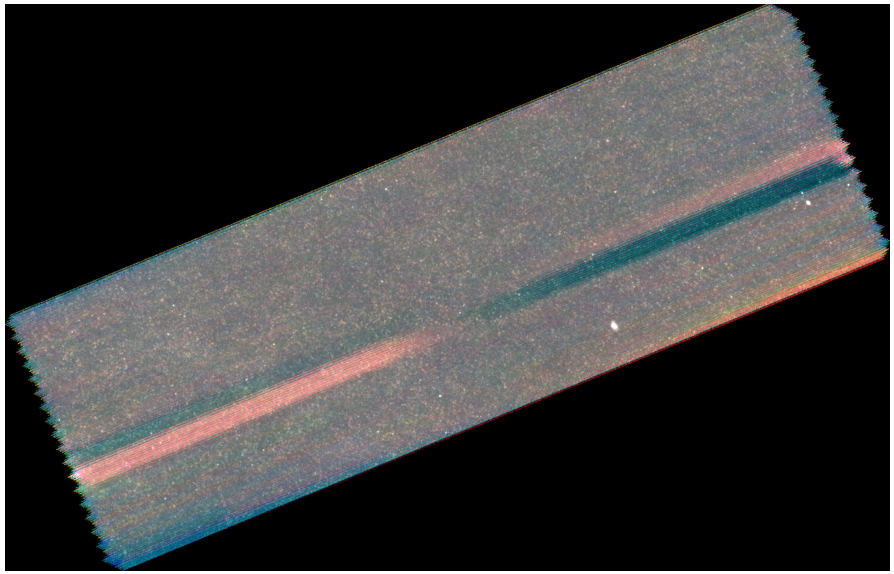
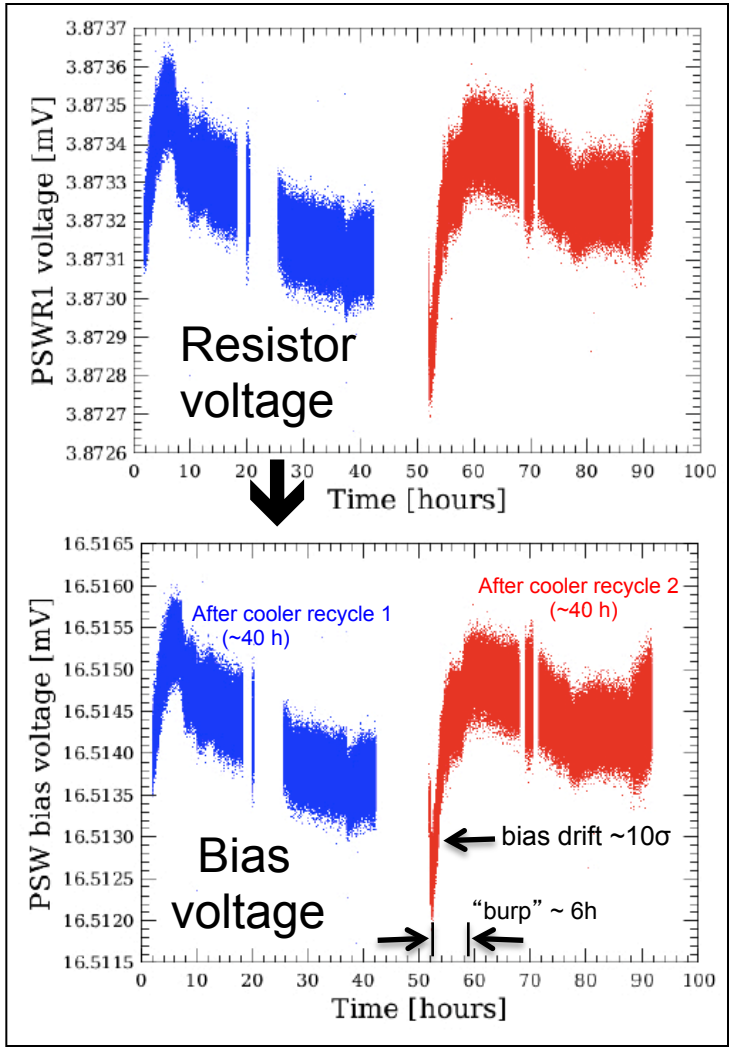
Major Issues in SPIRE Map-Making:

- the "cooler burp effect": broad stripes
- residual temperature drift: artificial gradient in scans
- errors in the baseline removal: thin stripes

"Cooler Burp"

- Every time when SPIRE is switched on after a cooler recycle, the first ~6 h sees rapid drifts in both the temperature and the bias voltage.
- This causes abnormal drifts in detector timelines, which in turn cause stripes in maps observed during the "cooler burp" period.





Goals of this map-making test campaign:

- Compare SPIRE mapmakers (including high resolution map-makers) objectively and comprehensively.
- In particular, identify the strengths and limitations of different mapmakers in dealing with the known SPIRE map-making issues.
- Provide information for users to choose the right map-maker for their science.
- Provide guidance for future development of the SPIRE scan-map data reduction pipeline.

Participating Map-Makers:

- Naïve Mapper (default of SPIRE SPG until HIPE 8)
- Destriper:
  - polynomial-order = 0 (default of SPIRE SPG since HIPE 9)
  - polynomial-order = 1
- Scanamorphos
- SANEPIC
- Unimap
- HiRes (high resolution mapper)
- SUPREME (high resolution mapper)

Test Cases: Requirements

They shall cover the following parameter space of SPIRE scanmap observations:

- observation mode (nominal/parallel, scan speed, sampling rate);
- source brightness;
- map size;
- depth;
- complexity of the extended emission.

Also, they shall include examples of:

- observations suffering from ”cooler burp" effects;
- sky regions with strong large-scale gradient.

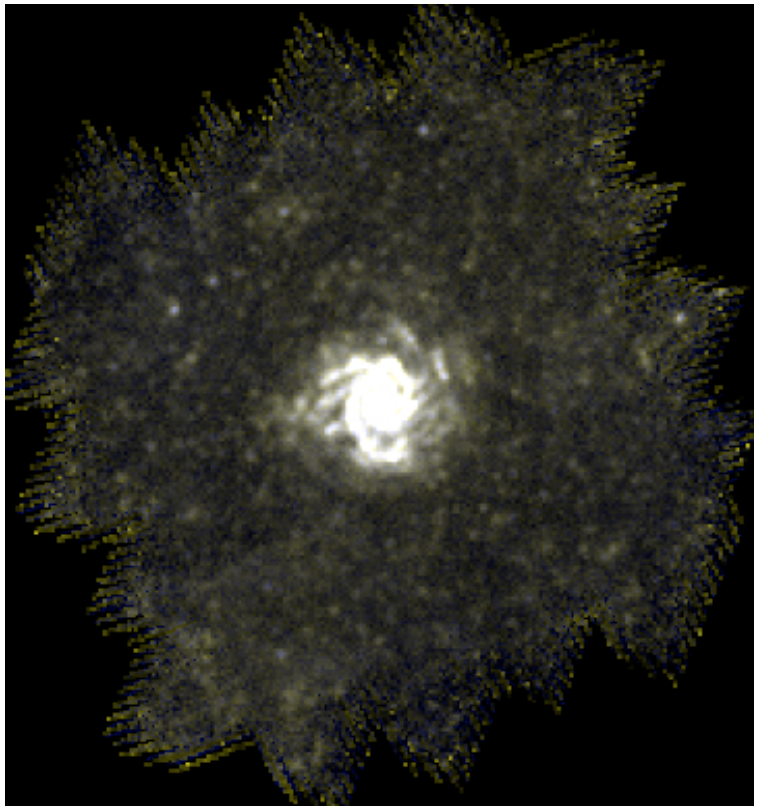
In total: 13 test cases (5 real, 8 simulated)

Test Cases – Nominal mode (scan-speed=30”/s, sampling-rate=18 Hz)

5 Cases (2 real, 3 simu):

- case 1: artificial sources (simu)
- case 2: cirrus region (simu)
- case 3: Lockman-North field (real)
- case 4: M51 (simu)
- case 12: NGC 628 (real)

Example: NGC 628 (Sbc galaxy)

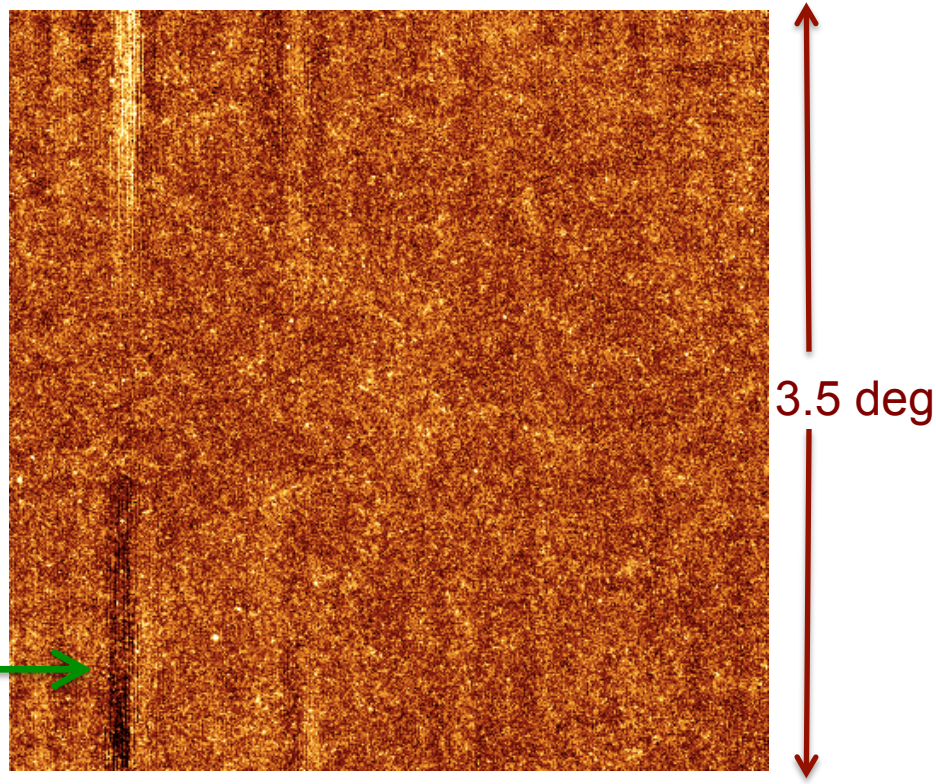


Test Cases – fast-scan mode (scan-speed=60”/s, sampling-rate=18 Hz)

3 Cases (1 real, 2 simu):

- case 5: artificial sources (simu)
- case 6: Galactic Center (simu)
- case 7: Lockman-SWIRE field (real)

Example: Lockman-SWIRE (dark field)

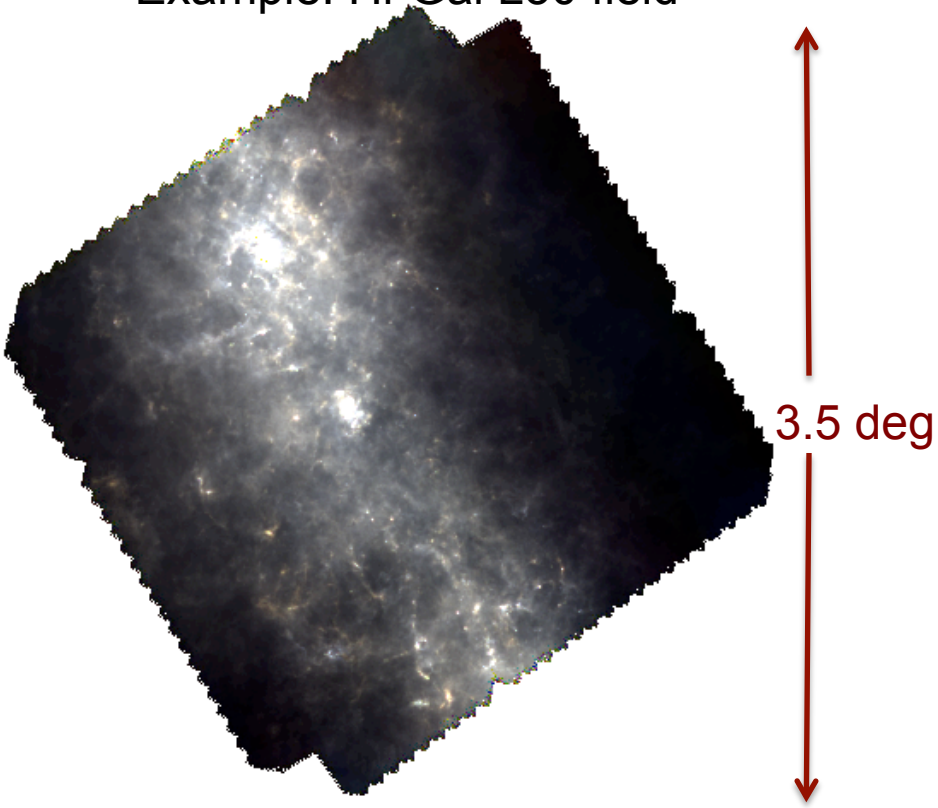


Test Cases – parallel mode (scan-speed=20”/s, sampling-rate=10 Hz)

5 Cases (2 real, 3 simu):

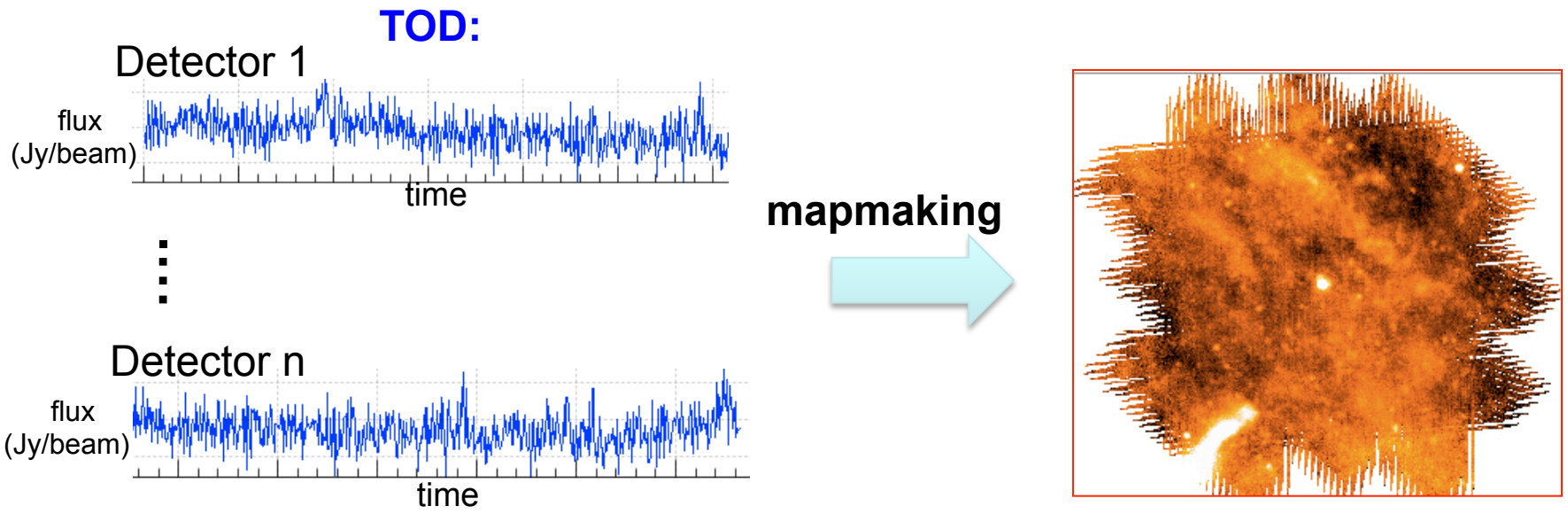
- case 8: artificial sources (simu)
- case 9: Galactic Center (simu)
- case 10: cirrus region (simu)
- case 11: ELAIS N1 field (real)
- case 13: Hi-Gal L30 field (real)

Example: Hi-Gal L30 field



Input Data:

- Time-ordered data (TOD) of real or simulated SPIRE scan-map observations.



Input Data:

- The TOD have the format of SPIRE Level-1 Photometer Scan Product (PSP).
- They have been corrected for the following instrumental effects (using the standard SPIRE scan-map data reduction pipeline):
  - glitches
  - electrical low-pass filter
  - non-linearity
  - bolometer time response.
- For each test case, two sets of input data were generated:

  Set-1: including also temperature drift correction; no turn-around data (used by Naïve, Destriper, HiRes)

  Set-2: no temperature correction; including the turn-around data (used by Scanamorphos, SANEPIC, Unimap)

Summary of Map-Makers' Results

		Mapmaker						
Case	Description	Naive	Destriper	Scanamorphos	SANEPIC	Unimap	HiRes	SUPREME
1	Nominal sources	x	x	x	x	x		
2	Nominal cirrus	x	x	x	x			
3	Nominal dark	x	x	x	x			
4	Nominal M51	x	x	x	x			
5	Fastscan sources	x	x	x	x	x		
6	Fastscan MK center	x	x	x	x	x		
7	Fastscan dark	x	x	x	x			
8	Parallel sources	x	x	x	x			
9	Parallel MK center	x	x	x	x			
10	Parallel cirrus	x	x	x	x	x	x	x
11	Parallel dark	x	x	x	x			
12	Nominal NGC 628	x	x	x		x	x	
13	Parallel Hi-Gal L30	x	x	x		x	x	

Map Projection Requirements:

- Rotation angle: crota2 = 0 (north-up)
- Output pixel size:
  PSW: 6”
  PMW: 10”
  PLW: 14”
- Projection: RA – TAN, DEC – TAN

Map-Maker Comparison Metrics

(1) deviation from the truth (simulated cases)
(2) spatial power spectra (both real and simulated)
(3) point source photometry (cases of artificial sources)
(4) extended source photometry
(5) difference between maps by two super-resolution map-makers, and difference from other maps.

(Details will be presented in later talks dedicated to individual metrics.)

Summary

- 7 participating map-makers (Naïve, Destriper, Scanamorphos, SANEPIC, Unimap, HiRes, SUPREME)
- 13 test cases, covering observations in different modes, brightness levels, complexity of the emission structures, etc.
- 5 comparison metrics.