Simulated IOC Flatfields (24micron) and Illumination Corrections (70 and 160micron)

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ABSTRACT

This report presents results on the statistical quality of simulated flatfields (24micron) and ICs (70 and 160microns). The main differences with respect to John Stansberry's flatfield report are: i) **We make use of simulated RAW datasets (produced using mips_simulator) which include photon noise. The datasets are reduced using the UofA pipeline (mips_sloper); ii)We make use of Herve Dole's newest simulations as released January 31st 2003. Previous simulations overestimated the number of sources at all three MIPS wavelengths; iii) We analyze the quality of simulated flatfields and ICs in terms of the zodi brightness and HI Galactic column density (cirrus); iv) We analyze the quality of simulated flatfields and ICs in terms of the observing mode: photometry mode and scan mode**.

Dependence on observing mode (photometry vs. scan). At 24microns we find no statistical differences in the quality of flatfields obtained in photometry mode and scan mode for number of combined DCE > 60. At 70 and 160microns we find that in general ICs observed in scan mode are of equal or better quality than those obtained in photometry mode. Note that in John's report he found that at 160micron ICs obtained in scan mode had lower S/N. We find however that at 160microns there is a strong dependence on the cirrus component (see below), so a direct comparison between ICs obtained in photometry and scan mode is difficult because, according to the simulations, the cirrus structure changes on scales similar to the fields covered by the observations.

Dependence on the number of combined DCEs We find that our results on the statistical quality of simulated ICs (70 and 160microns) in terms of the number of combined DCEs are different from those in John Stansberry's report because Herve Dole's previous simulations of the sky overestimated the number of sources at all three wavelengths. At 24microns 60DCEs or more DCEs (depending on zodi brightness) will produce flatfields to better than 0.5%RMS for zodi brightness of 20, 30 and 40MJy/strd, and Galactic column densities of NH=10^{20}atoms/cm2 and NH=10^{21}atoms/cm2. At 70micron between 100DCEs and 200DCEs (depending on zodi brightness and Galactic column density) will produce ICs to better than 0.5%. The most complicated situation appears to be at 160microns, where we find that the number of DCEs required to produce an IC to better than 1% varies between 300 and 500DCEs depending on the zodi brightness and especially the cirrus component.

Dependence on the zodi brightness We have simulated flatfields for zodi brightness at 24micron of 20, 30 and 40MJy/sr (or zodi brightness at 70microns of 5.3, 8 and 10.6MJy/sr, or zodi brighness at 160microns of 0.9, 1.3 and 1.8MJy/sr) for Galactic HI column densities of log NH=20 and log NH=21. For the case of lowest zodi brightness at 24microns we find that 60DCEs −that is, number of DCEs observed every time a flatfield in photometry mode is obtained − will always produce a flatfield with RMS of 0.5%. Flatfields

observed at higher zodi brightnesses will always produce RMS better than 0.5%. In scan mode we will observe ~118DCE which results in RMS of between 0.3% and 0.2% depending of the 24micron zodi brightness. At 70 and 160 microns higher zodi brightnesses also produce higher S/N Ics, but the main factor determining the quality of the ICs is the cirrus component (especially at 160micron).

Dependence on the Galactic column density (cirrus component). The effect of the cirrus component is most significant at 70 and 160microns, so extra care will be necessary when median combining DCEs. It may be required to throw away DCEs with a bright cirrus component when constructing Ics as they can significantly degrade the quality of the IC.

1. Introduction: Flatfields and ICs during IOC

Briefly, during IOC we will obtain routine Flatfields and IC using the two standard observing modes: photometry and scan. For a detailed description of the IOC flatfield/IC tasks we refer the reader to the IOC cookbooks of tasks MIPS−914, MIPS−915, MIPS−916, MIPS−917, MIPS−918 and MIPS−919.

In this report we will investigate the statistical quality of SIMULATED flatfields and ICs as a function of number of combined DCEs, Galactic column density and zodi brightness at 24micron −since we will try to use the same region of the sky to obtain flatfields and ICs at all three wavelengths.

There are a number of differences with respect to John Stansberry's flatfield report:

i. **We make use of simulated RAW datasets (produced using mips_simulator) which include photon noise. The datasets are reduced using the UofA pipeline (mips_sloper).**

ii. **We make use of Herve Dole's newest simulations as released January 31st 2003. Previous simulations overestimated the number of sources at all three MIPS wavelengths.**

iii. **We analize the quality of simulated flatfields and ICs in terms of the zodi brightness and HI column density (cirrus).**

iv. **We analyze the quality of simulated flatfields and ICs in terms of the observing mode: photometry mode and scan mode**.

1.1 − Some notes on Herve Dole's simulations

The "normal" zodi SED at high ecliptic latitude is:

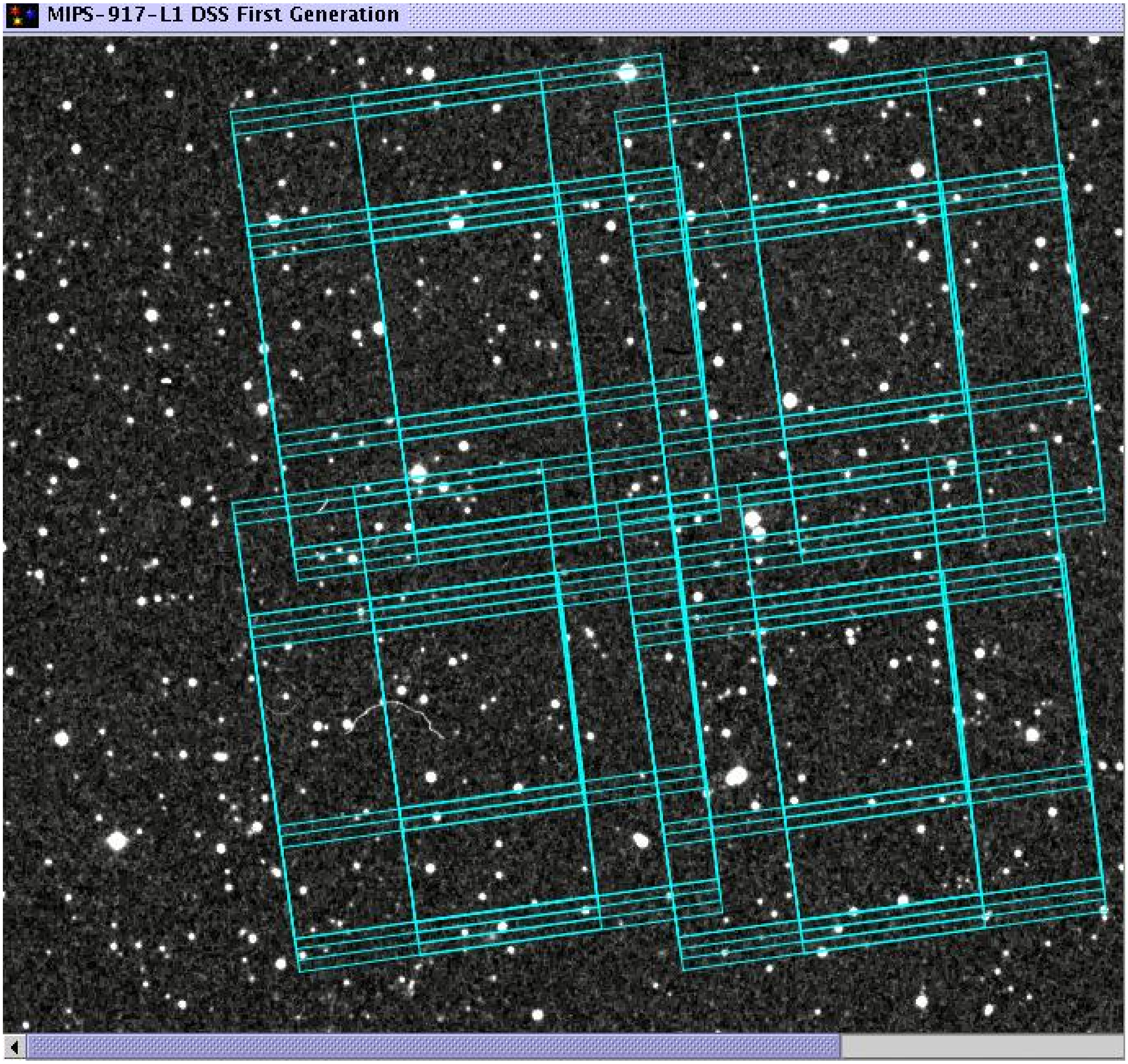
- at 24microns: 27.30 MJy/sr
- at 70microns: 7.29 MJy/sr
- at 160microns: 1.21 MJy/sr

A fixed factor (ie the same at 24, 70 and 160) was applied to generate the maps with zodi brightnesses at 24microns of 20, 30 and 40MJy/sr. The conversion from Galactic HI column density (cirrus component), used the cirrus SED from Boulanger et al. A cirrus of NH=10^{20}atoms/cm^2 has a brightness

- at 24microns: 0.03 MJy/sr
- at 70microns: 0.12 MJy/sr
- at 160microns: 1.5 MJy/sr

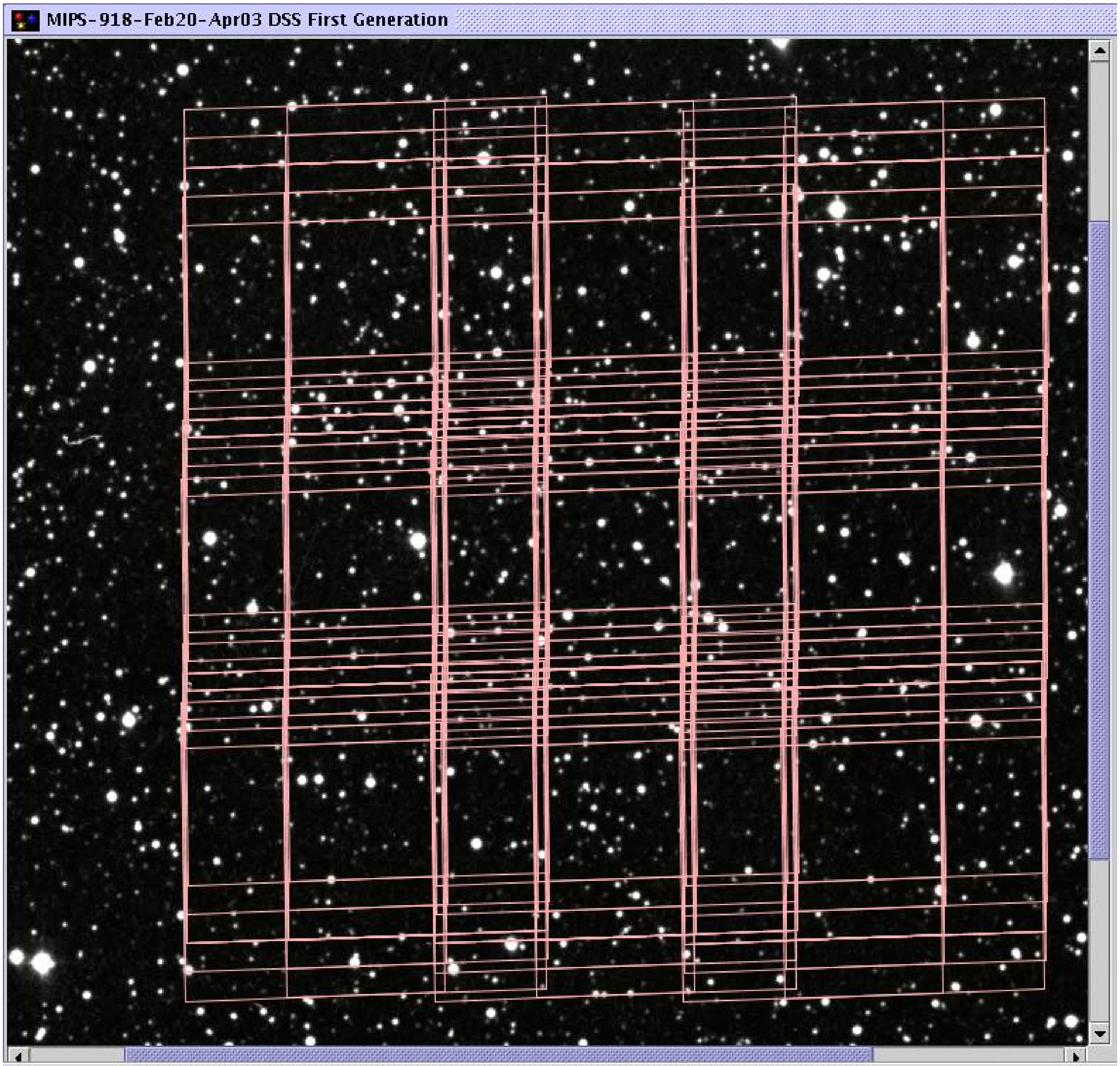
1.2 − 24micron Routine Photometry Flatfields

The IOC task to obtain Routine Flatfields in Photometry Mode is MIPS−917. A 4 point dither map (1 cycle) will be obtained at 24microns with 3 second DCEs in a region of the sky chosen to avoid bright point sources. The offsets between positions are 400 arcseconds. At each position of the dither pattern there will be 14 images, so a total of 56 images will be obtained each time the task is executed. The map will require about 10.3 minutes of observing time. This is the AOR file overlaid on the sky:



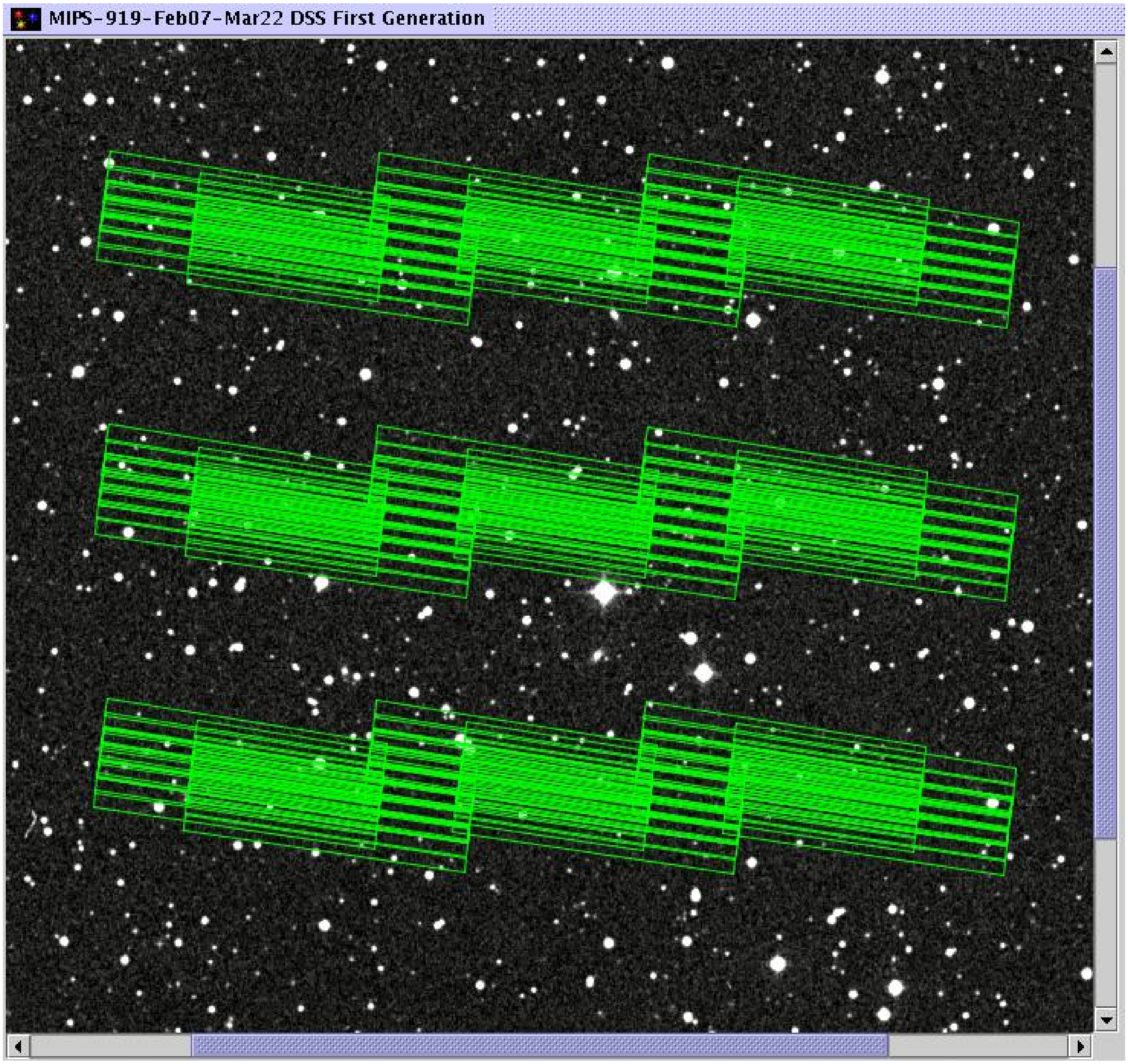
1.3 − 70micron Routine photometry ICs

The IOC task to obtain 70 micron IC in photometry mode is MIPS−918. A 3x3 square dither map (1 cycle) will be obtained at 70microns with 3 second DCEs in a region of the sky chosen to avoid bright point sources. The offsets are 300 arcseconds. At each position there will be 12 images, so a total of 108 images will be produced each time this task is excecuted. The map will require about 21.0 minutes of observing time. This is the AOR file overlaid on the sky:



1.4 160micron Routine Photometry ICs

The IOC task to obtain 160 micron IC in photometry mode is MIPS−919. A 3x3 square dither map (1 cycle) will be obtained at 160micron with 3 second DCEs in a region of the sky chosen to avoid bright point sources. The offsets are 300 arcseconds. At each position there will be 12 images, so a total of 108 images will be obtained each time this task is executed. The map will require about 21.0 minutes of observing time. This is the AOR file overlaid on the sky:



1.5 24, 70 and 160micron Routine Scan Flatfields and ICs

A 2 degree long (1 leg) scan map will be obtained using the fast scan AOT in a region of the sky chosen to avoid bright point sources. This will produce a total of 118 images per wavelength to be median combined to produce flatfields and ICs. The map will require about 12.7 minutes of observing time. The IOC tasks are MIPS−914, MIPS−915 and MIPS−916.

2. Simulation of Flatfields and ICs: producing raw data and data reduction

This report presents results on the statistical quality of SIMULATED Flatfields and Illumination Corrections to be taken during IOC, as an extension of the report wrote by John Stansberry. The main differences with respect to the previous report are the following:

- We used the latest Herve Dole's simulations (as of January 2003) of the sky at 24, 70 and 160microns with two different values of the column density: NH=10^{20}atoms/cm^2 and NH=10^{21}atoms/cm^2. We used three different 24micron zodi brightnesses to investigate the effect of the zodi brightness on the S/N of the flatfields:
    - 20MJy/sr
    - 30 MJy/sr
    - 40 Mjy/sr
- We used *mips_simulator* (includes photon noise) in conjunction with the AOR files (see cookbooks) to be used during IOC to simulate raw data at all three wavelengths. In particular we investigate the flatfields/ICs to be obtained in:
    - photometry mode. This shows how we simulated raw data at 24micron for one pointing in photometry mode.

```
mips_simulator -r -p -a 24 map_obslf_2048_0024_nh20.0.zodi20.fits flat-
phot-24micron.aor -o flatzodi20_phot24_pos1
```

    - scan mode. This is an example of simulated scan data. Note that because the size of Herve's maps is 1.24x1.24 square degrees, the 2−degree scan maps had to be simulated in two steps:

```
mips_simulator -r -p -a 24 map_obslf_2048_0024_nh20.0.zodi20.fits flat-
phot-24micron.aor -o flatzodi20_phot24_pos1
```

- We did the data reduction using *mips_sloper*, eg, for 24micron data:

```
mips_sloper -oa -oc -b -d -l flatzodi20_phot24_pos10.24.raw.fits
```

and for 70micron data:

```
mips_sloper -l -oa -oc flatzodi20_phot70_pos10.70.raw.fits
```

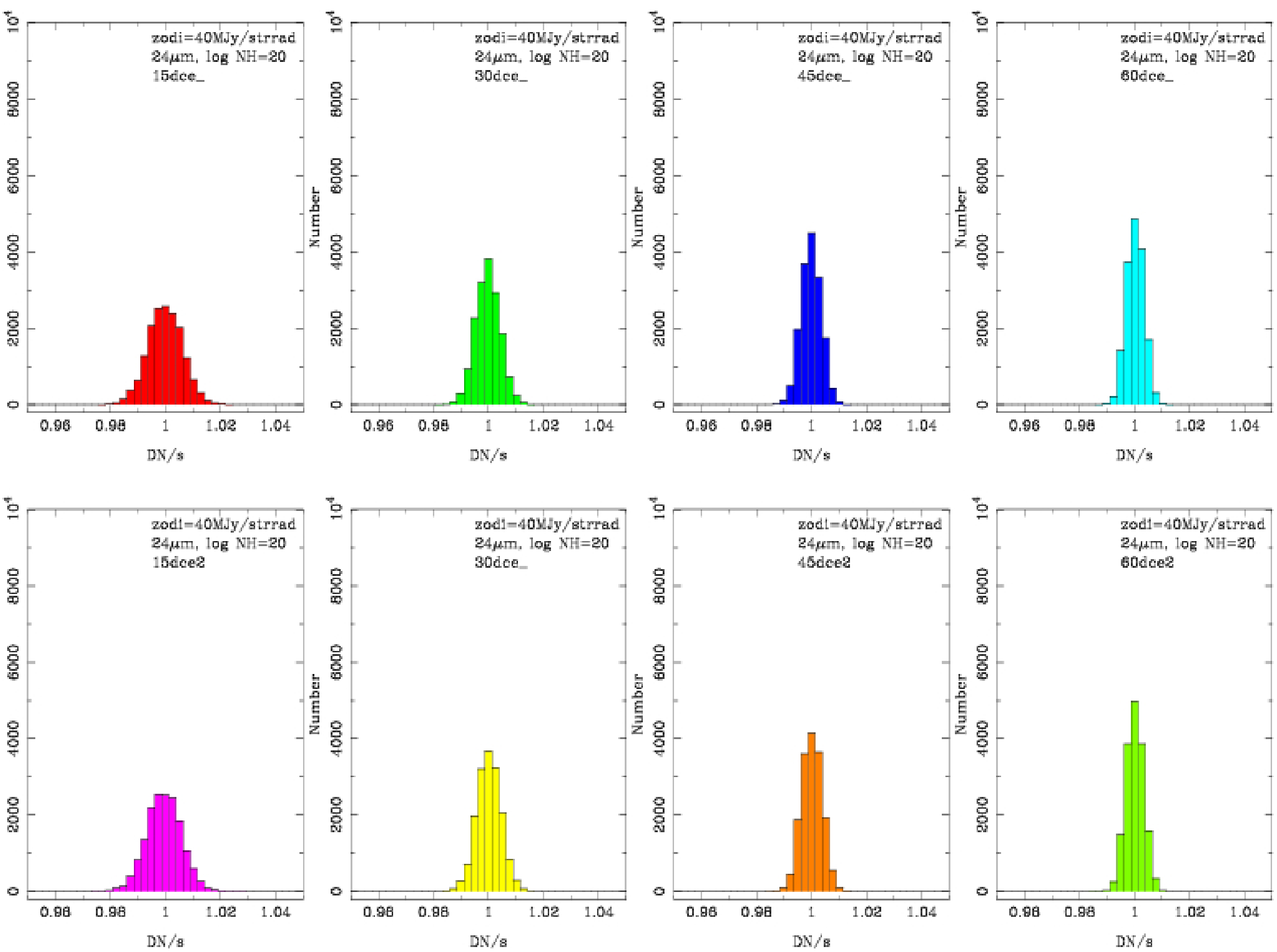
At the time of the writing of this report we were not able to run *mips_caler* on the reduced data because of some missing keyword in the header regarding the stim flash frequency. We subtracted the dark images using *imarith* in IRAF

- reduced DCEs were median combined (with sigma rejection) and normalized to unity to produce flatfields and illumination corrections using **IRAF tasks *imcombine* and *bscale***

3. Results for Flatfields/ICs obtained in Photometry Mode

In what follows we show the dependence of the qualitiy of the flatfields/ICs obtained in photometry mode as a function of the number of DCEs and zodi brightness.

Results at 24micron



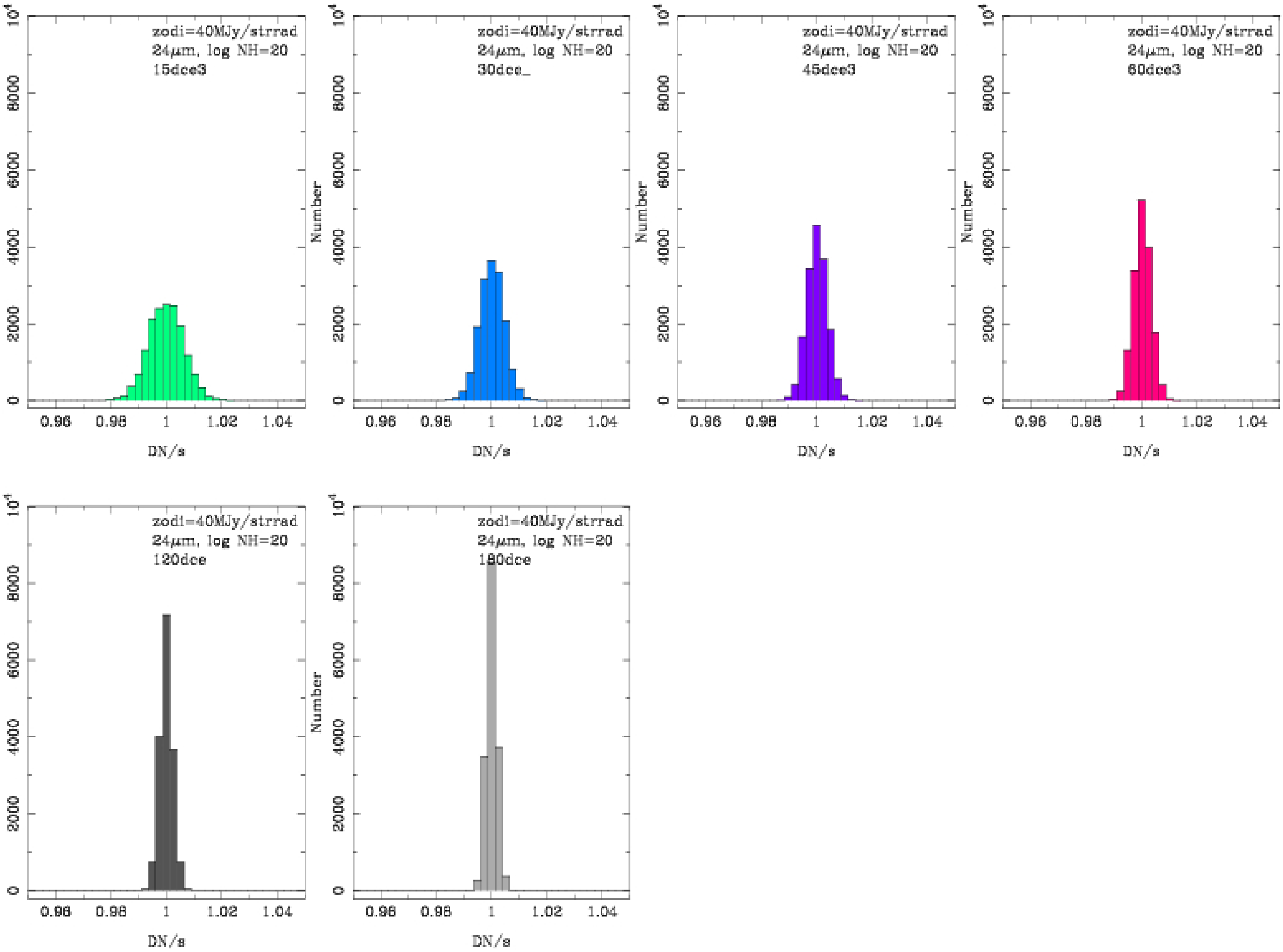


Figure 1: Histograms of simulated **24micron routine PHOTOMETRY MODE** flatfields for **zodi brightness=40MJy/sr**, for different choices of fields (first top three panels, rightmost graphs=60DCEs, represent the case of executing the IOC task once). The bottom panel shows the combination of two (=120DCEs) and three (=180DCE) fields. Galactic Column Density NH=10^{20}atoms/cm^{2}.

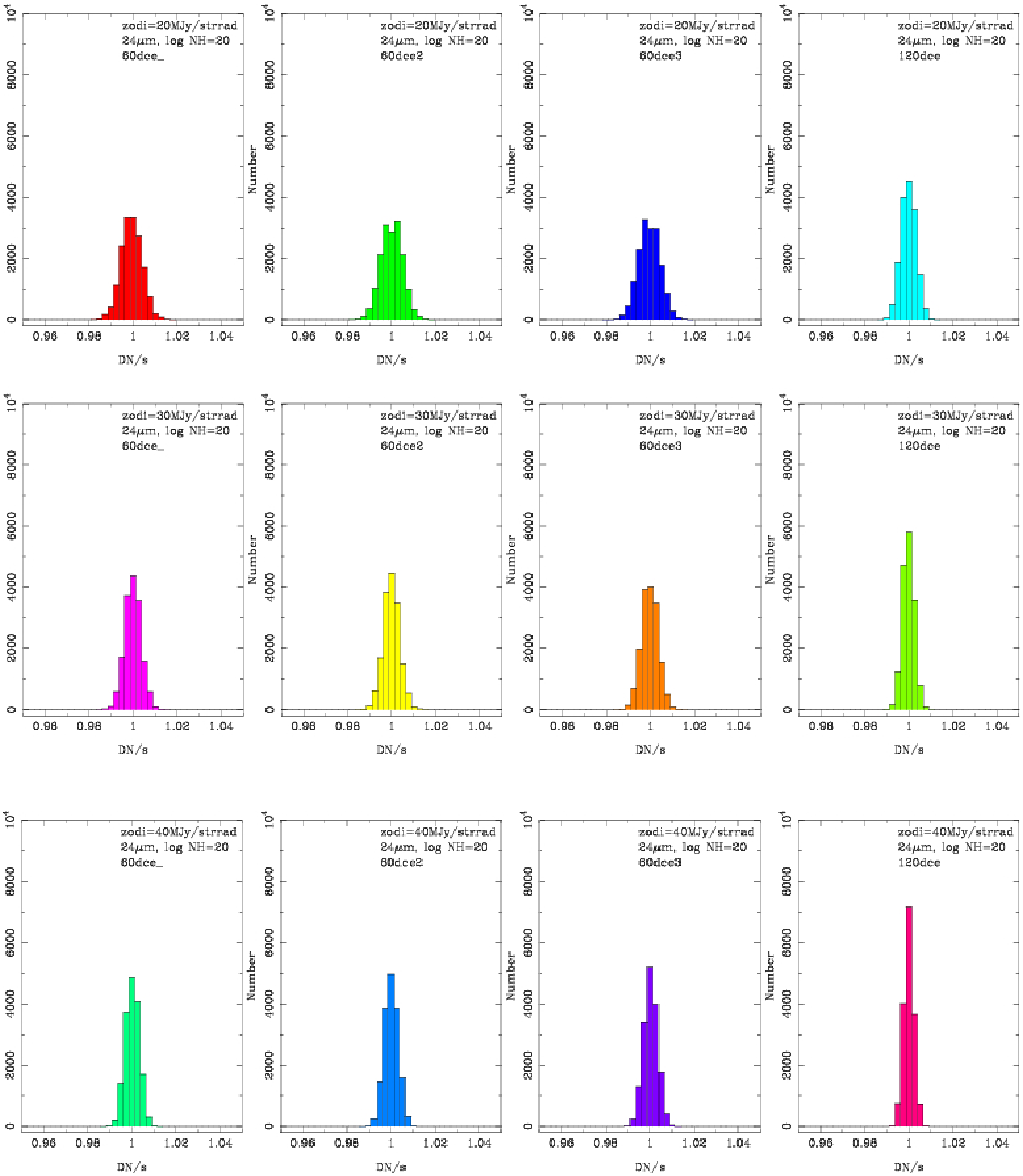

zodi=20MJy/strrad
24μm, log NH=20
60dce_
zodi=20MJy/strrad
24μm, log NH=20
60dce2
zodi=20MJy/strrad
24μm, log NH=20
60dce3
zodi=20MJy/strrad
24μm, log NH=20
120dce
zodi=30MJy/strrad
24μm, log NH=20
60dce_
zodi=30MJy/strrad
24μm, log NH=20
60dce2
zodi=30MJy/strrad
24μm, log NH=20
60dce3
zodi=30MJy/strrad
24μm, log NH=20
120dce
zodi=40MJy/strrad
24μm, log NH=20
60dce_
zodi=40MJy/strrad
24μm, log NH=20
60dce2
zodi=40MJy/strrad
24μm, log NH=20
60dce3
zodi=40MJy/strrad
24μm, log NH=20
120dce
Number
DN/s
0.96
0.98
1
1.02
1.04
0
2000
4000
6000
8000
10^4

Figure 2: Effect of the zodi brightness (top panel=20MJy/sr, mid panel=30MJy/sr, bottom panel=40MJy/sr) on the S/N of different simulated flatfields obtained in **PHOTOMETRY mode at 24micron**. The three leftmost panels show flatfields constructed with 60DCEs, the rightmost panels are flatfields constructed with 120DCEs. Galactic Column Density NH=10^{20}atoms/cm^2.

The following tables (Table1 and Table2) give the statistics of the simulated flatfields in photometry mode at 24microns as a function of number of DCEs, field and zodi brightness, where sigma is the standard deviation (in %) over the array, and skew is the skewness of the distribution of DN/s. Table 1 is for Galactic Column Density of NH=10^{20}atoms/cm2 and Table 2 is for NH=10^{21}atoms/cm2.

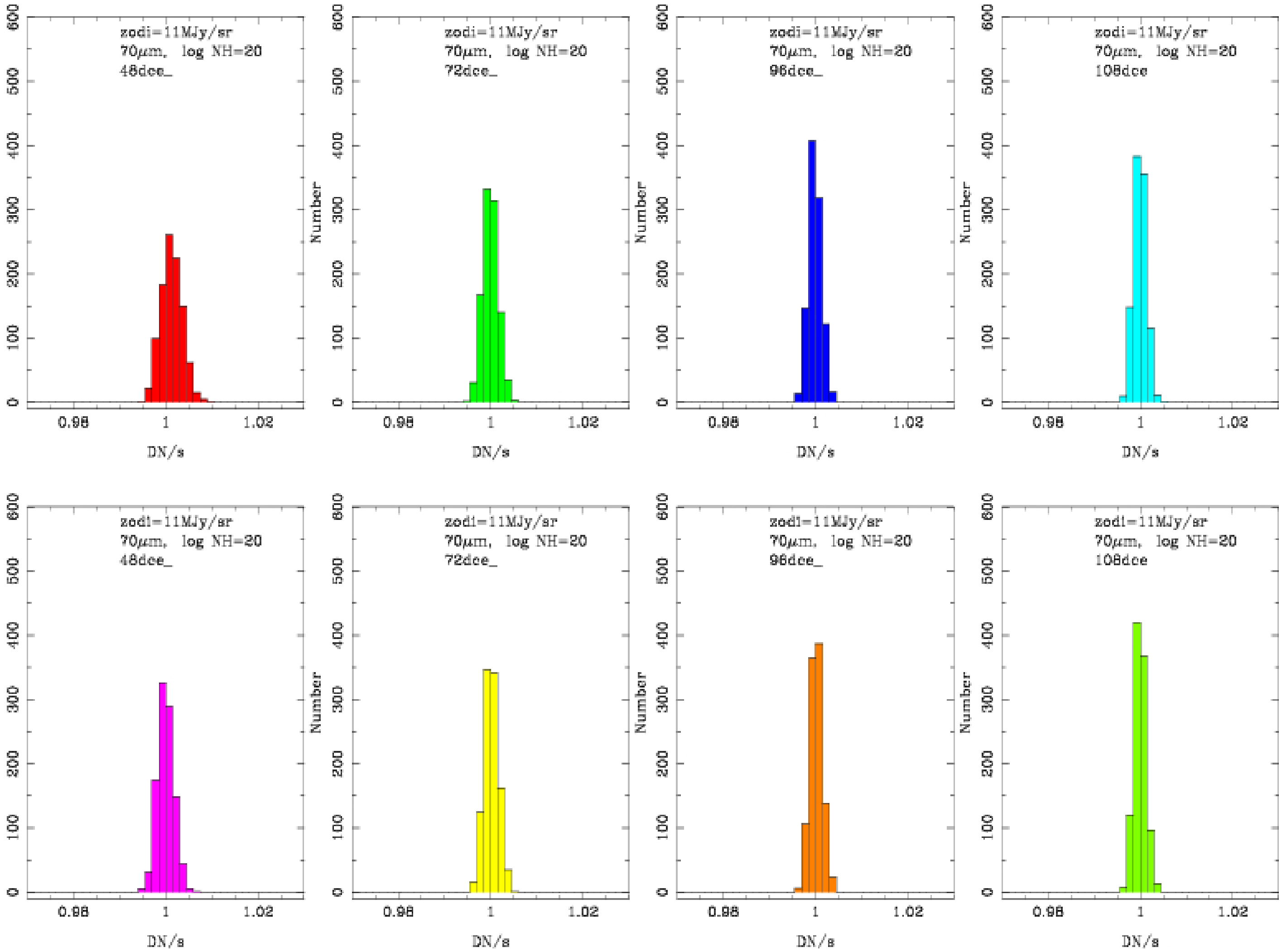
Table 1: Statistics for 24 μm Simulated Flatfields obtained in Photometry Mode. Galactic Column Density $N_H = 10^{20}$ atoms cm^{-2}.

	no. DCE	Median	σ (%)	skew
zodi=20MJy/strd at 24 μm				
Field 1	30	0.99902	0.66975	0.01809
	45	0.99869	0.55260	0.00537
	60	0.99901	0.47692	0.01059
Field 2	30	1.00000	0.66918	-0.00304
	45	1.00001	0.55358	-0.02702
	60	1.00001	0.47908	-0.02594
Field 3	30	0.99967	0.66681	-0.01862
	45	0.99901	0.55139	0.02618
	60	0.99934	0.47817	0.00459
	120	0.99968	0.33960	0.00577
	180	0.99967	0.27804	0.01335
zodi=30MJy/strd at 24 μm				
Field 1	30	0.99978	0.51701	-0.02518
	45	0.99956	0.43247	-0.00691
	60	1.00000	0.37290	0.00476
Field 2	30	0.99956	0.51721	0.01599
	45	0.99956	0.42978	0.01363
	60	0.99978	0.37049	0.02252
Field 3	30	1.00000	0.52432	-0.02091
	45	1.00000	0.43228	0.03318
	60	0.99956	0.37373	0.01354
	120	0.99956	0.26422	0.01744
	180	1.00000	0.21640	0.01669
zodi=40MJy/strd at 24 μm.				
Field 1	30	0.99966	0.43696	0.03058
	45	0.99967	0.36336	0.00243
	60	1.00017	0.31150	-0.01128
Field 2	30	1.00016	0.43631	-0.00822
	45	1.00000	0.36171	0.00829
	60	1.00000	0.31252	0.02348
Field 3	30	1.00017	0.43770	0.02334
	45	1.00033	0.36303	0.01349
	60	1.00034	0.31218	0.01509
	120	0.99984	0.22245	-0.00320
	180	1.00000	0.18266	-0.02240

Table 2: Statistics for 24 μm Simulated Flatfields obtained in Photometry Mode. Galactic Column Density $N_H = 10^{21}$ atoms cm^{-2}.

	no. DCE	Median	σ (%)	skew
zodi=20MJy/strd at 24 μm				
Field 1	30	0.99967	0.65953	0.02411
	45	1.00099	0.54788	0.00824
	60	1.00031	0.47215	0.00451
Field 2	30	1.00133	0.66757	0.01545
	45	1.00067	0.55481	0.00939
	60	1.00001	0.48083	-0.01182
Field 3	30	0.99967	0.66242	0.02230
	45	0.99999	0.55208	0.00765
	60	1.00032	0.48009	-0.00544
	120	1.00034	0.33967	0.01378
	180	1.00032	0.28097	-0.01568
zodi=30MJy/strd at 24 μm				
Field 1	30	0.99955	0.51908	0.00805
	45	1.00022	0.42950	-0.00457
	60	1.00000	0.37064	-0.00045
Field 2	30	1.00001	0.51924	0.01466
	45	1.00067	0.43290	0.01345
	60	1.00001	0.37397	0.03050
Field 3	30	1.00044	0.52152	0.03092
	45	1.00000	0.43291	0.01719
	60	1.00000	0.37525	0.00435
	120	1.00000	0.26466	-0.00033
	180	1.00022	0.21711	0.03655
zodi=40MJy/strd at 24 μm.				
Field 1	30	0.99950	0.43843	0.00805
	45	0.99983	0.36165	0.01138
	60	1.00000	0.31407	0.00704
Field 2	30	1.00051	0.43379	-0.03347
	45	1.00051	0.36367	-0.01831
	60	1.00050	0.31210	-0.03242
Field 3	30	0.99967	0.43483	0.00857
	45	0.99984	0.36265	-0.01142
	60	1.00000	0.31230	-0.02146
	120	1.00016	0.22235	-0.03442
	180	0.99967	0.18258	-0.04582

Results at 70micron



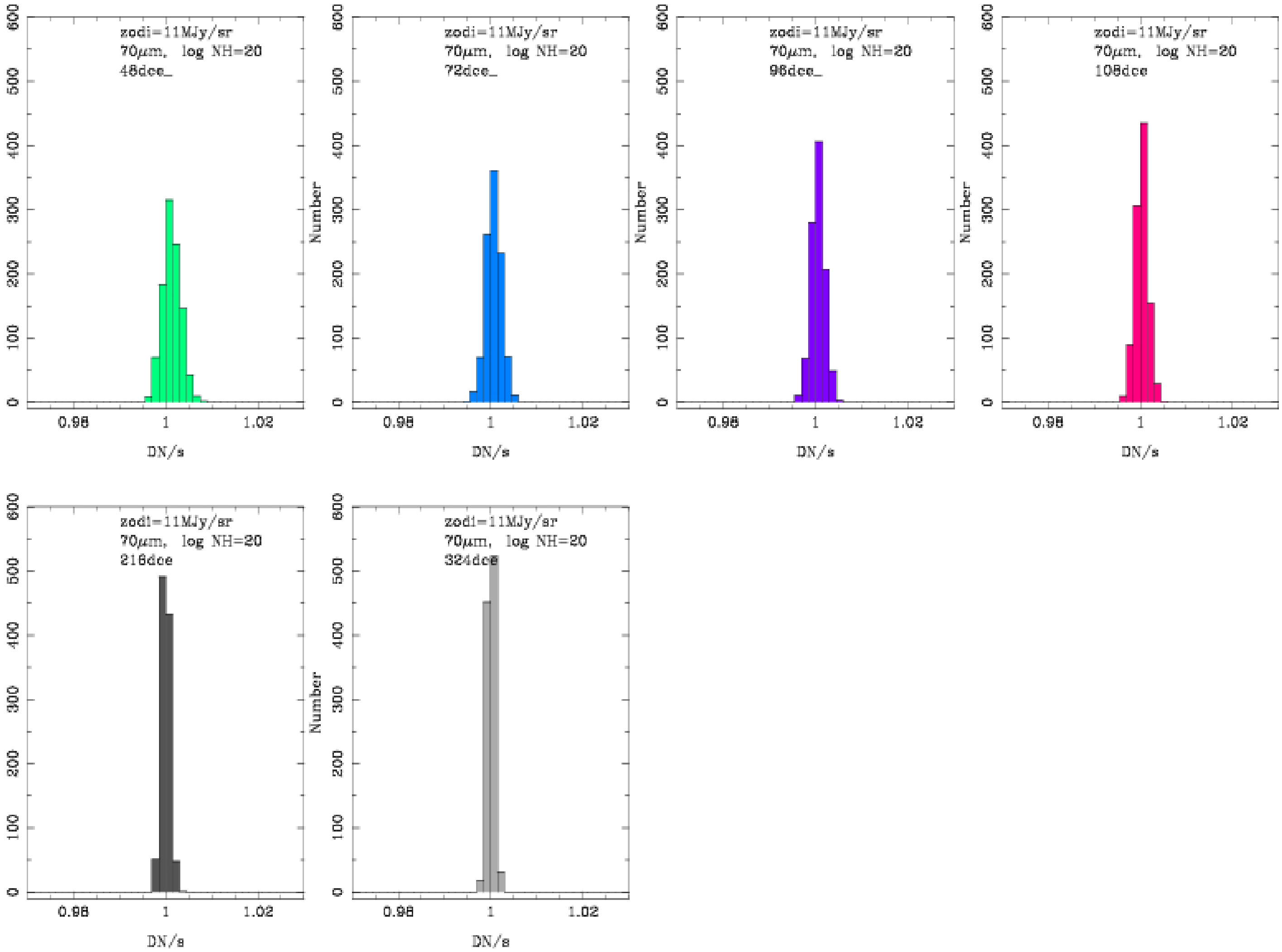


Figure 3: Histograms of simulated **70micron routine PHOTOMETRY mode** ICs for **zodi brightness(70micron)=11MJy/sr** for different choices of fields (first three panels from top, rightmost graphs=108DCEs represent the case of executing the IOC task once). The bottom panel shows the combination of two (=216DCEs) and three (=324DCE) fields. Galactic Column Density NH=10^{20}atoms/cm^2.

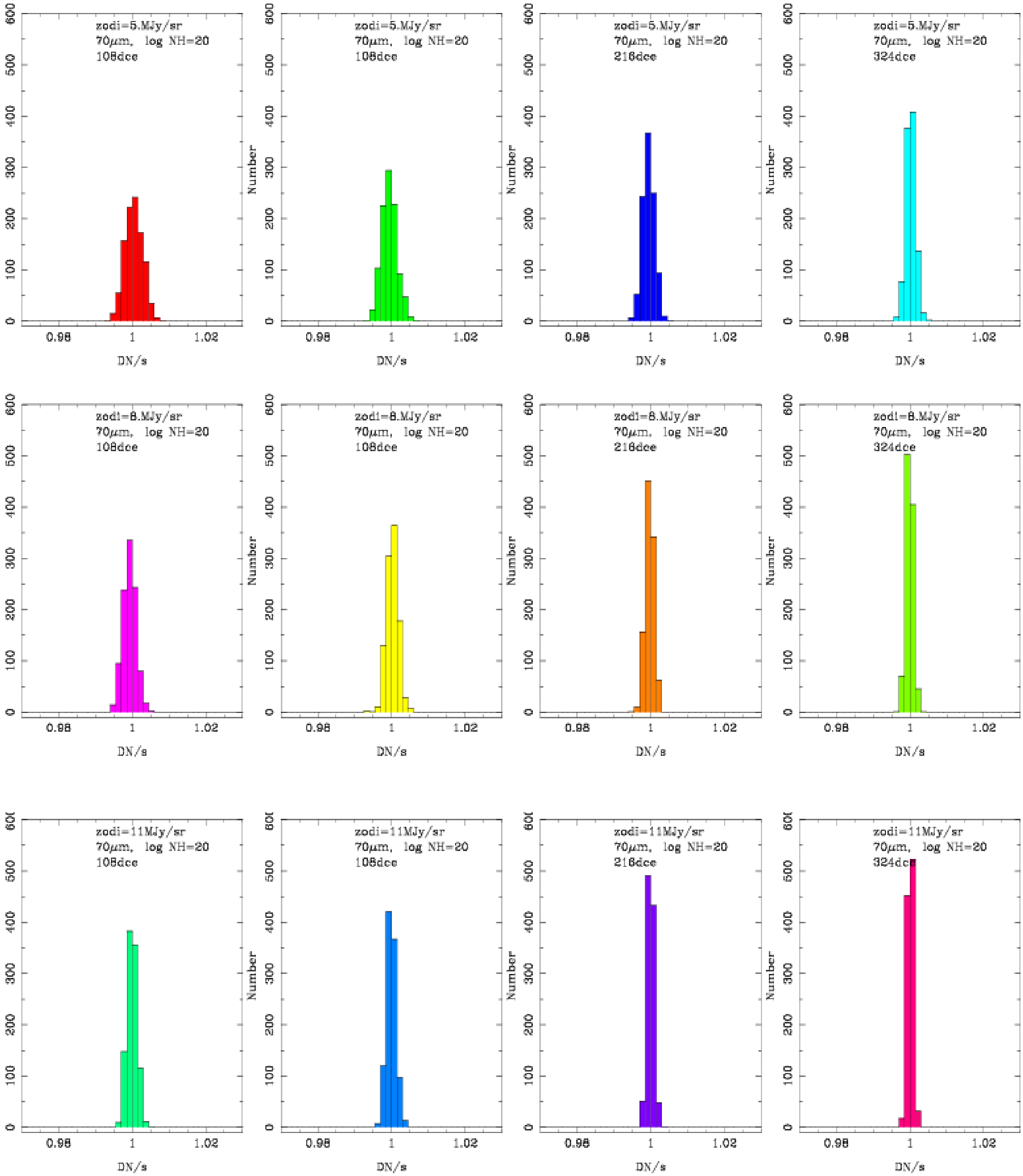

zodi=5.MJy/sr
70μm, log NH=20
108dce
zodi=5.MJy/sr
70μm, log NH=20
108dce
zodi=5.MJy/sr
70μm, log NH=20
216dce
zodi=5.MJy/sr
70μm, log NH=20
324dce
zodi=8.MJy/sr
70μm, log NH=20
108dce
zodi=8.MJy/sr
70μm, log NH=20
108dce
zodi=8.MJy/sr
70μm, log NH=20
216dce
zodi=8.MJy/sr
70μm, log NH=20
324dce
zodi=11MJy/sr
70μm, log NH=20
108dce
zodi=11MJy/sr
70μm, log NH=20
108dce
zodi=11MJy/sr
70μm, log NH=20
216dce
zodi=11MJy/sr
70μm, log NH=20
324dce
Number
DN/s
0.98
1
1.02
0
100
200
300
400
500
600

Figure4: Simulated **70micron ICs** in **PHOTOMETRY mode in terms of the zodi brightness** (top panel=5.3MJy/sr, mid panel=8.MJy/sr, bottom panel=10.6MJy/sr). The two leftmost panels show flatfields constructed with 108DCEs (number of DCEs obtained everytime the task is executed for two different fields), the other panels are flatfields constructed combining 2 and 3 fields. Galactic Column Density NH=10^{20}atoms/cm^2.

The following tables (Tables 3 and Table 4) give the statistics of the simulated ICs at 70microns in terms of number of DCEs, field used and zodi brightness, where sigma is the standard deviation (%) over the array, and skew is the skewness of the distribution of DN/s. Table 3 is for Galactic Column Density of NH=10^{20}atoms/cm2 and Table 4 is for NH=10^{21}atoms/cm^2.

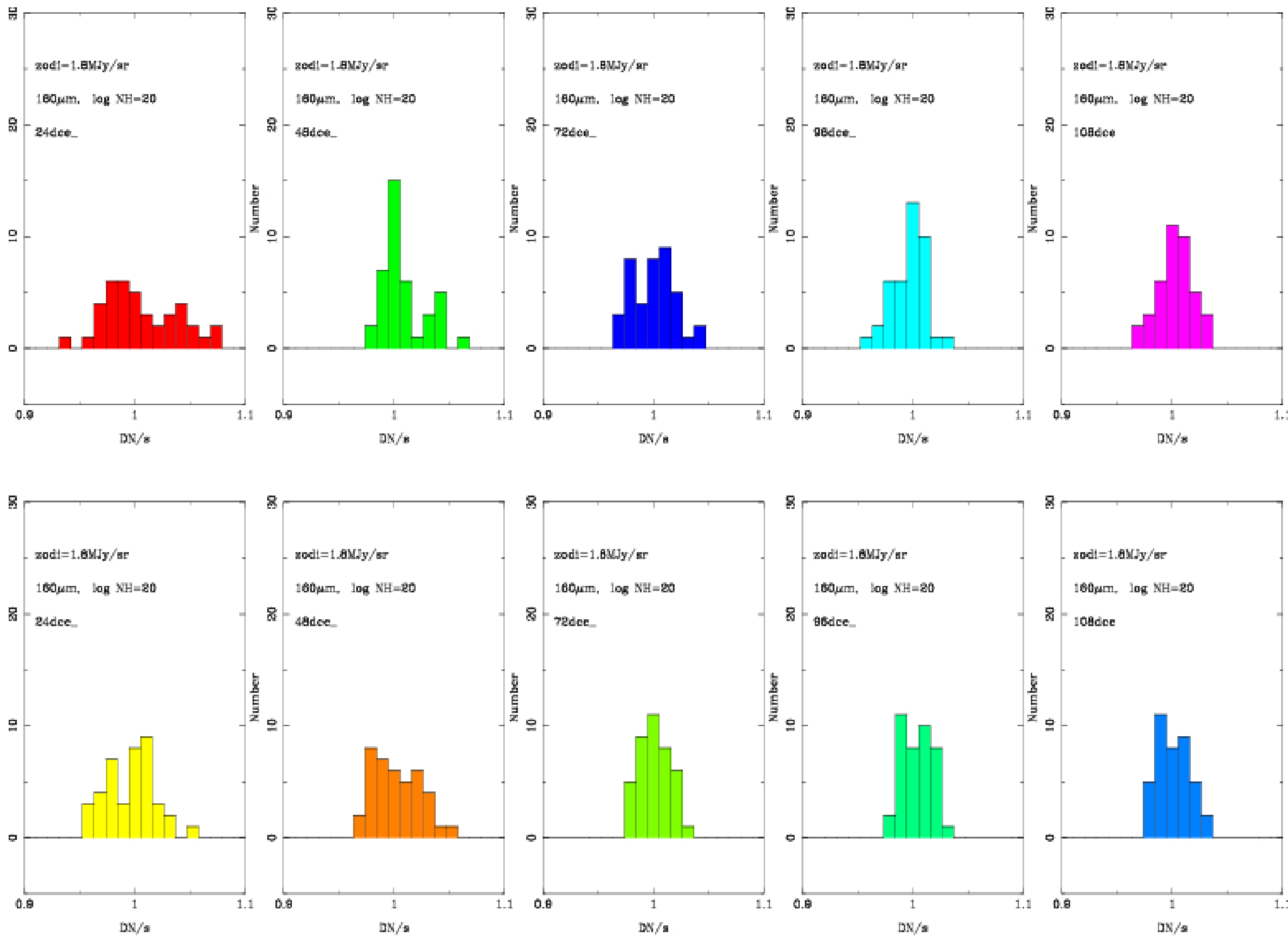
Table 3: Statistics for 70 μm Simulated Flatfields obtained in Photometry Mode. Galactic Column Density $N_{\rm H} = 10^{20}$ atoms cm^{-2}.

	no. DCE	Median	σ (%)	skew
zodi=5.3MJy/sr at 70 μm				
Field 1	72	1.00071	0.28997	0.02632
	96	0.99990	0.24245	0.02089
	108	1.00039	0.23575	0.07619
Field 2	72	0.99903	0.24198	0.20303
	96	0.99955	0.21289	0.20619
	108	0.99925	0.20817	0.24711
Field 3	72	1.00056	0.27597	0.14281
	96	1.00051	0.24045	0.12528
	108	1.00012	0.22611	0.03802
	216	0.99939	0.15777	0.07208
	324	1.00016	0.12905	0.17698
zodi=8MJy/sr at 70 μm				
Field 1	72	0.99954	0.21845	0.18513
	96	0.99932	0.17943	0.06616
	108	0.99919	0.17650	0.06201
Field 2	72	1.00039	0.18346	-0.05798
	96	1.00030	0.16473	0.07727
	108	1.00025	0.15848	-0.03643
Field 3	72	1.00088	0.19398	0.28373
	96	1.00044	0.17367	0.13372
	108	0.99996	0.16291	0.07497
	216	0.99969	0.11737	-0.08602
	324	0.99983	0.09499	-0.04757
zodi=10.6MJy/sr at 70 μm.				
Field 1	72	0.99990	0.16609	0.16193
	96	0.99982	0.13884	0.21686
	108	0.99990	0.13550	0.21774
Field 2	72	1.00008	0.14807	0.11464
	96	1.00013	0.13314	0.12069
	108	0.99988	0.12625	0.15129
Field 3	72	1.00069	0.16536	0.00012
	96	1.00054	0.14725	0.01922
	108	1.00032	0.13921	0.05552
	216	0.99991	0.08976	0.12316
	324	1.00007	0.07586	0.16001

Table 4: Statistics for 70 μm Simulated Flatfields obtained in Photometry Mode. Galactic Column Density $N_{\rm H} = 10^{21}$ atoms cm^{-2}.

	no. DCE	Median	σ (%)	skew
zodi=5.3MJy/sr at 70 μm				
Field 1	72	0.99843	0.39835	-0.20517
	96	0.99766	0.39140	-0.40016
	108	0.99881	0.32902	-0.12483
Field 2	72	0.99881	0.27112	0.15631
	96	0.99968	0.24382	0.26192
	108	0.99945	0.23155	0.19988
Field 3	72	1.00328	0.85383	-0.11473
	96	1.00092	0.83469	-0.02280
	108	0.99944	0.88398	-0.01172
	216	0.99981	0.20080	0.26238
	324	1.00086	0.23265	0.54323
zodi=8MJy/sr at 70 μm				
Field 1	72	0.99957	0.26363	-0.13950
	96	1.00012	0.25324	-0.28022
	108	0.99960	0.21987	-0.15885
Field 2	72	1.00058	0.19736	0.06628
	96	0.99980	0.17379	0.25601
	108	0.99994	0.16307	0.15673
Field 3	72	1.00291	0.60586	-0.13657
	96	1.00083	0.59305	-0.11521
	108	0.99948	0.62219	-0.10534
	216	0.99987	0.14182	0.11887
	324	1.00068	0.16007	0.37712
zodi=10.6MJy/sr at 70 μm.				
Field 1	72	0.99993	0.21137	-0.05008
	96	1.00004	0.20469	-0.24325
	108	1.00038	0.17901	-0.06418
Field 2	72	1.00000	0.15611	0.10477
	96	0.99987	0.13930	0.17589
	108	0.99936	0.13427	0.15743
Field 3	72	1.00029	0.47162	-0.13153
	96	1.00164	0.46357	-0.06259
	108	1.00161	0.48146	0.00319
	216	0.99964	0.11105	0.15059
	324	0.99979	0.12744	0.27807

Results at 160micron



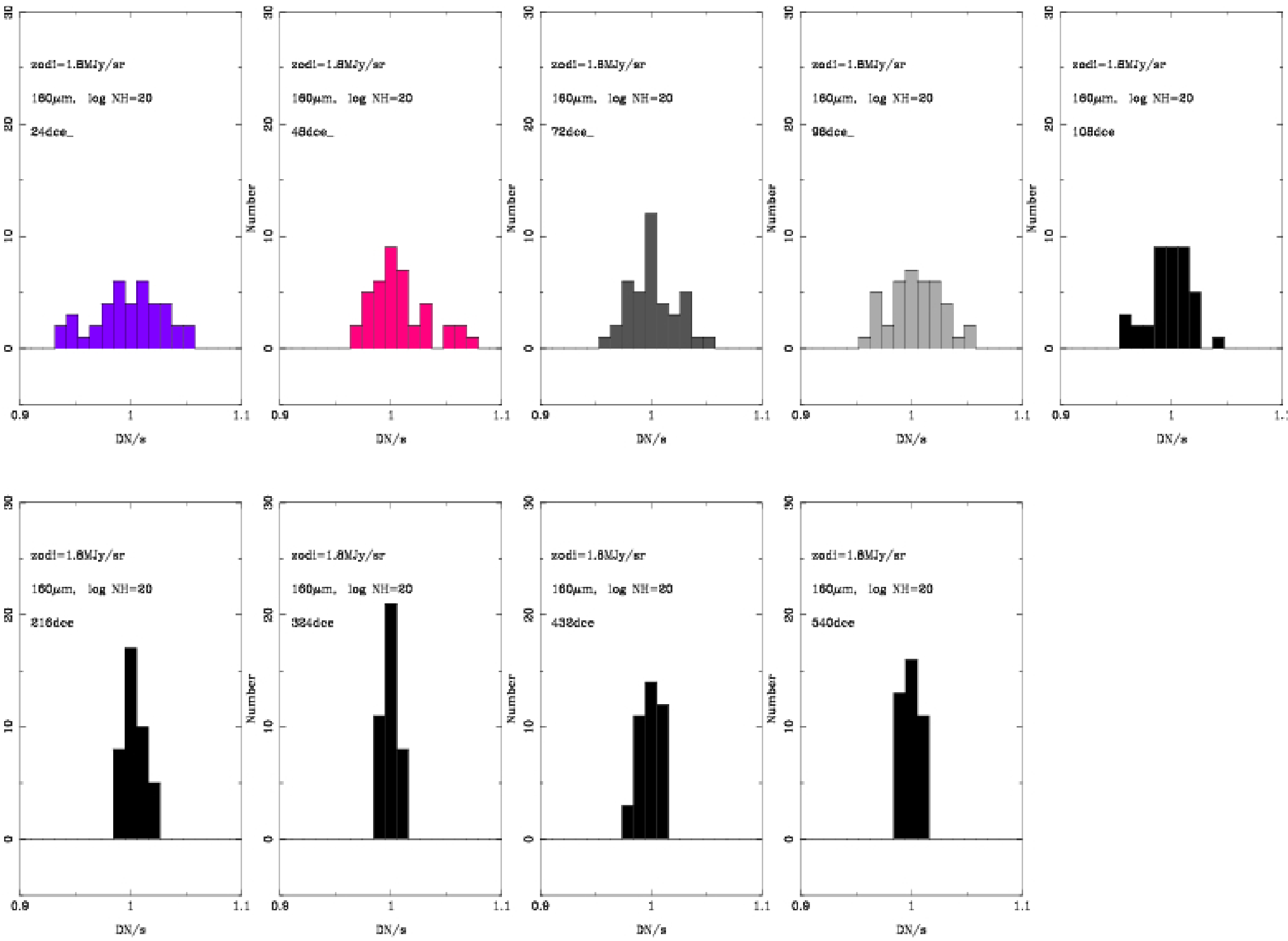


Figure 5: Histograms of simulated **160micron routine PHOTOMETRY IC** for **zodi brightness(160micron)=1.8MJy/sr,** for different choices of fields (first three panels from top, rightmost graphs=108DCEs represent the case of executing the IOC task once). The bottom panel shows Ics constructed by combining two (=216DCEs), three (=324DCE), four (=432DCE) and five (=540DCE) fields. Galactic Column Density NH=10^{20}atoms/cm^2.

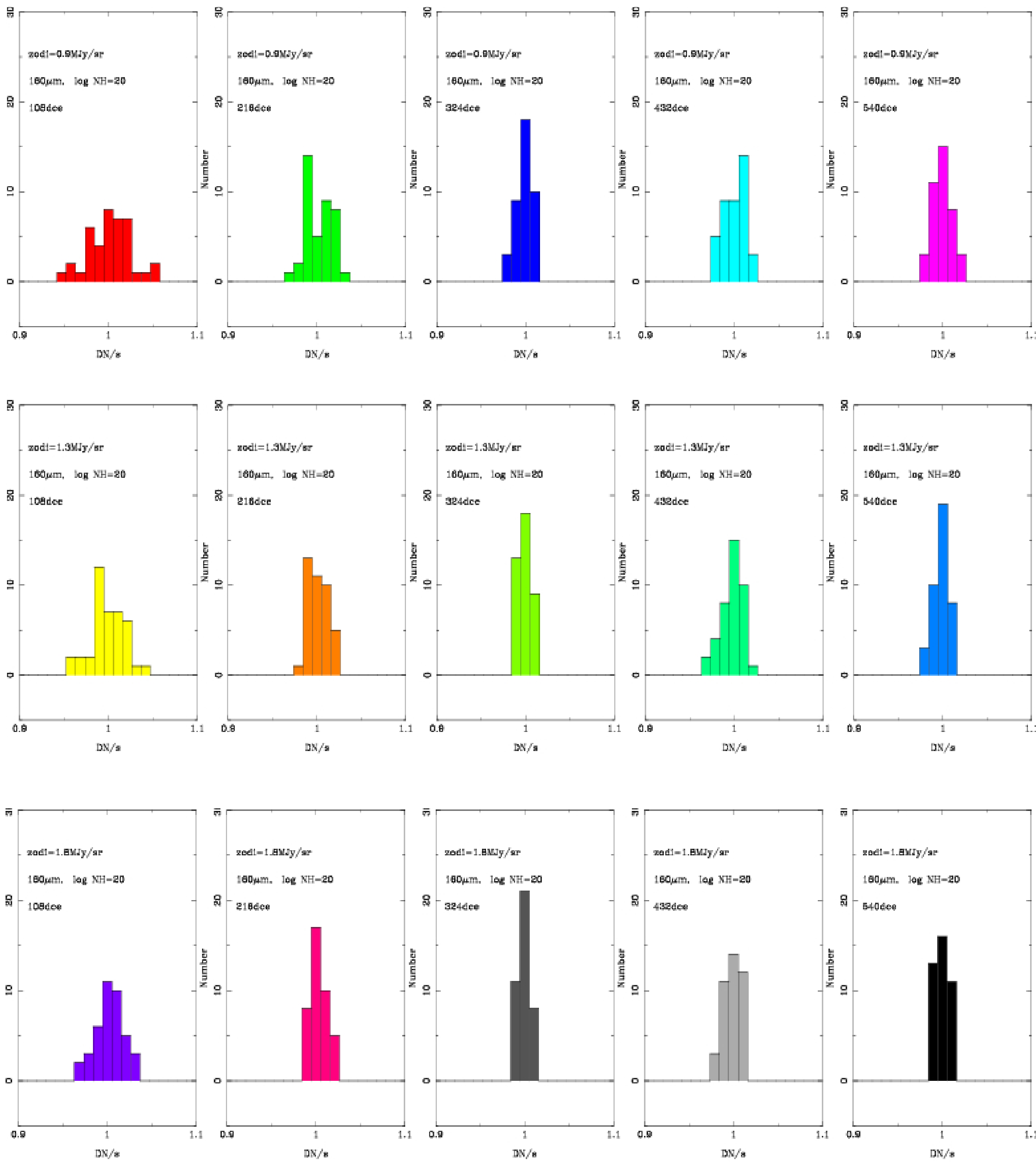


Figure6: Simulated 160micron ICs obtained in **PHOTOMETRY as a function of the zodi brightness** (top panel=0.9MJy/sr, mid panel=1.3MJy/sr, bottom panel=1.8MJy/sr). The leftmost panels show flatfields

constructed with 108DCEs (number of DCEs obtained everytime the task is executed), the other panels are flatfields constructed combining 2, 3, 4 and 4 fields.Galactic Column Density NH=10^{20}atoms/cm^2.

The following tables (Table5 and Table6) give the statistics of the simulated ICs at 160microns in terms of number of DCEs, field used and zodi brightness, where sigma is the standard deviation (%) over the array, and skew is the skewness of the distribution of DN/s. Table 5 is for Galactic Column Density of NH=10^{20}atoms/cm2 and Table 6 is for NH=10^{21}atoms/cm2.

Table 5: Statistics for 160 μm Simulated ICs obtained in Photometry Mode. Galactic Column Density $N_{\rm H} = 10^{20}$ atoms cm^{-2}.

	no.	Median	σ (%)	skew
zodi=0.9MJy/sr at 160 μm				
Field 1	72	1.00000	3.07003	0.39343
	108	1.00000	2.33924	-0.00397
Field 2	72	1.00000	1.91962	0.29795
	108	1.00000	2.30741	0.15125
Field 3	72	1.00000	2.87471	-0.03764
	108	1.00000	2.56368	-0.27851
Field 4	72	1.00000	2.88901	-0.12273
	108	1.00000	2.60961	-0.27615
	216	1.00000	1.41682	0.06901
	324	1.00000	0.87516	-0.40052
	432	1.00000	1.25921	-0.18288
	540	1.00000	1.05399	-0.02300
zodi=1.3MJy/sr at 160 μm				
Field 1	72	1.00000	2.35393	-0.00376
	108	1.00000	1.95145	-0.08474
Field 2	72	1.00000	1.68558	0.31818
	108	1.00000	1.73357	0.22669
Field 3	72	1.00000	2.26878	0.29778
	108	1.00000	2.23284	0.18501
Field 4	72	1.00000	2.04419	-0.12776
	108	1.00000	2.19900	-0.25278
	216	1.00000	1.10066	0.10629
	324	1.00000	0.71019	-0.18157
	432	1.00000	1.12124	-0.54786
	540	1.00000	0.81093	-0.41459
zodi=1.8MJy/sr at 160 μm.				
Field 1	72	1.00000	1.95307	0.27715
	108	1.00000	1.61079	0.02706
Field 2	72	1.00000	1.39393	0.26728
	108	1.00000	1.41080	0.20601
Field 3	72	1.00000	2.13416	0.28210
	108	1.00000	1.80151	-0.32524
Field 4	72	1.00000	2.04419	-0.12776
	108	1.00000	1.83948	-0.02965
	216	1.00000	0.94098	0.23401
	324	1.00000	0.63326	-0.00539
	432	1.00000	0.82003	-0.40483
	540	1.00000	0.70866	-0.23528

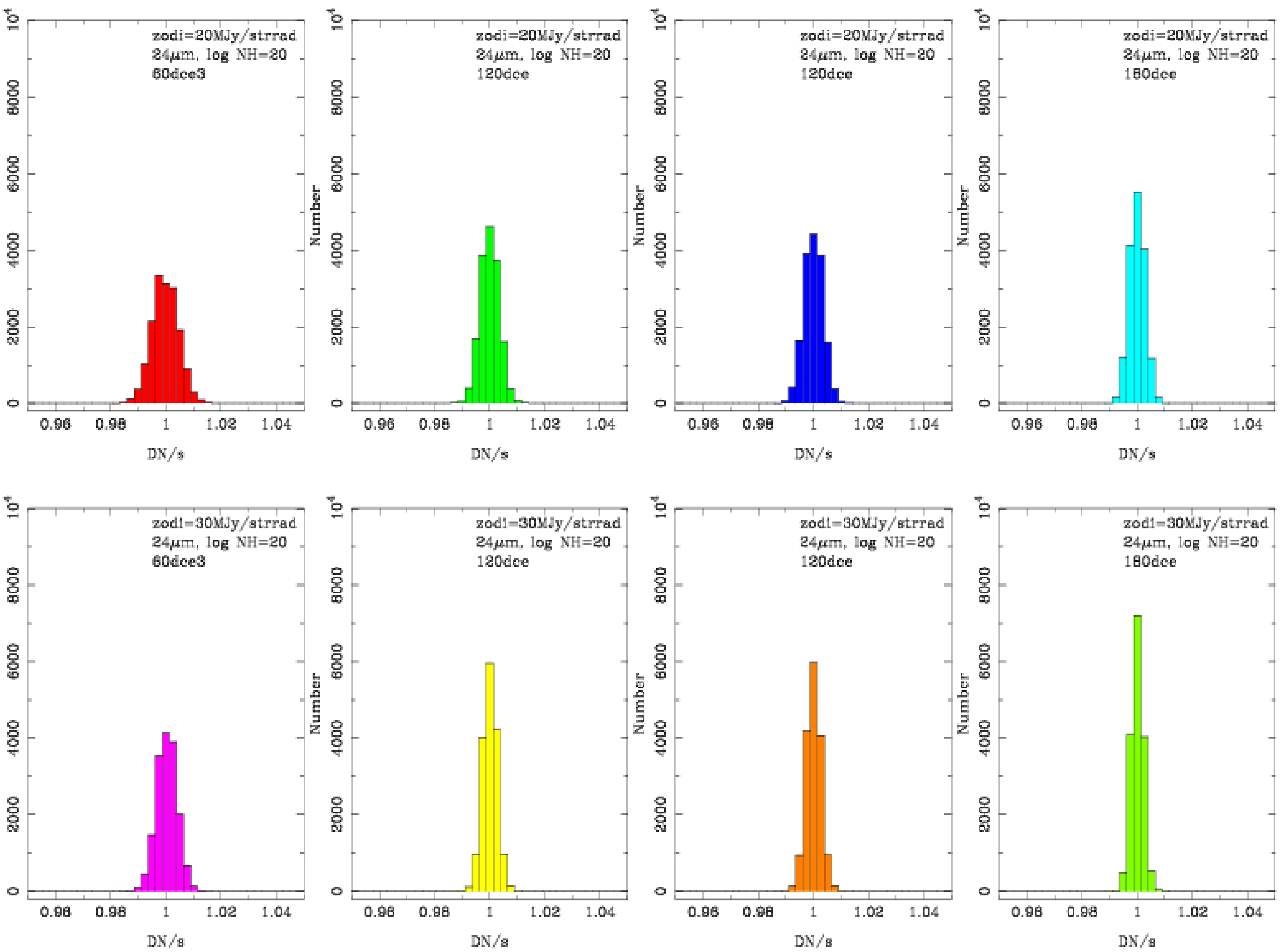
Table 6: Statistics for 160 μm Simulated ICs obtained in Photometry Mode. Galactic Column Density $N_{\rm H} = 10^{21}$ atoms cm^{-2}.

	no.	Median	σ (%)	skew
zodi=0.9MJy/sr at 160 μm				
Field 1	72	1.00000	2.88615	0.17860
	108	1.00000	3.33303	0.34408
Field 2	72	1.00000	2.75168	-0.24584
	108	1.00000	3.06358	-0.07139
Field 3	72	1.00000	5.20200	-0.49646
	108	1.00000	3.58118	-0.71500
Field 4	72	1.00000	6.20880	-0.06321
	108	1.00000	5.30382	0.23466
	216	1.00000	2.12731	-0.07705
	324	1.00000	1.89560	-0.10162
	432	1.00000	5.05797	-0.86786
	540	1.00000	1.38734	0.06560
zodi=1.3MJy/sr at 160 μm				
Field 1	72	1.00000	2.47823	0.20799
	108	1.00000	2.95271	0.37265
Field 2	72	1.00000	2.29100	-0.32979
	108	1.00000	2.59605	0.01816
Field 3	72	1.00000	4.98072	-0.59213
	108	1.00000	3.47331	-0.49714
Field 4	72	1.00000	5.80873	-0.05243
	108	1.00000	5.14571	0.24798
	216	1.00000	2.01066	-0.40066
	324	1.00000	1.75848	-0.39263
	432	1.00000	4.70407	-0.82030
	540	1.00000	1.17157	0.10277
zodi=1.8MJy/sr at 160 μm.				
Field 1	72	1.00000	2.27847	0.15702
	108	1.00000	2.67864	0.35464
Field 2	72	1.00000	2.13272	-0.26678
	108	1.00000	2.35098	-0.01358
Field 3	72	1.00000	4.66040	-0.56052
	108	1.00000	3.21781	-0.62516
Field 4	72	1.00000	5.80873	-0.05243
	108	1.00000	4.83554	0.28354
	216	1.00000	1.65313	-0.37520
	324	1.00000	1.51845	-0.02556
	432	1.00000	4.17866	-0.91567
	540	1.00000	1.15653	0.06518

4. Results for Flatfields/ICs obtained in Scan Mode

In what follows we show the dependence of the qualitiy of the flatfields/ICs obtained in scan mode as a function of the number of DCEs, zodi brightness and Galactic column density.

Results at 24micron



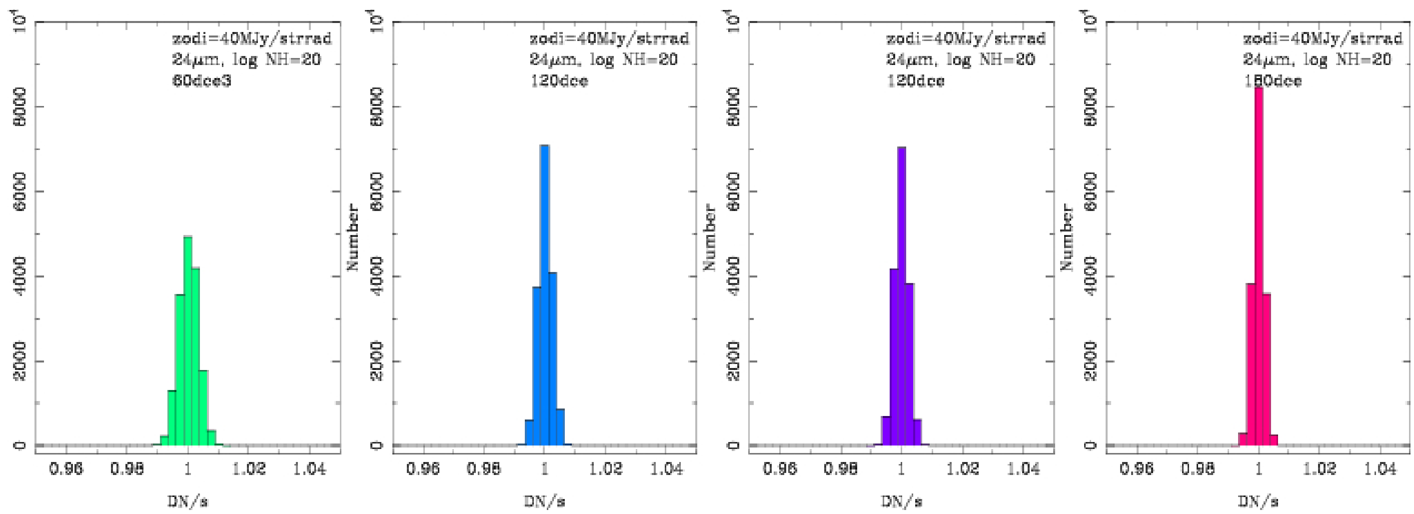


Figure 7: Simulated **24micron** flatfields obtained in **SCAN mode.** This figures shows the **effect of the zodi brightness** (top panel=20MJy/sr, mid panel=30MJy/sr, bottom panel=40MJy/sr) and number of DCEs. A typical IOC flatfield observed in scan mode will be the result of median combining ~120DCEs. Galactic Column Density NH=10^{20}atoms/cm^2.

The following tables (Table 7 and Table8) give the statistics of the simulated flatfields in scan mode at 24microns as a function of number of DCEs, field and zodi brightness, and Galactic column density, where sigma is the standard deviation (in %) over the array, and skew is the skewness of the distribution of DN/s. Table 7 is for Galactic Column Density of NH=10^{20}atoms/cm2 and Table 8 is for NH=10^{21}atoms/cm2.

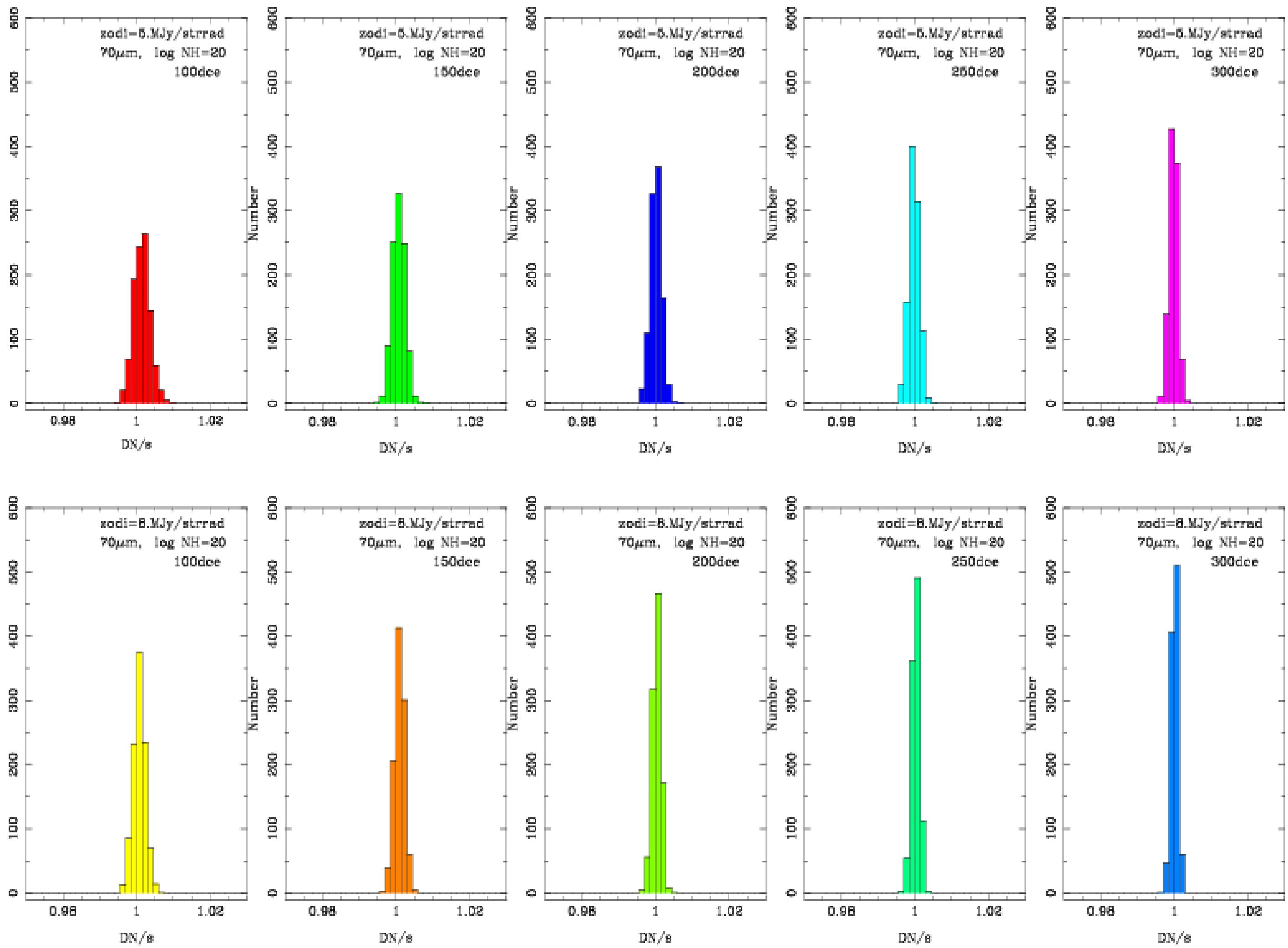
Table 7: Statistics for 24 μm Simulated Flatfields obtained in Scan Mode. Galactic Column Density $N_{\rm H} = 10^{20}$ atoms cm^{-2}.

no. DCE	Median	σ (%)	skew
zodi=20MJy/strd at 24 μm			
60dce ($\simeq$ 1degree)	1.00066	0.47780	-0.01198
60dce ($\simeq$ 1degree)	1.00099	0.47758	0.02888
60dce ($\simeq$ 1degree)	0.99966	0.47092	0.01060
120dce ($\simeq$ 2degrees)	1.00000	0.33807	0.02278
120dce ($\simeq$ 2degrees)	1.00000	0.33817	0.00223
180dce	1.00000	0.27651	0.00883
zodi=30MJy/strd at 24 μm			
60dce ($\simeq$ 1degree)	1.00000	0.37022	0.02019
60dce ($\simeq$ 1degree)	1.00067	0.37024	-0.04528
60dce ($\simeq$ 1degree)	1.00044	0.36811	-0.01749
120dce($\simeq$ 2degrees)	1.00022	0.26275	-0.00594
120dce ($\simeq$ 2degrees)	1.00022	0.26341	0.01896
180dce	1.00022	0.21487	0.04843
zodi=40MJy/strd at 24 μm			
60dce ($\simeq$ 1degree)	0.99983	0.31024	0.01946
60dce ($\simeq$ 1degree)	1.00033	0.30845	0.00695
60dce ($\simeq$ 1degree)	1.00034	0.31106	0.01330
120dce ($\simeq$ 2degrees)	1.00017	0.22153	-0.00250
120dce ($\simeq$ 2degrees)	1.00000	0.22081	-0.00271
180dce	1.00000	0.18014	-0.01222

Table 8: Statistics for 24 μm Simulated Flatfields obtained in Scan Mode. Galactic Column Density $N_{\rm H} = 10^{21}$ atoms cm^{-2}.

no. DCE	Median	σ (%)	skew
zodi=20MJy/strd at 24 μm			
60dce ($\simeq$ 1degree)	0.99935	0.47550	-0.00170
60dce ($\simeq$ 1degree)	0.99967	0.47552	-0.04144
60dce ($\simeq$ 1degree)	1.00034	0.47853	0.01317
120dce ($\simeq$ 2degrees)	1.00000	0.34617	-0.00690
120dce ($\simeq$ 2degrees)	0.99966	0.33655	-0.01614
180dce	0.99967	0.27767	-0.01858
zodi=30MJy/strd at 24 μm			
60dce ($\simeq$ 1degree)	0.99977	0.37230	-0.00922
60dce ($\simeq$ 1degree)	1.00022	0.37147	0.00035
60dce ($\simeq$ 1degree)	0.99978	0.36868	-0.01717
120dce ($\simeq$ 2degrees)	1.00000	0.26369	0.03475
120dce ($\simeq$ 2degrees)	0.99978	0.26160	-0.01378
180dce	0.99999	0.21551	0.02161
zodi=40MJy/strd at 24 μm			
60dce ($\simeq$ 1degree)	0.99933	0.30987	0.00533
60dce ($\simeq$ 1degree)	1.00017	0.31113	-0.00867
60dce ($\simeq$ 1degree)	1.00033	0.31181	-0.01155
120dce ($\simeq$ 2degrees)	1.00033	0.22067	-0.01221
120dce ($\simeq$ 2degrees)	1.00016	0.22143	0.00999
180dce	1.00017	0.18112	0.01725

Results at 70micron



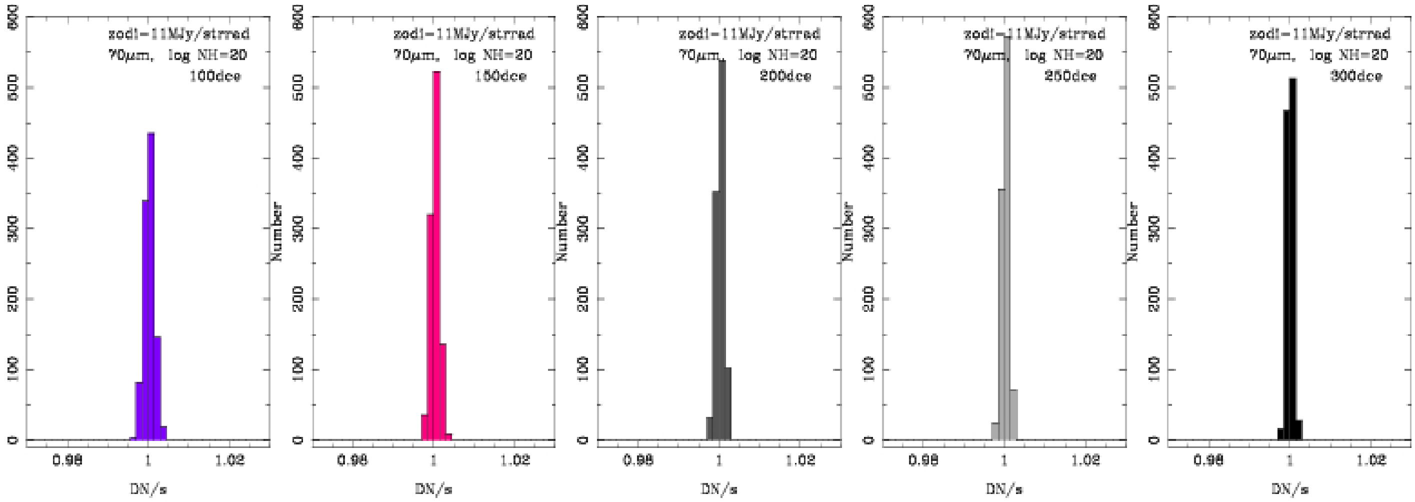


Figure 8: Simulated 70micron Ics obtained in SCAN mode. We show the **effect of the zodi brightness** (top panel=5.3MJy/sr, mid panel=8MJy/sr, bottom panel=10.6MJy/sr) and number of DCEs. A typical IOC flatfield observed in scan mode will be the result of median combining ~120DCEs. Galactic Column Density NH=10^{20}atoms/cm^{2}.

The following tables (Table 9 and Table 10) give the statistics of the simulated ICs in scan mode at 70microns as a function of number of DCEs, field and zodi brightness, and Galactic column density where sigma is the standard deviation (in %) over the array, and skew is the skewness of the distribution of DN/s. Table 9 is for Galactic Column Density of NH=10^{20}atoms/cm2 and Table 10 is for NH=10^{21}atoms/cm2.

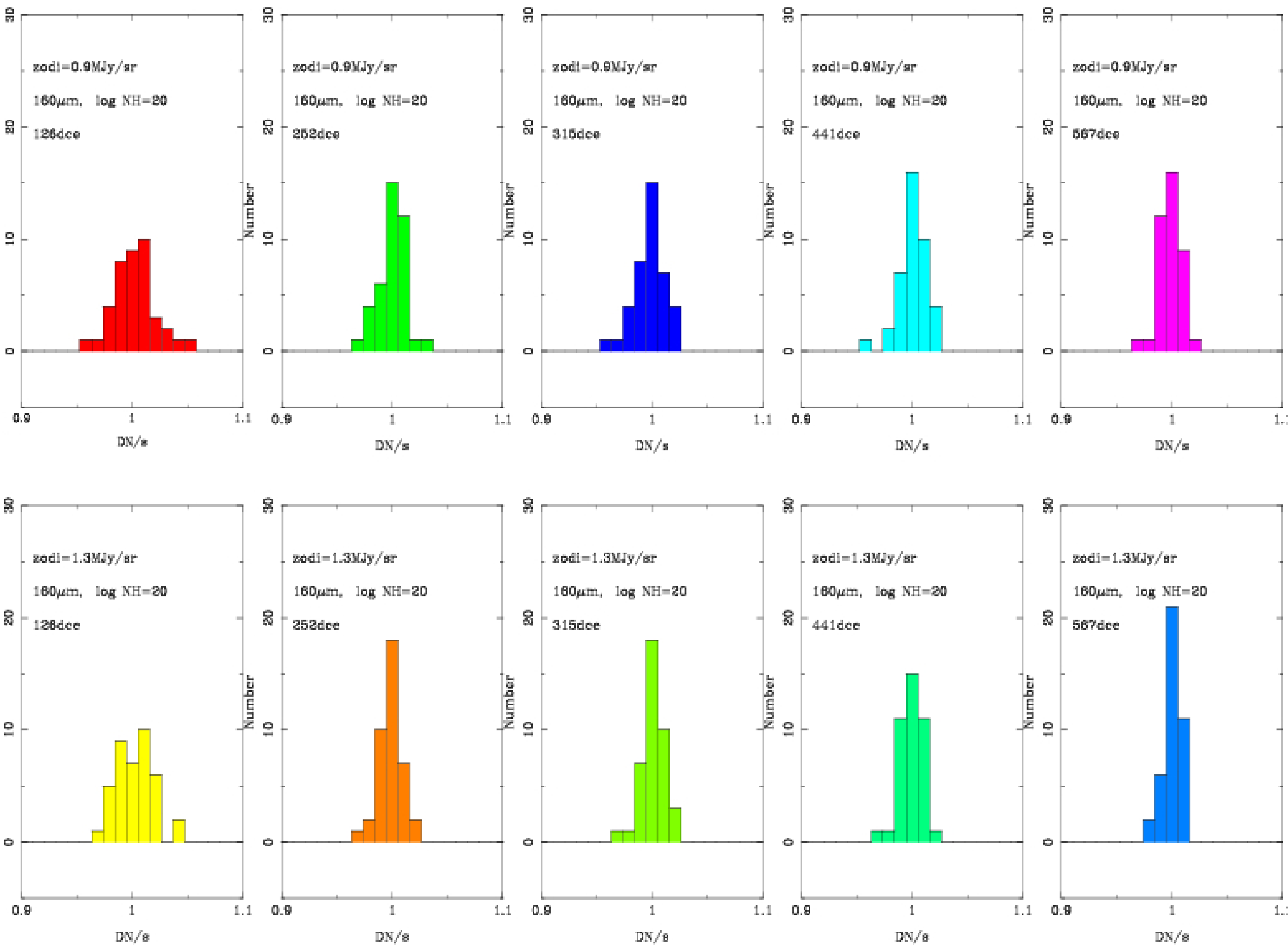
Table 9: Statistics for 70 μm ICs obtained in Scan Mode. Galactic Column Density $N_{\rm H} = 10^{20}$ atoms cm^{-2}.

no. DCE	Median	σ (%)	skew
zodi=5.3MJy/sr at 70 μm			
50dce ($\simeq$ 1degree)	1.00113	0.31788	0.07078
50dce ($\simeq$ 1degree)	1.00196	0.31978	0.10679
50dce ($\simeq$ 1degree)	1.00054	0.28998	0.24602
100dce($\simeq$ 2degrees)	1.00020	0.21180	0.15827
100dce($\simeq$ 2degrees)	1.00144	0.22003	0.16402
150dce	1.00067	0.17817	0.09191
200dce	1.00019	0.15440	0.02955
250dce	0.99970	0.14351	-0.01503
300dce	0.99980	0.12131	0.00943
zodi=8MJy/sr at 70 μm			
50dce ($\simeq$ 1degree)	1.00027	0.23766	0.04039
50dce ($\simeq$ 1degree)	1.00083	0.23211	0.10758
50dce ($\simeq$ 1degree)	0.99917	0.22068	-0.05727
100dce ($\simeq$ 2degrees)	0.99945	0.15808	-0.05136
100dce ($\simeq$ 2degrees)	1.00065	0.16742	0.06102
150dce	1.00096	0.13761	-0.00148
200dce	1.00042	0.12009	-0.12141
250dce	1.00026	0.10832	-0.13935
300dce	1.00015	0.09372	-0.16858
zodi=10.6MJy/sr at 70 μm			
50dce ($\simeq$ 1degree)	0.99922	0.18487	0.21634
50dce ($\simeq$ 1degree)	1.00044	0.17905	-0.00275
50dce ($\simeq$ 1degree)	1.00088	0.18054	0.18120
100dce ($\simeq$ 2degrees)	1.00037	0.13022	-0.00688
100dce ($\simeq$ 2degrees)	1.00032	0.12623	0.03926
150dce	1.00039	0.10308	0.08288
200dce	1.00027	0.09314	-0.10931
250dce	1.00028	0.08373	-0.06341
300dce	1.00007	0.07316	-0.01724

Table 10: Statistics for 70 μm ICs obtained in Scan Mode. Galactic Column Density $N_{\rm H} = 10^{21}$ atoms cm^{-2}.

no. DCE	Median	σ (%)	skew
zodi=5.3MJy/sr at 70 μm			
50dce ($\simeq$ 1degree)	1.00069	0.50380	0.28692
50dce ($\simeq$ 1degree)	1.00059	0.52316	0.03700
50dce ($\simeq$ 1degree)	0.99780	0.63693	-0.10999
100dce ($\simeq$ 2degrees)	0.99915	0.35666	-0.29536
100dce ($\simeq$ 2degrees)	0.99973	0.37713	0.07390
150dce	0.99797	0.32428	0.33706
200dce	0.99990	0.26585	0.03700
250dce	0.99854	0.26069	0.06177
300dce	0.99969	0.26664	0.08054
zodi=8MJy/sr at 70 μm			
50dce ($\simeq$ 1degree)	0.99915	0.35124	0.14914
50dce ($\simeq$ 1degree)	1.00128	0.37367	0.21335
50dce ($\simeq$ 1degree)	1.00188	0.44271	-0.04783
100dce ($\simeq$ 2degrees)	1.00011	0.24845	-0.22436
100dce ($\simeq$ 2degrees)	1.00001	0.26914	0.22277
150dce	1.00003	0.22687	0.33808
200dce	1.00076	0.18295	0.14727
250dce	0.99957	0.18081	0.11442
300dce	0.99976	0.18085	0.11992
zodi=10.6MJy/sr at 70 μm			
50dce ($\simeq$ 1degree)	1.00021	0.27650	0.17888
50dce ($\simeq$ 1degree)	1.00005	0.30422	0.14052
50dce ($\simeq$ 1degree)	0.99868	0.35431	-0.10471
100dce ($\simeq$ 2degrees)	0.99925	0.19736	-0.17267
100dce ($\simeq$ 2degrees)	0.99991	0.21075	0.08095
150dce	0.99955	0.17781	0.18441
200dce	1.00015	0.14639	0.10074
250dce	0.99976	0.14119	0.10536
300dce	1.00010	0.13999	0.12621

Results at 160micron



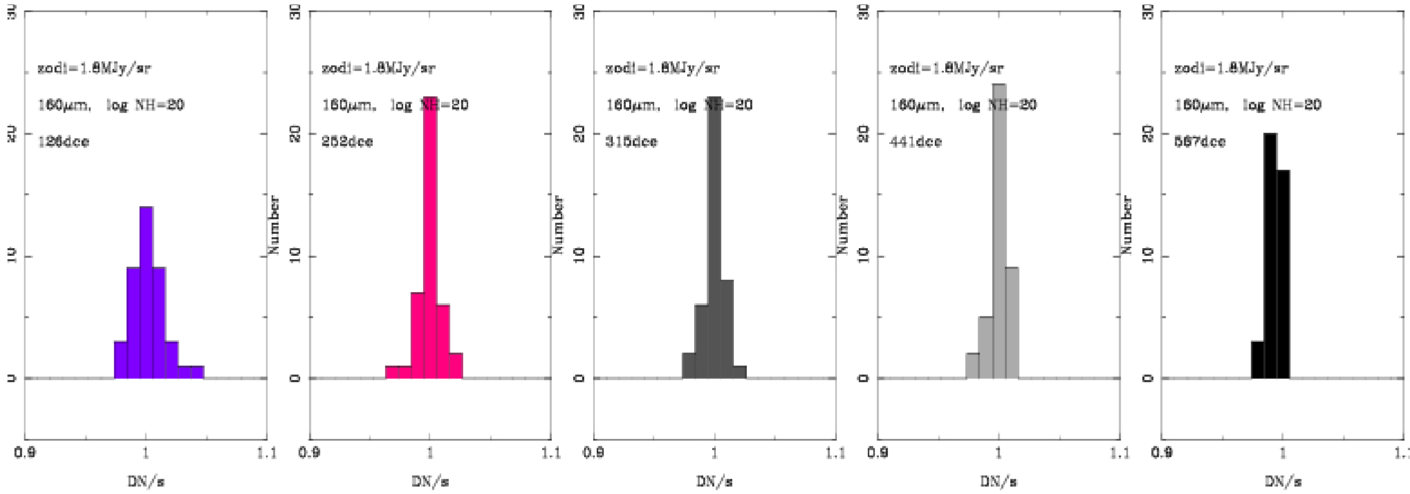


Figure 9: Simulated 160micron Ics obtained in SCAN mode. We show the **effect of the zodi brightness** (top panel=0.9MJy/sr, mid panel=1.3MJy/sr, bottom panel=1.8MJy/sr) and number of DCEs. A typical IOC flatfield observed in scan mode will be the result of median combining ~120DCEs. Galactic Column Density NH=10^{20}atoms/cm^2.

The following tables (Table 11 and Table12) gives the statistics of the simulated ICs in scan mode at 160microns as a function of number of DCEs, field and zodi brightness, and Galactic column density where sigma is the standard deviation (in %) over the array, and skew is the skewness of the distribution of DN/s. Table 11 is for Galactic Column Density of NH=10^{20}atoms/cm2 and Table 12 is for NH=10^{21}atoms/cm2.

Table 11: Statistics for 160 μm ICs obtained in Scan Mode. Galactic Column Density $N_{\rm H}$ = 10^{20} atoms cm^{-2}.

no. DCE	Median	σ (%)	skew
zodi=0.9MJy/sr at 160 μm			
126dce ($\simeq$ 2degrees)	1.00000	1.90983	0.43419
126dce ($\simeq$ 2degrees)	1.00000	1.91200	-0.61588
126dce ($\simeq$ 2degrees)	1.00000	3.27098	0.81128
189dce	1.00000	2.59326	0.57228
189dce	1.00000	1.67335	-0.14663
252dce	1.00000	1.20804	-0.38948
315dce	1.00000	1.32295	-0.78888
441dce	1.00000	1.23421	-0.59736
567dce	1.00000	0.95820	-0.48289
zodi=1.3MJy/sr at 160 μm			
126dce ($\simeq$ 2degrees)	1.00000	1.67259	0.24660
126dce ($\simeq$ 2degrees)	1.00000	1.56978	-0.48986
126dce ($\simeq$ 2degrees)	1.00000	2.30241	0.78515
189dce	1.00000	1.91499	0.53862
189dce	1.00000	1.38215	-0.31963
252dce	1.00000	1.10611	-0.25190
315dce	1.00000	1.08099	-0.22217
441dce	1.00000	0.99991	-0.56851
567dce	1.00000	0.78298	-0.78340
zodi=1.8MJy/sr at 160 μm			
126dce ($\simeq$ 2degrees)	1.00000	1.37012	0.52884
126dce ($\simeq$ 2degrees)	1.00632	1.33026	-0.37280
126dce ($\simeq$ 2degrees)	1.01219	2.12526	0.80544
189dce	1.00151	1.53635	0.50388
189dce	1.00258	1.26549	-0.32705
252dce	0.99955	0.92588	-0.26208
315dce	1.00012	0.86186	-0.54145
441dce	0.99999	0.78303	-0.89478
567dce	0.99290	0.63276	-0.52140

Table 12: Statistics for 160 μm ICs obtained in Scan Mode. Galactic Column Density $N_{\rm H}$ = 10^{21} atoms cm^{-2}.

no. DCE	Median	σ (%)	skew
zodi=0.9MJy/sr at 160 μm			
126dce ($\simeq$ 2degrees)	1.00000	2.76523	-0.57644
126dce ($\simeq$ 2degrees)	1.00000	4.91852	-0.19500
126dce ($\simeq$ 2degrees)	1.00000	5.14088	-0.16736
189dce	1.00000	1.88303	0.26713
189dce	1.00000	2.12800	0.13334
252dce	1.00000	2.83059	-0.07831
315dce	1.00000	2.43508	0.11656
441dce	1.00000	1.20853	-0.19775
567dce	1.00000	0.80539	-0.01643
zodi=1.3MJy/sr at 160 μm			
126dce ($\simeq$ 2degrees)	1.00000	2.37883	-0.31331
126dce ($\simeq$ 2degrees)	1.00000	4.69531	-0.18340
126dce ($\simeq$ 2degrees)	1.00000	4.68428	0.02055
189dce	1.00000	1.85575	0.57528
189dce	1.00000	2.10668	0.22441
252dce	1.00000	2.57800	0.05899
315dce	1.00000	2.14119	0.18118
441dce	1.00000	0.97925	-0.07032
567dce	1.00000	0.71419	0.22976
zodi=1.8MJy/sr at 160 μm			
126dce ($\simeq$ 2degrees)	1.00000	2.30653	-0.59215
126dce ($\simeq$ 2degrees)	0.95668	4.16097	-0.19619
126dce ($\simeq$ 2degrees)	0.97596	4.18113	0.06933
189dce	1.00000	1.50393	0.35642
189dce	1.01580	2.03240	0.19285
252dce	1.04103	2.48015	0.09083
315dce	1.00715	2.07411	0.17059
441dce	0.99558	0.84785	0.02836
567dce	1.00000	0.78398	0.02224

5. Discussion and Conclusions

Dependence on observing mode (photometry vs. scan)

- At 24microns we find no statistical differences in the quality of flatfields obtained in photometry mode and scan mode for a combined number of DCE > 60.

- At 70 and 160microns we find that in general ICs observed in scan mode are of equal or better quality than those obtained in photometry mode. Note that in John's report he found that at 160micron ICs obtained in scan mode had lower S/N. We find however that at 160microns there is a strong dependence on the cirrus component (see below), so a direct comparison between Ics obtained in photometry and scan mode is difficult because, according to the simulations, the cirrus structure changes on scales similar to the fields covered by the observations.

Dependence on the number of combined DCEs

- We find that our results on the statistical quality of simulated Ics (70 and 160microns) in terms of the number of combined DCEs are different from those in John Stansberry's report because Herve Dole's previous simulations of the sky overestimated the number of sources at all theree wavelengths.

- at 24microns 60DCEs or more DCEs (depending on zodi brightness) will produce flatfields to better than 0.5%RMS for zodi brightness of 20, 30 and 40MJy/strd, and Galactic column densities of NH=10^{20}atoms/cm2 and NH=10^{21}atoms/cm2.

- at 70micron between 100DCEs and 200DCEs (depending on zodi brightness and Galactic column density) will produce Ics to better than 0.5%

- the most complicated situation appears to be at 160microns, where we find that the number of DCEs required to produce an IC to better than 1% varies between 300 and 500DCEs depending on the zodi brightness and especially the cirrus component.

Dependence on the zodi brightness

- Effect of zodi brightness at 24micron. We have simulated flatfields for zodi brightness at 24micron of 20, 30 and 40MJy/strd for column densities of log NH=20 and log NH=21. For the case of lowest zodi brightness at 24microns we find that 60DCEs −that is, number of DCEs observed every time a flatfield in photometry mode is obtained − will always produce a flatfield with RMS of 0.5%. Flatfields observed at higher zodi brightnesses will always produce RMS better than 0.5%. In scan mode we will observe ~118DCE which results in RMS of between 0.3% and 0.2% depending of the 24micron zodi brightness.

Dependence on the Galactic column density (cirrus component)

- The effect of the cirrus component is most significant at 70 and 160microns, so extra care will be necessary when median combining DCEs. It may be required to throw away DCEs with a bright cirrus component when constructing Ics as they can significantly degrade the quality of the IC. A clear example can be seen from Tables 5 and 6. Clearly Field 4 corresponds to an area of the sky with a higher cirrus component. When that region is used to produce an IC with 432DCEs the standard deviation becomes worse than the IC constructed with 324DCEs.

6. TO DO LIST:

- Construct flatfields and ICs using *mips_enhancer* when this option becomes available −as during IOC this will be the automated way to make flatfields− and compare statistical quality with those made using IRAF