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Technical Instrument Report WFPC2 2005-004

Creating a WFPC2 Yearly Superdark

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September 26, 2005

ABSTRACT

This TIR describes the process for producing a yearly superdark file from one hundred and twenty of the individual weekly dark images taken during the year as part of the WFPC2 calibration plan. This file is used to produce weekly dark calibration files that are used to calibrate all WFPC2 observations throughout the following year.

Introduction

During each week of operation five WFPC2 dark images are taken. These five images, along with the previous year's superdark, are used to create a weekly dark file to be delivered to the archive for use in calibrating all WFPC2 observations from that week. The basis of each weekly dark is the previous year's superdark, created from 120 of the individual dark images from that year. The superdark provides the values for pixels with stable dark current values while the weekly darks provide the values for pixels that vary significantly and differ from the superdark pixel values by five sigma or more.

Procedure

1) Locate data. There will five charge transfer efficiency (CTE) corrected darks for each weekly dark date used, as produced and archived by the *dodark.cl* script used in weekly dark creation. In the current procedures for making weekly darks (WFPC2 TIR 2005-001) a copy of these files is saved to /data/snap4/mrichard/2002_darks. The location may change but it will be indicated within *dodark.cl*.

Make a list of all the darks (including .c0h extension) available for use in the superdark. Name the list *all_files.txt.*

Finding the images taken from Aug 2003 to Aug 2004:

ls -l /data/snap4/vera/2002_darks/ | grep 2003
ls -l /data/snap4/vera/2002_darks/ | grep 2004

#This produces:
1

```
drwxrwx---   2 verap        512 Sep 10  2003 au04/
drwxrwx---   2 verap        512 Sep 10  2003 au06/
drwxrwx---   2 verap        512 Oct 21  2003 au11/
drwxrwx---   2 verap       1024 Oct 21  2003 au18/
drwxrwx---   2 verap       1024 Oct 21  2003 au25/
drwxrwx---   2 verap       1024 Dec 12  2003 de01/
drwxrwx---   2 verap        512 Dec 12  2003 de08/
```
etc.

#Then:

ls /data/snap4/vera/2002_darks/au/*c0h >> all_files.txt*
ls /data/snap4/vera/2002_darks/de/*c0h >> all_files.txt*
ls /data/snap4/vera/2002_darks/no/*c0h >> all_files.txt*
etc.

My *all_files.txt* looks like this:

```
/data/snap4/vera/2002_darks/au04/u8gxh301m.c0h
/data/snap4/vera/2002_darks/au04/u8gxh302m.c0h
/data/snap4/vera/2002_darks/au04/u8gxh303m.c0h
/data/snap4/vera/2002_darks/au04/u8gxh304m.c0h
/data/snap4/vera/2002_darks/au04/u8gxh305m.c0h
```
etc.

---

1. Herein "#" indicates non-command lines or comments. Lines in *italics* indicate commands to be typed.

2) Randomly choose 120 darks and divide them into three groups of forty darks each.
Use the program *list_split.py* to do this. The script can be found in data/snap4/mrichard/wfpc2/superdark_repository/scripts/.

python list_split.py
Input filelist: *all_files.txt*
Number to select: *40*
Random(rnd) or sequently (seq)?: *rnd*

You will use the first three lists (list_40_1, list_40_2, list_40_3) as a random selection of the 120 darks that will go into the superdark. The rest of the lists will not be needed.

rm list_40_[4-9]

---

3) Copy the chosen darks to your working directory.

cat list_40_[1-3] >> filesused.txt
awk '{print "cp "$1" ."}' filesused.txt >> cp1.cl
nawk '{sub(/.c0h/,".c0d"); if ($0 !~/xxx/) print}' cp1.cl >> cp2.cl

in IRAF:

cl < cp1.cl
cl < cp2.cl

---

4) You will need the .c1h files that correspond to the randomly chosen .c0h files.
They were not saved on disk so you will request them from the archive. In Starview, choose Searches, HST, Instruments, WFPC2, and WFPC2 Instrument from the pull-down menu. Set the search criteria to the following:

Exposure Length = 1800
Start Time = mm/dd/yy.. mm/dd/yy or >mm/dd/yy
Image Type = dark
Serials = off

Use the *Show Override (Expert Only)* option to select just the extension .c1f

Type in *c1f* and check the box for the *Fetch only listed extensions* option
Have the data transferred to a subdirectory in your superdark working directory called *all_c1f*

*ls *c0h >> filesused_c0h.txt*
nawk '{sub(/.c0h/,"_c1f.fits"); if ($0 !~/xxx/) print}' filesused_c0h.txt >> filesused_c1f.txt
awk '{print "cp all_c1f/"$1" ."}' filesused_c1f.txt >> cp3.cl

in IRAF

cl < cp3.cl
set imtype=hhh
*strfits *fits*
mkdir fits
*mv *fits fits*
*!rm all_c1f/*fits*
!rmdir all_c1f

---

5) Recalibrate all .c0h dark files with the superbias (gain=7) for the same year.
You will create scripts to process each image, with lines like the following:

imcalc /data/..../u8gz6v01m.c0h,n9a14385u.r2h,p1p1510lu.r2h rebias/u8gz6v01m.c0h "im1+im2-im3"

where n9a14385u.r2h is the old (previous year's) superbias and p1p1510lu.r2h is the new (same year's) superbias

Make sure you have the new and old superbiases in your working directory. Superbiases are available from the archive and can also be found in /data/snap4/mrichard/superbias_repository.

#To create your own rebias cl script:

*ls *c0h >> files.txt*
awk '{print "imcalc "$1",n9a14385u.r2h,p1p1510lu.r2h rebias/"$1" im1+im2-im3"}' files.txt >> rebias_c0h.cl

Using this procedure you will start with lines like this:

imcalc u8gxh302m.c0h,n9a14385u.r2h,p1p1510lu.r2h rebias/u8gxh302m.c0h
im1+im2-im3
and will need to add quotation marks by hand, so they look like this:

imcalc u8gxh302m.c0h,n9a14385u.r2h,p1p1510lu.r2h rebias/u8gxh302m.c0h
'im1+im2-im3'

create a directory where the newly biased files will be saved:

mkdir rebias

Now in IRAF:

cl < rebias_c0h.cl

---

6) Now move the unrebiased files to a subdirectory and move the rebiased files to your working directory.

mkdir unrebiased
*mv *c0h *c0d unrebiased*
mv rebias/ .*

---

7) Combine darks into three files consisting of forty darks each.

noisepar.readnoise=1.73; noisepar.gain=7.5; noisepar.scalenoise=0

mkdark inf=@list_40_1 outfile=dark_pt1.r3h outfile2=dark_pt1.b3h sig="4,4,3,2" rad=1.5 pfact=0.5 hot=4096 min=0 init=min

mkdark inf=@list_40_2 outfile=dark_pt2.r3h outfile2=dark_pt2.b3h sig="4,4,3,2" rad=1.5 pfact=0.5 hot=4096 min=0 init=min

mkdark inf=@list_40_3 outfile=dark_pt3.r3h outfile2=dark_pt3.b3h sig="4,4,3,2" rad=1.5 pfact=0.5 hot=4096 min=0 init=min

---

8) Combine the three files to create a single superdark and normalize the result to one second, also updating the header

imcalc "dark_pt1.r3h,dark_pt2.r3h,dark_pt3.r3h" "dark_all.r3h" "((im1+im2+im3)/3.0)/ 1843.60"

hedit (images="dark_all.r3h",fields="exptime", value=1.0, add=yes,addonly=no,delete=no,verify=no, show=yes,update=yes)
hedit (images="dark_all.r3h",fields="darktime", value=1.0, add=yes,addonly=no,delete=no,verify=no, show=yes,update=yes)

---

9) Divide the DQF files into six lists of twenty images each, using *list_split.py*

nawk '{sub(/_c1f.fits/,".c1h"); if ($0 !~/xxx/) print}' filesused_c1f.txt >> filesused_c1h.txt

python list_split.py
Input filelist: *filesused_c1h.txt*
Number to select: *20*
Random(rnd) or sequently (seq)?: *rnd*

---

10) Add the individual dark .c1h files to create two new masks, one with flagged pixels for those pixel with flags in ANY of the individual masks, and one with flags for only those pixels that had flags in ALL of the individual masks.

#The expressions used in adding the masks are in the files *par20_or.txt* and *par20_and.txt,* copies of which can be created or found in /data/snap4/mrichard/wfpc2/ superdark_repository/scripts/.

par20_or.txt reads:
im1 || im2 || im3 || im4 || im5 || im6 || im7 || im8 || im9 || im10 || im11 || im12 || im13 || im14 || im15 || im16 || im17 || im18 || im19 || im20

Using *par20_or.txt* as the *addmasks* evaluation expression produces a mask that has flags set for pixels that are flagged in ANY of the 20 masks being added

addmasks "@list_20_1" tmp1.b3h "@par20_or.txt"
addmasks "@list_20_2" tmp2.b3h "@par20_or.txt"
addmasks "@list_20_3" tmp3.b3h "@par20_or.txt"
addmasks "@list_20_4" tmp4.b3h "@par20_or.txt"
addmasks "@list_20_5" tmp5.b3h "@par20_or.txt"
addmasks "@list_20_6" tmp6.b3h "@par20_or.txt"

Now combine all six OR masks into a single mask for all one hundred twenty DQF files

*ls tmp*b3h > masklist.txt*
addmasks "@masklist.txt" dark_bit_OR.b3h "im1 || im2 || im3 || im4 || im5 || im6"
*imdel tmp*b3h*

par20_and.txt reads:
im1 && im2 && im3 && im4 && im5 && im6 && im7 && im8 && im9 && im10 && im11 && im12 && im13 && im14 && im15 && im16 && im17 && im18 && im19 && im20

Using *par20_and.txt* as the *addmasks* evaluation expression produces a mask that has flags set for only those pixels that are flagged in ALL of the 20 masks that are being added

addmasks "@list_20_1" tmp1.b3h "@par20_and.txt"
addmasks "@list_20_2" tmp2.b3h "@par20_and.txt"
addmasks "@list_20_3" tmp3.b3h "@par20_and.txt"
addmasks "@list_20_4" tmp4.b3h "@par20_and.txt"
addmasks "@list_20_5" tmp5.b3h "@par20_and.txt"
addmasks "@list_20_6" tmp6.b3h "@par20_and.txt"

Now combine all six AND masks into a single mask for all one hundred twenty DQF files.

addmasks "@masklist.txt" dark_bit_AND.b3h "im1 && im2 && im3 && im4 && im5 && im6"
*imdel tmp*b3h*

---

11) Create a final DQF mask based on certain criteria:

Combine the three .c1h files from the *mkdark* steps in Section 7 to get the sum of images used as input for each pixel (each pixel value will be the number of individual images that were used in determining the value of that pixel in the final superdark).

imcalc "dark_pt1.b3h,dark_pt2.b3h,dark_pt3.b3h" "dark_sum.b3h" "im1+im2+im3"

Create a mask for pixels that had more than half of infiles used in dark_sum.b2h AND had a dark rate > 0.02 (value = 512 = bad pixel)

imcalc "dark_sum.b3h,dark_all.r3h" "dark_msk.b3h" "if im1.ge.60 && im2.gt.0.02 then 512. else 0."

If less than half of the one hundred twenty individual darks were used and the *dark_bit_OR.b3h* file. does not equal zero, then use the *dark_msk.b3h* value. If less than sixty images were used and the *dark_bit_OR.b3h* value is zero, then set the pixel to 2.

imcalc "dark_sum.b3h,dark_bit_OR.b3h,dark_msk.b3h" "dark_tot1.b3h" "if im1.lt.60 && im2.eq.0.0 then 2.0 else im3"
imcalc "dark_sum.b3h,dark_bit_OR.b3h,dark_tot1.b3h" "dark_tot2.b3h" "if im1.lt.60 && im2.ne.0.0 then im2 else im3"

If none of the individual files were used, then use the *dark_bit_AND.b3h* value. If there was a non-zero value to start, use the dark_tot2.b3h value from the last step.

imcalc "dark_bit_AND.b3h,dark_tot2.b3h" "dark_tot3.b3h" "if im1.ne.0.0 then im1 else im2"

If the DQF pixel value is eight or ten, replace it with 512 (general bad pixel value).

imcalc "dark_tot3.b3h" "dark_tot3b.b3h" "if im1 .eq. 8 .or. im1 .eq. 10 then 512. else im1"

gcopy dark_tot3b.b3h super2004.b3h
gcopy dark_all.r3h super2004.r3h

---

12) Create a header for the new superdark.

Use the previous year's superdark header as a starting point for creating the new header.

a) Make a new history file for weekly darks using the following template.

Replace the dates, the list of files used, and the superbias name with appropriate values and name the file *hist_[year]*.

These history files can be found in /data/snap4/mrichard/wfpc2/superdark_repository.

****

This is a SUPERDARK created from an average of 120 input darks.
The input darks were from the date range of Sep 09, 2002,
thru Aug 06 2003, and consisted of the following files:

u8gxba01m u8gxha05m u8gz2m01m u8gz4l01m u8gz7e01m
u8gxba02m u8gxia01m u8gz2n01m u8gz4m01m u8gz7f01m
u8gxba03m u8gxia02m u8gz2p01m u8gz4n01m u8gz7g01m
u8gxba04m u8gxia03m u8gz2q01m u8gz4v01m u8gz7h01m
u8gxba05m u8gxia04m u8gz2r01m u8gz4w01m u8gz7j01m
u8gxca01m u8gxia05m u8gz2s01m u8gz4x01m u8gz7k01m
u8gxca02m u8gz0p01m u8gz2t01m u8gz4y01m u8gz7l01m
u8gxca03m u8gz0q01m u8gz3d01m u8gz4z01m u8gz7m01m
u8gxca04m u8gz0r01m u8gz3e01m u8gz5v01m u8gz7n01m
u8gxca05m u8gz0s01m u8gz3f01m u8gz5w01m u8gz7v01m
u8gxd301m u8gz0t01m u8gz3g01m u8gz5x01m u8gz7w01m
u8gxd302m u8gz0v01m u8gz3h01m u8gz5y01m u8gz7x01m
u8gxd303m u8gz0w01m u8gz3j01m u8gz5z01m u8gz7y01m
u8gxd304m u8gz0x01m u8gz3k01m u8gz6j01m u8gz7z01m
u8gxd305m u8gz0y01m u8gz3l01m u8gz6k01m u8gz8701m
u8gxea01r u8gz0z01m u8gz3m01m u8gz6l01m u8gz8801m
u8gxea02m u8gz2101m u8gz3n01m u8gz6m01m u8gz8901m
u8gxea03m u8gz2201m u8gz4701m u8gz6n01m u8gz8a01m
u8gxea04m u8gz2301m u8gz4801m u8gz6v01m u8gz8b01m
u8gxea05m u8gz2401m u8gz4901m u8gz6w01m u8gz8j01m
u8gxha01m u8gz2501m u8gz4a01m u8gz6x01m u8gz8k01m
u8gxha02m u8gz2j01m u8gz4b01m u8gz6y01m u8gz8l01m
u8gxha03m u8gz2k01m u8gz4j01m u8gz6z01m u8gz8m01m
u8gxha04m u8gz2l01m u8gz4k01m u8gz7d01m u8gz8n01m

All the datasets were calibrated using CALWP2.1.3.5.2,
utilizing the most up-to-date reference files, including
the new superbias:n9a14385u, where appropriate.

The datasets were combined in 12 groups of 10 and the CTE trails
were removed. The CTE-corrected images were then combined to
create the final superdark file, which was normalized to a

darktime of 1.0 second for each CCD. Mkdark parameters used were:

```
 sigmas  =          4,4,3,2
 radius  =            0
 pfactor =            0
 hotthres=           4096.
 minval  =           -99.
```

The associated DQF file was computed in the following manner:

If more than 60 input files are valid and the dark current is <= 0.02 DN/s, then the pixel value is 0 (valid data).

If more than 60 input files are valid and the dark current is > 0.02 DN/s, then the pixel value is 512 (uncorrectable warm pixel).

If <= 60 input files are valid, set the pixel value to the "bitwise-OR" of all input masks (any flag set in any of the input files is set on the mask).

If none of the input files are valid, set the pixel value to the "bitwise-AND" of all input masks (bad pixel).

****

b) Open the header for the previous superdark and delete all the HISTORY comments.

nedit super2003.r3h

c) You will create a program to edit the header starting with the programs *hedit_r3h_2004.cl* and *hedit_b3h_2004.cl* from the previous year.

The programs can found in /data/snap4/mrichard/wfpc2/superdark_repository/scripts. They are also included as Appendices A and B and at the end of this report.

Change all years in the hedit programs from the old to the new year.

!nawk '{gsub(/2003/,"2004"); if ($0 !~/xxx/) print}' hedit_r3h_2003.cl >> hedit_r3h_2004.cl

!nawk '{gsub(/2003/,"2004"); if ($0 !~/xxx/) print}' hedit_b3h_2003.cl >> hedit_b3h_2004.cl

Update the PEDIGREE dates in the hedit scripts to reflect the earliest and latest dates of the individual images used in the superdark creation (do this by hand).

!more hedit_?3h_2004.cl | grep PEDIGREE
!nedit hedit_r3h_2004.cl
!nedit hedit_b3h_2004.cl

d) Run the *hedit* programs and additional formatting steps to finish the header updates.

cl < hedit_r3h_2004.cl

groupmod super2004.r3h super2004a.r3h group.txt delete
imdel super2004.r3h
imrename super2004a.r3h super2004.r3h

cl < hedit_b3h_2004.cl

groupmod super2004.b3h super2004a.b3h group.txt delete
imdel super2004.b3h
imrename super2004a.b3h super2004.b3h

e) Update or add USEAFTER and COMMENT keywords.

hedit super2004.r3h useafter ' Aug 01 2003 00:00:00' add+ verify-
hedit super2004.b3h useafter ' Aug 01 2003 00:00:00' add+ verify-

hedit super2004.r3h comment ' WFPC2 Yearly Superdark created by [your name]' add+ verify-
hedit super2004.b3h comment 'WFPC2 Yearly Superdark created by [your name]' add+ verify-

---

13) Subtract the old superdarks from the new superdarks for comparison

mkdir compare

cd compare
cp ../old_superdarks/superdark200?/ compare*
imcalc super2004.r3h,super2003.r3h, super2004-2003.r3h "im1-im2"
imcalc super2004.b3h,super2003.b3h, super2004-2003.b3h "im1-im2"
...etc.

---

14) Check the image quality.

a) Display the new superdark and the difference images.

Look for possible problems, such as .....

b) Compute general image statistics, and look for significant changes from previous years.

gstat super200?.r3h >> stats.txt
gstat super200?.b3h >> dqf_stats.txt

c) Compute statistics for bad pixels.

gstat super2004-.b3h low=0.1 fiel='npix' >> new_badpix.txt*

This gives the number of pixels which are flagged in the new superdark which were not flagged in the previous superdark

gstat super2004-.b3h up=-0.1 fiel='npix' >> old_badpix.txt*

This gives the number of pixels which were flagged in the previous superdarks which are not flagged in the new superdark

---

15) Notify the person who makes weekly darks that a new superdark is available for use.

The year will need to be changed within the *dodark.cl* and *wkdark.cl* scripts and a copy of the new superdark will be needed in the working *darkpros* directory.

---

16) After you have created the superdark it should be delivered to the archive and to the cdbs/uref directory so that it will be available for access from outside the institute.

The requirements for delivery quality checks are described in CDBS TIR 2005-01 “Assessment and Delivery of Reference Files” and the group can be contacted with questions (cdbs@stsci.edu).

Note: The process of arranging for superdarks to be made available from the archive was underway at the time of this report.

a) Perform all necessary steps as described in the CDBS TIR, including:

*stwfits *.r2? *.b2?*
*/data/cdbs1/tools/bin/certify *fits*
*fitsverify *fits*
*hselect *fits “pedigree,useafter,descrip,comment,history” yes*

Check with the CDBS group for updated requirements

b) Send an email to cdbs@stsci.edu with the completed CDBS template:

#The current template:

****
1-Name of deliverer:
(other e-mail addresses)
2-Date of delivery:
3-Instrument:
4-Type of file (bias,pht,etc.):
5-History section in header [0] complete? (yes/no):
6-USEAFTER, PEDIGREE, DESCRIP, and COMMENT have been checked? (yes/no)
7-CDBS Verification complete? (fitsverify,certify,etc.):
8-Should these files be ingested in the OPUS, DADS and CDBS databases?
(if not indicate it clearly which ones):
9-Files run through CALXXX or SYNPHOT? (yes/no):
10-Does it replace an old reference file? (yes/no):
10a-If yes, which one?
11- What is the level of change of the file? (e.g. compared to old file it

could be: SEVERE, MODERATE, TRIVIAL, 1‰, 5‰ etc.):
12-Description of how the files were "tested" for correctness:
13-Disk location and name of files

****

Acknowledgements

Previous work by V. Platais and G. Brammer was used in writing this report.

References

“Assessment and Delivery of Reference files,” R. Diaz-Miller, 2005;
http://www.stsci.edu/hst/observatory/cdbs/documents/TIR-CDBS-2005-01.pdf

http://www.stsci.edu/hst/observatory/cdbs/deliveries/delivery_form.html

Scripts:
/data/snap4/mrichard/wfpc2/superdark_repository/scripts
/data/snap4/mrichard/wfpc2/darkpros

Old superdarks:
/data/snap4/mrichard/wfpc2/superdarks_repository/superbias*

Appendix A: Scripts hedit_b3h_2004.cl

```
hedit super2004.b3h  READTIME                0 #/ Length of time for CCD readout in clock ticks

hedit super2004.b3h  PA_V3                   0 #/ position angle of v3 of HST
hedit super2004.b3h  RA_SUN                  0 #/ right ascension of the sun
hedit super2004.b3h  DEC_SUN                 0 #/ declination of the sun
hedit super2004.b3h  EQNX_SUN             2000.0 #/ equinox of the sun
hedit super2004.b3h  MTFLAG                  F #/ moving target flag; T if it is a moving target
hedit super2004.b3h  EQRADTRG            0.000000 #/ equatorial radius of target (km)
hedit super2004.b3h  FLATNTRG            0.000000 #/ flattening of target
hedit super2004.b3h  NPDECTRG            0.000000 #/ north pole declination of target
hedit super2004.b3h  NPRATRG             0.000000 #/ north pole right ascension of target
hedit super2004.b3h  ROTRTTRG            0.000000 #/ rotation rate of target
hedit super2004.b3h  LONGPMER            0.000000 #/ longitude of prime meridian
hedit super2004.b3h  EPLONGPM            0.000000 #/ epoch of longitude of prime meridian (sec)
hedit super2004.b3h  SURFLATD            0.000000 #/ surface feature latitude
hedit super2004.b3h  SURFLONG            0.000000 #/ surface feature longitude
hedit super2004.b3h  SURFALTD            0.000000 #/ surface feature altitude (km)

hedit super2004.b3h  PODPSFF                 0 #/ 0  (no  podps fill); 1  (podps fill present)
hedit super2004.b3h  STDCFFF                 0 #/ ST DDF fill present (T#/F)
hedit super2004.b3h  STDCFFP    '            ' #/ ST DDF fill pattern (hex)
hedit super2004.b3h  RSDPFILL             -100 #/ bad data fill value for calibrated images

hedit super2004.b3h  UEXPODUR                0 #/ commanded duration of exposure (sec)
hedit super2004.b3h  NSHUTA17                0 #/ Number of AP17 shutter B closes
hedit super2004.b3h  DARKTIME              1.0 #/ Dark time (seconds)
hedit super2004.b3h  UEXPOTIM                0 #/ Major frame pulse time preceding exposure start
hedit super2004.b3h  PSTRTIME   '            ' #/ predicted obs. start time (yyyy.ddd:hh:mm:ss)
hedit super2004.b3h  PSTPTIME   '            ' #/ predicted obs. stop time (yyyy.ddd:hh:mm:ss)

hedit super2004.b3h  SUNANGLE                0 #/ angle between sun and V1 axis
hedit super2004.b3h  MOONANGL   '            ' #/ angle between moon and V1 axis
hedit super2004.b3h  SUN_ALT                 0. #/ altitude of the sun above Earth's limb
hedit super2004.b3h  FGSLOCK    '            '
          #/ commanded FGS lock (FINE,COARSE,GYROS,UNKNOWN)
hedit super2004.b3h  TIME-OBS   '            ' #/ UT time of start of observation (hh:mm:ss)
hedit super2004.b3h  EXPSTART                0. #/ exposure start time (Modified Julian Date)
hedit super2004.b3h  EXPEND                  0. #/ exposure end time (Modified Julian Date)
hedit super2004.b3h  EXPTIME                 0. #/ exposure duration (seconds)--calculated
hedit super2004.b3h  EXPFLAG    '            '  #/ Exposure interruption indicator

hedit super2004.b3h  TARGNAME   'DARK        ' #/ proposer's target name
hedit super2004.b3h  RA_TARG             0.000000 #/ right ascension of the target
hedit super2004.b3h  DEC_TARG            0.000000 #/ declination of the target
hedit super2004.b3h  ECL_LONG            0.000000 #/ ecliptic longitude of the target
hedit super2004.b3h  ECL_LAT             0.000000 #/ ecliptic latitude of the target
hedit super2004.b3h  GAL_LONG                0. #/ galactic longitude of the target
hedit super2004.b3h  GAL_LAT                 0. #/ galactic latitude of the target
hedit super2004.b3h  PROPOSID   '            ' #/ PEP proposal identifier
hedit super2004.b3h  PEP_EXPO   '            ' #/ PEP exposure identifier incl sequence
hedit super2004.b3h  LINENUM                 0. #/ PEP proposal line number
hedit super2004.b3h  SEQLINE    '            '  #/ PEP line number of defined sequence
hedit super2004.b3h  SEQNAME    '            '  #/ PEP define#/use sequence name
```

```
hedit super2004.b3h  PEDIGREE   'INFLIGHT 08/01/2003 - 08/01/2004'    add+
hedit super2004.b3h  DESCRIP    '120 frame superdark, median used for crrej'   add+
hedit super2004.b3h  exptime   1.0
hedit super2004.b3h  darktime  1.0

hedit super2004.b3h  FILETYPE   'DQF              ' #/ type of data found in data file

chpixtype super2004.b3h[1]   super2004a.b3h[1/4] short
chpixtype super2004.b3h[2]   super2004a.b3h[2]   short
chpixtype super2004.b3h[3]   super2004a.b3h[3]   short
chpixtype super2004.b3h[4]   super2004a.b3h[4]   short
imdel    super2004.b3h
imrename super2004a.b3h super2004.b3h
```

Appendix B: Script hedit_r3h_2004.cl

```
hedit super2004.r3h  FILETYPE   'DRK              ' #/ type of data found in data file
hedit super2004.r3h  TELESCOP   'HST              ' #/ telescope used to acquire data
hedit super2004.r3h  INSTRUME   'WFPC2            ' #/ identifier for instrument used to acquire data
hedit super2004.r3h  EQUINOX                2001.0 #/ equinox of celestial coord. system

hedit super2004.r3h  ROOTNAME   '        '          #/ rootname of the observation set

hedit super2004.r3h  MODE       'FULL             ' #/ instr. mode: FULL (full res.), AREA (area int.)
hedit super2004.r3h  SERIALS    'OFF              ' #/ serial clocks: ON, OFF

hedit super2004.r3h  IMAGETYP   'CDBS             ' #/ type of exposure identifier
hedit super2004.r3h  CDBSFILE   'DARK             '
          #/ GENERIC#/BIAS#/DARK#/PREF#/FLAT#/MASK#/ATOD#/
hedit super2004.r3h  PKTFMT                   34 #/ packet format code

hedit super2004.r3h  FILTNAM1   '                 ' #/ first filter name
hedit super2004.r3h  FILTNAM2   '                 ' #/ second filter name
hedit super2004.r3h  FILTER1                   0 #/ first filter number (0-48)
hedit super2004.r3h  FILTER2                   0 #/ second filter number (0-48)
hedit super2004.r3h  FILTROT             0.000000 #/ partial filter rotation angle (degrees)
hedit super2004.r3h  LRFWAVE             0.000000 #/ linear ramp filter wavelength

hedit super2004.r3h  UCH1CJTM                  0. #/ TEC cold junction #1 temperature (Celsius)
hedit super2004.r3h  UCH2CJTM                  0. #/ TEC cold junction #2 temperature (Celsius)
hedit super2004.r3h  UCH3CJTM                  0. #/ TEC cold junction #3 temperature (Celsius)
hedit super2004.r3h  UCH4CJTM                  0. #/ TEC cold junction #4 temperature (Celsius)
hedit super2004.r3h  UBAY3TMP                  0. #/ bay 3 A1 temperature (deg C)
hedit super2004.r3h  KSPOTS     'OFF              ' #/ Status of Kelsall spot lamps: ON, OFF
hedit super2004.r3h  SHUTTER    '                 ' #/ Shutter in place at beginning of the exposure
hedit super2004.r3h  ATODGAIN                  7.0 #/ Analog to Digital Gain (Electrons#/DN)

hedit super2004.r3h  MASKCORR   '        '          #/ Do mask correction: PERFORM, OMIT, COMPLETE
hedit super2004.r3h  ATODCORR   '        '          #/ Do A-to-D correction: PERFORM, OMIT, COMPLETE
hedit super2004.r3h  BLEVCORR   '        '          #/ Do bias level correction
hedit super2004.r3h  BIASCORR   '        '          #/ Do bias correction: PERFORM, OMIT, COMPLETE
hedit super2004.r3h  DARKCORR   '                   ' #/ Do dark correction: PERFORM, OMIT, COMPLETE
hedit super2004.r3h  FLATCORR   '                   ' #/ Do flat field correction
hedit super2004.r3h  SHADCORR   '                   ' #/ Do shaded shutter correction
hedit super2004.r3h  DOSATMAP   '                   ' #/ Output saturated pixel map
hedit super2004.r3h  DOPHOTOM   '                   ' #/ Fill photometry keywords
hedit super2004.r3h  DOHISTOS   '                   ' #/ Make histograms: PERFORM, OMIT, COMPLETE
hedit super2004.r3h  OUTDTYPE   '                   ' #/ Output image datatype: REAL, LONG, SHORT

hedit super2004.r3h  MASKFILE   '                   ' #/ name of the input DQF of known bad pixels
hedit super2004.r3h  ATODFILE   '                   ' #/ name of the A-to-D conversion file
hedit super2004.r3h  BLEVFILE   '                   ' #/ Engineering file with extended register data
hedit super2004.r3h  BLEVDFIL   '                   ' #/ Engineering file DQF
hedit super2004.r3h  BIASFILE   '                   ' #/ name of the bias frame reference file
hedit super2004.r3h  BIASDFIL   '                   ' #/ name of the bias frame reference DQF
hedit super2004.r3h  DARKFILE   '                   ' #/ name of the dark reference file
hedit super2004.r3h  DARKDFIL   '                   ' #/ name of the dark reference DQF
hedit super2004.r3h  FLATFILE   '                   ' #/ name of the flat field reference file
hedit super2004.r3h  FLATDFIL   '                   ' #/ name of the flat field reference DQF
hedit super2004.r3h  SHADFILE   '                   ' #/ name of the reference file for shutter shading
```

```
hedit super2004.r3h  PHOTTAB    '              ' #/ name of the photometry calibration table
hedit super2004.r3h  GRAPHTAB   '              ' #/ the HST graph table
hedit super2004.r3h  COMPTAB    '              ' #/ the HST components table

hedit super2004.r3h  SATURATE              4095 #/ Data value at which saturation occurs
hedit super2004.r3h  USCALE                1.0 #/ Scale factor for output image
hedit super2004.r3h  UZERO                 0.0 #/ Zero point for output image

hedit super2004.r3h  READTIME                0 #/ Length of time for CCD readout in clock ticks

hedit super2004.r3h  PA_V3                   0 #/ position angle of v3 of HST
hedit super2004.r3h  RA_SUN                  0 #/ right ascension of the sun
hedit super2004.r3h  DEC_SUN                 0 #/ declination of the sun
hedit super2004.r3h  EQNX_SUN           2001.0 #/ equinox of the sun
hedit super2004.r3h  MTFLAG                  F #/ moving target flag; T if it is a moving target
hedit super2004.r3h  EQRADTRG         0.000000 #/ equatorial radius of target (km)
hedit super2004.r3h  FLATNTRG         0.000000 #/ flattening of target
hedit super2004.r3h  NPDECTRG         0.000000 #/ north pole declination of target
hedit super2004.r3h  NPRATRG          0.000000 #/ north pole right ascension of target
hedit super2004.r3h  ROTRTTRG         0.000000 #/ rotation rate of target
hedit super2004.r3h  LONGPMER         0.000000 #/ longitude of prime meridian
hedit super2004.r3h  EPLONGPM         0.000000 #/ epoch of longitude of prime meridian (sec)
hedit super2004.r3h  SURFLATD         0.000000 #/ surface feature latitude
hedit super2004.r3h  SURFLONG         0.000000 #/ surface feature longitude
hedit super2004.r3h  SURFALTD         0.000000 #/ surface feature altitude (km)

hedit super2004.r3h  PODPSFF                 0 #/ 0  (no  podps fill); 1  (podps fill present)
hedit super2004.r3h  STDCFFF                 0 #/ ST DDF fill present (T#/F)
hedit super2004.r3h  STDCFFP    '            ' #/ ST DDF fill pattern (hex)
hedit super2004.r3h  RSDPFILL             -100 #/ bad data fill value for calibrated images

hedit super2004.r3h  UEXPODUR                0 #/ commanded duration of exposure (sec)
hedit super2004.r3h  NSHUTA17                0 #/ Number of AP17 shutter B closes
hedit super2004.r3h  DARKTIME              1.0 #/ Dark time (seconds)
hedit super2004.r3h  UEXPOTIM                0 #/ Major frame pulse time preceding exposure start
hedit super2004.r3h  PSTRTIME   '            ' #/ predicted obs. start time (yyyy.ddd:hh:mm:ss)
hedit super2004.r3h  PSTPTIME   '            ' #/ predicted obs. stop time (yyyy.ddd:hh:mm:ss)

hedit super2004.r3h  SUNANGLE                0 #/ angle between sun and V1 axis
hedit super2004.r3h  MOONANGL   '            ' #/ angle between moon and V1 axis
hedit super2004.r3h  SUN_ALT                 0. #/ altitude of the sun above Earth's limb
hedit super2004.r3h  FGSLOCK    '            '
     #/ commanded FGS lock (FINE,COARSE,GYROS,UNKNOWN)
hedit super2004.r3h  TIME-OBS   '            ' #/ UT time of start of observation (hh:mm:ss)
hedit super2004.r3h  EXPSTART                0. #/ exposure start time (Modified Julian Date)
hedit super2004.r3h  EXPEND                  0. #/ exposure end time (Modified Julian Date)
hedit super2004.r3h  EXPTIME                 0. #/ exposure duration (seconds)--calculated
hedit super2004.r3h  EXPFLAG    '            '  #/ Exposure interruption indicator

hedit super2004.r3h  TARGNAME   'DARK        ' #/ proposer's target name
hedit super2004.r3h  RA_TARG          0.000000 #/ right ascension of the target
hedit super2004.r3h  DEC_TARG         0.000000 #/ declination of the target
hedit super2004.r3h  ECL_LONG         0.000000 #/ ecliptic longitude of the target
hedit super2004.r3h  ECL_LAT          0.000000 #/ ecliptic latitude of the target
hedit super2004.r3h  GAL_LONG                0. #/ galactic longitude of the target
hedit super2004.r3h  GAL_LAT                 0. #/ galactic latitude of the target
hedit super2004.r3h  PROPOSID   '            '

hedit super2004.r3h  PEP_EXPO   '            ' #/ PEP exposure identifier including sequence
```

```
hedit super2004.r3h  LINENUM                  0. #/ PEP proposal line number
hedit super2004.r3h  SEQLINE   '              ' #/ PEP line number of defined sequence
hedit super2004.r3h  SEQNAME   '               ' #/ PEP define#/use sequence name

hedit super2004.r3h  PEDIGREE   'INFLIGHT 08/01/2003 - 08/01/2004'    add+
hedit super2004.r3h  DESCRIP    '120 frame superdark, median used for crrej'   add+
hedit super2004.r3h  exptime   1.0
hedit super2004.r3h  darktime  1.0
```