



PACS Calibration Framework

*Cate Liu
&
NHSC PACS Team
(NHSC/Caltech)*

What is Calibration Framework?

The calibration framework is a set of software that provides definitions and access tools for calibration products

The starting point in this framework from a user perspective is the *calibration tree*, also known as *calTree*. The calibration tree is a simple tree-like structure which points to all the calibration products as leaves.

For more detailed description, see:

[http://herschel.esac.esa.int/twiki/pub/Pacs/PacsCalibration/
The_PACS_Calibration_Framework_-_issue_0.13.pdf](http://herschel.esac.esa.int/twiki/pub/Pacs/PacsCalibration/The_PACS_Calibration_Framework_-_issue_0.13.pdf)



The PACS Calibration Tree

PACS calibration tree has **three branches**: **common**, **spectrometer** and **photometer**. The *spectrometer* and *photometer* branch each contain the calibration products that are specific for that instrument. The *common branch* contains *all the* calibration products which are shared between the different units in the instrument and those which do not fall easily within one of the two other branches.

How to retrieve calTree in HIPE

Three branches in calTree

```
File Edit Run Pipelines Scripts Window Tools Help
[Icons] [Icons] [Icons] [Icons] [Icons] [Icons]
Console x
HIPE>
HIPE>
HIPE>
HIPE>
HIPE>
HIPE> calTree = getCalTree()
HIPE>
HIPE> print calTree
PACS Calibration Tree
  Model   : FM
  Scope   : BASE
  Version : 56
  Branches: [common, photometer, spectrometer]
HIPE>
HIPE>
HIPE>
HIPE>
HIPE>
HIPE>
HIPE>
```

Jython Interpreter 100% | 172 of 15845 MB

```
File Edit Run Pipelines Scripts Window Tools Help
Console x
HIPE>
HIPE> print calTree.photometer
PacsCalPhot Calibration Products:
absorption           : FM, 2
apertureCorrection   : FM, 3
arrayInstrument      : FM, 6
badPixelMask        : FM, 7
calSources           : FM, 1
clSaturationLimits  : FM, 1
clTransferFunction   : FM, 1
coolerRecyclingTimes : FM, 10
corrZeroLevel       : FM, 3
crosstalkMatrix     : FM, 2
detectorReadoutTimeShift : FM, 1
detectorSortMatrix  : FM, 3
diffCS              : FM, 3
filterTransmission  : FM, 1
flatField           : FM, 4
gain                : FM, 1
invntt              : FM, 1
invnttBL            : FM, 4
invnttBS            : FM, 4
invnttRed           : FM, 4
masks               : FM, 1
noisePerPixel       : FM, 1
nonLinearCoef       : FM, 2
photometricStabilityThreshold : FM, 1
responsivity        : FM, 7
satLimits           : FM, 2
subArrayArray       : FM, 5
timedep             : FM, 56
HIPE>
```

Photometer branch shows the calibration products with their version number. FM=Flight Model

How to retrieve the Calibration Tree?

- From a HIPE session – default calTree, the latest version of the calibration tree

```
HIPE> calTree = getCalTree()
```

- From an observation – the calTree associated with a Herschel observation (obs) when it was processed, but not necessarily the latest version

```
HIPE> calTree = obs.calibration
```

- The preferred way - load the proper calibration products and make sure time dependent products are chosen for the given time

```
HIPE> calTree = getCalTree(obs=obs)
```

```
HIPE> calTree = getCalTree(time=frames.startTime)
```

How to retrieve the Calibration Tree? – Cont.

- Difference between following two statements

```
HIPE> calTree=obs.calibration
```

```
HIPE> calTree=getCaltree(obs=obs)
```

- a) The first returns the calTree that was used during processing of that observation with SPG. If you want to reprocess the observation the same way as done by SPG at that time, this is what you need.
- b) The second returns the latest and most up-to-date calTree from your HIPE session (make sure the updater was used). This is what you want to use to reprocess an observation with the latest knowledge in PACS calibration.

The version of the Calibration Tree

- Check the version of your calTree

```
HIFE> print calTree.version
```

- Getting an older version of the calTree

```
HIFE> calTree_v3=getCaltree(version=3)
```

Please note that the version of a calTree is different from the version of a calibration product.

How to retrieve Calibration Products?

- Use dot-notation

```
HIFE> resp = calTree.photometer.responsivity
```

- Some calibration products are time dependent due to instrument evolution and aging
- Access an older version of a calibration product

```
HIFE> ai = getCalProduct(unit="spectrometer", name="arrayInstrument",  
version=5)
```

How to use this calibration product:

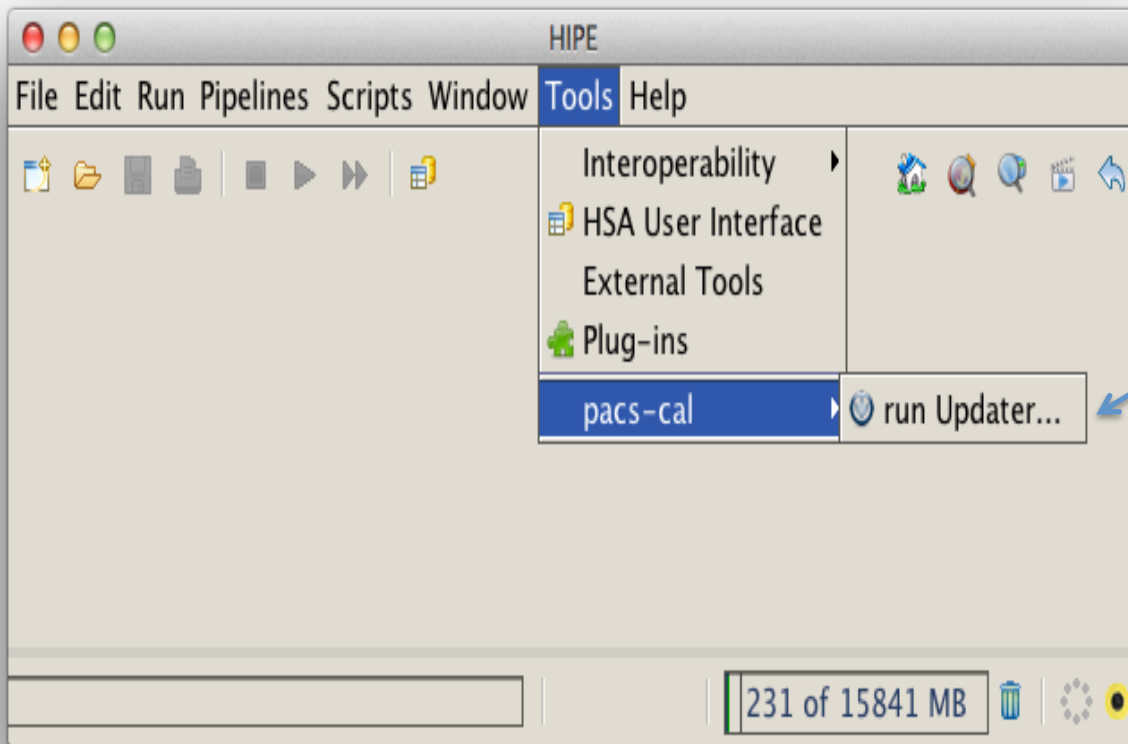
```
HIFE>frames = specAssignRaDec(frames, arrayInstrument=ai)
```

```
HIFE>calTree = getCalTree()
```

```
HIFE>calTree.spectrometer.arrayInstrument = ai
```

Update Calibration Products

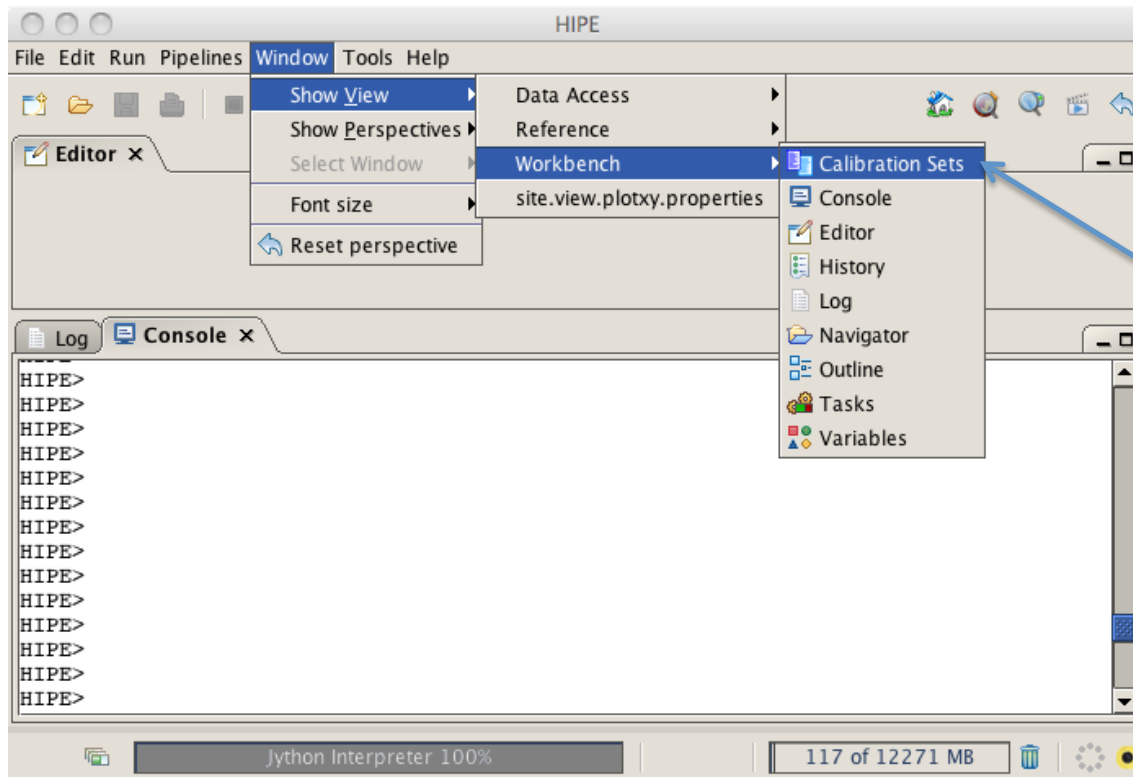
- Calibration products need to be installed on your local disk when using HIPE for the first time.



Running this will show a progress bar analyzing if there are any products need updating. Follow the instructions.

Inspecting Calibration Products

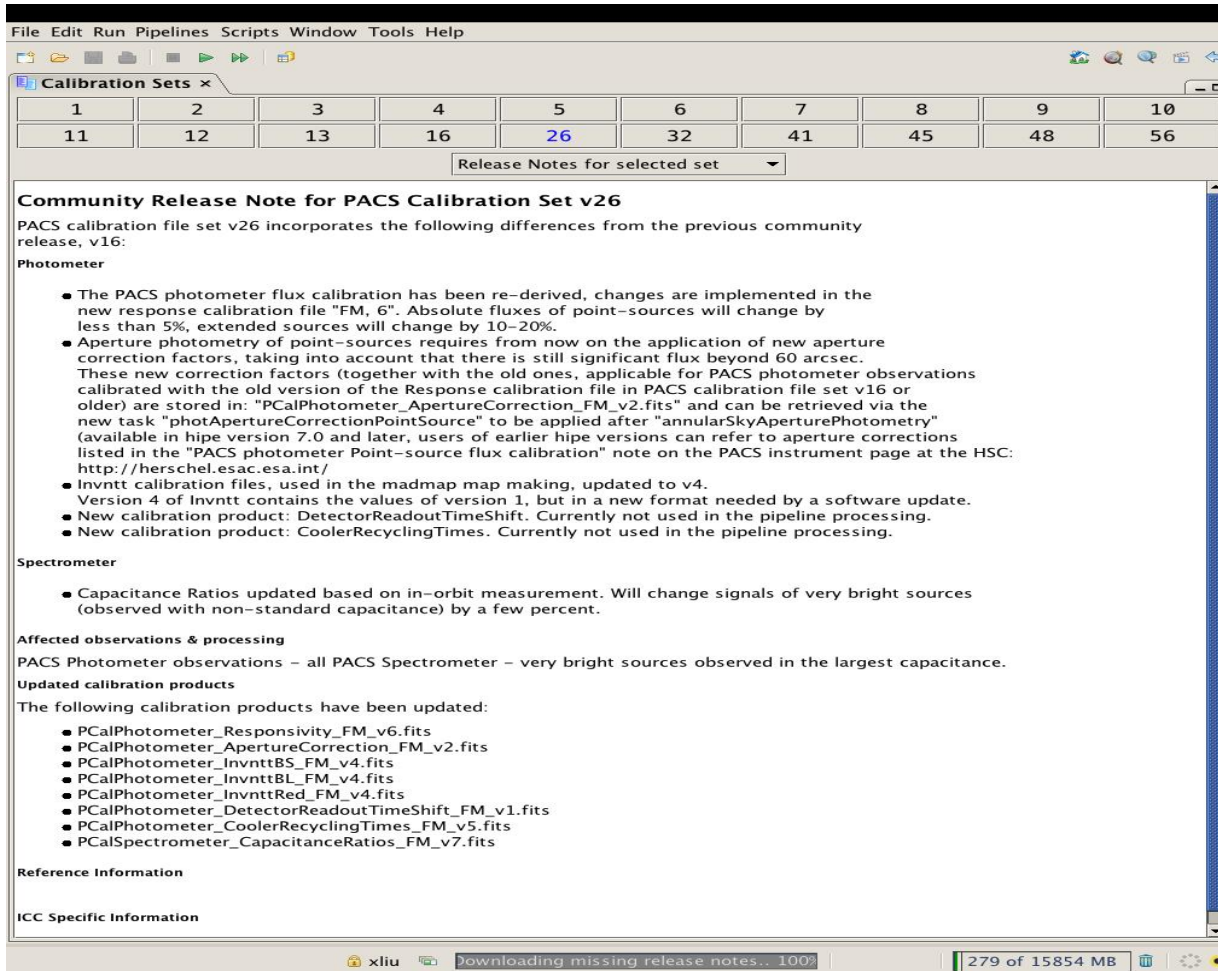
- The calibration sets View allows you to inspect the calibration sets that have been installed on your system



Go to the Calibration Sets view

Inspecting Calibration Products – Cont.

- The figures below show the calibration sets view with set 26 selected



1	2	3	4	5	6	7	8	9	10
11	12	13	16	26	32	41	45	48	56

Release Notes for selected set

Community Release Note for PACS Calibration Set v26

PACS calibration file set v26 incorporates the following differences from the previous community release, v16:

Photometer

- The PACS photometer flux calibration has been re-derived, changes are implemented in the new response calibration file "FM, 6". Absolute fluxes of point-sources will change by less than 5%, extended sources will change by 10-20%.
- Aperture photometry of point-sources requires from now on the application of new aperture correction factors, taking into account that there is still significant flux beyond 60 arcsec. These new correction factors (together with the old ones, applicable for PACS photometer observations calibrated with the old version of the Response calibration file in PACS calibration file set v16 or older) are stored in: "PCalPhotometer_ApertureCorrection_FM_v2.fits" and can be retrieved via the new task "photApertureCorrectionPointSource" to be applied after "annularSkyAperturePhotometry" (available in hipec version 7.0 and later, users of earlier hipec versions can refer to aperture corrections listed in the "PACS photometer Point-source flux calibration" note on the PACS instrument page at the HSC: <http://herschel.esac.esa.int/>)
- Invntt calibration files, used in the madmap map making, updated to v4. Version 4 of Invntt contains the values of version 1, but in a new format needed by a software update.
- New calibration product: DetectorReadoutTimeShift. Currently not used in the pipeline processing.
- New calibration product: CoolerRecyclingTimes. Currently not used in the pipeline processing.

Spectrometer

- Capacitance Ratios updated based on in-orbit measurement. Will change signals of very bright sources (observed with non-standard capacitance) by a few percent.

Affected observations & processing

PACS Photometer observations – all PACS Spectrometer – very bright sources observed in the largest capacitance.

Updated calibration products

The following calibration products have been updated:

- PCalPhotometer_Responsivity_FM_v6.fits
- PCalPhotometer_ApertureCorrection_FM_v2.fits
- PCalPhotometer_InvnttBS_FM_v4.fits
- PCalPhotometer_InvnttBL_FM_v4.fits
- PCalPhotometer_InvnttRed_FM_v4.fits
- PCalPhotometer_DetectorReadoutTimeShift_FM_v1.fits
- PCalPhotometer_CoolerRecyclingTimes_FM_v5.fits
- PCalSpectrometer_CapacitanceRatios_FM_v7.fits

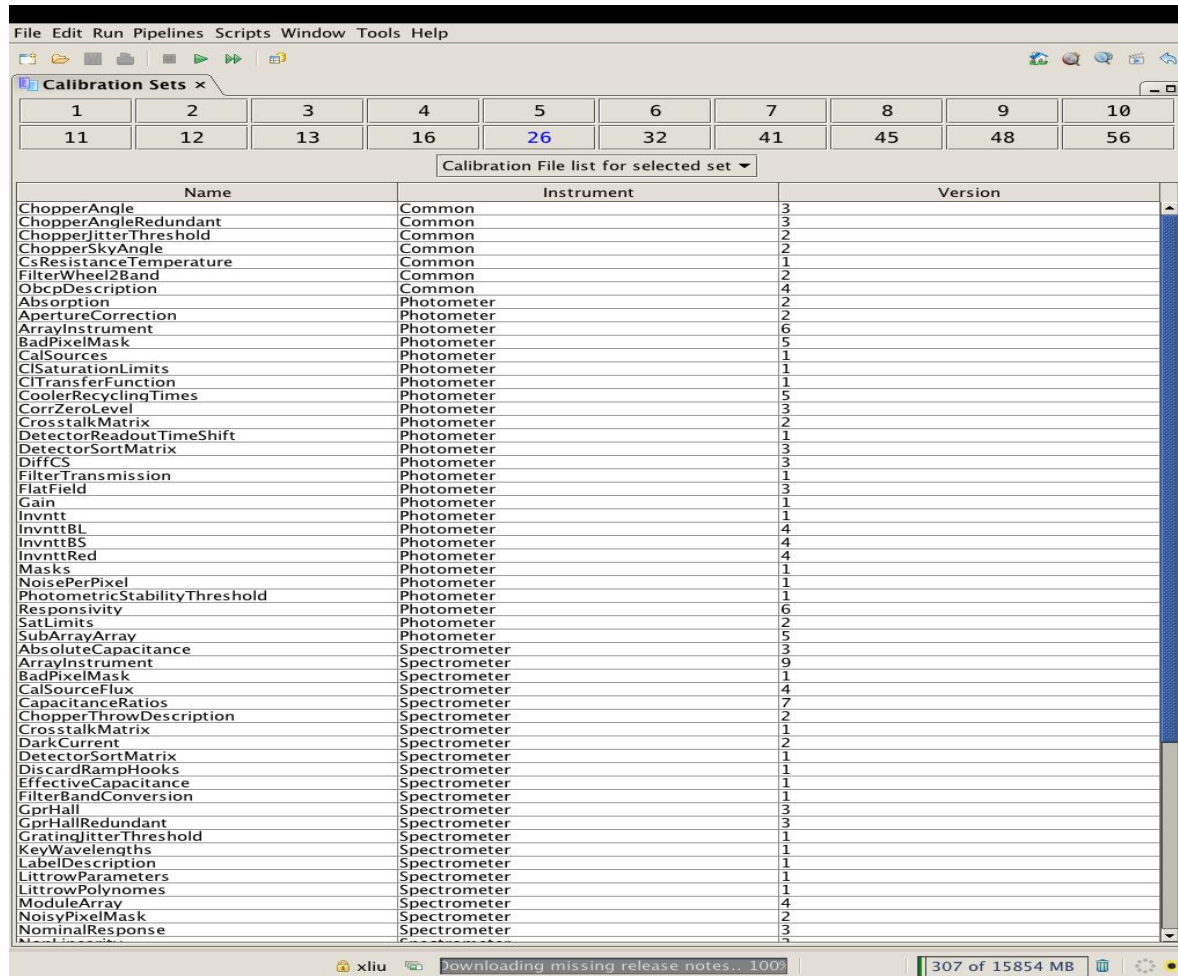
Reference Information

ICC Specific Information

Release notes shown in Calibration Sets view

Inspecting Calibration Products – Cont.

- The figures below show the calibration sets view with set 26 selected



Name	Instrument	Version
ChopperAngle	Common	3
ChopperAngleRedundant	Common	3
ChopperJitterThreshold	Common	2
ChopperSkyAngle	Common	2
CsResistanceTemperature	Common	1
FilterWheel2Band	Common	2
ObspDescription	Common	4
Absorption	Photometer	2
ApertureCorrection	Photometer	2
ArrayInstrument	Photometer	6
BadPixelMask	Photometer	5
CalSources	Photometer	1
CSaturationLimits	Photometer	1
CITransferFunction	Photometer	1
CoolerRecyclingTimes	Photometer	5
CorrZeroLevel	Photometer	3
CrosstalkMatrix	Photometer	2
DetectorReadoutTimeShift	Photometer	3
DetectorSortMatrix	Photometer	3
DiffCS	Photometer	3
FilterTransmission	Photometer	1
FlatField	Photometer	3
Gain	Photometer	1
Invntt	Photometer	1
InvnttBL	Photometer	4
InvnttBS	Photometer	4
InvnttRed	Photometer	4
Masks	Photometer	1
NoisePerPixel	Photometer	1
PhotometricStabilityThreshold	Photometer	1
Responsivity	Photometer	6
SatLimits	Photometer	2
SubArrayArray	Photometer	5
AbsoluteCapacitance	Spectrometer	3
ArrayInstrument	Spectrometer	9
BadPixelMask	Spectrometer	1
CalSourceFlux	Spectrometer	4
CapacitanceRatios	Spectrometer	7
ChopperThrowDescription	Spectrometer	2
CrosstalkMatrix	Spectrometer	1
DarkCurrent	Spectrometer	2
DetectorSortMatrix	Spectrometer	1
DiscardRampHooks	Spectrometer	1
EffectiveCapacitance	Spectrometer	1
FilterBandConversion	Spectrometer	1
GprHall	Spectrometer	3
GprHallRedundant	Spectrometer	3
GratingJitterThreshold	Spectrometer	1
KeyWavelengths	Spectrometer	1
LabelDescription	Spectrometer	1
LittrowParameters	Spectrometer	1
LittrowPolynomes	Spectrometer	1
ModuleArray	Spectrometer	4
NoisyPixelMask	Spectrometer	2
NominalResponse	Spectrometer	3

File list shown in Calibration Sets view