PACS Spectrometer
Flux Calibration concept

PICC-KL-TN-034

Prepared by	P. Royer	
	B, Vandenbussche	
	J. Blommaert	
Approved by		
Authorised by		

Distribution List

Recipients	***Affiliation***	***Nr. of Copies***

Document Change Record

Issue	***Date***	***Description***
Draft 1	01-10-2008	First version
Draft 2	06-10-2008	Added pipeline steps
1	10/03/09	Cleaned up some notations, added relative calsource flux for non-prime key wavelengths, added summary of wavelength switching co-location

Table of Contents

1 Introduction

We describe the spectrometer flux calibration concept.

For the first iteration, the following assumptions are taken:

- The RSRF within the sky field of view does not depend on chopper position
- The optical flatfield (i.e. the illumination of the detector pixels) does not depend on chopper position.

2 Definition of terms

Notation	**Quantity**	**Dependencies**
ij	detector pixel index (pixel I, module j)	
CS1, CS2	Internal calibration source 1 / 2	
A, B	Nod positions	
$E_{\lambda T}$	Spectral irradiance (flux density) of the telescope Background	i,j, chopper position, time of observation
$E_{\lambda S}$	Spectral irradiance (flux density) of the sky background	ra,dec,roll
D	Dark Current	i,j, time of observation
$E_{\lambda O}$	Spectral irradiance (flux density) of the object	i,j, source
G_0	Gain / response at the beginning of the observation Responsivity (pixel to pixel variation and absolute calibration at the key wavelength)	i,j, time of observation
G_t	Gain	
RSRF	Relative Spectral Response Function	i,j,λ

3 Integrating capacitance

The photocurrent of the PACS photoconductors can be integrated over four different capacitances, depending on the dynamic range of the signal. The selected integrating capacitance can change within the observation. The spectrophotometric calibration is done against the smallest capacitance (140fF) for every pixel.

These capacitances are physically different devices for every pixel, hence the ratio between the different capacitances is different per pixel.

The ratios between the different capacitances for every pixel are stored in calibration table spectrometer.CapacitanceRatios. Pipeline step convertSignal2StandardCap divides by this ratio.

4 Internal calibration block measurements

Within every AOT, there is one (or several) internal calibration block measurements. A small scan (up/down) is performed around a key wavelength in the red and one blue spectral band, while chopping between the two internal calibration sources.

The key wavelength scanned depends on the spectral bands selected in HSPOT:

	B3A	B2A	B2B	R1
Line scan [73-98] and [103-210] microns (2nd and 1st order)			75	150
Line scan [55-73] and [103-210] microns (3rd and 1st order)	60			180
Range scan [73-98] and [103-210] microns (2nd and 1st order)			75	150
Range scan [55-73] and [103-210] microns (3rd and 1st order)	60			180
SED red [73-98] and [103-210] microns (2nd and 1st order)			75	150
SED blue [55-73] and [103-210] microns (3rd and 1st order)	60			180
SED blue high sensitivity [60-73] extended 2nd order		60		120

Historically, in ground tests also other key wavelengths have been used:

	B3A	B2A	B2B	R1
Line or range selected in order 3 [55-73] microns	55			165
Line or range selected in order 2 [73-98] microns			65	130
Line or range selected in order 2 [73-98] microns			74	148
Line or range selected in order 2 [73-98] microns			82	164
Line or range selected in order 1 [103-210] microns, filter A		65		130
Line or range selected in order 1 [103-210] microns, filter A				148
Line or range selected in order 1 [103-210] microns, filter A	55			165
Line or range selected in order 1 [103-210] microns, filter B				130
Line or range selected in order 1 [103-210] microns, filter B			74	148
Line or range selected in order 1 [103-210] microns, filter B			82.5	165

Each spectral band has one prime key wavelength, to which the absolute flux scaling of the entire band is scaled:

150R1
75B2B
60B2A
60B3A

The secondary key wavelengths appearing (cfr tables above) are then:

55B3A, 65B2A, 65B2B, 74B2B, 82B2B, 825B2B

180R1, 120R1, 165R1, 130R1, 148R1, 164R1, 130R1

The signal recorded in the PACS pixels at one grating position for the two chopper positions (CS1/CS2) is :

$$N_{CS1,ij,\lambda} = E_{\lambda,ij,CS1} \,.\, RSRF_{ij,\lambda} \,.\, R_{ijt} + D_{ij,t} \qquad [V/sec = Jy\ .\ 1\ .\ 1.\ V/sec/Jy\ .\ + V/sec)]$$

$N_{CS2,i,j,\lambda} = E_{\lambda,ij,CS2} \,.\, RSRF_{ij,\lambda} \,.\, R_{ijt} + D_{ij,t}$ [V/sec = Jy . 1 . 1. V/sec/Jy . + V/sec)]

with

$N_{CS1,ij,\lambda}$	Signal recorded on the CS1 chopper plateaus
$N_{CS2,ij,\lambda}$	Signal recorded on CS2 chopper plateaus
$E_{\lambda,ij,CS1}$	the spectral irradiance (flux density) of CS1 seen by pixel ij at wavelength λ
$E_{\lambda,ij,CS2}$	the spectral irradiance (flux density) of CS2 seen by pixel ij at wavelength λ
$RSRF_{ij,\lambda}$	the relative spectral response, relative to the response a the prime keyλ
$R_{ij,t}$	The response at the prime key wavelength at the time of the observation
$D_{ij,t}$	Dark current at time of the observation

In the pipeline step stepDiffCs, we first calculate the average (over all grating positions/wavelengths) of the differences between the two calibration sources. This is calculated per pixel:

$$
\begin{aligned}
&< N_{CS1,i,j,\lambda} - N_{CS2,ij,\lambda} > \\
&\quad = < (E_{\lambda,ij,CS1} \,.\, RSRF_{ij,\lambda} \,.\, R_{ij,t} + D_{ij,t}) - (E_{\lambda,ij,CS2} \,.\, RSRF_{ij,\lambda} \,.\, R_{ij,t} \,.+ D_{ij,t}) > \\
&\quad = R_{ijt} \,.\, < RSRF_{ij,\lambda} \,.\, E_{\lambda,i,j,CS1} - RSRF_{ij,\lambda} \,.\, E_{\lambda,i,j,CS2} > \\
&\quad = R_{ijt} \,.\, [< RSRF_{ij,\lambda} \; E_{\lambda,ij,CS1} > - < RSRF_{ij,\lambda} \,.\, E_{\lambda,ij,CS2} >]
\end{aligned}
$$

[V/sec]

The RSRF depends on the incident angle of the beam through the different filters in the spectrometer chain. The detectors see the two calibration sources and the sky field of view under significantly different angles, and therefore different RSRFs are applicable. These RSRFs can not been determined explicitly. We therefore use the 'dirty' calibration source densities, i.e. not corrected for the RSRF.

The dirty calibration source flux densities $< RSRF_{ij,p\lambda} \; E_{p\lambda,ij,CS1} >_{p\lambda}$ and $< RSRF_{ij,p\lambda} \,.\, E_{p\lambda,ij,CS2} >_{p\lambda}$ are stored for all prime key wavelengths in calibration table spectrometer.CalSourceFlux. [Jy]

The ratios of the dirty calibration source flux densities at the different key wavelengths to the dirty calibration source flux densities at the prime key wavelengths of the spectral bands of the same detector are stored in spectrometer.RelCalSourceFlux. ($< RSRF_{ij,\lambda} \; E_{\lambda,ij,CS1} >_{\lambda} / < RSRF_{ij,p\lambda} \; E_{p\lambda,ij,CS1} >_{p\lambda}$)

This allows the pipeline step specDiffCs to calculate the absolute pixel response and the dark current for every observation at the time of the calibration block measurement:

$$
\begin{aligned}
R_{ijt0} = \; & < N_{CS1,i,j,\lambda} - N_{CS2,i,j,\lambda} >_{\lambda} / \\
& [(< RSRF_{ij,\lambda} \; E_{\lambda,ij,CS1} >_{\lambda} / < RSRF_{ij,p\lambda} \; E_{p\lambda,ij,CS1} >_{p\lambda}) \,.\, < RSRF_{ij,p\lambda} \; E_{p\lambda,ij,CS1} >_{p\lambda} \\
& - (< RSRF_{i,j,\lambda} \,.\, E_{\lambda,i,j,CS2} >_{\lambda} / \; RSRF_{ij,p\lambda} \,.\, E_{p\lambda,ij,CS2} >_{p\lambda}) \,.\, < RSRF_{ij,p\lambda} \; E_{p\lambda,ij,CS2} >_{p\lambda}]
\end{aligned}
$$

[V/sec/Jy]

and

$$
\begin{aligned}
D_{ij,t0} = \; & \tfrac{1}{2} \; [[\; <N_{CS1,ij,\lambda}>_{\lambda} - \\
& \qquad R_{ijt} \; (<E_{\lambda,ij,CS1} \,.\, RSRF_{ij,\lambda}>_{\lambda} / < RSRF_{ij,p\lambda} \; E_{p\lambda,ij,CS1} >_{p\lambda}) \,.\, < RSRF_{ij,p\lambda} \; E_{p\lambda,ij,CS1} >_{p\lambda}] \\
& [<N_{CS1,ij,\lambda}>_{\lambda} - \\
& \qquad R_{ijt} \; (<E_{\lambda,ij,CS1} \,.\, RSRF_{ij,\lambda}>_{\lambda} / \; RSRF_{ij,p\lambda} \,.\, E_{p\lambda,ij,CS2} >_{p\lambda}) \,.\, < RSRF_{ij,p\lambda} \; E_{p\lambda,ij,CS2} >_{p\lambda}]]
\end{aligned}
$$

[V/sec]

5 Chopped line scan and range scan measurements

The chopped line scan or range scan measurements, we perform a chop-nod pattern with nod positions A-B-B-A. Chopping is symmetrical to the optical axis, so that the source is on the positive chopper plateau at nod positions A, and at the negative chopper plateau at nod positions B.

The signal seen in a detector at nod position A (on-chopper plateau, positive chopper angle), nod position A (off-chopper plateau, negative chopper angle), nod position B (on-chopper plateau, negative chopper angle) and nod positition B (off-chopper plateau, positive chopper angle) are:

$$N_{\mathrm{Aon},\,ij,\lambda} = (E_{\lambda,ij,O} + E_{\lambda,ij,S} + E_{\lambda,ij,T+})\, RSRF_{ij,\lambda} \,.\, R_{ijt} + D_{ij,t}$$

$$N_{\mathrm{Aoff},\,ij,\lambda} = (E_{\lambda,ij,S} + E_{\lambda,ij,T-})\, RSRF_{ij,\lambda} \,.\, R_{ijt} + D_{ij,t}$$

$$N_{\mathrm{Bon},\,ij,\lambda} = (E_{\lambda,ij,O} + E_{\lambda,ij,S} + E_{\lambda,ij,T-})\, RSRF_{ij,\lambda} \,.\, R_{ijt} + D_{ij,t}$$

$$N_{\mathrm{Boff},\,ij,\lambda} = (E_{\lambda,ij,S} + E_{\lambda,ij,T+})\, RSRF_{ij,\lambda} \,.\, R_{ijt} + D_{ij,t}$$

In order to cancel out the sky background and the telescope background, we would like to calculate the double differential ($N_{\mathrm{Aon},\,ij,\lambda} - N_{\mathrm{Aoff},\,ij,\lambda}$) + ($N_{\mathrm{Bon},\,ij,\lambda} - N_{\mathrm{Boff},\,ij,\lambda}$) at every grating position. However, the response R_{ijt} is drifting on time scales of ~10 seconds within the observation. Also, the RSRF is different for different grating positions (hence different chopper cycles). Therefore, we first need to differentiate on short timescales, i.e. the on-off within a chopper cycle. This will cancel out the dark current and sky background in the pipeline step specDiffChop:

$$\begin{aligned}
\Delta_{A,\,ij,\lambda} &= N_{\mathrm{Aon},\,ij,\lambda} - N_{\mathrm{Aoff},\,ij,\lambda} \\
&= (E_{\lambda,ij,O} + E_{\lambda,ij,S} + E_{\lambda,ij,T+})\, RSRF_{ij,\lambda} \,.\, R_{ijt} + D_{ij,t} - (E_{\lambda,ij,S} + E_{\lambda,ij,T-})\, RSRF_{ij,\lambda} \,.\, R_{ijt} - D_{ij,t} \\
&= (E_{\lambda,ij,O} + E_{\lambda,ij,S} + E_{\lambda,ij,T+} - E_{\lambda,ij,S} - E_{\lambda,ij,T-})\, RSRF_{ij,\lambda} \,.\, R_{ijt} \\
&= (E_{\lambda,ij,O} + E_{\lambda,ij,T+} - E_{\lambda,ij,T-})\, RSRF_{ij,\lambda} \,.\, R_{ijt}
\end{aligned}$$

$$\begin{aligned}
\Delta_{B,\,ij,\lambda} &= N_{\mathrm{Bon},\,ij,\lambda} - N_{\mathrm{Boff},\,ij,\lambda} \\
&= (E_{\lambda,ij,O} + E_{\lambda,ij,S} + E_{\lambda,ij,T-})\, RSRF_{ij,\lambda} \,.\, R_{ijt} + D_{ij,t} - (E_{\lambda,ij,S} + E_{\lambda,ij,T+})\, RSRF_{ij,\lambda} \,.\, R_{ijt} - D_{ij,t} \,] \\
&= (E_{\lambda,ij,O} + E_{\lambda,ij,S} + E_{\lambda,ij,T-} - E_{\lambda,ij,S} - E_{\lambda,ij,T+})\, RSRF_{i,j,\lambda} \,.\, R_{ijt} \,] \\
&= (E_{\lambda,ij,O} + E_{\lambda,ij,T-} - E_{\lambda,ij,T+})\, RSRF_{ij,\lambda} \,.\, R_{ijt} \,]
\end{aligned}$$

$RSRF_{ij,\lambda}$ is stored in calibration table spectrometer.Rsrf<band>. Pipeline step rsrfCal divides by the RSRF, normalised to 1 at the key wavelengths. The corrected differentials are then:

$$\Delta^*_{A,\,ij,\lambda} = (E_{\lambda,ij,O} + E_{\lambda,ij,T+} - E_{\lambda,ij,T-}) \,.\, R_{ijt}$$

$$\Delta^*_{B,\,ij,\lambda} = (E_{\lambda,ij,O} + E_{\lambda,ij,T-} - E_{\lambda,ij,T+}) \,.\, R_{ijt}$$

The detector response R_{ijt0} at the time of the calibration block is calculated as described above, in the pipeline step specDiffCs. For ground data, this response is stable over longer timescales, and can be used for the entire observation, i.e. $R_{ijt} = R_{ijt0}$

In-orbit, the detector response R_{ijt} drifts on short timescales. The pipeline module specFitSignalDrift determines the detector response R_{ijt} for the whole observation based on the off-plateau data as follows:

$$N_{off,\ ij,\lambda} = (E_{\lambda,ij,S} + E_{\lambda,ij,T-})\ RSRF_{i,j,\lambda} \,.\, R_{ijt} + D_{ij,t}$$

For these telescope background signals, we subtract the dark current determined from the calibration block by specCsRespCal, and divide by the RSRF.

$$N^{*}_{off,\ ij,\lambda} = (E_{\lambda,ij,S} + E_{\lambda,ij,T-})\ R_{ijt}$$

We assume that the response drift R_{ijt} / R_{ijt0} averages to 1 when averaging over all detectors. We therefore just divide by the calibration block response R_{ijt0}. The resulting spectra $(\lambda , (E_{\lambda,ij,S} + E_{\lambda,ij,T-}))$ and $(\lambda , (E_{\lambda,ij,S} + E_{\lambda,ij,T+}))$ of all detectors (25 * 16) are then noise filtered and rebinned to construct the average background spectrum $(\lambda , (E_{\lambda,<ij>,S} + E_{\lambda,<ij>T-}))$ and $(\lambda , (E_{\lambda,<ij>,S} + E_{\lambda,<ij>T+}))$ This allows to calculate the response drift for each chopper cycle:

$$R_{ijt} = N^{*}_{off,\ ij,\lambda} \ / \ (E_{\lambda,<ij>,S} + E_{\lambda,<ij>T-}) \quad \text{for nod positions A}$$

$$R_{ijt} = N^{*}_{off,\ ij,\lambda} \ / \ (E_{\lambda,<ij>,S} + E_{\lambda,<ij>T+}) \quad \text{for nod positions B}$$

The pipeline step specRespCal divides Δ^{*} by these detector responses R_{ijt} to calculate:

$$\Delta^{**}_{A,\ ij,\lambda} = E_{\lambda,ij,O} + E_{\lambda,ij,T+} - E_{\lambda,ij,T-}$$

$$\Delta^{**}_{B,\ ij,\lambda} = E_{\lambda,ij,O} + E_{\lambda,ij,T-} - E_{\lambda,ij,T+}$$

Adding the two nods per grating position in specAddNod:

$$(\Delta^{**}_{A,\ ij,\lambda} + \Delta^{**}_{B,\ ij,\lambda}) / 2 = E_{\lambda,ij,O} + E_{\lambda,ij,T+} - E_{\lambda,ij,T-} + E_{\lambda,ij,O} + E_{\lambda,ij,T-} - E_{\lambda,ij,T+}) / 2$$
$$= E_{\lambda,ij,O}$$

6 Staring range scans and line scans

In ILT/IST several unchopped measurements were performed (e.g. the quickfullspectrum measurements, the wavelength calibration measurements, etc.) In these measurements with low background, and in the absence of response drifts due to irradiation effects, the same calibration files and pipeline steps can be used, without the chop/nod differences.

Dark current and response are determined from calibration block measurement, or, if not available, dark from cold calibration source measurement and response from RSRF measurement (stored in calibration tables

7 Wavelength switching

Four blocks:

Calibration source block

off position line scan $A_1B_1B_1A_1A_2B_2B_2A_2$-$A_3B_3B_3A_3$...

Calibration source block

on position $A_1B_1B_1A_1A_2B_2B_2A_2$-$A_3B_3B_3A_3$...

From Calibration blocks: determine dark and gain at key wavelengths at beginning of off and on

Subtract dark

RsrfCal

Determine continuum C from full power (average over all pixels) -> average over pixels never seeing the line ?

for off block: calculate $(n_A - n_B) / (n_A + n_B) = (E_A - E_B) / (E_A + E_B)$

for on block: calculate $(n_A - n_B) / (n_A + n_B) =$

$$[(E_A + P_A + C_A) - (E_B + P_B + C_B)] / [E_A + E_B + P_A + P_B + C_A + C_B]$$

Estimate CA + CB from continuum full power

Assume PA + PB = 0

Subtract EA – EB / EA + EB -> first estimate of PA-PB; deconvolve to P

re-iterate with estimate of (PA, PB)

8 Calibration of capacitance ratios

The capacitance ratios have been measured on ground during FM-ILT by measuring the same OGSE blackbody source at the 4 integrating capacitances.

The ratio between capacitance c1 and capacitance c2 is :

$$< N_{CS1,i,j,\lambda} - N_{CS2,i,j,\lambda} >_{c1} / < N_{CS1,i,j,\lambda} - N_{CS2,i,j,\lambda} >_{c2}$$

9 Calibration of the RSRF and nominal response

During Instrument Level tests, full-range scans were performed on calibrated cryogenic blackbody sources of known temperature.

$$N_{BB,i,j,\lambda} = (E_{\lambda,i,j,BB} \,.\, RSRF_{i,j,\lambda} \,.\, R_{ijt} + D_{ij,t}) \,.\, C_{ij,c}$$

$D_{ij,t}$ is determined from measurements on a cold calibration source prior to the measurement.

$E_{\lambda,i,j,BB}$ is a planck function with known temperature, so we can calculate the absolute spectral response function:

$$ASRF_{ij,\lambda} = (N_{BB,i,j,\lambda} - D_{ij,t}) / E_{\lambda,i,j,BB} \,.\, C_{ij,c}$$

We then disentangle $RSRF_{i,j,\lambda}$ and R_{ijt} by normalising the RSRF to 1 over the prime key wavelength intervals:

$$R_{ijt} = < ASRF_{i,j,p\lambda} >$$

$$RSRF_{i,j,\lambda} = ASRF_{ij,\lambda} / R_{ijt}$$

$RSRF_{i,j,\lambda}$ is stored in calibration table spectrometer.Rsrf<band>

R_{ijt} is stored in calibration table spectrometer.NominalResponse

10 Ground Calibration of calibration source flux density

During instrument level tests, full scans are made of the two internal calibration sources:

$$N_{CS1,i,j,\lambda} = (E_{\lambda,i,j,CS1} \,.\, RSRF_{i,j,\lambda} \,.\, R_{ijt} + D_{ij,t}) \,.\, C_{ij,c}$$

$$N_{CS1,i,j,\lambda} = (E_{\lambda,i,j,CS1} \,.\, RSRF_{i,j,\lambda} \,.\, R_{ijt} + D_{ij,t}) \,.\, C_{ij,c}$$

$D_{ij,t}$ is determined from measurements on a cold calibration source prior to the measurement.

$C_{ij,c}$ is taken from spectrometer.CapacitanceRatios.

R_{ijt} is taken from spectrometer.NominalResponse

This allows to calculate to calculate the flux densities of the two calibration sources over the key wavelengths without RSRF correction:

$$< RSRF_{i,j,key\lambda} \; E_{key\lambda,i,j,CS1} > \; = \; < N_{CS1,i,j,\lambda} - D_{ij,t} > / \; R_{ijt} \,.\, C_{ij,c}$$

$$< RSRF_{i,j,key\lambda} \; E_{key\lambda,i,j,CS2} > \; = \; < N_{CS2,i,j,\lambda} - D_{ij,t>/} \, R_{ijt} \,.\, C_{ij,c}$$

These are stored in calibration tables spectrometer.CalSourceFlux.

11 In-orbit calibration of calibration source flux density

The in-orbit absolute flux calibration measurements consist of standard chopped range scans of celestial calibration sources over the key wavelength ranges. The standard pipeline for chopped range scans is run (cfr above), resulting in a measurement of $E_{\lambda,ij,O}$. These are averaged over key wavelength range for all pixels in module 12 (the central spaxel of the IFU), and corrected for diffraction losses. The ratio $<E_{\lambda,i12,O}> / \; E_{\lambda,ref}$ is then the correction to apply to $< RSRF_{i,j,key\lambda} \; E_{key\lambda,i,j,CS1} >$ and $< RSRF_{i,j,key\lambda} \; E_{key\lambda,i,j,CS2} >$ in calibration table spectrometer.CalSourceFlux.

12 Summary of pipeline steps

12.1 Chopped range scan / line scan AOT

```
frames = convertSignal2StandardCap(frames, <caltree.spectrometer. CapacitanceRatios>)

CsResponseAndDark = specDiffCs(frames, <caltree.spectrometer. CalSourceFlux>)

responseDrift = specFitSignalDrift(frames, CsResponseAndDark)

frames = specDiffChop(frames)

frames = specRsrfCal(frames, <caltree.spectrometer. RsrfR1>,  <caltree.spectrometer. RsrfB3A>,)

frames = specRespCal(frames, responseDrift)

frames = specAddNod(frames)
```

12.2 Staring range scan / line scan with calibration block (ILT, IST)

frames = convertSignal2StandardCap(frames, <caltree.spectrometer. CapacitanceRatios>)

CsResponseAndDark = specDiffCs(frames, <caltree.spectrometer. CalSourceFlux>)

frames = specSubtractDark(frames, CsResponseAndDark)

frames = specRsrfCal(frames, <caltree.spectrometer. RsrfR1>, ...)

frames = specRespCal(frames, CsResponseAndDark)

12.3 Staring range scan / line scan no calibration block (ILT, IST)

frames = convertSignal2StandardCap(frames, <caltree.spectrometer. CapacitanceRatios>)

frames = specSubtractDark(frames, caltree.spectrometer.DarkCurrent)

frames = specRsrfCal(frames, <caltree.spectrometer. RsrfR1>, ...)

frames = specRespCal(frames, caltree.spectrometer.NominalResponse)

13 Calibration products

13.1 spectrometer.CapacitanceRatios

13.2 spectrometer.CalSourceFlux

13.3 spectrometer.RelCalSourceFlux

13.4 spectrometer.Rsrf<band>

13.5 spectrometer.DarkCurrent

13.6 spectrometer.NominalResponse

14 Auxiliary processing products

14.1 CsResponseAndDarkProduct

CsResponseAndDarkProduct
    Meta
    [0] – CsResponseAndDarkMeasurement
        Meta

- Time
- Dark
    - [“Red”] Double2d
    - [“Blue”] Double2d
- Response
    - [“R1”] Double2d
    - [“B3A”] Double2d
    - [“B2A”] Double2d
    - [“B2B”] Double2d

[1] – CsResponseAndDarkMeasurement

14.2 ResponseDriftProduct

- ResponseDriftProduct
    - Meta
    - initialResponse
        - [“R1”] Double2d
        - [“B3A”] Double2d
        - [“B2A”] Double2d
        - [“B2B”] Double2d
    - TableDataset drift
        - [“Time”] long1d finetime
        - [“Red”] Double3d
        - [“Blue”] Double3d
    - [1] – CsResponseAndDarkMeasurement