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Seite/Page: 1 von/of 3 Seiten/Pages

Betreff/Subj.: Closure of AI #01 &amp; AI #10 from HP-2-ASED-MN-0107 – Low emissivity FPUs &amp; reduced cooler recycling period

Dear Colleagues,

Please find attached the requested data (2 pages) which can be summarized following:  
 Low emissivity of the instrument FPU's would lead to a L1 temperature reduction of about 0.3K.  
 However, compatibility with straylight requirements has to be checked.  
 Reduction of the sorption cooler recycling period from 48 h to 24 h lead to a lifetime loss of about 12 days only.

Kind regards

**Astrium GmbH**

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Datum/Date: 23.04.2002  
Seite/Page: 2



## HP-2-ASED-MN-0107 \ AI#01:

To assess the gain in temperature, the following emissivities have been allocated to the FPUs:

PACS housing	0.05 (baseline 0.2)
SPIRE housing	0.05 (baseline 0.1)
JFETs housing	0.05 (baseline 0.1)
HIFI housing	0.05 (baseline 0.05)

For the apertures the baseline emissivities have been taken unchanged:

PACS aperture	0.1
SPIRE aperture	1.0
HIFI aperture	1.0

Two different calculation runs have been performed:

- with a free-floating mass flow to get also information on the change in lifetime
- with a fixed mass flow of 2.1 mg/s to isolate the effect of changed emissivity from the change in massflow.

### Results:

By reducing the emissivities like described above, the total radiative heat input via the beam entrance onto the FPU's can be reduced from ~16 mW to ~11 mW (independent of using (a) or (b)) and thus, a gain in L1 temperature of about 0.3 K can be achieved. Detailed data are listed following:

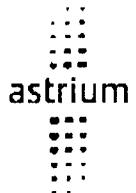
#### a) Floating mass flow

- $\Delta T$  (PACS, L1) = -0.34 K
- $\Delta T$  (SPIRE, L1) = -0.26 K
- $\Delta T$  (HIFI, L1) = -0.17 K
- $\Delta T$  (HOB) = +0.1 K
- $\Delta$ lifetime = +11 days (equivalent to a massflow decrease of 0.02 mg/s to 2.05 mg/s)

#### b) Fixed mass flow of 2.1 mg/s

- $\Delta T$  (PACS, L1) = -0.36 K
- $\Delta T$  (SPIRE, L1) = -0.30 K
- $\Delta T$  (HIFI, L1) = -0.25 K
- $\Delta T$  (HOB) = 0.0 K
- $\Delta$ lifetime = 0 days (fixed massflow)

Abs./Sender: Armin Hauser  
 Datum/Date: 23.04.2002  
 Seite/Page: 3



## HP-2-ASED-MN-0107 \ AI #10:

The change of the PACS and SPIRE cooler recycling period from 48 h to 24 h is equivalent to an increase of heat dissipation at the sorption cooler pumps (Level 0) in average mode. This increase ( $\Delta QI$ ) has been estimated as follows:

- Assumptions for PACS in **48 h** cooler recycling period (baseline):

48h (=2880 min) Photometer Mode duration, consisting of

- 65 min pump heating:	42 mW
- 45 min pump cooling down:	122 mW
- 2770 min nominal Phot. operating:	1.24 mW
→ Average sorption cooler dissipation (Phot. mode, avg):	4.05 mW

48h Spectrometer Mode duration (Sorption cooler in stand-by):

→ Sorption cooler dissipation (Spec. mode):	0.6 mW
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→ Dissipation in average mode:  $4.05/6 + 0.6/6 = 0.775$  mW

- Assumptions for PACS in **24 h** cooler recycling period (option):

2 x 24h (=2880 min) Photometer Mode duration, consisting of

- 2 x 65 min pump heating:	42 mW
- 2 x 45 min pump cooling down:	122 mW
- 2 x 1330 min nominal Phot. operating:	1.24 mW
→ Average sorption cooler dissipation (Phot. mode, avg):	6.85 mW

48h Spectrometer Mode duration (Sorption cooler in stand-by):

→ Sorption cooler dissipation (Spec. mode):	0.6 mW
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→ Dissipation in average mode:  $6.85/6 + 0.6/6 = 1.242$  mW

The resulting increase of dissipation in average mode including 20% margin is:

$$\Delta QI (\text{PACS, average}) = (1.242 - 0.775) \text{ mW} * 1.2 = 0.467 \text{ mW} * 1.2 = \mathbf{0.56 \text{ mW}}$$

The same approach is assumed for SPIRE:

$$\Delta QI (\text{SPIRE, average}) = \mathbf{0.56 \text{ mW}}$$

### Results:

Addition of the above calculated  $\Delta QI$ 's of  $2 * 0.56$  mW to the previous dissipation of the cooler pumps in average mode leads to the following results (based on the PM7 status of the thermal model):

- $\Delta \text{lifetime} = -12$  days (equivalent to a massflow increase of 0.02 mg/s)
- $\Delta T (\text{HOB}) = -0.1\text{K}$