Telefax/Telecopy

astrium

Datum/Date: 24.04.02

Herschel

An/To:

+33 4 92 92 30 10
Alcatel Space, Cannes, F
G. Lund, B. Collaudin

+31 71 565 32 44
ESTEC, Noordwijk, NL
Ch. Jewell, M.Linder

+89 30000 3272
MPE, Garching, D
J. Schubert

+031 302 540 860
SRON, Groningen, NL
C. Wafelbakker,
R. Roelfsema

+44 1235 44 6667
RAL, Oxfordshire, UK
J. Delderfield, S. Hays, B. SWINYARD, D. GRIFFIN

Kopie an/ Copy to:

Astrium GmbH
R.Hohn, E.Hölzle, J.Kroeker,
H.Faas, D.Schink, S.Idler J.Hinger,
K.Wagner, G.Jahn

Abs./Sender: Armin Hauser
Abt./Dep.: ED 37/Herschel
Tel./Phone: +49 75 45 8-9771
Fax/Fax: +49 75 45 8-42 43
E-Mail: Armin.Hauser@astrium-space.com
Ref.: HP-ASED-0260/02

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Betreff/Subj.: Closure of AI #01 & AI #10 from HP-2-ASED-MN-0107 – Low emissivity FPUs & 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

i. V. K. Moritz

i. A. E. Hölzle

Abs./Sender: Armin Hauser
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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:
a) with a free-floating mass flow to get also information on the change in lifetime
b) 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
- ΔT (PACS, L1) = -0.34 K
- ΔT (SPIRE, L1) = -0.26 K
- ΔT (HIFI, L1) = -0.17 K
- ΔT (HOB) = +0.1 K
- Δlifetime = +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
- ΔT (PACS, L1) = -0.36 K
- ΔT (SPIRE, L1) = -0.30 K
- ΔT (HIFI, L1) = -0.25 K
- ΔT (HOB) = 0.0 K
- Δlifetime = 0 days (fixed massflow)

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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 (ΔQI) 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, avrg): 4.05 mW

  48h Spectrometer Mode duration (Sorption cooler in stand-by):
  → Sorption cooler dissipation (Spec. mode): 0.6 mW

  → 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, avrg): 6.85 mW

  48h Spectrometer Mode duration (Sorption cooler in stand-by):
  → Sorption cooler dissipation (Spec. mode): 0.6 mW

  → 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:

ΔQI (PACS, average) = (1.242-0.775) mW * 1.2 = 0.467 mW * 1.2 = **0.56 mW**

The same approach is assumed for SPIRE:

ΔQI (SPIRE , average) = **0.56 mW**

Results:

Addition of the above calculated ΔQI'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):

- **Δlifetime = -12 days** (equivalent to a massflow increase of 0.02 mg/s)
- ΔT (HOB) = -0.1K