Herschel – mission status and future

Göran Pilbratt, Herschel Project Scientist
- on behalf of the many who made and make Herschel possible
Fairing integration on 10 May 2009
V188 rollout on 13 May 2009
V188 launch on 14 May 2009

<table>
<thead>
<tr>
<th>ORBITE</th>
<th>ESTIMATION PROVISOIRE</th>
<th>MIN</th>
<th>VISEE</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perigee (km)</td>
<td>270.0</td>
<td>265.5</td>
<td>270.0</td>
<td>274.5</td>
</tr>
<tr>
<td>Apogee (km)</td>
<td>1 197 080.</td>
<td>1 041 822.</td>
<td>1 193 622.</td>
<td>1 345 422.</td>
</tr>
<tr>
<td>Inclinaison (deg)</td>
<td>5.99</td>
<td>5.94</td>
<td>6.00</td>
<td>6.06</td>
</tr>
</tbody>
</table>

Mise à feu (H0) le 14/05/09 à 13 h 12 min 00 s (UT)
soit le 14/05/09 à 10 h 12 min 00 s (Kourou)

Le Chef de Mission

Le Responsable Charge Utile Ariane
Early mission phases – the Plan

- 14 May: Herschel launched (together with Planck)
- Commissioning Phase (COP) ~2 months
  - Functional testing
  - Cryocover opening after ~1 month
- Performance Verification Phase (PVP) ~3 months
  - Verification, optimisation & release of observing modes
  - HIFI malfunction early on (on 2 August)
- Science Demonstration Phase (SDP) ~1 month
  - Use released observing modes, optimise & release observing programmes – get initial science as ‘by-product’
- Routine Science Phase (RSP) ≥36 months
  - Overall planning and GT awarded based on 3 years RSP
- By necessity ‘gradual transitions’ between phases
Spacecraft
Cooldown – HTT

Herschel Post Launch transient - HTT

Launch 14/5/09 13:12

Max 1.965 19/6/09 15 15
Close Large Nozzle valves V505-V504 05/06/09

Open Cover 08/06/09
Delta V 8.7 m/s 15/5 17:30

Reaction wheel maintenance

Flight Data from MUST server, Prediction from M. Linder (20/5/09 & 30.5)
Cooldown – levels 0, 1, 2, & 3

Herschel Post Launch transient - Level 0, 1, 2, 3

Flight Data from MUST server, Prediction from M.Linder (30/5/09)

http://herschel.esac.esa.int/
Cooldown – CVV & shields

Herschel Post Launch transient - CVV - Shields

Flight Data from MUST server, Prediction from M.Linder (30/5/09)

SDP DP workshop       14/12/2009
Göran L. Pilbratt       VG # 10
http://herschel.esac.esa.int/
Cooldown – telescope, LOU, & CVV

Herschel Post Launch transient - CVV - LOU-Telescope

Flight Data from MUST server, Prediction from M. Linder (30/5/09)

http://herschel.esa.int/
Herschel lifetime - 1

• Herschel lifetime ingredients and modelling
  • Amount of usable He at launch (filling level, launch attempt)
  • Transient phase He use particularly uncertain
  • Stationary conditions
    • CVV average stationary outside temperatures
    • Stationary average dissipation
      ⇒ Model average He mass-flow
  • Calculate lifetime
    ⇒ Pre-launch estimates of mission lifetime around 4 years

• During stationary conditions
  • Remaining lifetime = current He mass / average mass-flow
  • Mission lifetime = remaining lifetime + current time into mission
  • Remaining amount of He can be measured (DLCM)
  • Repeated DLCMs also give mass-flow
    ⇒ Measure (rather than model) lifetime
Herschel lifetime - 2

• At In-Orbit Commissioning Review (IOCR)
  • Mid-July – just reached stationary conditions
  • Amount of He at launch known at 333.5 kg
  • Transient phase use modelled/estimated
  • Stationary conditions
    • CVV average stationary outside temperatures measured
    • Stationary average dissipation
      ⇒ Average He mass-flow modelled at 2.668 mg/s
      ⇒ Mission lifetime estimated at 3.78 years

• First DLCM on OD#195
  • Remaining amount He measured at 283 ± 14 kg (269-297 kg)
  • Use 2.668 mg/s => 1228 ± 50 days (1168-1288 days)
  • Compute total mission lifetime => 3.65-3.98 years
  • Estimated amount of He was 275 kg (consistent)
    ⇒ Mission lifetime given as 3.8 years (end ~March 2013)
Herschel lifetime - 3

- There are (still) large uncertainties ...

- ... but confidence of 3.5 year mission strengthened
Cooldown and to date – telescope
1 July-12 December – telescope
Cooldown and to date – CVV
1 July-12 December – CVV
‘Seasonal’ temperature evolution

- Pre-launch modelling ‘cold’ and ‘hot’ cases
  - Takes into account a number of factors including
    - Solar ‘constant’
    - Spacecraft attitude
    - Uncertainties in various parameters

- **Telescope M1 Δ(‘hot’-'cold’) ~8 K**
  - Absolute temp ~5 K higher than predicted – Δ ~accurate
  - Attitude effects ~2 K
  ⇒ Seasonal effect ~6 K – appears close to observed

- **CVV Δ(‘hot’-'cold’) ~2 K**
  - Absolute temp ~8 K higher than predicted – Δ ~accurate
  - Attitude effects ~1 K
  ⇒ Seasonal effect ~1 K - appears close to observed
Herschel overall status - 1

Herschel is presently in ‘mixed phases’

- 14 May: Herschel (and Planck) launched
- 8-9 June: Herschel coolers were activated
- 14 July: Commissioning Phase (CoP) ended
- 15 July: Performance Verification Phase (PVP) activities started
- 21 July: Successful In-Orbit Commissioning Review (IOCR)
- 2 August: Malfunction of HIFI, it has not been operated since
- 1-3 September: PACS/SPIRE parallel mode executed first time
- 12 September: First Science Demonstration Phase (SDP) observations performed (SPIRE scan-map)
- 28 September: Delivery of first (SPIRE) SDP data products to users
- 18 October: First Routine Science Phase (RSP) observations conducted (PACS scan-map)
- 14-18 December: SDP Data Processing and Initial Results workshops
Time usage

Histogram of Time Usage per OD
ODs 0067 - 0152

- 81: HIFI went down
- 82, 83, 92: STR autonomous switchover impacts
- 113: Command sequence in early SPIRE spectrometer test
- 114: Unsuitable PACS epilogue in first parallel mode test
- 127-129: PACS readout anomaly in very fast readout eng. test (understood & fixed)
- 135: CDMS upload failure (understood & rescheduled)
- 143, 144: SPIRE SMEC current OOL
Herschel overall status - 2

Phase transitions

- **Commissioning Phase (CoP) to Performance Verification Phase (PVP)**
  - ‘In bulk’
  - In-Orbit Commissioning Review (IOCR) and transfer of responsibility from Project Manager to Mission Manager

- **Performance Verification Phase (PVP) to Science Demonstration Phase (SDP)**
  - AOT (or sub-AOT) one by one underway
  - AOT release *cons
  - Most PACS, SPIRE, and parallel mode relased

- **Science Demonstration Phase (SDP) to Routine Science Phase (RSP)**
  - KP (or part of KP) one by one underway
  - KP (or sub-KP) release telecons underway
  - 22 telecons for 17 KPs held
Herschel overall status - 3

- Herschel observations right now
  - SDP completion almost 60%
  - Of what’s left
    - ~½ is HIFI
    - ~½ is non-released PACS & SPIRE AOTs – mainly spectroscopy

- Currently we are mainly observing RSP!!
  - Scheduling underway over Christmas and the New Year – to be completed this week

- HIFI activities to re-commence in January 2010
  - HIFI to be allocated ~50% of Herschel time in early 2010
  - HIFI Priority Science Programme (PSP) to be executed in February-April 2010
Future AOs

• **Mission lifetime 3.5-4 years**
  - Routine science phase duration 3-3.5 years
  - About 6600 hours science time per year

• **Key Programmes**
  - Allocated ~11000 hours or ~1.7 years

• **Time available to be allocated**
  - Total RSP – KP allocated = ~1.3-1.8 years
  - Resonable to have 2 AOs

• **Timing for future AOs**
  - Existing KPs cover – ‘in one block’ – to summer 2011
  - Want many available AORs to ensure efficient scheduling
  - HIFI experience shows you need to robust against instrument temporarily out of action
  ⇒ want AO-1 AORs by late 2010, issue AO early 2010
Future Timeline

Exact dates to be communicated

- Mid-December 2009: SDP DP and IR workshops
- Early January 2010: Special (but short) AAS Herschel initial results session (2x90 min on 5 January)
- End February 2010: ‘Grand HSA opening’ (with public HIPE v2.0 release)
- End February 2010: GT AO issue
- End March 2010: A&A papers submission deadline
- End March 2010: GT AO proposal deadline
- End April 2010: OT AO issue
- Begin May 2010: ‘First Results’ workshop (ESLAB 2010)
- Mid-May 2010: A&A papers acceptance deadline (then preprints on astro/ ph publicly available) & user reduced data delivery
- End June 2010: OT AO submission deadline
- July 2010: A&A issue publication
- July 2010: HSC technical evaluation of OT proposals
- September 2010: HOTAC process OT proposals
We have come a long way!