SPIRE Vibration testing
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Scope
This document discusses the rational for SPIRE not doing a second cold vibration test after fitting of the SMEC to the PFM.

Status to date
The FPU was qualified by performing a room temperature vibration at RAL at SM level, and a cryo-vibration test at CSL at CQM level.
The PFM has (or will shortly) have seen a cryo-vibration test campaign in three axis to acceptance levels.

Post test activities
After this latest test campaign, the FPU will have the following activities carried out on it.

1. Unpack and mount on its MGSE, no disassembly required.
2. Remove the photometer cover
3. Remove the tri-ax accelerometer mounted on the photometer detector box. (three fasteners which are not refitted)
4. Refit the photometer cover.
5. Remove the spectrometer cover.
6. Remove the tri-ax accelerometer mounted on the spectrometer detector box. (three fasteners which are not refitted)
7. Remove the DM SMEC (4 fasteners)
8. Fit the PFM SMEC (4 fasteners plus four connector screws)
9. Refit the Spectrometer cover

Both the spectrometer and photometer covers are attached to the SPIRE optical bench by approximately 65 fasteners. These are all retained by locking inserts and are clearly visible from the outside after the instrument is reassembled.

Workmanship testing
Normally a workmanship vibration test would be carried out after such activities.
For normal instruments a room temperature test would be acceptable. However SPIRE cannot be vibrated warm (except at very low levels) because at ambient temperature, the tension in the detector Kevlar suspension system is too high to tolerate modest vibration levels. Consequently SPIRE would like to avoid this test for the following reasons.

- It would take approximately two months to complete the re-test campaign, because it would involve warm up and removal from the RAL test facility, transport to CSL, installation in the cryo-vibration facility, cool down, test, warm up, removal, transport back to RAL, installation in the RAL test facility cool down.

- There is significant risk to the instrument during these activities, especially transport and handling.

- We feel that this time would be better spent continuing the test and calibration campaign at RAL.

Possible alternative strategy

- Conduct a rigorous inspection during and after the work carried out on the FPU. This would involve a check sheet of every activity, including listing every fastener to ensure it is fitted, torqued, locked and inspected. This could be carried out by an independent inspector, e.g ESA PA.
- Carry out a low level resonance search (0.25g, 20 to 2000 Hz) or very low level random test at RAL, and compare the signatures obtained with those recorded during the cry-vibration test at CSL. Assuming there was no significant change in signature this would prove that the structural integrity of the FPU was unchanged.
- This warm low level test could be carried out immediately after the SMEC fitting and thus have minimum impact on the overall schedule.

SPIRE considers that this approach is lower risk approach and allows considerably more testing and calibration time which is vital for the optimum scientific return.