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ORIENTATION OF SPACERS IN THE HESSI BLANKET MATERIAL

BACKGROUND

Since HESSI imaging is based on the modulation of the detected x-ray flux, to achieve high dynamic range imaging, it is essential to minimize factors which result in uncontrolled temporal changes in the x-ray throughput. Ideally, only the grids should modulate the x-ray flux. Absorbing materials that are spatially uniform are not a problem, except for the overall reduction in throughput. We need to alert, however, to the effect of spatially non-uniform absorbing elements. In this memo, we consider the effects of the non-uniform spacer structure within the blanket material..

The spacers in the blanket structure are threads (about 100 μ in diameter) which are loosely woven to form the sides of a parallelogram pattern about 1½ mm on a side, with angles of about 100 and 80 degrees. A single thread would absorb a significant fraction of 3 kev photons incident on the thread itself.

The main cause for concern is due to the interaction between the long narrow apertures in the attenuators and the threads. To enable a small, but controlled fraction of the lowest energy x-rays to pass through the attenuators, each attenuator has a small area that is thin and so transparent at low energies. To avoid modulation between this small area and grid slits, this area is in the form of a long narrow aperture which is oriented at a substantial (>60 degree) angle with respect to the slits. The risk is that if the blanket spacers are roughly parallel to the narrow attenuator aperture, then either all or very few of the low energy x-rays would get through the aperture, depending on the source location and the uncontrolled position of the blanket spacer.

A solution to this problem is to orient the blanket spacers at a substantial angle (>30 degrees) with respect to the linear attenuator apertures. The purpose of this write-up is to document an appropriate range of such angles.

It should be noted the orientation constraints are driven by the attenuator apertures, and not the grid slits directly. In the absence of the attenuator aperture , there would be no problem even if the slits were parallel to the threads, since the pitch of the threads is so uncontrolled that there would be no opportunity for coherent interaction when averaged over the diameter of the detector. Also, in the presence of the linear attenuator aperture, the lower grid slits are exposed over a sufficiently short length that the slit orientation is still not relevant in this context.

Finally, it should be noted that the orientation constraints apply only to blankets in the direct line-of-sight above the detectors.

ORIENTATION CONSTRAINTS

The table below indicates the nominal grid slit orientations in the X-Y plane in a coordinate system specified in the Spectrometer ICD (eg PDR volume III, page 70). (This is NOT the Pegasus coordinate system..) An orientation of zero degrees corresponds to a slit oriented parallel to the X axis. A slit orientation of +30 degrees would be aligned, for example, between the +X+Y quadrant and the –X-Y quadrant.

The minimum number of linear aperture orientations that can satisfy the requirement of being at least 60 degrees away from the slit orientation is 2. A set of linear aperture orientations meeting this requirement is also shown.

GRID	SLIT ORIENTATION degrees	LINEAR APERTURE degrees
1	22.5	105
2	167.5	105
3	22.5	105
4	167.5	105
5	45	105
6	135	15
7	45	105
8	0	105
9	90	15

With this choice of attenuator aperture orientations, the +-30 degree exclusion zone for thread orientations compared to the linear apertures then is –15 to 45 degrees and 75 to 135 degrees.

Therefore, acceptable orientations for the spacer threads are
45 to 75 degrees and 135 to 165 degrees.