VISTA

Sky subtraction in offset fields with VISTA

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1 Available Strategies

Currently the VISTA/VIRCAM template allows only indirect strategies to subtract the sky for extended objects.

- The science template allows to specify if the object is extended which would then trigger a special recipe for the pipeline reduction. In this case the sky must be taken in another field with a concatenated observation of a sky field. It is unclear how the concatenated sky could be automatically associated with the science observations. This would be for targets with a diameter of greater then the field of view covered with one detector.
- 2. For targets smaller then the field of view of a single detector of the mosaic a tile pattern can be selected such that the offset between two pawprints is along the y-direction where the distance between the detectors is larger. This will be only possible if the execution time taken on pawprints is short I presume between 1 minute for H, Ks and 5 minutes for narrow band filters.
- 3. For targets smaller then the field of view of a single detector of the mosaic one can select with keyword "SEQ.NESTING" the option FJPME which would change to the next pawprint between two exposures.

2 Expected Problems

Near infrared observations are sky and flat field limited. At the expected level of the sky illumination it may not be possible to reduce the flat field fixed pattern structures of the detectors down to the photon noise level.

- The sky is variable on time scale of minutes. The sky residual would in this case show the fixed pattern of the detector.
- The telescope pupil with rotate with the changing paralactic angle in respect to the instrument which will introduce relatively sharp structures after only a short telescope tracking time, depending on the position on the sky.

3 Sky fields and project which may have problems:

- galactic center
- LMC bar
- maybe NGC 6822 and similar galaxies

The VMC survey actually requests to concatenate 3 hour long execution time OBs in the LMC bar with another 3 hours long execution of a sky OB in the outer parts of the LMC.

4 VISTA/VIRCAM compared with HAWKI:

HAWKI has two templates which allows to take sky fields within the Autojitter sequence (AutoJitterOffset, FixedSkyOffset) and one template (GenericOffet) where any sequence of sky and object exposures can be specified by the users.

The AutoJitterOffset template takes a sequence of observation like (OSSOOSSO) where 'O' and 'S' indicate that the exposures of DIT * NDIT are taken in 'O'bject or in 'S'ky fields. It is possible to specify different values for NDIT for sky and object frames. The sky field is taken around a circle with a radius of up to 600 arcseconds with randomly selected positions on this circle.

The FixedSkyOffset would take a similar sequence but with all sky exposures in the same sky field. The template would add jitter offsets between the respective object and sky exposures.

The GenericOffset template allow the user to specify which exposures of a sequence is a sky and which is an object exposure (Examples could be 'OSOOSOOSO' or 'SOOSOOS'). All offsets must be given by the users. The user indicates which exposures are sky and object frames to make sure that the exposures are treated in an appropriate way by the later pipeline data reduction.

5 Summary:

For the VISTA/VIRCAM field of view there is no obvious way to take sky fields close enough in time and close enough in paralactic angle.

Sky fields close in time could be taken with templates similar like the FixedSkyOffset template of HAWKI with the modification that (in case of the larger offsets required for VISTA) one should not specify the offset between object and sky field but the paralactic coordinates of the sky field. It is to be discussed if auto guiding and wave front sensing is required in these sky fields.

To take valid sky fields which are close in time and which would match the paralactic angle of the object frames is a different topic. I'm uncertain if we should ever consider this.

6 Suggestions:

This are rather questions then suggestions,...

- We need to give numbers in the documentation on how long one should stay on a position. Like for HKs probably not more then DIT*NDIT = 60s for normal fields or DIT*NDIT*NOFF = 60s for extended targets which are about the size of the VIRCAM detectors unless you select for "SEQ.NESTING" the option FJPME?
- We should document in the manuals and instruction which tile pattern is better in which case. Check and discuss if our default tile pattern is the best in terms of the sky subtraction if there is a large object in the field of view. In the normal fields we would rather prefer a tile pattern which takes short offset (x-direction) as close as possible in time?

• Investigate the offset strategy with VMC Cioni et al. which would be so far the only client for special sky fields. I think that the LMC bar can be done very well without sky fields if the number of jitter positions is large enough?