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NIRSpec Technical Note
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JWST/NIRSpec SKY to MSA coordinate transform

Abstract:

We have generated a polynomial fit of the SKY to MSA coordinate transform and this technical note provides a description of this coordinate transform model and of the associated file (PCF format).

Change log		
Version	**Date**	**Description**
1	18.11.2011	First release

1 INTRODUCTION

As part of the NIRSpec instrument performance simulator (IPS) development, we have developed a framework to describe the coordinate transforms between key planes of the NIRSpec instrument. We have used this framework to model the SKY to MSA coordinate transform and, in this technical note we provide a description of this coordinate transform and of the associated file containing the coefficients for its polynomial representation.

2 THE FRAMEWORK FOR THE MODELING OF THE COORDINATE TRANSFORMS

2.1 Coordinate transform modeling

During the development of the NIRSpec instrument performance simulator, we have progressively converged toward a coordinate transform model that includes two components:

- A paraxial component that contains only very simple transformations (a translation, a scaling, a rotation and a final translation).
- A 5-degree 2D polynomial that comes on top of this paraxial component. It could be interpreted as the distortion component coming on top of an ideal optical system described by the paraxial component.

A detailed description of this model (including its mathematical implementation) is available in a dedicated memorandum (NIRS-CRAL-MO-1004, “Parameterizations of the coordinate transforms in NIRSpec.

2.2 Coordinate transform files

Still in the frame of the development of the IPS, we have also defined a format for the files in which coordinate transform parameters could be stored (the so-called PCF files). The format of these files is described in details in the IPS ICD (NIRS-CRAL-ID-1195). The file is named: coordinateTransform_NIRSpec_SKYtoMSA_CaF2_filter.pcf

3 THE SKY TO MSA COORDINATE TRANSFORM

3.1 Inputs for the model

To construct this model of the NIRSpec SKY to MSA coordinate transform, we have used "as-designed" models of the JWST telescope and of NIRSpec fore-optics. The computation has only been performed for NIRSpec configurations including a CaF2-substrate filter (i.e. typically all the long-pass filters used in spectroscopic mode).

In the long-term (future versions of this note) at least two (BK7 and CaF2 substrate cases) models will have to be generated to account for the slightly different (chromatic) behaviour of the two substrates.

3.2 Nominal paraxial transform

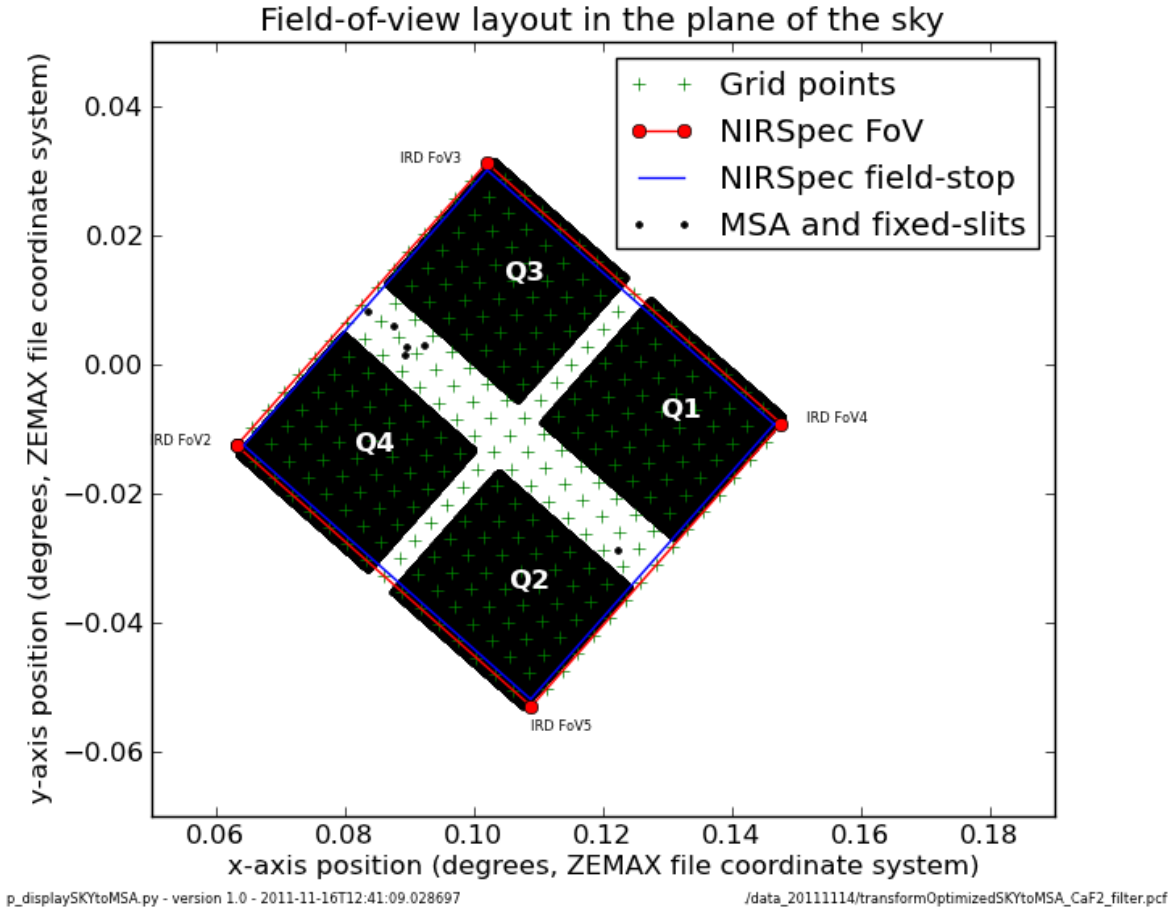
From the complete SKY to MSA coordinate transform, we have computed the nominal paraxial transform for the centre of the field of view, i.e. the paraxial transform yielding locally equivalent scale factors and rotation (see detailed definition in NIRS-CRAL-MO-1004).

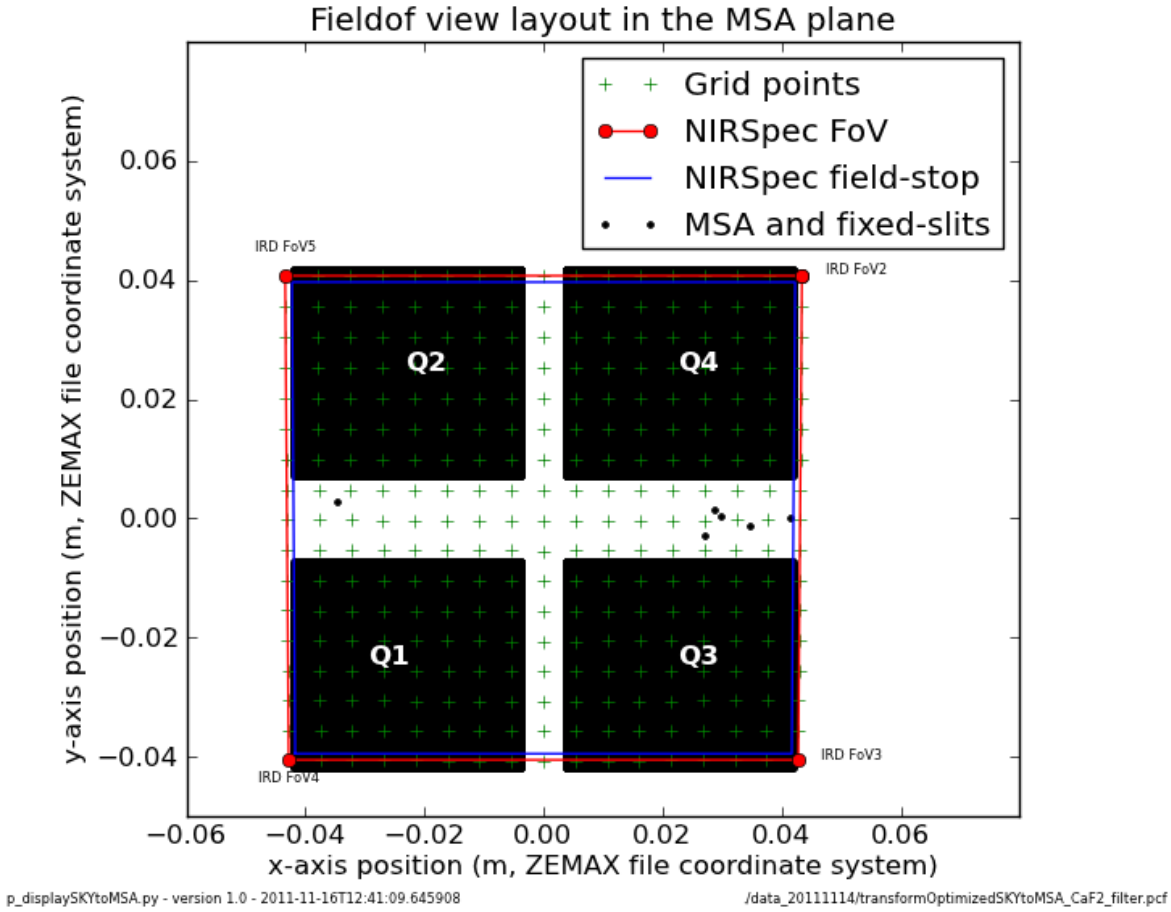
The parameters of this nominal paraxial transform are listed in the table below.

Parameter	Value	Comments
Position of the centre of the field of view in the SKY plane	(0.10539,-0.1087) in degrees	As per the NIRSpec IRD field-of-view description
Position of the projection of the centre of the field of view in the MSA plane.	(-0.3,+370.3) in microns	Values computed using the coordinate transform model.
Scaling factors	(-1.416,-1.391)	This corresponds to equivalent focal length values of (-81.14 m, -79.71 m). This corresponds to typical plate scales in the MSA plane of (-2.54 arcsec/mm, -2.59 arcsec/mm). Negative values indicate flips of the axes.
Rotation angle	-41.50 degrees	CAUTION: this field rotation complicates the interpretation of the scaling factors / equivalent focal lengths / plate scales.

3.3 Field of view layout

We have also generated figures showing the field-of-view layout in the SKY and MSA planes that can help to understand the coordinate systems used in these two planes.




Fieldof view layout in the MSA plane
Grid points
NIRSpec FoV
NIRSpec field-stop
MSA and fixed-slits
IRD FoV5
IRD FoV2
IRD FoV4
IRD FoV3
Q1
Q2
Q3
Q4
y-axis position (m, ZEMAX file coordinate system)
x-axis position (m, ZEMAX file coordinate system)
0.06
0.04
0.02
0.00
−0.02
−0.04
−0.06
−0.04
−0.02
0.00
0.02
0.04
0.06
p_displaySKYtoMSA.py - version 1.0 - 2011-11-16T12:41:09.645908
/data_20111114/transformOptimizedSKYtoMSA_CaF2_filter.pcf