## PixInsight – Steps to get your Galaxy

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These are only tipps to work with some features of PixInsight to development your galaxy image. Each image is unique and need it's own processing. You should know the principle handling of PixInsight to understand following guide.

This document works with following facts:

- PixInsight 1.7
- b/w camera and images in L, R, G and B

You find the described XPSM files on following web-link: <u>http://www.astrophoto.at/PixInsight</u>

#### Quick Guide:

- 1) Master-Bias / Master Dark
- 2) Calibrate Flats
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- 15) Increase color saturation
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- 23) Generate LRGB
- 24) Remove unwished color tint
- 25) Increase color saturation
- 26) Final curves transformation for wished brightness

## <u>1) Master-Bias / Master Dark</u>

Integrate your Bias and your Darks with following parameters:

Σ	ImageIntegration	× ×
Input Images		\$
1 V Dark001_2_360	m20.fit	Add Files
2 V Dark002_2_300	m20.fit	Set Reference
3 ✓ Dark003_2_360 4 ✓ Dark -004 2 360	m20.fit m20.fit	
5 🗸 Dark005_2_360	m20.fit	Select All
6 V Dark006_2_360	m20.fit	Invert Selection
8 V Dark008_2_360	m20.fit	Toggle Selected
		Remove Selected
		Clear
		Full paths
Format Hints		¥
Image Integration		\$
Combination: 🚺	1edian 🔻	
Normalization: 🚺	lo normalization 🔹	
Weights: D	on't care (all weights = 1) 🔻	
Weight keyword:		
	Generate integrated image	
	Generate a 64-bit result image	
V	Evaluate noise	
	Close previous images	
Buffer size (MB): 1	6	
V	Use file cache	
Pixel Rejection (1)		¥
Pixel Rejection (2)		*
Pixel Rejection (3)		¥
Region of Interest		¥
		D N M
DarkIntegrati	ion ynsm	
Control your F	)ark and Diag integr	ation image
	Jark and blas integra	allon mage.
is the left shot		side, your
image tetch p	rogram nas added a	n oπset. Cut
the offset! In c	other case the image	calibration
fails.		

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¥

## 2) Calibrate Flats

ImageCalibration	≖ ×	Substruct the Bias from Flatfield. If you
Target Frames	\$	also have a Flat-Dark, substract it too.
1 🗸 🖹 F01.fit	Add Files	
2 🗸 📑 F02.fit	Select All	
3 ✓ B F03.fit	Select All	
4 ♥ E F04.iit 5 ♥ E F05.fit	Invert Selection	
6 ✓ 📓 F06.fit	Toggle Selected	
7 🗸 🖹 F07.fit	Remove Selected	
8 🗸 🖹 F08.fit		
	Clear	
	Full paths	
Format Hints	¥	
Output Files	\$	
Output directory: E:/2011/20110525_M101/F	<b>▼</b>	
Output extension: .fit Prefix:	Postfix: _c	
Sample format: 32-bit floating point 💌		
Output pedestal (DN): 0		
Overwrite existing files	error: Continue 🔻	
Pedestal	¥	
Overscan	¥	
✓ Master Bias	\$	
E:/Dark2009/PI_Biasx19_m25.fit	•	
Calibrate		
Master Dark	\$	
Calibrate		
✓ Optimize		
Optimization window (px): 1024		
CFA pattern detection: Detect CFA 💌		
Master Flat	\$	
	•	
Calibrate		
× •	<b>B</b> 💥	

## 3) Master-Flat

		Elear     Full paths		ImageIntegration with this parameters.
Format Hints			₹.	
Image Integration			\$	Normally you take for each channel
Combination:	Average 🔻			flatfields (L. P. C. P.). Integrate it
Normalization:	Multiplicative 🔻			seperately.
Weights:	Don't care (all weights = 1) 🔻			
Weight keyword:				FlatIntegration.xpsm
l	🗸 Generate integrated image			5 ,
[	🔲 Generate a 64-bit result image			
[	Evaluate noise			
[	Close previous images			
Buffer size (MB):	16			
	Use file cache			
Pixel Rejection (1)			₹.	

#### 4) Calibrate images

ImageCalibration	× ×	lf you don't ha
Target Frames	\$	from your Mas
1 🗸 🖺 L_M101_600m20_03.fit	Add Files	check the "Ma
2 ✓ 🖺 L_M101_600m20_04.fit	Select All	twice
4 ✓ 📓 L_M101_600m20_06.fit	Invert Selection	
5 🗸 🖹 L_M101_600m20_07.fit		Integrate I R
6 ✓ 🖺 L_M101_600m20_08.fit 7 ✓ 🗈 L_M101_600m20_09.fit	loggle Selected	change the Ma
8 ✓ 📓 L_M101_600m20_10.fit	Remove Selected	right. Also cha
9 ✓ 🚡 L_M101_600m20_11.fit	Clear	another tempe
	Full paths	
Format Hints	¥	
Output Files	\$	
Output directory: E:/2011/20110525_M101/C	•	
Output extension: .fit Prefix: P	Postfix: _c	
Sample format: 32-bit floating point 🔻		
Output pedestal (DN): 0		
Overwrite existing files On er	rror: Continue 🔻	
Pedestal	¥	
Overscan	¥	
Master Bias	\$	
	•	
Calibrate		
Master Dark	\$	
E:/Dark2009/PI_m20/PI_Dark_0600x8m20.fit	-	
Calibrate		
V Optimize		
Optimization window (px): 1024 🚔		A Berlin Barry
CFA pattern detection: Detect CFA 💌		
✓ Master Flat	\$	
E:/2011/20110525_M101/MasterFlatL.fit	-	
Calibrate		A Start Start
L 0	вж	

5) Remove remained hot- and darkpixel

Sometimes ther are hot- and darkpixel after calibration. Use following PixelMath function to remove it. You can also edit it to change the threshold.

Use RemoveHotPixel.xpsm at first, in other case sometimes you get a halo around the hotpixels.

RemoveHotPixel.xpsm RemoveDarkPixel.xpsm If you don't have substract the Bias from your Master-Dark, you must not check the "Master Bias" checkbox!!! In other case PI substract the Bias twice.

Integrate L, R, G and B seperately and change the Master-Flat filename to the right. Also change the Dark if you have another temperature or binning.



#### 6) Register images

StarAlignment		≭ X
Reference image: 525_M101/Beschreibung/C/L_M101_600m20 Working mode: Register/Match Images  Generate masks Frame adaptation	)_07_	c.fit File 🔻 🔻
Target Images		\$
1       ✓       B_M101_600m20_01_chp.fit         2       ✓       B_M101_600m20_02_chp.fit         3       ✓       B_M101_600m20_03_chp.fit         4       ✓       B_M101_600m20_04_chp.fit         5       ✓       G_M101_600m20_02_chp.fit         6       ✓       G_M101_600m20_02_chp.fit         7       ✓       G_M101_600m20_03_chp.fit         8       ✓       G_M101_600m20_04_chp.fit         9       ✓       G_M101_600m20_04_c.fit         10       ✓       L_M101_600m20_05_c.fit         11       ✓       L_M101_600m20_05_c.fit         12       ✓       L_M101_600m20_06_c.fit	4 III +	Add Files Add Views Select All Invert Selection Toggle Selected Remove Selected Clear
Format Hints		Ŧ
Output Images		\$
Output directory: E:/2011/20110525_M101/Beschreibung/A		•
Output extension: .fit Prefix: Postfix: _r Sample format: Same as target Overwrite existing files On error: Co	ontinu	Mask: _m
Star Detection		•
Star Matching		•
Interpolation		•
X = •		<b>⊾</b> ¥

Select one of the L images as reference and put all R, G, B and L images in the "Target Images" field. Select your output directory and press the round button on the bottom.

#### 7) Integrate images

In this example, I took 10 images for L and 4 images for each color channel.

Integration for	r more images		Integration for	or few images	
Σ	ImageIntegration	≖ ×	Σ	ImageIntegration	<b>≭</b> X
Input Images		\$	Input Images		\$
1 🗸 L_M101_600m	120_03_c_r.fit	Add Files	1 🗸 B_M101_600m	20_01_chp_r.fit	Add Files
2 V L_M101_600m 3 V L_M101_600m	20_04_c_r.fit	Set Reference	2 V B_M101_600m	20_02_chp_r.fit 20_03_chp_r.fit	Set Reference
4 🗸 L_M101_600m	20_06_c_r.fit	Select All	4 ✓ B_M101_600m	20_04_chp_r.fit	Select All
5 ✓ L_M101_600m	20_07_c_r.fit	Invert Selection			Invert Selection
7 🗸 L_M101_600m	120_09_c_r.fit	Taggle Selected			Tangla Salastad
8 < L_M101_600m	20_10_c_r.fit				
10 V L_M101_600m	/20_11_c_r.tit )20 12_c_r.fit	Remove Selected			Remove Selected
		Clear			Clear
		Full paths			Full paths
Format Hints		Ŧ	Format Hints		*
Image Integration		\$	Image Integration		2
Combination:	Average 🔻		Combination:	Average 🔻	
Normalization:	Additive 🔻		Normalization:	Additive	
Weights:	Noise evaluation 🔻		Weights:	Noise evaluation	
Weight keyword:			Weight keyword:		
	📝 Generate integrated image			Generate integrated image	
	Generate a 64-bit result image			Generate a 64-bit result image	
	Evaluate noise			Evaluate noise	
	Close previous images			Close previous images	
Buffer size (MB):	16		Buffer size (MB):	16	
	✓ Use file cache			Use file cache	
Pixel Rejection (1)		\$	Pixel Rejection (1)		\$
Rejection algorithm:	Winsorized Sigma Clipping 🔻	←	Rejection algorithm:	Percentile Clipping 🔹 <	←
Normalization:	Scale + zero offset 🔻		Normalization:	Scale + zero offset 🔻	
	Generate rejection maps			Generate rejection maps	
	Clip low pixels			Clip low pixels	
	Clip high pixels			Clip high pixels	
	Clip low range			Clip low range	
	Clip high range			Clip high range	
Pixel Rejection (2)		\$	Pixel Rejection (2)		*
Pixel Rejection (3)		¥	Pixel Rejection (3)		*
Region of Interest		*	Region of Interest	t i i i i i i i i i i i i i i i i i i i	Ŧ
<b>L</b> •		▶ ★ 米			🗅 k 💥

#### 8) Remove remained disturbances

In this case, the red channel has a remained satellite track (to few images to remove it automatically). Remove it with CloneStamp.

	25	CloneStamp	<b>≖</b> ×
	Radius: 10 🚖	Copy brush Show bou	nds
	Softness: 0.50 Opacity: 1.00		
	No target view selected	×	₩ ◀ ▶ ₩
	📐 🗸 🗙		15 米

## 9) Generate RGB

	ChannelCombination	≭ X
Color Space	Channels / Source Images	]
💿 RGB 💿 CIE X	Z R R	•
	*b* G G	
	B B	<b>•</b>
⊖ HSI ⊚ CIE L*	*h* Target: <no selected="" view=""></no>	•
		<b>D</b> 💥
	*h* Target: <no selected="" view=""></no>	- • ×



#### 10) Calibrate RGB channels



#### 11) Crop RGB and L images

Check RGB and L for the common area and draw the crop rectangle. Save the DynamicCrop process (pull the triangle to the working place) for using the same process for RGB and L.

- <del>-</del> + ×



#### 12) Remove gradient

📕 DynamicBackgroundExtraction 📼 🗴	
Selected Sample: 1 of 53	
Sample #: 1	
Anchor X: 1928 Symmetries	
Anchor Y: 140	Tolerance: 2,5
Radius: 70	Default sample radius: 70
R/K: 0.007300	Target Image Correction: Substruction
G: 0.007260	Target image correction. Substruction
B: 0.007189	
Fixed	If you take big boxes and overlap it, mostly you get a
	good result.
Wr: 0.000	
Wa: 0.990	
Wb: 0.981	
Model Parameters (1)	
Shadows relaxation: 3,000	
Smoothing factor: 0.250 Unweighted	
Model Parameters (2)	
Sample Generation	
Default sample radius: 70 Regize All	
Samples per row: 10 Generate	
Minimum sample weight: 0,750	
Sample color:	
Bad sample color:	
Model Image 🛛 🗣	
Target Image Correction	
Correction: Subtraction	
Normalize	
Discard background model	
Replace target image	
Identifier: <auto></auto>	
Sample format: Same as target 🔹	
⊾ 🗸 🗙 🗈 🗦	



#### 13) Scale the brightness of RGB

Increase the brighness of the RGB image step by step. At first reset the "ScreenTransferFunction" to see the real brightness of image. Then repeat following process until the center of the galaxy have a black-value of app. 0.7 to 0.8.

- make a clone of the image
- invert clone
- take the clone as mask for the image
- shift the midtone arrow of histogramm (RGB/K selected) a bit to the left
- execute the histogram change
- close the clone image (mask of image is automatically removed)



## 14) Make stars of RGB smaller to avoid color halos

StarMask	<b>*</b> ×
Threshold: 0.10000 Mode: Star Mask	Generate star mask with default values.
Scale: 5 🖨 Growth: 2 🖨 Comp.:	2 🔄 Small: 1 🖶 Put the star mask to the image.
Smoothness: 16 🚔 🔲 Aggregate 📄 Binarize	Contours Invert
Shadows: 0.00000	
Midtones: 0.50000	
Highlights: 1.00000	
Truncation: 1.00000	
Limit: 1.00000	
	Ľ ¥
MorphologicalTransformation T X	
Operator: Erosion (Minimum)	Amount:0.6
Interlacing: 1	5 elements
Iterations: 1	Circular structure
Amount: 0.60	
Selection: 0,50	
Structuring Element	
Size: 5 (25 elements)	
Way: 1 of 1 •	
🗶 🔣 🔛 🖼 🖽	
1 🛛 🔛 🛛 Manage	
<unnamed></unnamed>	
Thresholds 🗧	
<b>⊾</b> =	

## 15) Increase color saturation

V ColorSaturation	≖ ×	lf the color oct water is some flat in one colit
		If the color saturation is very flat, increase it.
📭 🍬 🐹 💥 🕁 1 🚍 1	Range: 1 🚔 🛛 🗰	
Hue: 0.00000	୬ /▶ @ ₩	
Saturation: 0.58559 > 1 / 2		
Hue shift: 0.000		
⊾ 🔳 🔶	<b>⊾</b> ¥	

#### 16) Reduce noise of RGB

If there is a noise in the background of the RGB, you can remove it or decrease it, if you extract the image in RGB and I channels and recombine them with LRGB function.

	ChannelExtraction		жX
Color Space	Channels / Target Images		]
RGB CIE XYZ	R <auto></auto>		
○ HSV ○ CIF I*a*b*	G <auto></auto>		
	B <auto></auto>		
	Sample Format: Same as source		•
			Ŀ ₩
	ChannelExtraction		×Χ
Color Space	Channels / Target Images		
💿 RGB 💿 CIE XYZ	✓ H <auto></auto>		
○ HSV ○ CIE L*a*b*	Si <auto></auto>		
HSI CIE L*c*h*	▼ I <auto></auto>		
	Sample Format: Same as source		<b></b>
⊾ 🔳			ъж
-			
<b>.</b>	LRGBCombination	≖ ×	
Channels / Source Image	es	\$	
L RGB_I		<b>•</b>	
R RGB_R		<b>•</b>	
G RGB_G		<b>•</b>	
B RGB_B		<b>•</b>	
Target: <pre></pre> No View Select	ted>	<b>•</b>	
Channel Weights		*	
Transfer Functions		\$	
Lightness: 0.500			
Saturation: 0.500			
Chrominance Noise R	Reduction	*	
		Ľ ¥	

#### Don't forget to check "Chromatic Noise Reduction".



#### 17) Scale the brightness of L

Increase the brigthness of the Luminance image step by step. Look at 13).

#### 18) Darken the center of galaxy

Generate a **star mask** with default values, invert it and put it to the image, before execute the HDRWaveletTransform.

HDRWaveletTransform	×	×
Number of layers: 6 🚔 Number of iterations: 1 🚔 🗸	Inverte	ed
Overdrive: 0.000		
Scaling function: B3 Spline (5)		•
▼ To lightness Preserve hue		
Lightness mask		
Deringing	3	¥.
Midtones Balance	3	¥.
K =	<b>B</b>	ж

#### 19) Make stars smaller

If the star mask of 18) is already on the image, invert it again or generate a new **star mask**.

Execute MorphologicalTransformation with parameter of below example. Then execute Deconvolution and then MorphologicalTransformation again.

In this case the star shapes were not exactly round. For this reason the "Aspect ratio" was changed from 1 to 0.76.

🗰 Morp	hologicalTransformation $\mathbf{x} \mathbf{X}$
Morphologic	al Filter 🔹
Operator:	Erosion (Minimum)
Interlacing:	1
Iterations:	1
Amount:	0.40
Selection:	0.50
Structuring E	lement 🗶
	Size: 5 (25 elements) 🔻
	Way: 1 of 1
	💥 🔣 🔛 🖽 🖽
1 🛛 👪	Manage
<unnamed></unnamed>	
Thresholds	¥
	ЪЖ

👱 Dec	convolution	× ×
PSF		*
Gaussian PSF Motion Blu	Ir PSF External PSF	
StdDev: 0.80		
Shape: 1.70		
Aspect ratio: 0.76		
Rotation: 0.00	7×7	
Algorithm		\$
Algorithm: Regularized I	Richardson-Lucy	-
Iterations: 10 🚔		
Target: Luminance (	CIE Y) 🔻	
Deringing		*
<b>Wavelet Regularization</b>		\$
Noise model: Gaussian 🔻	) Wavelet layers: 2 🚔 🛛 B3 Spl	line (5) 🔹
Noise threshold	Noise reduction	
1: 3.00	1.00	
2: 2.00	0.70	
3: 1.00	0.70	
4: 1.00	0.70	
5: 1.00	0.70	
Convergence: 0.0000		Disabled
Dynamic Range Extension		¥
🔺 🔳		в ж

#### 20) Enhance Dark structures

If the center of galaxy has now a black value lower than 0.7, then increase the brithness a little bit like in step 13).

a) enhance middle size dark structures

Hipass radius=50, overlay 50%

- rename the image (double-click on the image name at left side) to "Original"
- generate 2 clones of the image
- rename "Original clone1" to "Blend"
- Hipass filter to "Original\_clone": Hipass\_r50.xpsm
- PixelMath: Original\_minus\_Clone.xpsm to image "Blend"
- put "Blend" to "Original" as Mask
- press the "Mask invert" button of "Original"
- Pixelmath: Overlay\_mult\_factor\_0p5.xpsm to image "Original"

b) darken big size dark structures

Don't remove the previous mask! We need it also for this step.

DarkStru structures	ctureEnhance v1.0 — A script for enhancement of dark image
The script larger stru increase e paramete Copyright	can also provide the mask used in the DSE process. To include inclures in the mask, increase the number of layers to remove. To enhancement of dark structures, increase the value of the <i>Amount</i> r. t © 2008 Carlos Sonnenstein and Oriol Lehmkuhl (Pteam)
Targ	jet image: 📘 Original 👻
- Mask P	arameters
Layers to	o remove: 8 🚖 🔲 Extract mask
Scaling	function: 5x5 B3 Spline
DSE Pa	rameters
	Amount: 0.99
1	Iterations: 1
	OK X Cancel

c) enhance fine dark structures

Hipass radius=30, overlay 30%

Same procedure as a), but with following processes instead: *Hipass\_r30.xpsm Overlay\_mult\_factor\_0p3.xpsm* 

Sometime it make sense to darken the center of galaxy again, like in 18).

#### 21) Sharpen of L

Generate a **star mask**, invert it and put it to the image.

🔣 ATrousWaveletTransform 🖛 🗙	
Wavelet Layers	In this case I changed the parameter of wavelets 1,2
Oyadic ○ Linear: 0 ↓ Layers: 6 ▼	and 3, but all with checked "Noise Reduction".
Scaling Function: Linear Interpolation (3)	
Layer Scale Parameters	ATWT_Sharp.xpsm
✓ 1 1 +0.200 S(3.000,0.50,1)	
✓ 2 2 +0.100 S(3.000,0.50,1)	
✓ 3 4 +0.100 S(3.000,0.50,1)	You have to find the best parameters for your image.
✓ 5 16	
✓ 6 32	
✓ R 64	
☑ Detail Layer 3/6	
Bias: 0.100	
✓ Noise Reduction	
Threshold: 3,000	
Amount: 0.50	
Iterational 1	
k-Sigma Noise Thresholding	
Deringing ¥	
Large-Scale Transfer Function	
Dynamic Range Extension	
Target: Laver Preview:	
RGB/K components ▼ No layer preview ▼	
<b>▶</b> ■ ♦ <b>Ŀ</b> ¥	

#### 22) Remove hot- and darkpixel which are generated by previous processing

Sometimes new hot- and darkpixels are generated at the previous processes. In this case make step 5) again. *RemoveHotPixel.xpsm RemoveDarkPixel.xpsm* 

#### 23) Generate LRGB

# Open the processed RGB image from step 16) Extract the RGB channels.

<b>N</b>	C	hannelExtraction	×	×
Color Space	Channels / Target In	mages		
RGB CIE XYZ	🔽 R	<auto></auto>		
	📝 G	<auto></auto>		
	📝 В	<auto></auto>		
© HSI ⊚ CIE L*c*h*	Sample Format: Sam	ne as source	•	
			<b>B</b> )	ĸ

Generate the LRGB with "Chrominance Noise Reduction"

2	LRGBCombination	жX	
Channe	els / Source Images	*	
🔽 L	Original_L	-	
🔽 R	RGB_R	•	
🔽 G	RGB_G	•	
<b>V</b> B	RGB_B	•	
Target:	<no selected="" view=""></no>	-	
Channe	l Weights	*	
Transfe	rFunctions	*	
Light Satura	ation: 0.500		
Chro	Chrominance Noise Reduction		
<b>N</b>	•	ЪЖ	

#### 24) Remove unwished color tint

In this example there is a green tint in the image.

8	SCNR	×	×
Color to remove:	Green		•
Protection method:	Average Neutral		•
Amount:	0.80		_
	Preserve lightness		
📐 🔳		в	ж

#### 25) Increase color saturation

If the color saturation is too flat, increase it, but make a mask before to avoid background color spots:

- clone image
- "CurvesTransformation" with S-curve parameter to increase the contrast
- put it to the image as mask

M ColorSaturation	<b>≖</b> X
♥ 및 其 🛛 💥 🕁 1 🕀 🗊	Range: 1 🔮 🗰
Hue: 0.00000	€ ∱ 陸 業
Saturation: 0.58559 > 1 / 2	
Hue shift: 0.000	
k 🖬 🔶	<u>ь ж</u>

#### 26) Final curves transformation for wished brightness



## Result:

