New PixInsight workflow for blending color and L/narrowband data of two optics

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#### **Premise:**

COLOR IMAGES ARE MADE PRIMARLY FOR AESTETHICS, AND YOU CAN USE:

- RGB (THE MOST "SCIENTIFIC" METHOD): CAN BE "BOOSTED" TO L-RGB
- ONE SHOOT COLOR (VIA DLSR OR OSC CAMERAS DEVOTED TO ASTRONOMY)

AND WHAT ABOUT A MIXED METHOD? THE IDEA OF THIS TECHNIQUE AROSE BECAUSE WE DO NOT HAVE A PERMANENT OBSERVATORY. WITH A PERMANENT OBSERVATORY AND UNLIMITED TIME, L-RGB (OR NB-RGB) USING ONLY THE "BIG" SCOPE WILL <u>ALWAYS</u> BE THE BEST CHOICE. WE DO NOT HAVE UNLIMITED TIME...

...BUT WE HAVE PIXINSIGHT! (AND A GOOD MOUNT)



### Some facts:

- ONLY THE L OR NB PART OF THE IMAGE DOES CONTRIBUTE TO DETAILS (SO L / NB IS THE "PRIMARY" IMAGE)
- DLSR HAVE EVOLVED! THE PERFORMANCE OF DLSR IS NO MORE «CLEARLY INFERIOR» TO ASTRONOMICAL OSC
- THE SCALE OF THE COLOR IMAGE CAN BE MUCH SMALLER THAN THE L / NB IMAGE
- MANY AMATEURS HAVE MORE THAN ONE TUBE/MOUNT, OR WORK IN GROUPS.



### And so...

#### TWO TUBES, ONE MOUNT

- CCD WILL IMAGE IN L OR NB USING THE "BIG TUBE"
- DLSR WILL IMAGE OSC USING THE "SMALL" TUBE

#### WORKING THIS WAY...

- PRODUCTIVITY DOUBLES
- YOU CAN "REVIVE" OLD TUBE/CAMERAS
- A TELEPHOTO LENS CAN BE THE "SMALL" TUBE IF THE PRIMARY IS NOT TOO BIG
- IF PROBLEMS ARISE, YOU CAN DROP ONE TUBE AND BRING SOMETHING HOME
- OFFERS OPPORTUNITIES TO COLLABORATE WITH FRIENDS, EVEN FAR AWAY AND NOT IN THE SAME NIGHT





#### **Does it make sense?**

- "RESOLUTION POINT OF VIEW"
  - THE BIGGER TUBE IS DEVOTED TO L OR NB THIS PROVIDE HIGH RESOLUTION
  - THE RESOLUTION NEEDED FOR COLOR IS MUCH LOWER. YOU CAN STRECH A LOT THE COLOR IMAGE BECAUSE RESOLUTION AND DEFINITION COMES FROM THE PRIMARY IMAGE
- "SIGNAL TO NOISE" POINT OF VIEW....
  - IF YOU HAVE 6 HRS...
    - L-RGB WOULD PRODUCE ROUGHY 3L + 1R + 1G + 1B (AND A NIGHTMARE OF CALIBRATIONS ☺)
    - THE DOUBLE TUBE WOULD PRODUCE 6L + 6RGB. FOR EACH COLOR 6:1!



### Limits of this technique: not many! ③

- SCALE TOLERANCE (BY EXPERIENCE)
  - UP TO 3:1 FOR SMALL OBJECTS (WITH "COMMON SENSE")
  - EVEN 5:1 FOR "BIG OBJECTS" (USALLY DLSR HAVE SMALLER PIXEL SIZE THAN CCDS)
- NEED TO COORDINATE SHUTTERS WITH GUIDE/DITHERING (ASTROART)

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MASTER - Blocco note X	SLAVE - Blocco note -	×
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Print "+++++++++++++++++++++++++++++"		
Print "Sveglio slave"	Input "Quante pose ",qp	
PauseResume()	Input "Durata posa (s) ",dp	
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### And now?

- WE HAVE TWO COMPLETE SETS OF IMAGES WE NEED TO "BLEND"
- EASY JOB
  - TRANSLATION (DITHERING COMPENSATION)
  - ROTATION (FIELD ROTATION, MERIDIAN FLIP)
- MEDIUM JOB
  - SCALE DIFFERENCES (DIFFERENT OPTICS)
- HARD JOB
  - DIFFERENTIAL DISTORTION (DIFFERENT OPTICS): STARS ARE NOT IN THE SAME POSITION ALL OVER THE IMAGE!



### **Distortion**





# **Assessing distortion in PixInsight**

- IMAGESOLVER SCRIPT (BY ANDRÈS DEL POZO)
  - SET THE APPROXIMATIVE IMAGE CENTER
  - SET FOCAL LENGTH (OR IMAGE SCALE)
  - SET PIXEL SIZE
  - ACTIVATE "DISTORTION CORRECTION"
    - Show distortion map
- GENERATE DISTORTION MODEL
  - USEFUL ONLY IN EXTREMELY DIFFICULT CASES
    - VERY STRONG DISTORTION
    - MOSAICS WITH DISTORTED OPTICS

Image Plate Solver v5.1.1 — A script for plate Copyright © 2012-2019 Andrés del Pozo	-solving astronomical images.
Target Image	-
O Active window	
• List of files	
	Add files
	Remove files
	Clear files
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○ Online star catalog: UCAC3 🔽	Terms of use of VizieR data
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Advanced Parameters	3
Distortion Correction	1
Spline smoothing: 0.01	
Show distortion map	
Use distortion model:	- E - E - E - E - E - E - E - E - E - E

# **Distortions Mosaic**



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# **Distortion effect:**

- BLINK Ha RGB
  - Ha:
    - Baker 200mm f/2,3
    - CCD SBIG 11000
    - 38 subframes 600s
  - RGB
    - Nikon Tele 300 f/2,8 (@ f/4)
    - Canon 350 (Baader modified)
    - 20 subframes 600s



# Handling Distortion in PixInsight

- REGISTRATION MODEL
  - 2-D SURFACE SPLINES
- DISTORTION CORRECTION
  - ACTIVE
- TRIMMING PARAMETERS
  - RESIDUAL: DECREASE TO REACH BETTER MATCHING
  - ITERATIONS: INCREASE TO REACH BETTER MATCHING
  - RANSAC TOL. AND RANSAC ITER.:
     INCREASE TO DEAL WITH STRONG DISTORTIONS

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Undistort	ed reference		
Registration model: 2-D Surfac	e Splines 🔍 🔻		
Spline smoothness: 0.25	]		
Distortion	n correction		
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Distortion iterations: 20			
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Scale tolerance: 0.100			
Interpolation			¥
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# **Distortion Correction:**









### Differences on the final image



### **Preprocessing: "fast" approach**

- PREPROCESS AS USUAL EVERY IMAGE SET SEPARATELY
  - BIAS, DARK, FLAT CALIBRATION, DEBAYERING FOR COLOR IMAGE, STARALIGNEMENT AND IMAGEINTEGRATION
    - STARALIGNEMENT WITHOUT DISTORTION CORRECTION
    - **PRIMARY MASTER LIGHT (L OR NB)**
    - SECONDARY MASTER LIGHTS (COLOR)
- REGISTER SECONDARY IMAGES ON PRIMARY ONE
  - STARALIGNEMENT WITH DISTORTION CORRECTION
- ADVANTAGE: "FAST"
- DRAWBACK: PERFORM TWO STARALIGNEMENT ON SECONDARY IMAGES



### Preprocessing: "accurate" approach

- PREPROCESS AS USUAL THE PRIMARY IMAGE SET
  - BIAS, DARK, FLAT CALIBRATION, STARALIGNEMENT AND IMAGEINTEGRATION
    - PRIMARY MASTER LIGHT (L OR NB)
- CALIBRATE EVERY SECONDARY IMAGE SET
  - BIAS, DARK, FLAT CALIBRATION, DEBAYERING
- REGISTER EACH SINGLE SECONDARY LIGHT (COLOR)
  - STARALIGNEMENT WITH DISTORTION CORRECTION
- IMAGEINTEGRATION ON SECONDARY SETS
  - SECONDARY MASTER LIGHT
- ADVANTAGE: PERFORM ONLY ONE STARALIGNEMENT ON SECONDARY IMAGES
- DRAWBACK: MORE COMPUTING TIME



# **Examples: California Nebula**

#### • Hα:

- Baker 200mm f/2,3
- CCD SBIG 11000
- 38 subframes 600s

#### • RGB

- Nikon Tele 300 f/2,8 (@ f/4)
- Canon 350 (Baader modified)
- 20 subframes 600s







# Examples: NGC 1333

#### • L:

- Williams Optics 110 FLT f/7
- CCD SBIG ST2000XM
- 32 subframes 300s

#### • RGB

- TecnoSky APO Triplet 130/900
- Canon 450 (Baader modified)
- 19 subframes 600s













## **Examples: Propeller Nebula**

- HA:
  - ORION ODK 12"
  - CCD Sbig 11000
  - 31 subframes 600s
- RGB
  - TecnoSky APO Triplet 130/900
  - Canon 450 (Baader modified)
  - 44 subframes 600s











### **Examples: Crescent Nebula**

#### • HA:

- ORION ODK 12"
- CCD Sbig 11000
- 36 subframes 600s

#### • RGB

- TecnoSky APO Triplet 130/900
- Canon 450 (Baader modified)
- 36 subframes 600s









# Thank You!

# And... use Astrobin.com!

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