A Hydrogen Alpha Imaging Introduction
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Hydrogen Alpha Imaging – An Introduction

Filters
- Choosing the filter for your application

Exposure
- Long duration exposures

Processing
- Easy steps to great Ha-images
• Advantages of Hydrogen Alpha Imaging
  - Image from severe light polluted locations - including full moon
  - Better signal to noise for emission line nebula
  - Reveal dramatic details not seen in other astronomical objects
  - Take longer exposures without blooming bright stars (NAGB cameras)

• Bandpass
  - **Narrowband** filters pass a narrow band of light (as little as 3 nm).
  - For example, a 656.3 nm filter with a bandpass of 10 nm, will pass light from 651.3 – 661.3 nm (5 nm on either side of 656.3 nm)
  - The narrower the bandpass, the greater the emission line isolation

• Bandpass and Focal Ratio
  - Narrow band filters work best where the angle of incidence to the filter is perpendicular to the light path. With Short f/ratio instruments (f/2.8 – f/4) incoming light is striking the filter more from normal incidence.
  - Creates a small shift of the passband off of its peak transmission towards shorter wavelengths.
  - Causes the loss of some of the light from the H-alpha line
Hydrogen Alpha Filters – Popular bandwidths

For telescopes operating at focal ratios below f/4, wider bandpass filters (10nm) are recommended to keep the peak wavelength within the highest transmission part of the filter. For slower scopes, a narrower filter is preferable.

<table>
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<tr>
<th>Popular Bandwidths</th>
<th>f-ratio</th>
<th>Application notes</th>
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| 10 – 13 nm         | f/2.8 > | • Brightest stars – high transmission (+90%)
|                    |         | • Great for HRBG combines, more subject to blooming
|                    |         | • Subject to gradients from moonlight and light pollution
|                    |         | • Dark sky site recommended |
| 6 nm               | f/4 >   | • Bright stars - high transmission (+90%)
|                    |         | • High contrast
|                    |         | • Low to moderate light pollution environment
|                    |         | • Dark sky site recommended |
| 4.5 nm             | f/5 >   | • Very high contrast, high transmission (80% - 90%)
|                    |         | • Fewer stars, minimal blooming
|                    |         | • Moderate to severe urban light pollution environment
|                    |         | • Dark sky site recommended, good moonlight rejection |
| 3 nm               | f/6 >   | • Very high contrast between nebula and sky background
|                    |         | • Fewest stars, least subject to blooming
|                    |         | • Typical Lower filter transmission (~60%)
|                    |         | • Best for Severe urban light pollution, moonlight rejection |
H-alpha Filter Use Examples

1.7” f/4
Nikon 180mm
Fremont Peak, California
Moderate Urban Light Pollution
10 nm

4” f/5
Takahashi FSQ
Coonabarabran, NSW, Australia
Extreme Dark Sky Site
6 nm

6” f/5.5
AstroPhysics EDF
Fremont Peak, California
Moderate Urban Light Pollution
4.5 nm

4” f/6
AstroPhysics EDT
San Jose, California
Severe Urban Light Pollution
3 nm
H-alpha Exposures – Key Points

• Sky background limited exposures may be impossible to reach due to the weak signal flux through the H-alpha filter.

• Exposures too short with low background ADU will result in extra noise in the final image. Limits your ability to stretch the histogram.

• For optimal results, sub-exposures should be as long as your tracking equipment, telescope, and observing conditions will allow.

• 30 minute to 60 minute sub-exposures are now normal for narrow band imaging. This leads to multiple hour, multi-night imaging. (3 to 10 hours total exposure time is typical)
H-alpha Exposures – Measuring Background ADU

H-alpha background ADU measurement

40 minutes, STL11K, FSQ 6nm filter
~380 ADU

Calculations indicate that this image may have needed 100 minutes or more exposure

Or…. A camera with higher QE
### H-alpha Exposures

#### STL 6303E

| Ideal Exposure Calculator | STL 6303E
---|---
| **Select a CCD Camera** | SBIG STL-6303E/LE
| **Enter Test Exposure Time in Minutes** | 40
| **Enter Measured Background Value** | 500
| **Select Percent Contribution from Readout Noise** | 10%
| **Ideal Subframe Exposure Time** | 33.53 minutes

#### STL 11000M

| Ideal Exposure Calculator | STL 11000M
---|---
| **Select a CCD Camera** | SBIG STL-11000M/CM
| **Enter Test Exposure Time in Minutes** | 40
| **Enter Measured Background Value** | 290
| **Select Percent Contribution from Readout Noise** | 70%
| **Ideal Subframe Exposure Time** | 223.54 minutes

Ha Exposures - 11000M or 6303?

Large format arrays have become very popular. Which one is best?

- The 6303 is optimized for H-a due to its high QE at 656.3 and low noise characteristics.

- The 11000M has about half the QE of the 6303, but larger field of view means less need for mosaics.
Deep Exposure Example - 4 hours accumulated exposure time

Sigma Orion, 6 x 2400", STL11000M, Tak FSQ f/5, 6nm bandpass
Deep Exposure Example - 4 hours accumulated exposure time

Barnard’s Loop, 6 x 2400", STL11000M, Nikon 180mm f/4, 10 nm bandpass
Long Duration Exposure Considerations

- Precision tracking
- A mount that can go well past the meridian
- Long guider exposures
- Precision Polar alignment
- Sold attachment of guidescope and cameras
- Eliminate cable drag points
- Focus check between sub-exp

- Large format arrays require an optical system that can produce a flat and fully illuminated field.
Hydrogen Alpha Image Processing

Getting the most from your image is as easy by following a few simple and basic steps

- DDP Stretching
- Adjusting Curves
- Adjusting Levels
- Handling bright areas with Lasso tool
Processing – DDP Stretch, MaximDL
Processing – Adjusting Curves in Photoshop

Imported into Photoshop as 16 bit .tif
Processing – Adjusting Curves in Photoshop
Processing – Adjusting Levels in PhotoShop
• Handling bright areas and highlighting detail with the Lasso tool
A List of common H-alpha catalogues


- **MRSL**, Pavla Marsalkova, 1974, Catalogue of 698 known emission nebulae, distribution of HII-regions along the whole galactic equator

- **LBN**, The Catalogue of Bright Nebulae, Lynds (1965), 1125 emission and reflection nebulae


- **RCW**, Catalogue of Rodgers, Cambell & Whiteoak, Mt. Stromlo Observatory – Dec 1957 to April 1959
  Entire region of the Milky Way south of the Palomar Sky Survey, +/- 15 degrees of the galactic equator. 181 emission nebula


Fires of Creation are waiting for your H-alpha exploration.
and now.........

Russ Croman