

Tri-Band Tribulations



Contents

Colour Imaging

Colour cameras

Sources of Light

Light from stars and nebulae

Sodium, mercury and LED street lights

Filters for Astro Imaging

Filter types

Colour transmission

Some Images

Examples of unfiltered/filtered images



2

Colour Cameras



How does a digital camera take colour images?

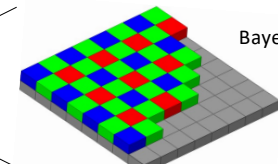
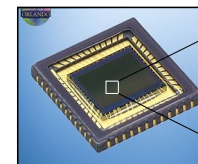


Some astro cameras are labelled OSC (one-shot colour) to distinguish them from mono cameras that use filters to create colour images.

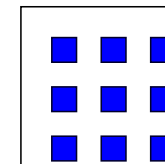
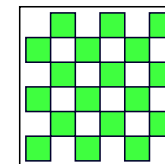
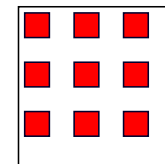


3

Colour Imaging



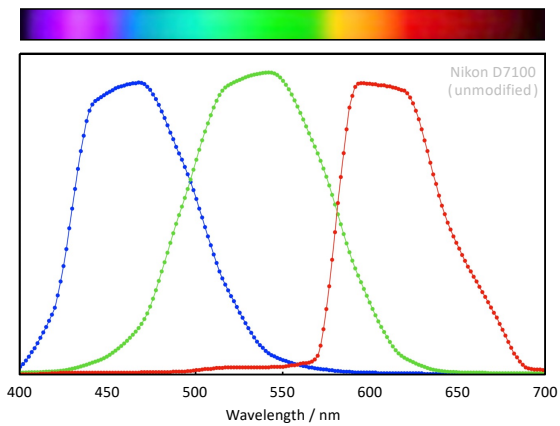
Bayer grid



4

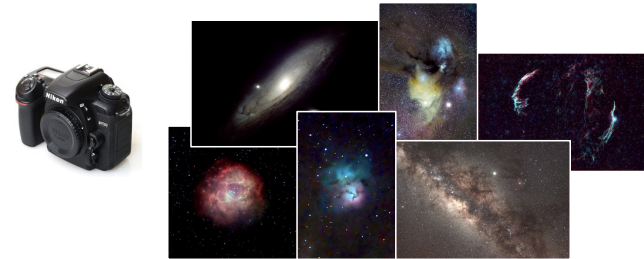
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Camera Colour Response



Colour Astrophotography

Many astronomical objects display wonderful colours that cannot be detected by the unaided human eye:

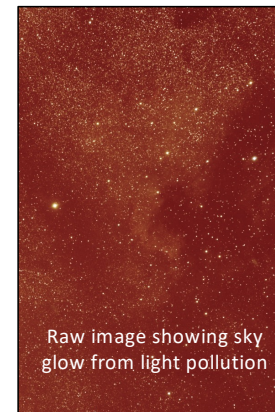


The colour receptors of the human eye do not work at low light levels and so we see faint objects in only monochrome.

Light Pollution



Light Pollution



Raw image showing sky glow from light pollution



Software can mitigate the impact of moderate LP

Tri-Band Tribulations

Colour Filters



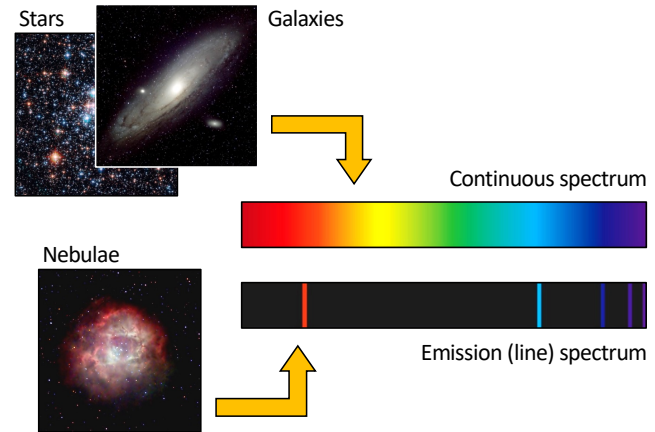
Can filters help suppress light pollution and hence improve the quality of colour astro images?



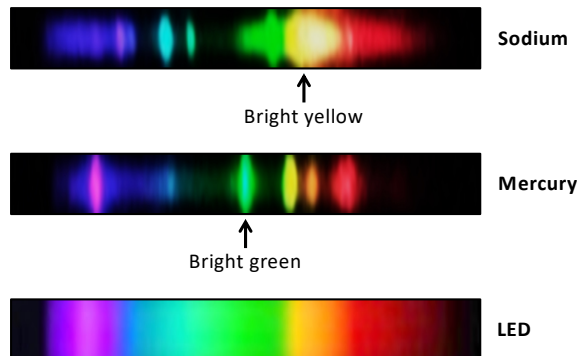
What exactly do they do?

We first need to consider the colours of astronomical objects.

Astronomical Spectra



Street Light Spectra



Filter Types

	Dual Band	Tri-Band	Quad-Band	Band Pass	Band Stop
Altair Astro	Dual	Tri	Quad	CLS	
Antlia	Dual	Tri			
Askar	Duo				CLS
Astro Essentials					
Astronomik	UHC			CLS	
Baader				Skyglow	UHC / CB
Burgess				BB Nebula	
Celestron					UHC
Chroma					LoGlow
Explore Scientific		UHC		CLS	
Hoya					Starscape
Hutech	NBx / NBz	NB1	IDAS LPS-V4	IDAS LPS-D2/3	IDAS LPS-D1/P2
Ice					LiPo
Irix					Edge
K&F					Natural Night
Lumicon	UHC			Deep Sky	
Nisi					Natural Night
Omega	Dual				
Omegon		Deep Sky		CLS / UHC	City Light
Opticstar					LPF
Optolong	L-eXtreme	L-eNhanse		CLS	UHC / L-Pro
Orion	Ultrablock				
OVL	UHC				LPF
Radian		Triad	Triad Ultra		
SkyTech		Tri	Quad	CLS	LPRO MAX
Sky-Watcher	UHC				
STC Astro	Duo				
Subony				CLS / UHC	
Tele Vue	Nebustar				
1000 Oaks				LP1	
ZWO	Duo				

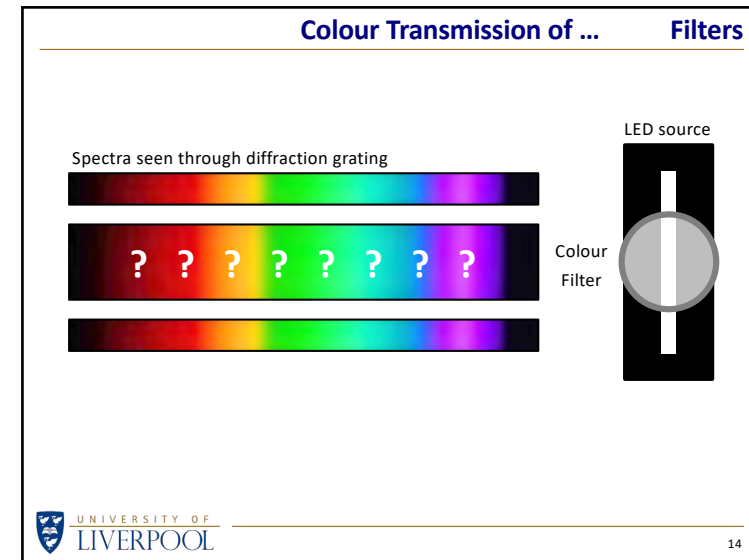
Tri-Band Tribulations

Filter Demos

	Dual Band	Tri-Band	Quad-Band	Band Pass	Band Stop
Altair Astro	Dual	Tri	Quad	CLS	
Antlia	Dual	Tri			
Ascar	Duo				CLS
Astro Essentials					
Astronomik	UHC			CLS	
Baader				Skyglow	UHC / CB
Burgess				BB Nebula	
Celestron					UHC
Chroma					LoGlow
Explore Scientific		UHC		CLS	
Hoya					Starscape
Hutech	NBx / NBz	NB1	IDAS LPS-V4	IDAS LPS-D2/3	IDAS LPS-D1/P2
Ice					LiPo
Irix					Edge
K&F					Natural Night
Lumicon	UHC			Deep Sky	
Nisi					Natural Night
Omega	Dual				
Omegon		Deep Sky		CLS / UHC	City Light
Opticstar					LPF
Optolong	L-eXtreme	L-eNance		CLS	UHC / L-Pro
Orion	UltraBlock				
OVI	UHC				LPF
Radian		Triad	Triad Ultra		
SkyTech		Tri	Quad	CLS	LPRO MAX
Sky-Watcher	UHC				
STC Astro	Duo				
Svbony				CLS / UHC	
Tele Vue	Nebustar				
1000 Oaks					
ZWO	Duo			LP1	

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13



14

Demonstration

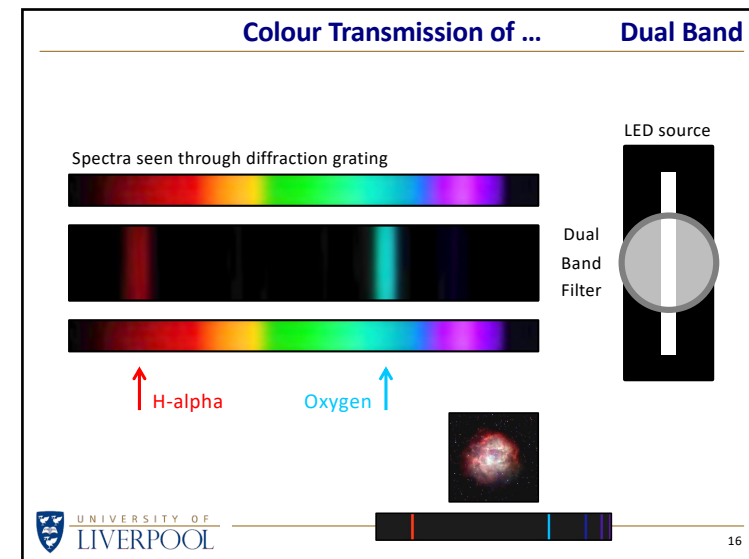
A box of diffraction gratings is now being passed around the audience.

Please take one.

Take it home with you if you would like to see the spectra of lights in your home or street lights in your neighbourhood.

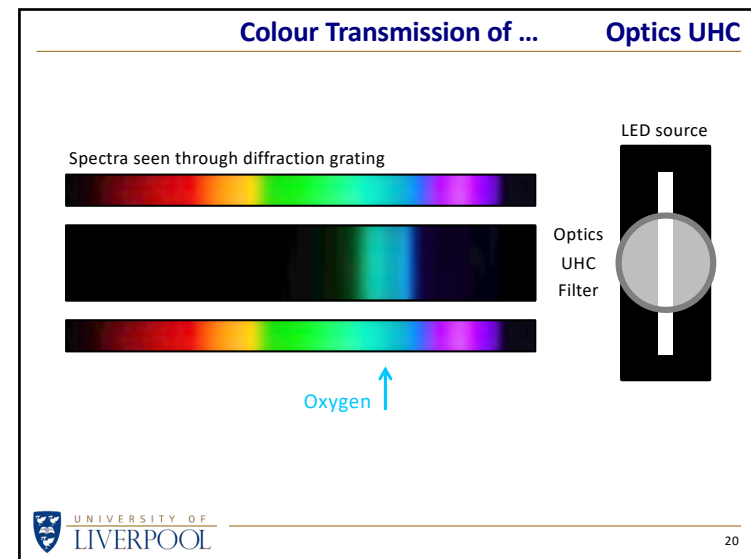
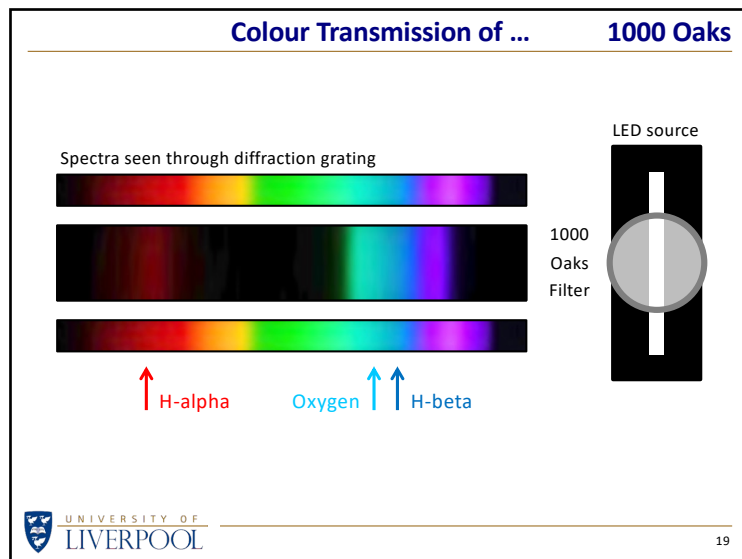
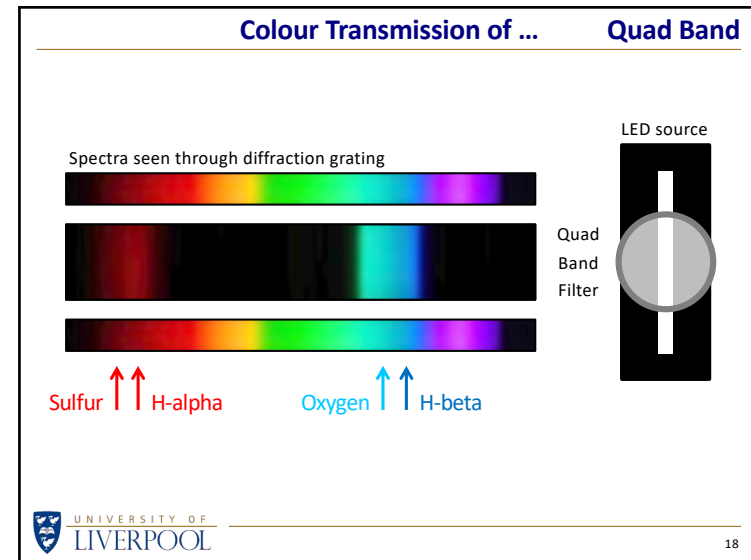
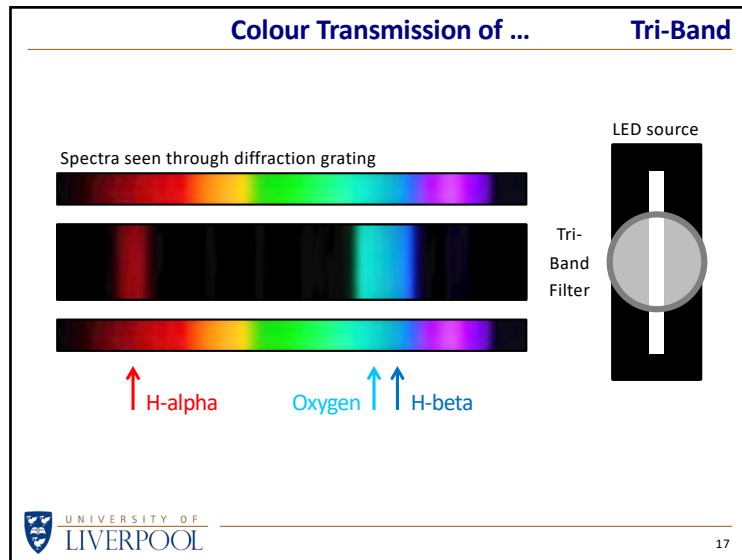
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15

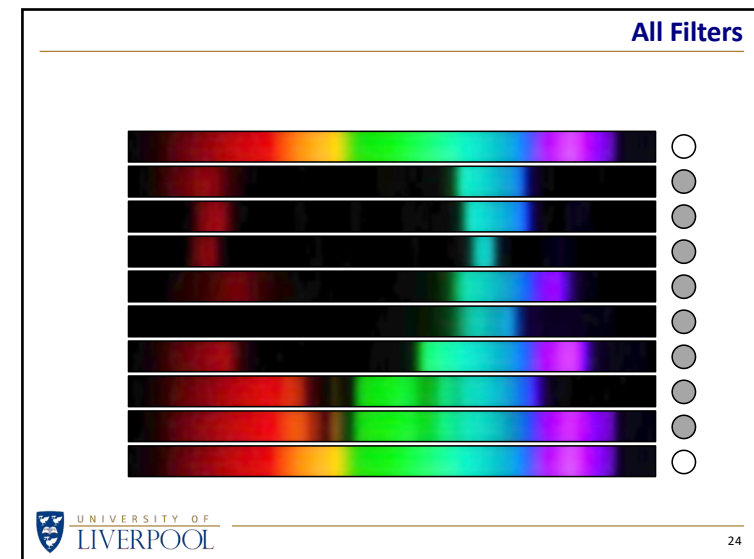
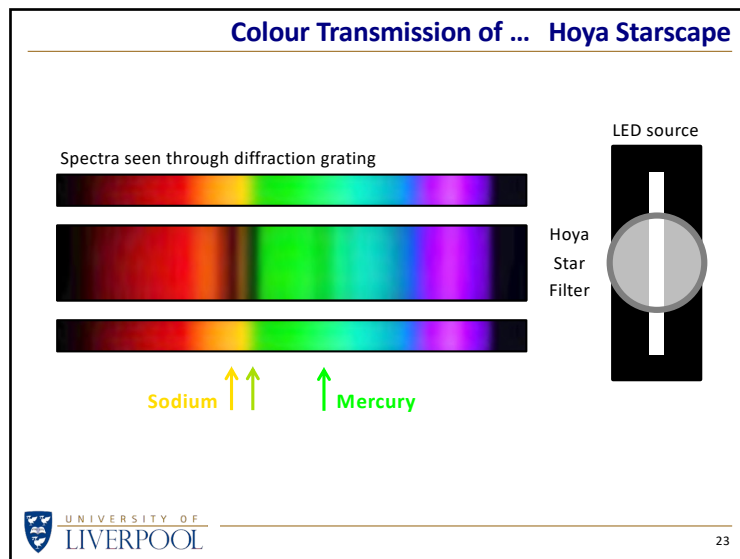
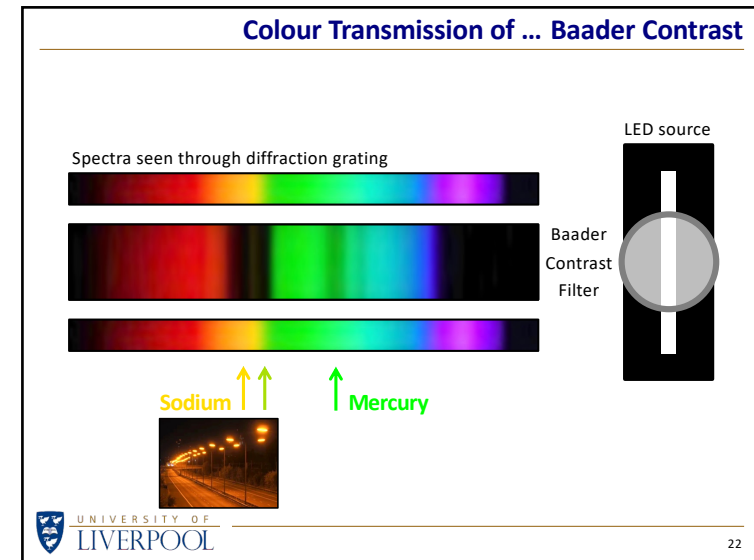
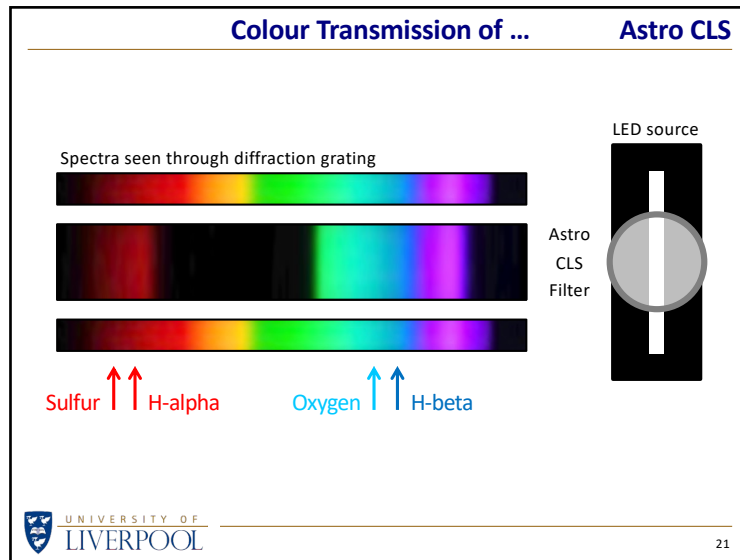


16

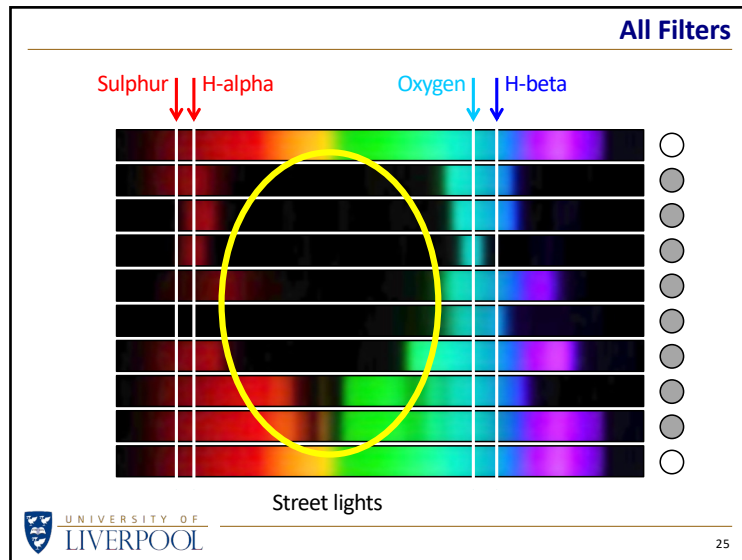
Tri-Band Tribulations



Tri-Band Tribulations



Tri-Band Tribulations



UHC Filters

	Dual Band	Tri-Band	Quad-Band	Band Pass	Band Stop
Altair Astro	Dual	Tri	Quad	CLS	
Antlia	Dual	Tri			
Ascar	Duo				
Astro Essentials					CLS
Astronomik	UHC			CLS	
Baader				Skyglow	UHC / CB
Burgess				BB Nebula	
Celestron					UHC
Chroma					LoGlow
Explore Scientific		UHC		CLS	
Hoya					Starscape
Hutech	NBx / NBz	NB1	IDAS LPS-V4	IDAS LPS-D2/3	IDAS LPS-D1/P2
Ice					LiPo
Irix					Edge
K&F					Natural Night
Lumicon	UHC			Deep Sky	
NISI					Natural Night
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Opticstar					LPF
Optolong	L-eXtreme	L-eNhanse		CLS	UHC / L-Pro
Orion	UltraBlock				
OVI	UHC				LPF
Radian		Triad	Triad Ultra		
SkyTech		Tri	Quad	CLS	LPPO MAX
Sky-Watcher	UHC				
STC Astro	Duo				
Svbony				CLS / UHC	
Tele Vue	Nebustar				
1000 Oaks				LP1	
ZWO	Duo				

26

Light Pollution (Sodium) Filters

Targets	Street Lights	
	Sodium	LED
Stars Galaxies	✓	✗
Nebulae	✓	✗

27

Dual/Tri/Quad Filters

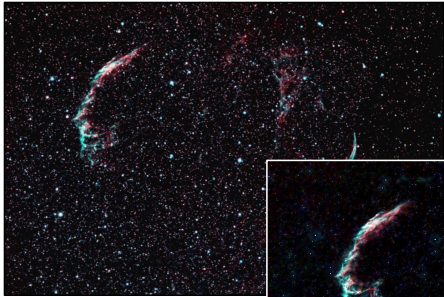
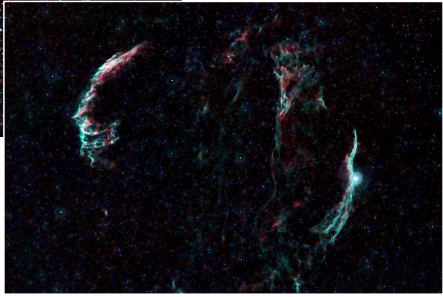
Targets	Street Lights	
	Sodium	LED
Stars Galaxies	✗	✗
Nebulae	✓	✓

28

Tri-Band Tribulations

Filter Summary		
Targets	Street Lights	
	Sodium	LED
Stars Galaxies	Dual/Tri/Quad ✗ Sodium filters ✓	Filters ineffectual – software only
Nebulae	Dual/Tri/Quad ✓ Sodium filters ✓	Dual/Tri/Quad ✓ Sodium filters ✗

Tri-Band Advantages
<p>In addition to reducing the sky glow from light pollution, there are other advantages to using a tri-band filter to image nebulae:</p> <ul style="list-style-type: none"> • Reduced glow from a bright Moon • Reduced sky glow at twilight • Most of the broadband light from stars is suppressed and so the stars are dimmed, making nebulae stand out more prominently

Veil Nebula Comparison
 <p>Taken from a dark sky site in 2019</p> <p>No Filter</p> <p>Note the crowded star field</p>
 <p>Taken from suburbia in 2022 ... close to an LED street light</p> <p>Tri-band filter</p>

www.liverpool.ac.uk/~sdb/Talks

Tri-band Tribulations

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1 Mar 2023