

Tri-Band Tribulations



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- Colour Imaging**
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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.

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Colour Imaging

Bayer grid

3D perspective view of a Bayer grid with red, green, and blue filters over a sensor array.

3x3 grid of red filters.

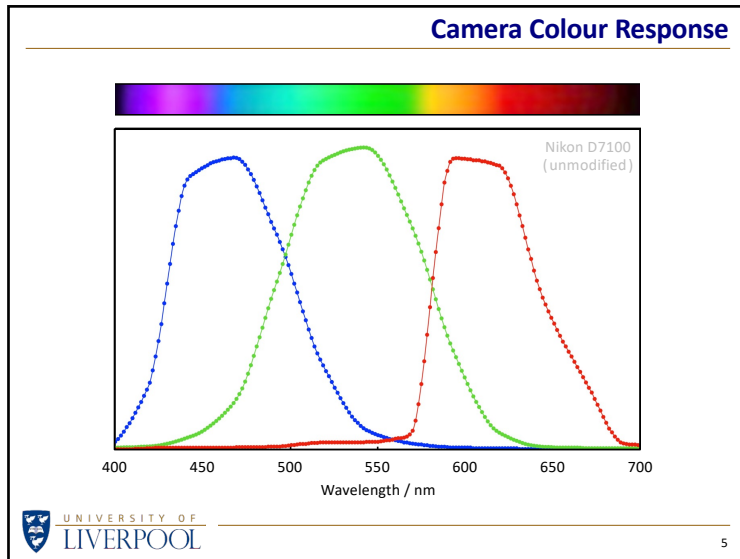
3x3 grid of green filters.

3x3 grid of blue filters.

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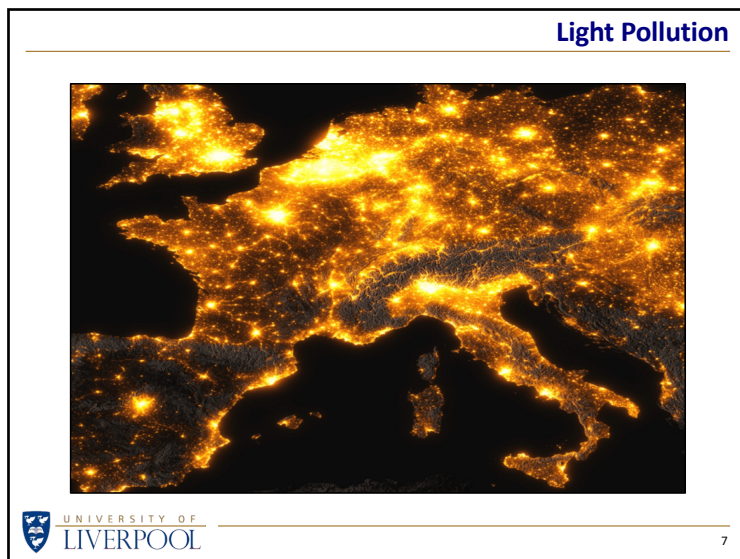
Colour Astrophotography

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.

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Light Pollution

Raw image showing sky glow from light pollution


Software can mitigate the impact of moderate LP

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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.



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Astronomical Spectra

Stars




Galaxies







Continuous spectrum

Nebulae



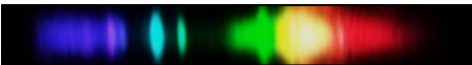


Emission (line) spectrum


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Street Light Spectra

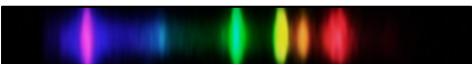
Zamorano, González and Tapia (2019) ACTION Street Spectra Manual



Sodium

↑


Bright yellow




Mercury

↑

Bright green




LED


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Filter Types

	Dual Band	Tri-Band	Quad-Band	Band Pass	Band Stop
Altair Astro	Dual	Tri	Quad	CLS	
Antlia	Dual	Tri			
Askar	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					LPo
Irix					Edge
K&F				Deep Sky	Natural Night
Lumicon	UHC				Natural Night
NISI					Natural Night
Omega	Dual				
Omegon		Deep Sky		CLS / UHC	City Light
Opticstar					LPF
Optolong	L-eXtreme	L-eNhance		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				
Svbony				CLS / UHC	
Tele Vue	Nebustar				
1000 Oaks				LP1	
ZWO	Duo				


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Filter Demos

	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	Dual				Natural Night
Omega					
Omegon		Deep Sky		CLS / UHC	City Light
Opticstar					LPF
Optolong	L-eXtreme	L-eNhanse		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				LP1	
ZWO	Duo				

Filter Brands

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Colour Transmission of ... Filters

Spectra seen through diffraction grating

LED source
Colour Filter

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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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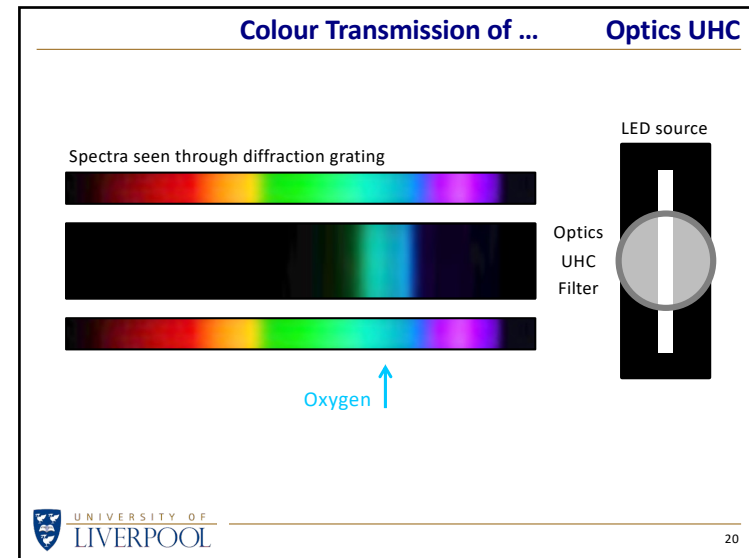
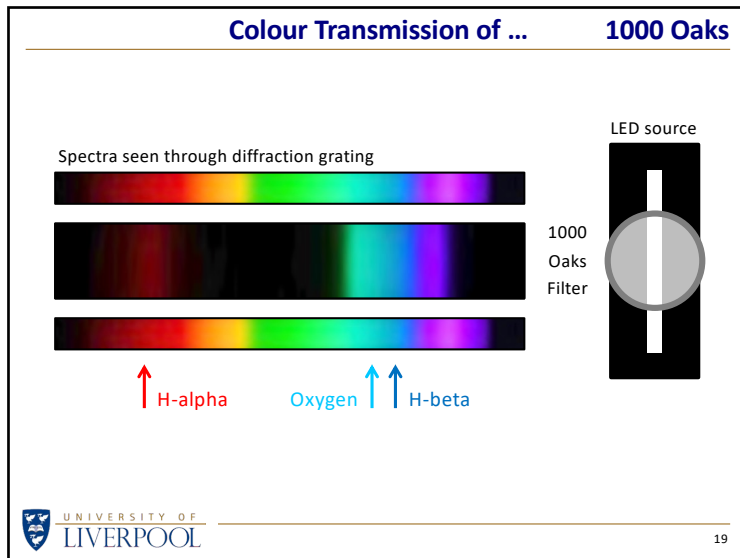
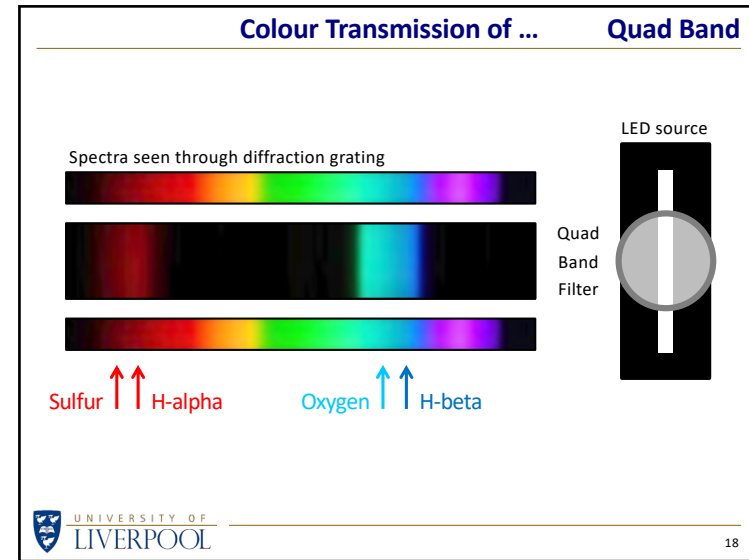
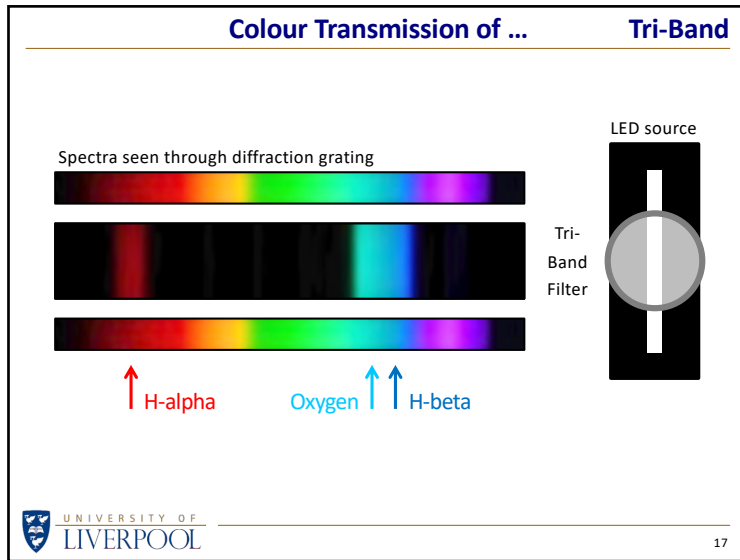
Colour Transmission of ... Dual Band

Spectra seen through diffraction grating

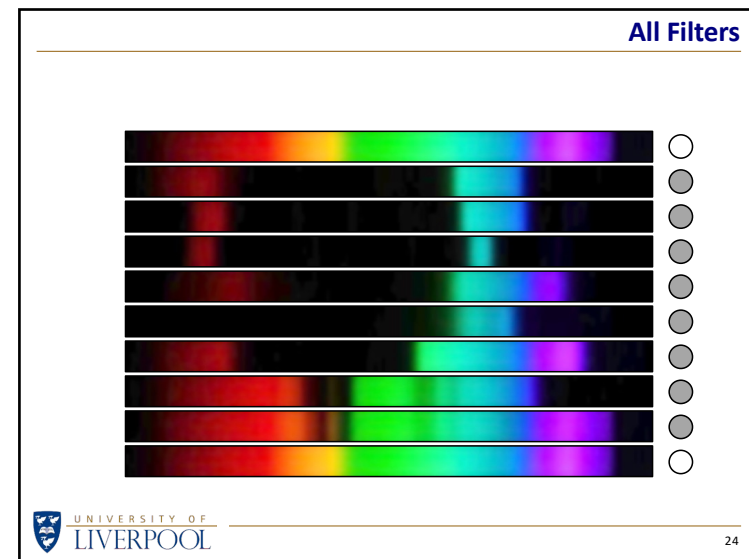
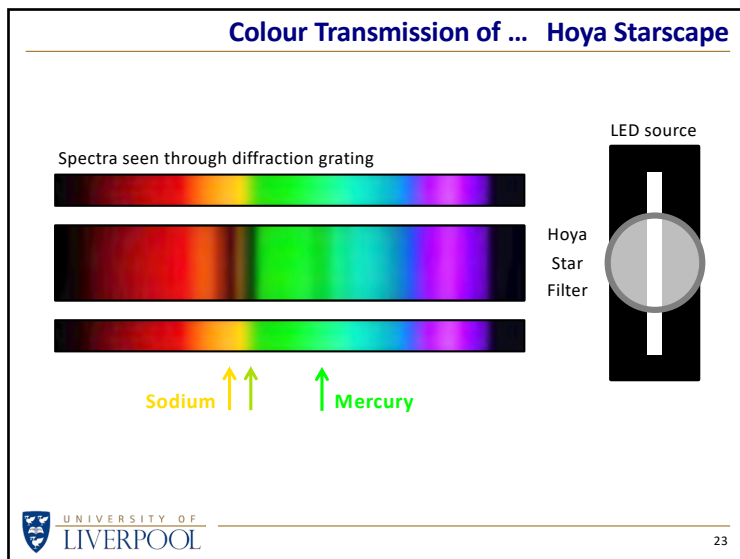
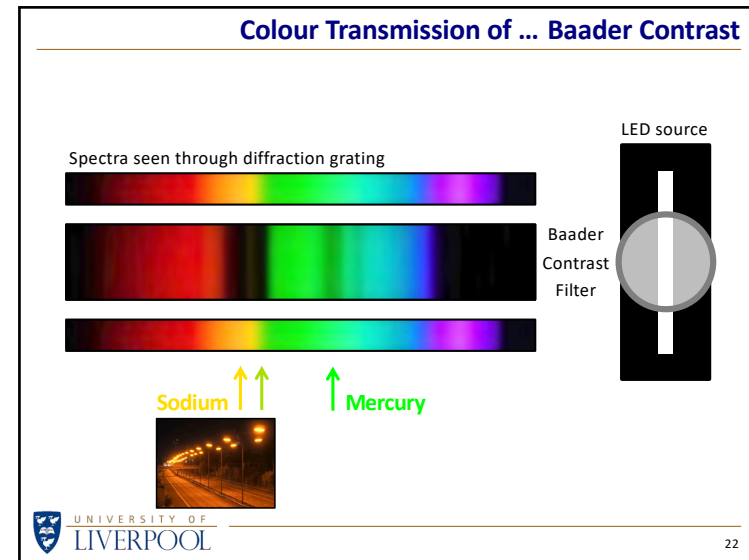
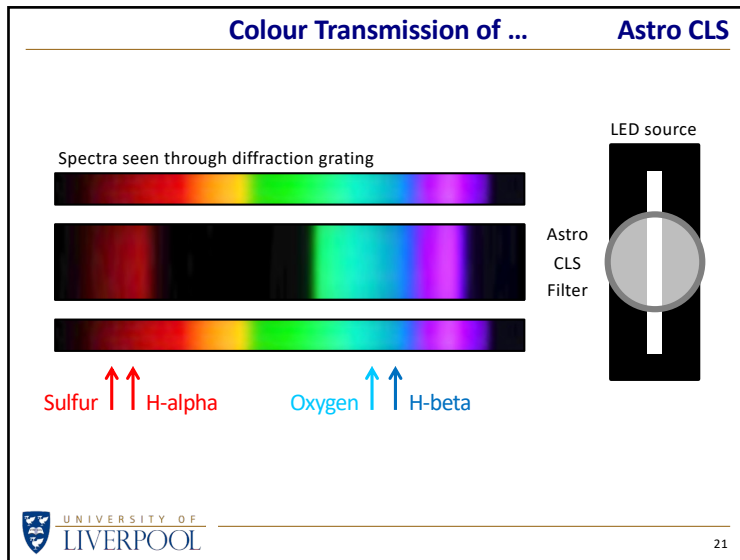
LED source
Dual Band Filter

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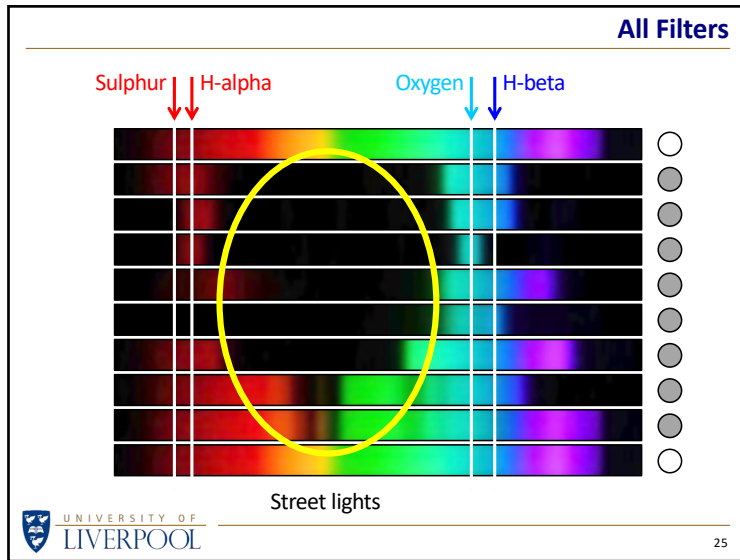
Tri-Band Tribulations



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			
Askar	Duo				
Astro Essentials				CLS	
Astronomik	UHC				
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				
OVI	UHC				LPF
Radian		Triad	Triad Ultra		
SkyTech		Tri	Quad	CLS	LPRO MAX
Sky-Watcher	UHC				
STC Astro	Duo				
Svbony				CLS / UHC	
Tele Vue					
1000 Oaks	Nebustar			LP1	
ZWO	Duo				

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Light Pollution (Sodium) Filters

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

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Dual/Tri/Quad Filters


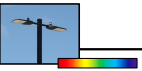
Targets	Street Lights	
	Sodium	LED
Stars Galaxies	✗	✗
Nebulae	✓	✓





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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 ✗


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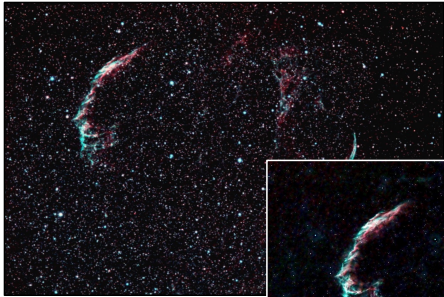
Tri-Band Advantages

In addition to reducing the sky glow from light pollution, there are other advantages to using a tri-band filter to image nebulae:

- 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


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Veil Nebula Comparison



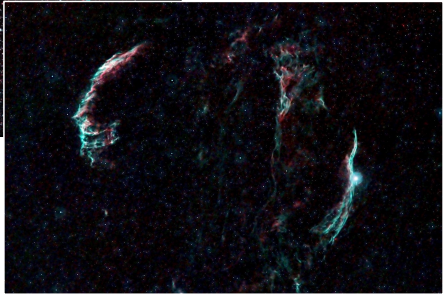
Taken from a dark sky site in 2019


No Filter

Note the crowded star field

Taken from suburbia in 2022
... close to an LED street light

Tri-band filter




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

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Dr Steve Barrett

BASoc 20 Mar 2023

