Video Astronomy & LP Filters

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View w/ Light Pollution

- Poor contrast
- Reddish-orange colour cast
- Faint nebulosity not visible
- Limits exposure time

NO FILTER

M8 Lagoon Nebula
Xtreme 418c
Gain 4, 1x60sec exp.
MAG +4.5 sky

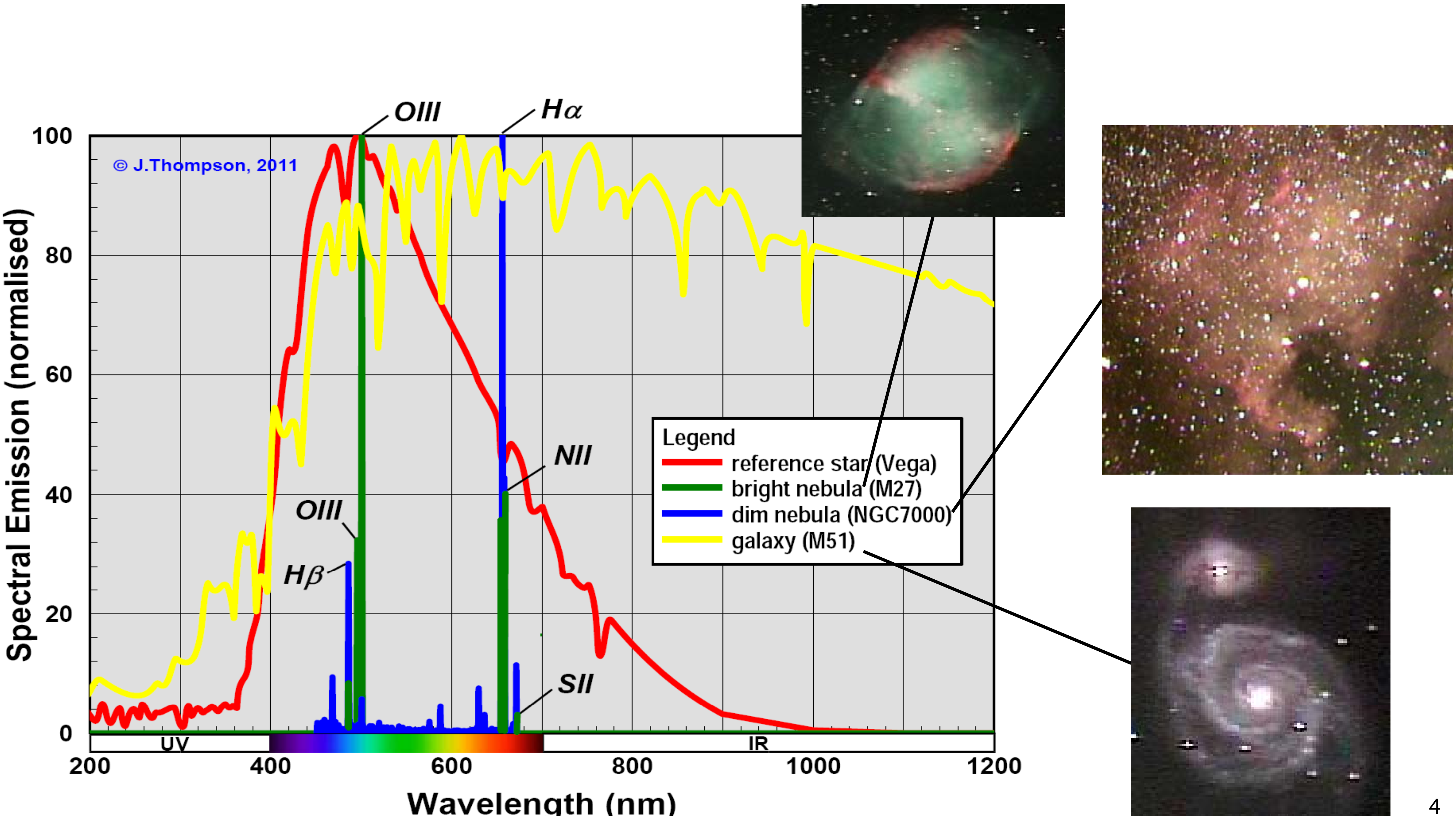
View w/out Light Pollution

- Improved contrast
- Nicer colours
- Faint nebulosity visible
- Increased exposure time limit
- Stars smaller

MEADE O-III

M8 Lagoon Nebula
Xtreme 418c
Gain 4, 1x60sec exp.
MAG +4.5 sky

What We Want To See...

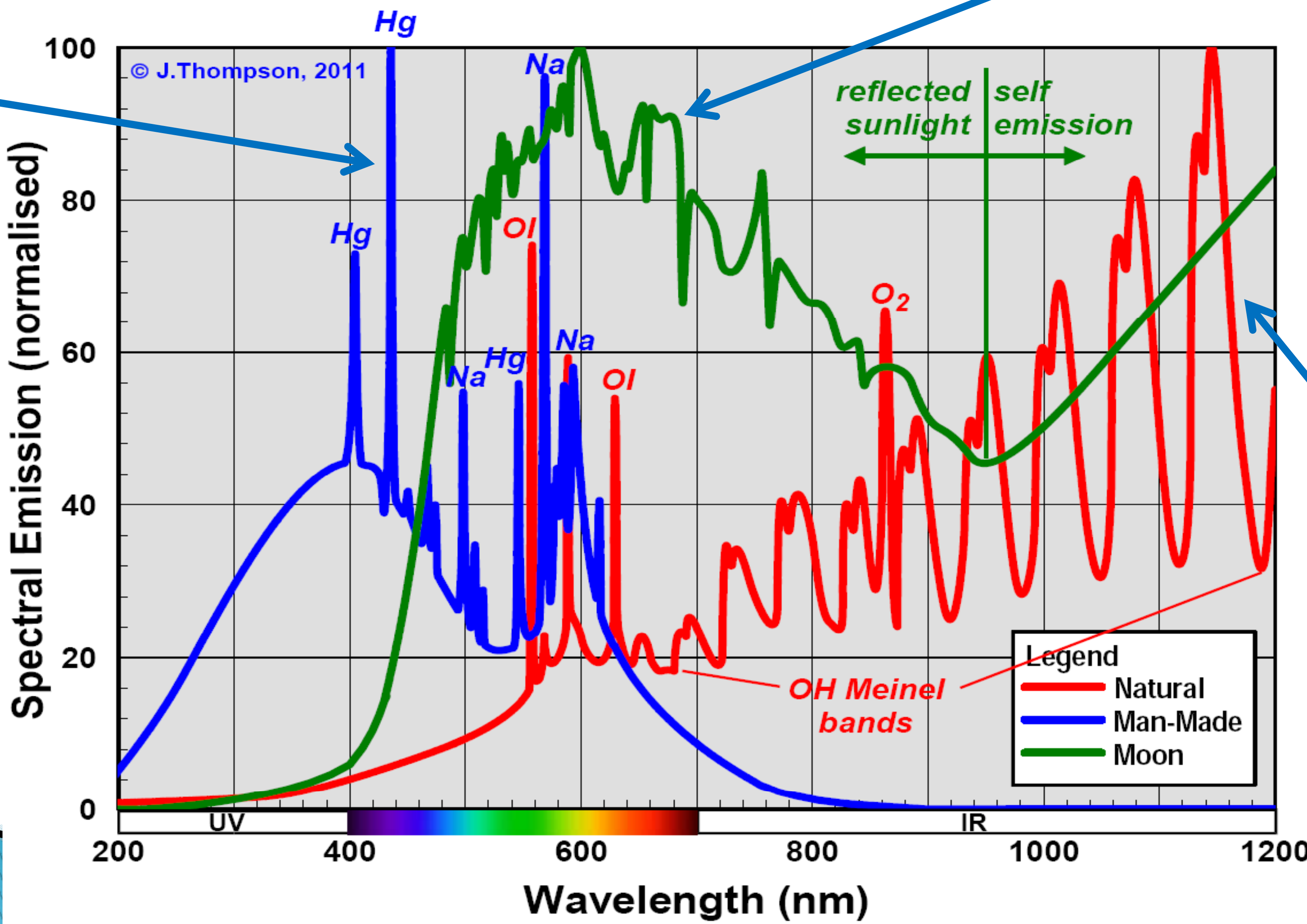


...and What We Don't

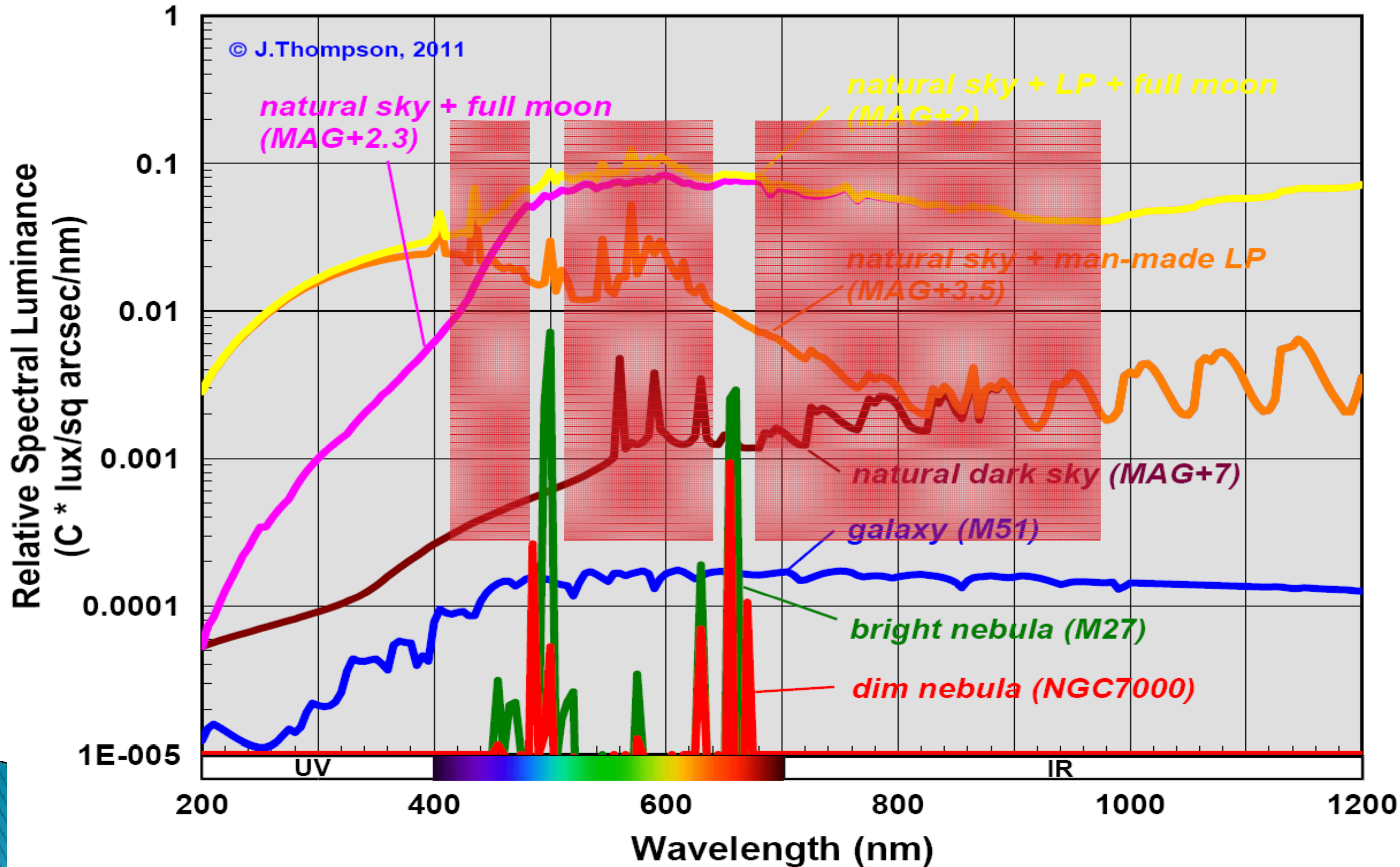
Man Made Light

Moon

Sky Glow



Relative Brightness of Sources



Astronomical Filters

- Piece of glass designed to make what we don't want to see darker
- Makes what we want to see easier to see (<u>but not brighter</u>)

Planetary
(Absorption, Colour, Wratten)

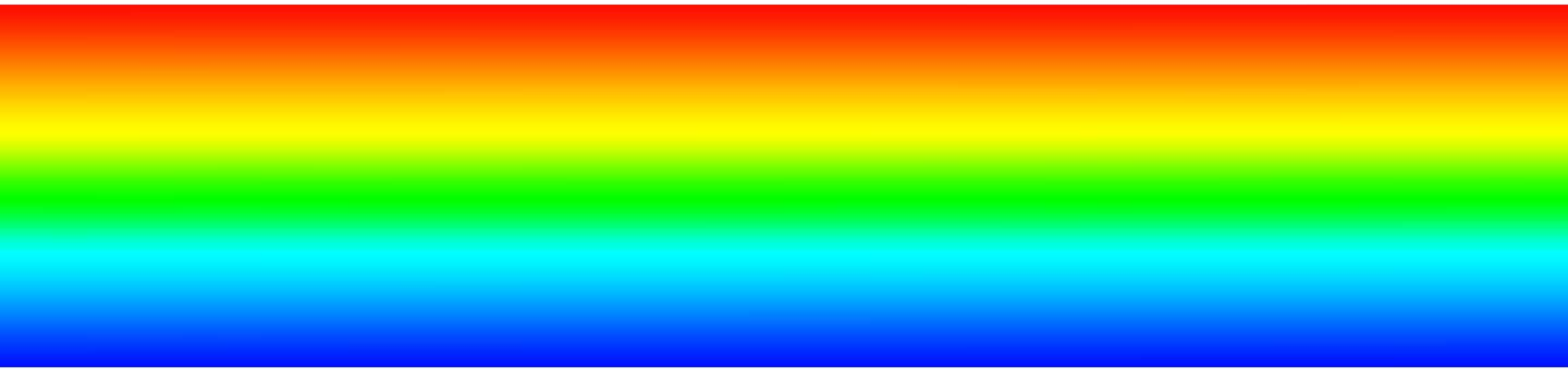
Deepsky
(Interference, Nebula, LP)

Special Filters

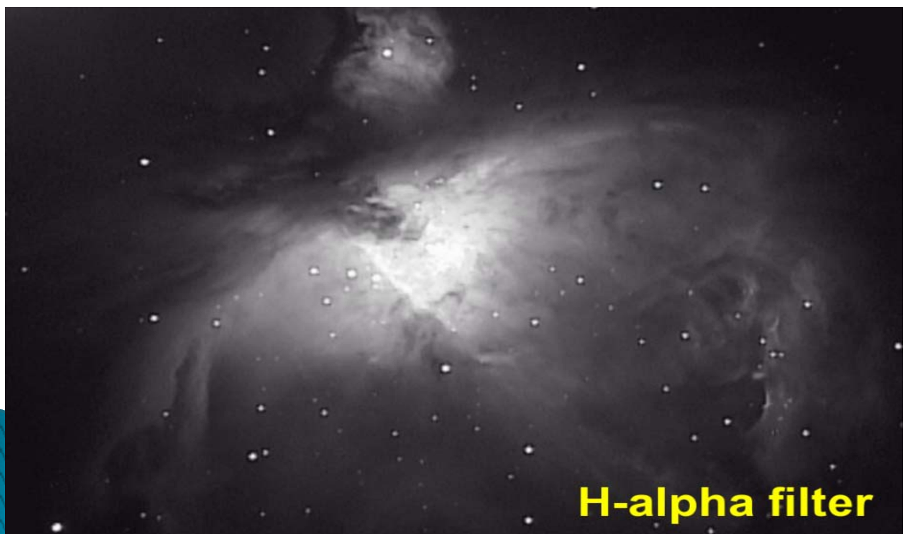
- Some special interference type filters also exist for:
  - Planetary observing
  - Chromatic aberration correction
  - Solar observing
- Let's ignore for now

Special Filters

Demonstration…



Example Application – Nebulae



Deepsky (Interference)

actual images

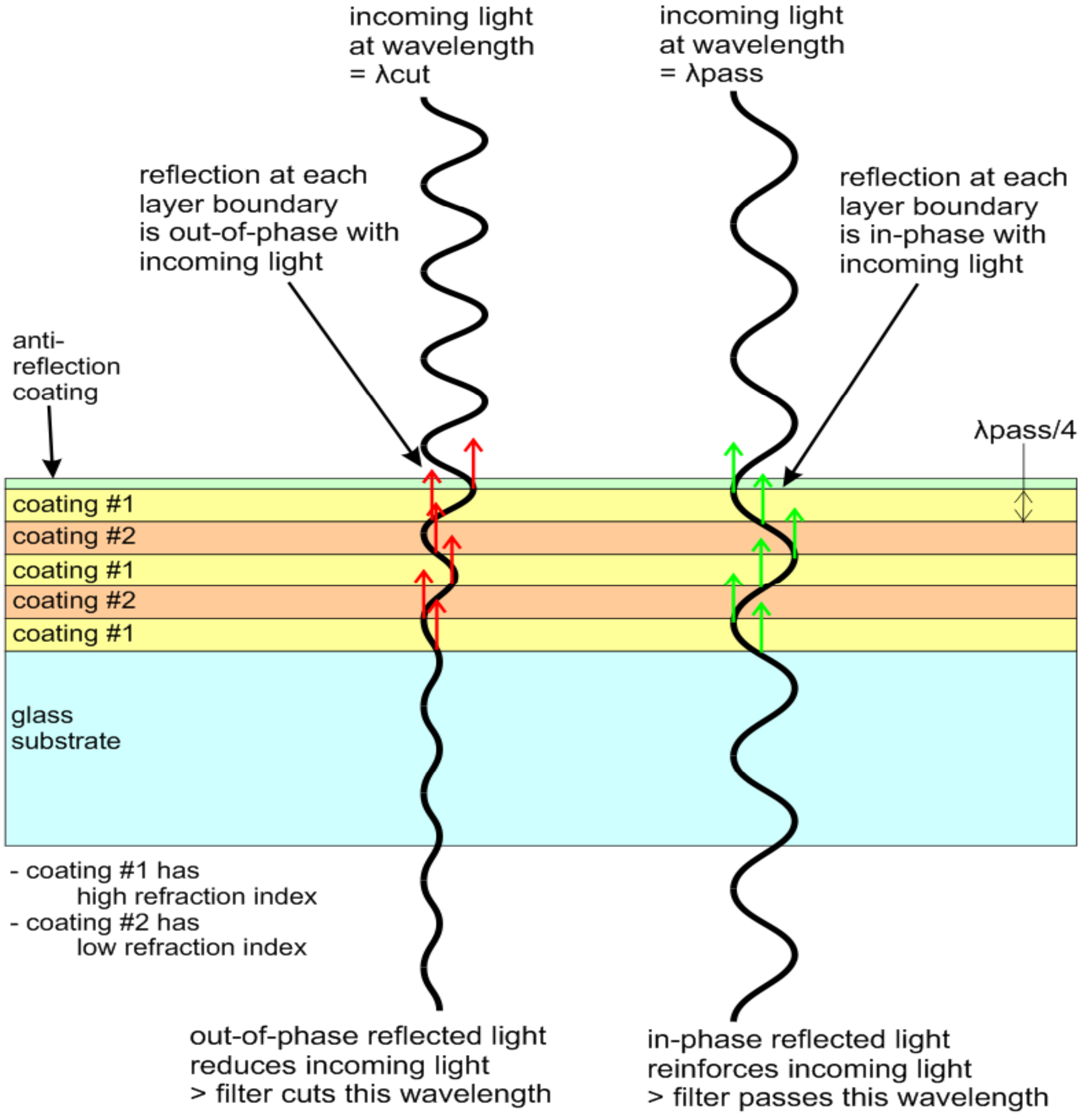
How do they work?

- Piece of glass held in an aluminum cell that screws to your eyepiece/camera

- Planetary filters:
  - glass is either: infused with a dye, or dyed gelatin is sandwiched between layers of glass
  - dye molecules absorb some wavelengths of light and not others
  - dye technology around since Stone Age!

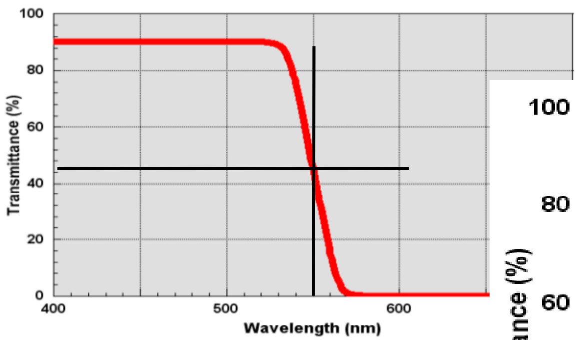
- Deepsky filters:
  - more complex – use wave property of light

Interference filters



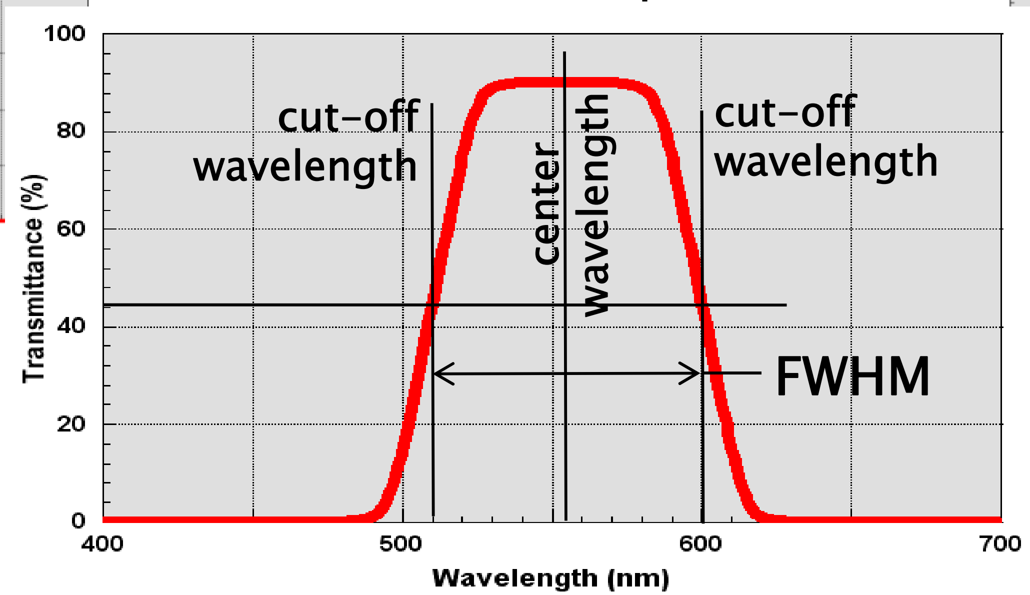
- 10's to 100's of alternating coatings on a glass substrate
- each coating has different refractive index
- light partly reflects at each boundary
- by design all undesired wavelength reflections are out-of-phase…null each other out

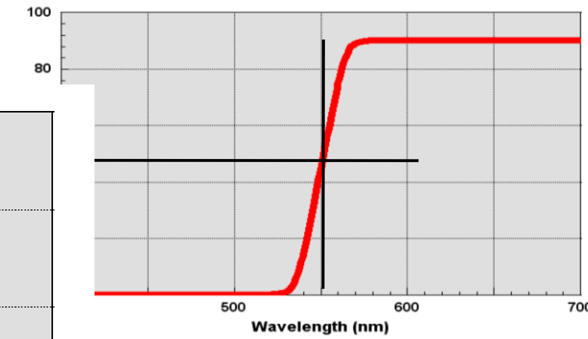
Filter response nomenclature



low pass

(wide) band pass

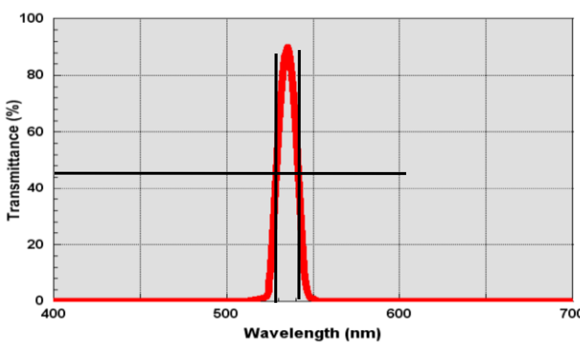




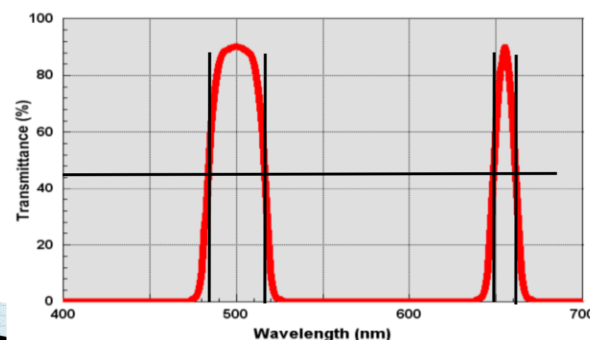
high pass

(block)

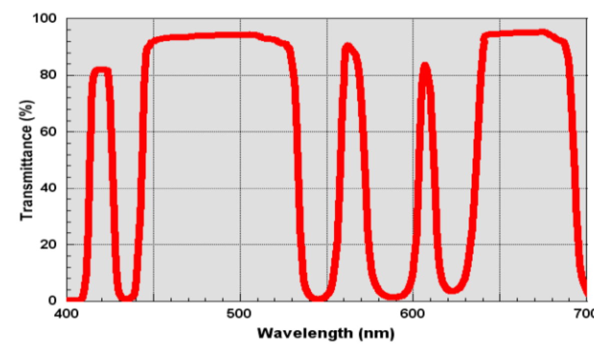
narrow band pass



dual band pass



multi-band pass

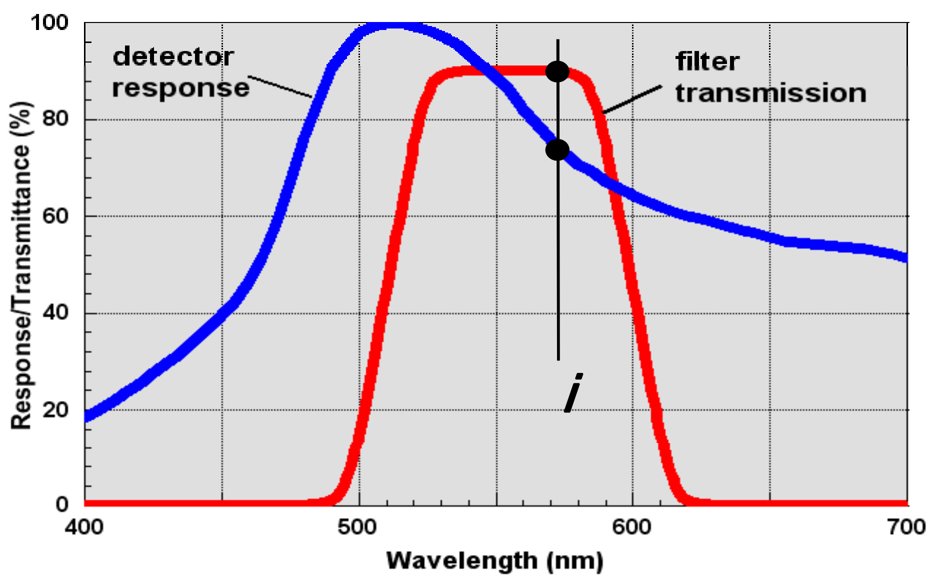


Luminous Transmissivity (%LT)

- A measure of how "dark" a filter is (how much light it blocks), with 100% = clear

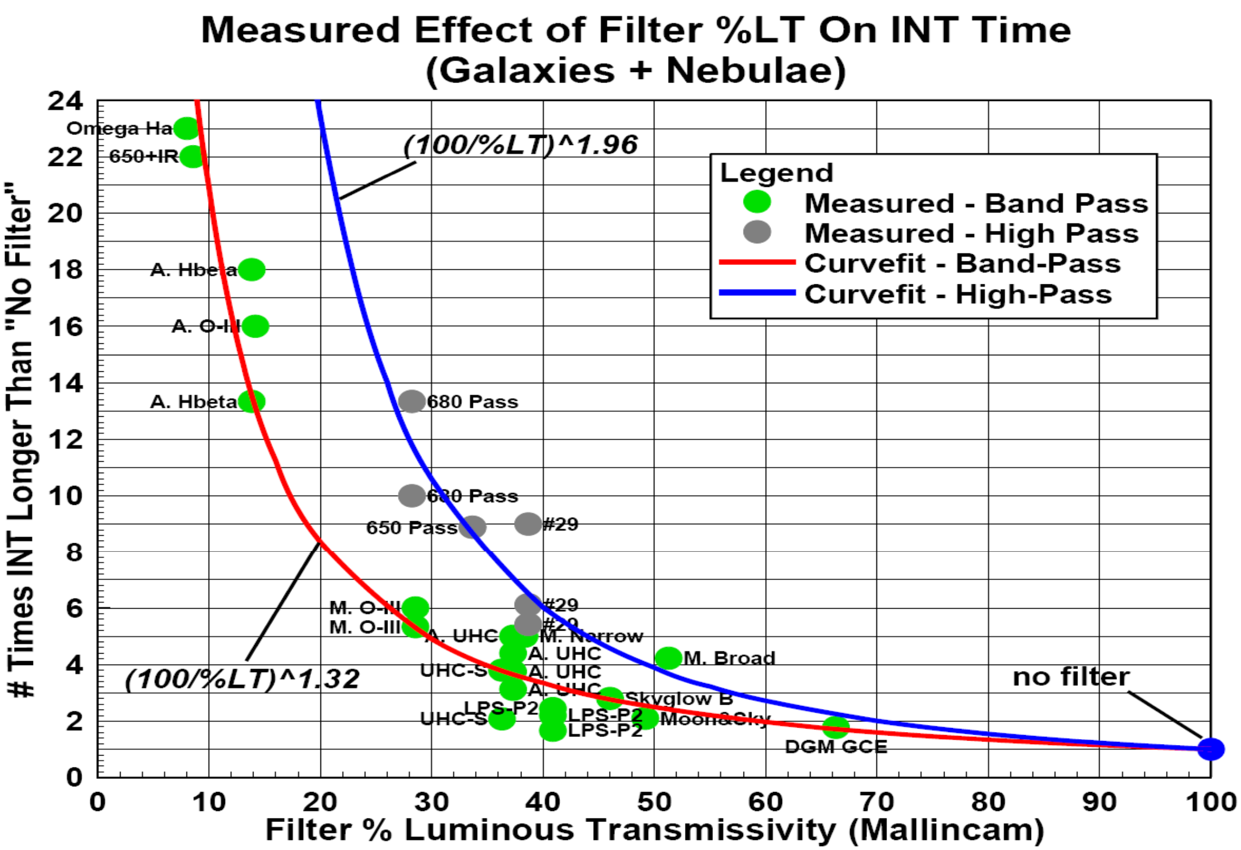
- Calculated based on response of detector (ie. different value for different sensors)

- Most often quoted assuming daytime eyeball use! (Planetary)



Deepsky Filters & Exposure

- Removal of LP means less total light getting to camera – image will be darker



- Compensate w/ EXP, BRT, or histogram adjustment
- Darker background allows even longer exposures to further increase image contrast
- Exposure increase much greater for galaxies & reflection nebulae

How deepsky filters affect contrast

- Predicted increase in contrast confirms deepsky filters work! – the narrower the better

	Category	Model	%LT	O-III Rich Bright Nebula	H-alpha Rich Dim Nebula	Galaxy
CCD (ICX418AKL)	Multiband	IDAS LPS-P2	40.9	+92.2%	+81.6%	-11.8%
	Extra Wide	Orion Skyglow Broadband	46.0	+145.7%	+126.4%	+28.1%
	Wide	Lumicon Deepsky	49.2	+151.1%	+138.2%	+36.6%
	Medium	Astronomik UHC	37.3	+259.8%	+238.6%	+52.9%
	Narrow	Orion Ultrablock	9.4	+397.9%	+64.7%	-25.0%
	O-III	Televue O-III	25.9	+303.3%	-4.0%	+56.7%
	H-alpha	Baader Scientific 7nm	1.5	>500%	>500%	+60.9%
	H-beta	1000 Oaks LP4	24.1	+128.1%	>500%	+123.4%
	IR Pass	Baader Scientific IR Pass	31.1	-80.7%	-54.0%	+246.9%

Prediction based on:
- Mv = +3.5 (typical large city suburbs)

Selecting a filter for deepsky

Object Type	Dark Sky	Light Polluted Sky
Emission Nebulae (incl. planetary neb. & supernova remnants)	Best contrast from narrowest deepsky filter your mount tracking will support. Adding IR cut will also help improve contrast with CCD.	
Galaxies, globular clusters, open clusters, reflection nebulae	Adding IR cut "can" help contrast with CCD.	Filters that pass IR are required, with wide to medium-wide band pass filters working best. Even more contrast on galaxies from IR high pass filters, if scope tracking will support (long EXP req'd).

- Unfocused IR in refractors (video/imaging):
  - Most ED doublets and APO triplets not a problem
  - Commercial camera lenses (esp. security) usually need IR cut

Filter Experiment

Light polluted sky (Ottawa), XT-mono, 66mm scope

No Filters (5sec INT, 0 BRT)

Filter Experiment

Multi-band LP

IDAS LPS-P2
(15sec INT,
0 BRT)

Filter Experiment

Wideband LP

Antares ALP
(20sec INT,
0 BRT)

Filter Experiment

Wideband LP + IR block

Antares ALP
+ IR block
(35sec INT,
0 BRT)

Filter Experiment

Medium band LP

Astronomik UHC (30sec INT, 0 BRT)

Filter Experiment

Medium band LP + IR block

Astronomik UHC + IR block (45sec INT, 0 BRT)

Filter Experiment

Narrowband LP + IR block

Meade O-III
+ BDRB
(70sec INT,
0 BRT)

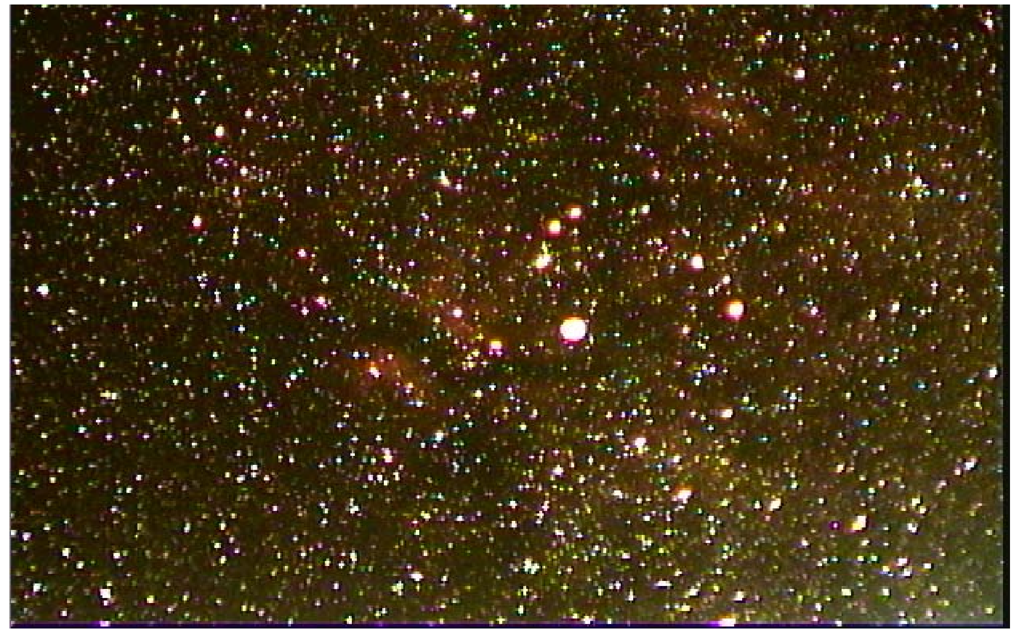
Filter Experiment

Wideband H-alpha

Omega Optical 35nm Halpha (80sec INT, 0 BRT)

Poor IR Focus Example

No Filters (20sec INT, 0 BRT)



Baader UV/IR Cut (45sec INT, 0 BRT)

- Images captured with achromatic Canon TV camera lens (17-102mm zoom)
- Affect of unfocused IR very evident – not simply bloated stars, fuzzy stars

Last words

- Feel free to experiment. Recommendations here are based on MY experience; yours may be different.
- Do not feel obligated to buy one of everything. Start with an affordable general purpose filter and build from there.
- For goodness sake HAVE FUN!