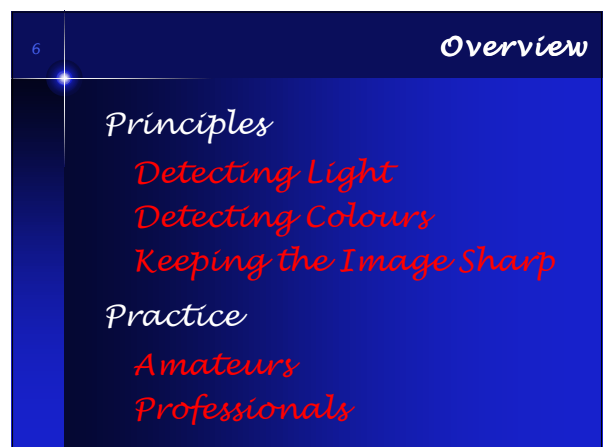
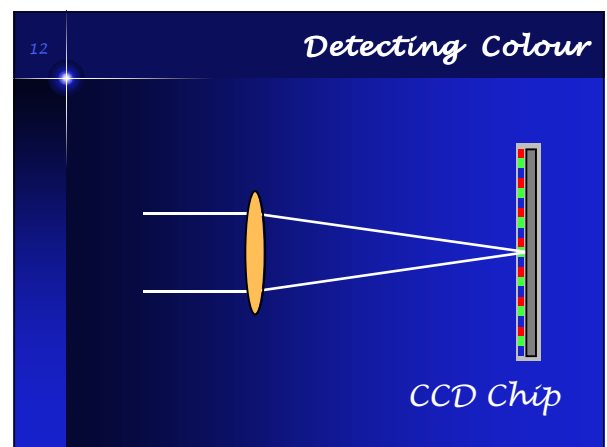
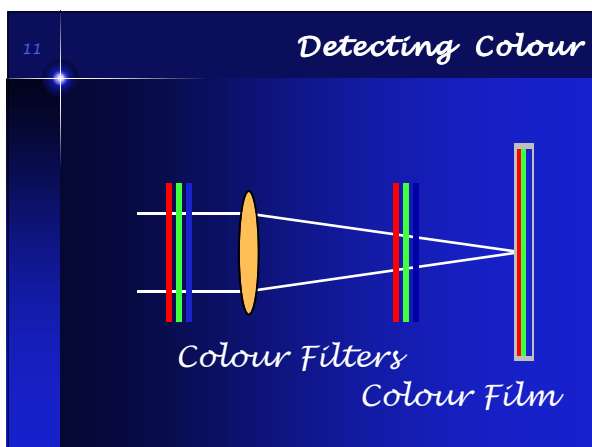
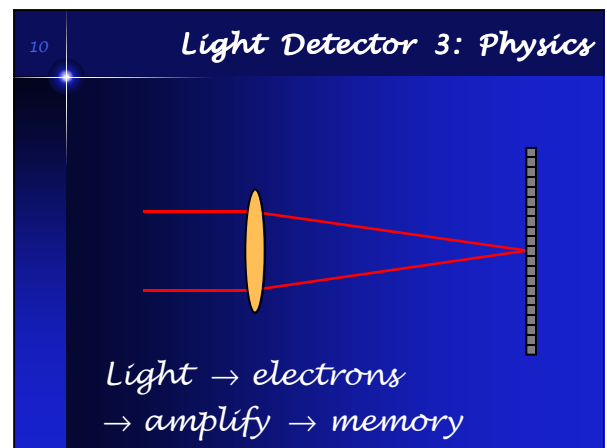
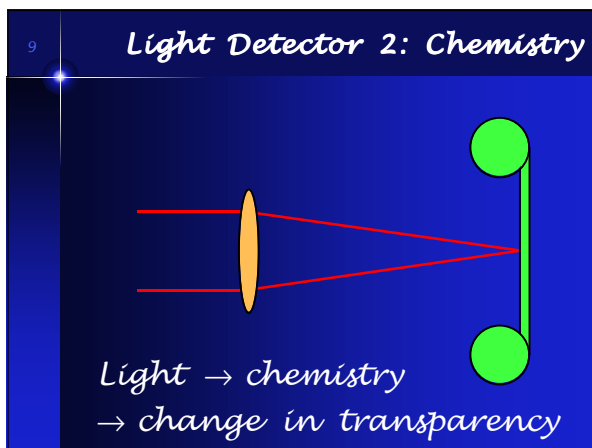
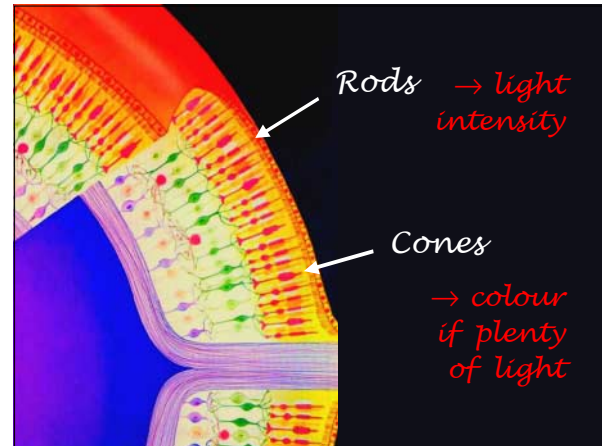
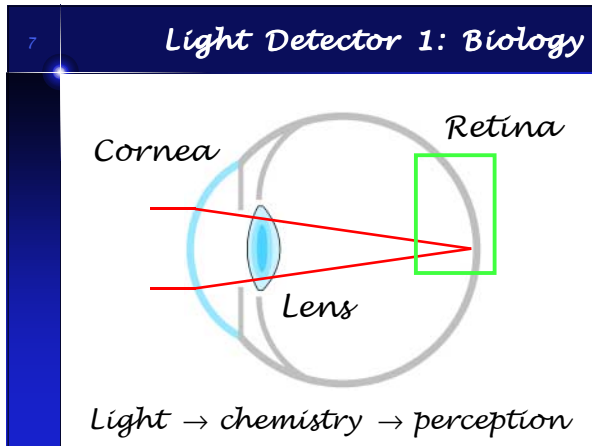


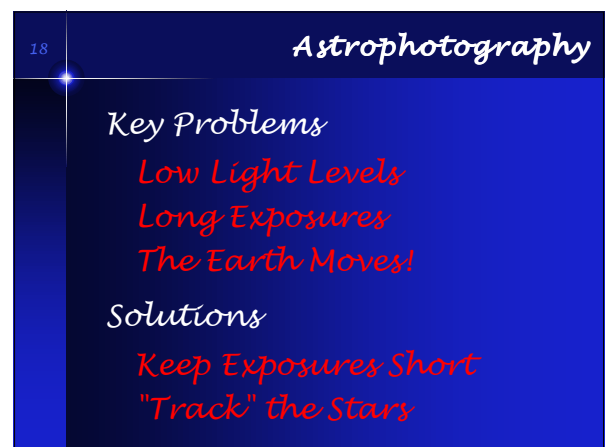
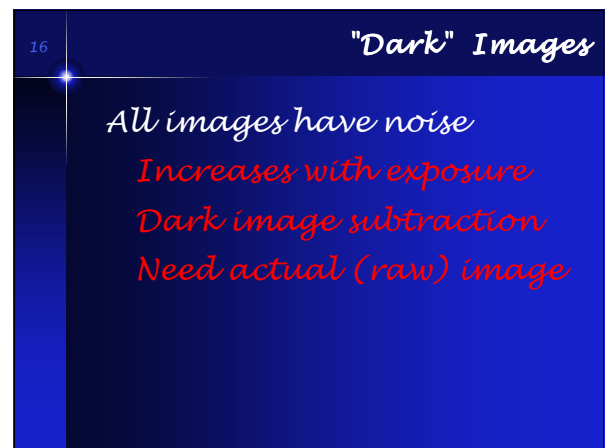
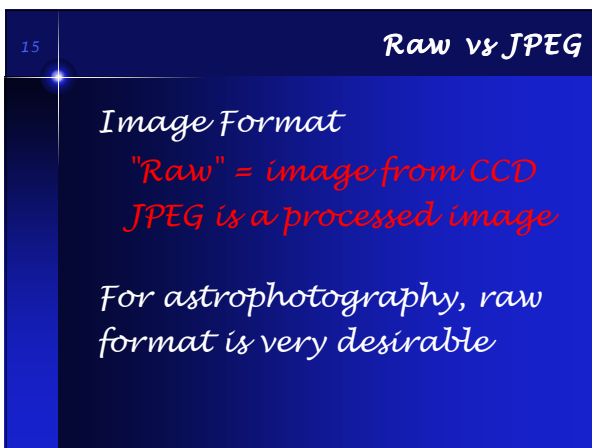
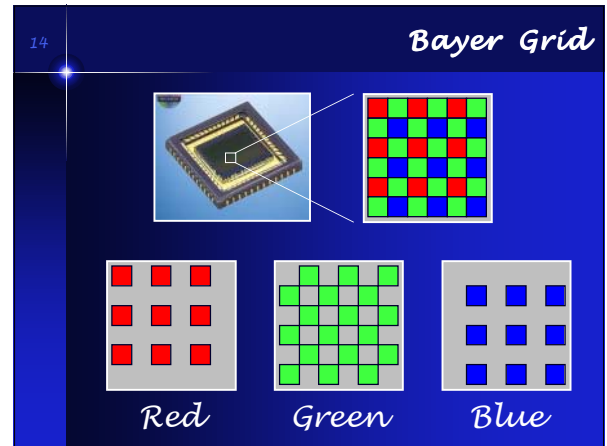
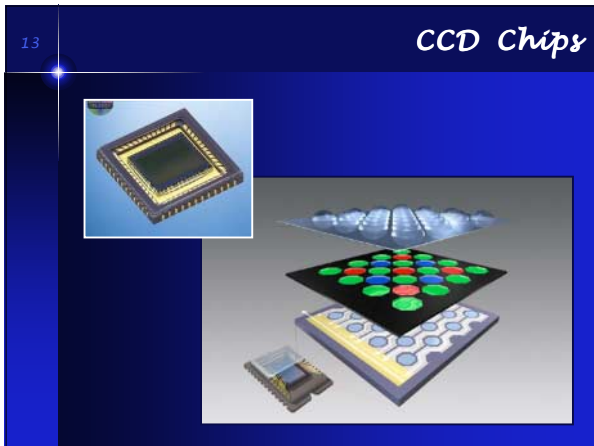
# Imaging the Universe



# Imaging the Universe



# Imaging the Universe



# Imaging the Universe

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## Photos on a Fixed Tripod

*Keep Exposures Short  
Use Tripod (or a Rock)  
Use Cable/Remote Release*

*Take Advantage of  
Holiday Skies*

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## Aurora Borealis

Particles from the Sun hit the Earth's atmosphere, making the air glow

The different colours are produced by the oxygen and nitrogen atoms, and the shapes are formed by the Earth's magnetic field

Aurora are best seen near the Arctic or Antarctic circles



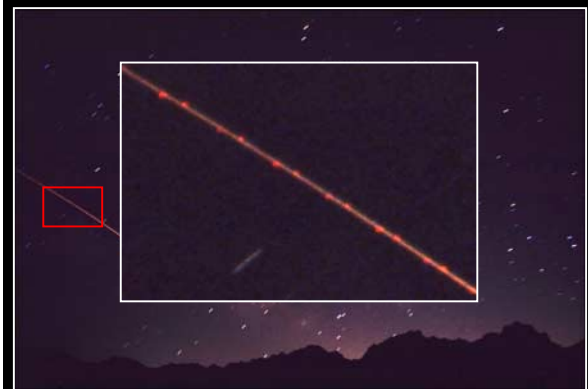
Aurora Borealis Exp=30s f/2.8 FL=24mm Fujichrome ISO400



North Polar Sky Exp=5m f/2.8 FL=24mm Fujichrome ISO200

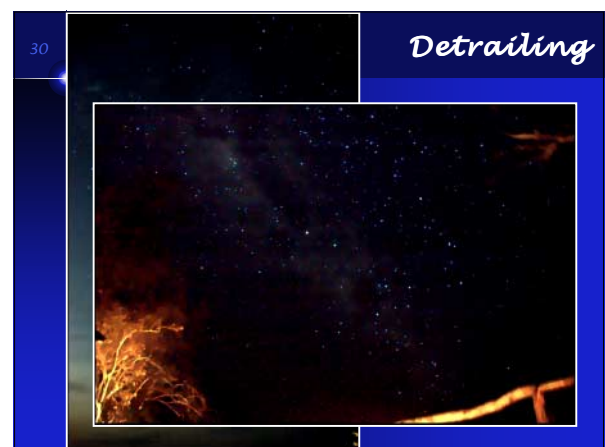
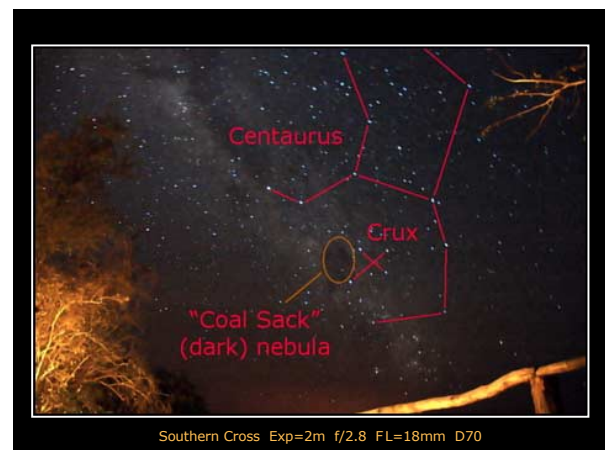


North Polar Sky Exp=1hr f/5.6 FL=24mm Fujichrome ISO400



Southern Sky Exp=5m f/2.8 FL=24mm Fujichrome ISO200

# Imaging the Universe



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## Following the Stars

The Earth rotates

"De"-rotate the camera

Rotate one rev per day

Axis ~ parallel with Earth's

Solutions

Build a motorised mount

"Piggy-back" on a telescope

32

## Piggy-Back Photography



M45 Pleiades Star Cluster Exp=300s f/4 FL=300mm D70

33

## Piggy-Back Photography



C20 North America Nebula Exp=600s f/4 FL=200mm D70

34

## Piggy-Back Photography



M31 Andromeda Galaxy Exp=600s f/4 FL=300mm D70

35

## Comet Hale-Bopp



Hale-Bopp Exp=2m f/6.3 FL=500mm Fujichrome

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## Telescopes

There are many types of telescopes available, making a choice somewhat confusing



# Imaging the Universe

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## Refractors



**Refractors**  
Use lenses to focus the light

38

## Reflectors



**Refractors**  
Use lenses to focus the light  
**Reflectors**  
Use mirrors to focus the light

39

## Catadioptric



**Refractors**  
Use lenses to focus the light  
**Reflectors**  
Use mirrors to focus the light  
**Schmidt-Cassegrains**  
Use both lenses and mirrors

40

## 'Goto' Telescopes



**Refractors**  
Use lenses to focus the light  
**Reflectors**  
Use mirrors to focus the light  
**Schmidt-Cassegrains**  
Use both lenses and mirrors  
**Compact S-C**  
Have user-friendly controllers to point the telescope

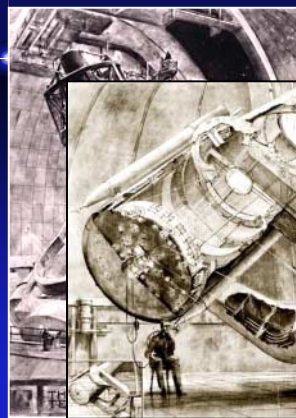
41

A domed observatory provides a stable platform for the telescope and shelter from the wind



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## Palomar



THE FOUR FOOT SCHMIDT-  
PHOTOGRAPHIC  
TELESCOPE

# Imaging the Universe

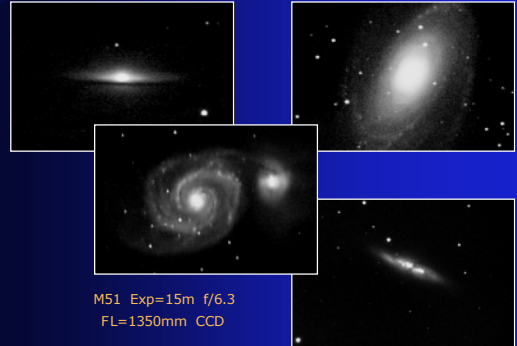
43

## My Observatory



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## What the Telescope Sees



M51 Exp=15m f/6.3  
FL=1350mm CCD

45

## Orion Nebula



A nebula is a cloud of gas that reflects light from nearby stars

This is a star 'nursery' where stars are being born



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## Liverpool Telescope



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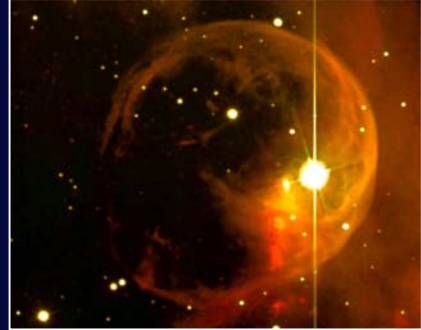
49

*Liverpool Telescope*



50

*Bubble Nebula*



51

*Spiral Galaxy M51*



52

*Globular Cluster M13*



53

*Ring Nebula M57*

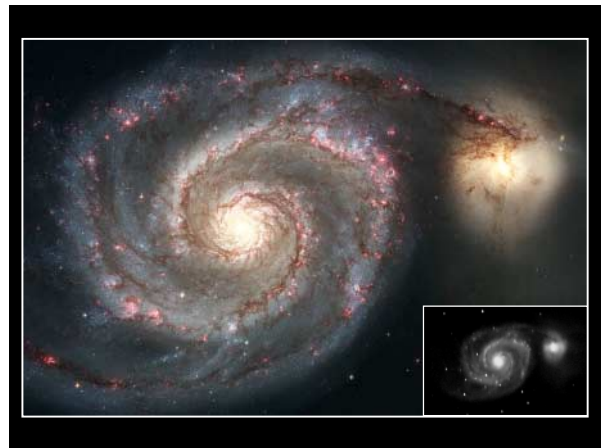


54

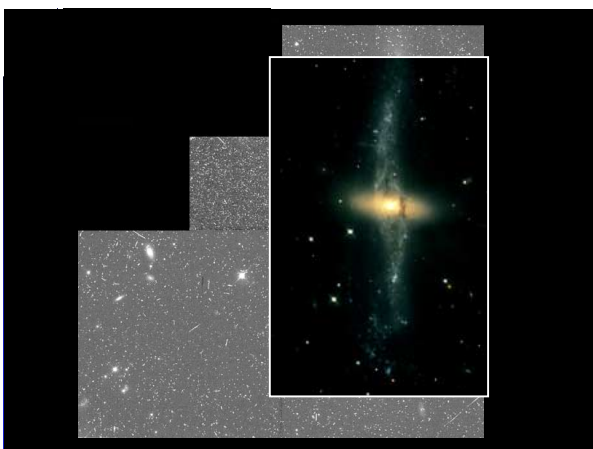
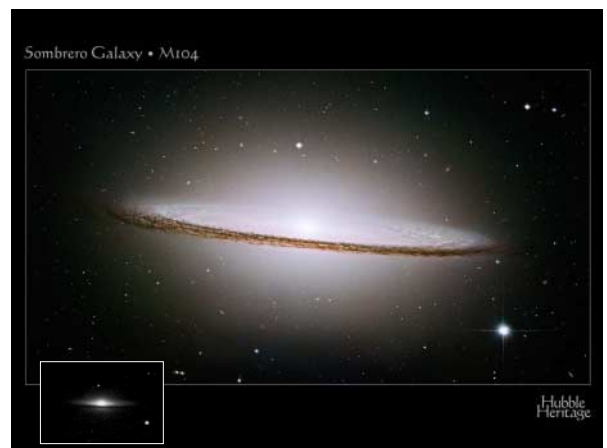
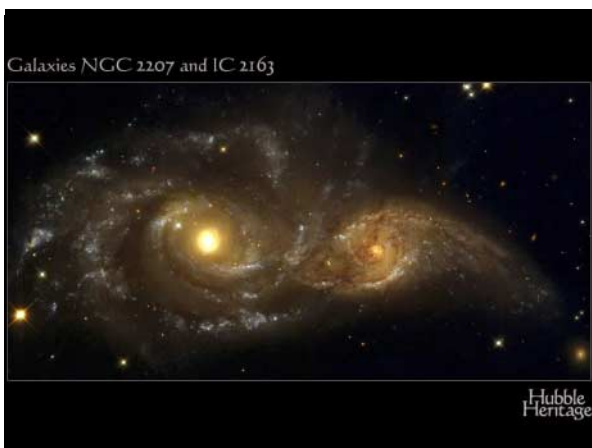
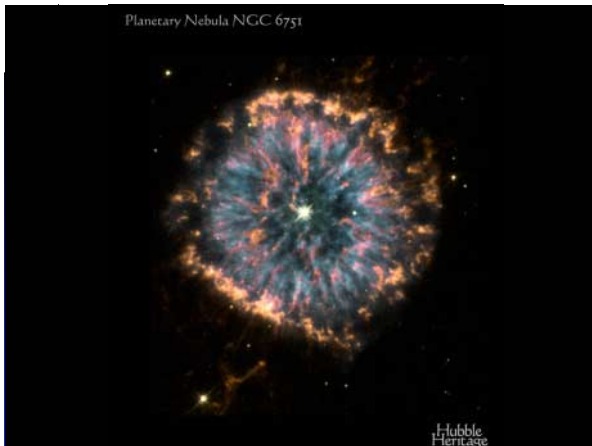
*Jupiter*



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## Amateurs and Professionals

### Amateurs

*Time is 'Free'*

*Cover the Whole Sky*

### Professionals

*Telescope Time Expensive*

*Limited Sky Coverage*

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## What Can You Do With... ?

**£ 1,000,000,000**



69

## What Can You Do With... ?

**£ 1,000,000**



70

## What Can You Do With... ?

**£ 1,000**



71

## What Can You Do With... ?

**£ 100**



72

## What Can You Do With... ?

**£ 10**

