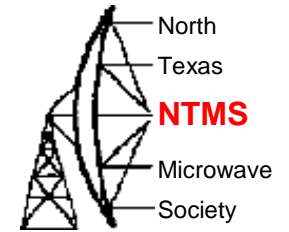


Astro-Imaging or Receiving at 300nm to 750nm Wavelengths

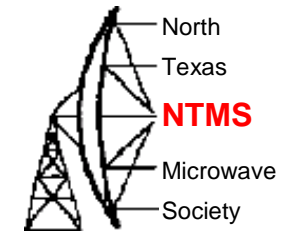
Wes Atchison
WA5TKU

Telescope Basics

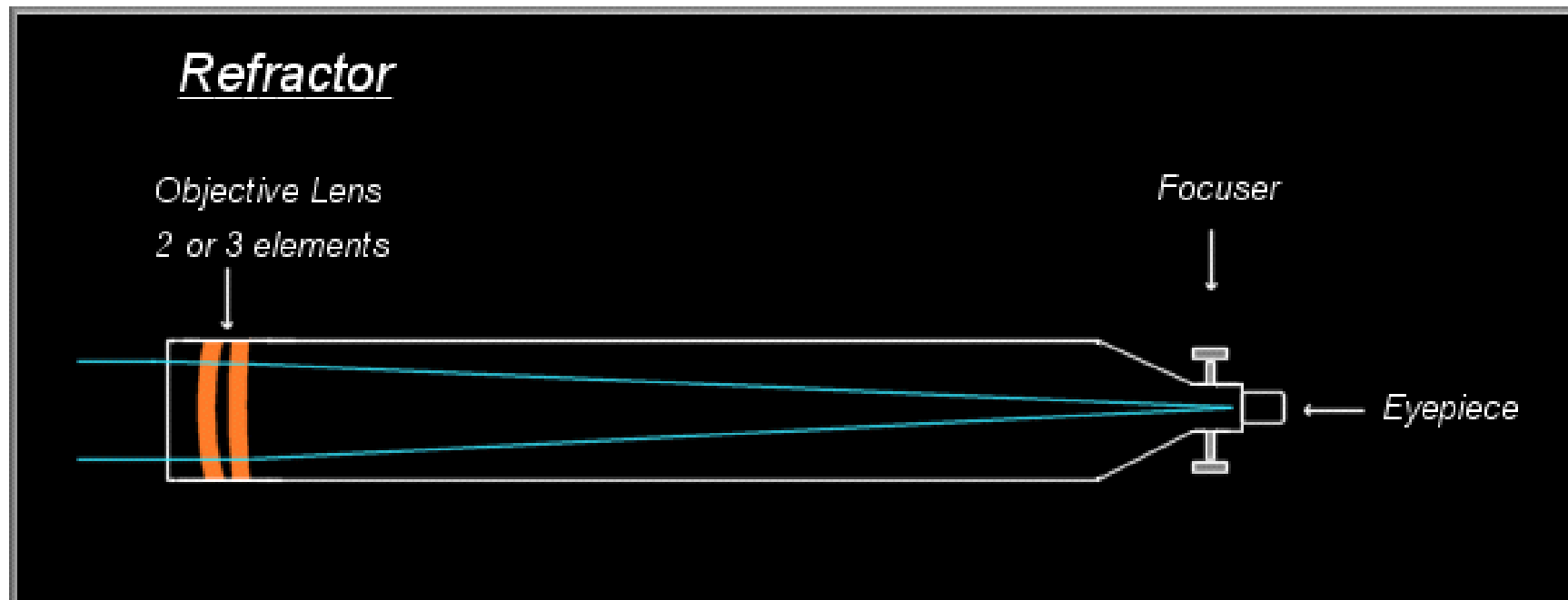


- Refractor
 - Galileo
 - 400 Years Ago Pointed @ Moon & Jupiter
- Reflector
 - Newton
 - 1669 Built 1st
- Catadioptric
 - Cassegrain - 1672
 - Schmidt - 1930
 - Maksutov - 1941

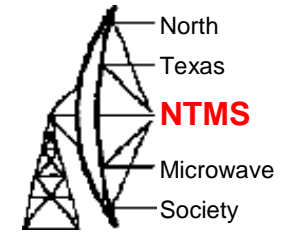
Telescope Basics



- Refractor



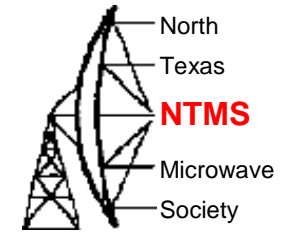
Radio Telescope



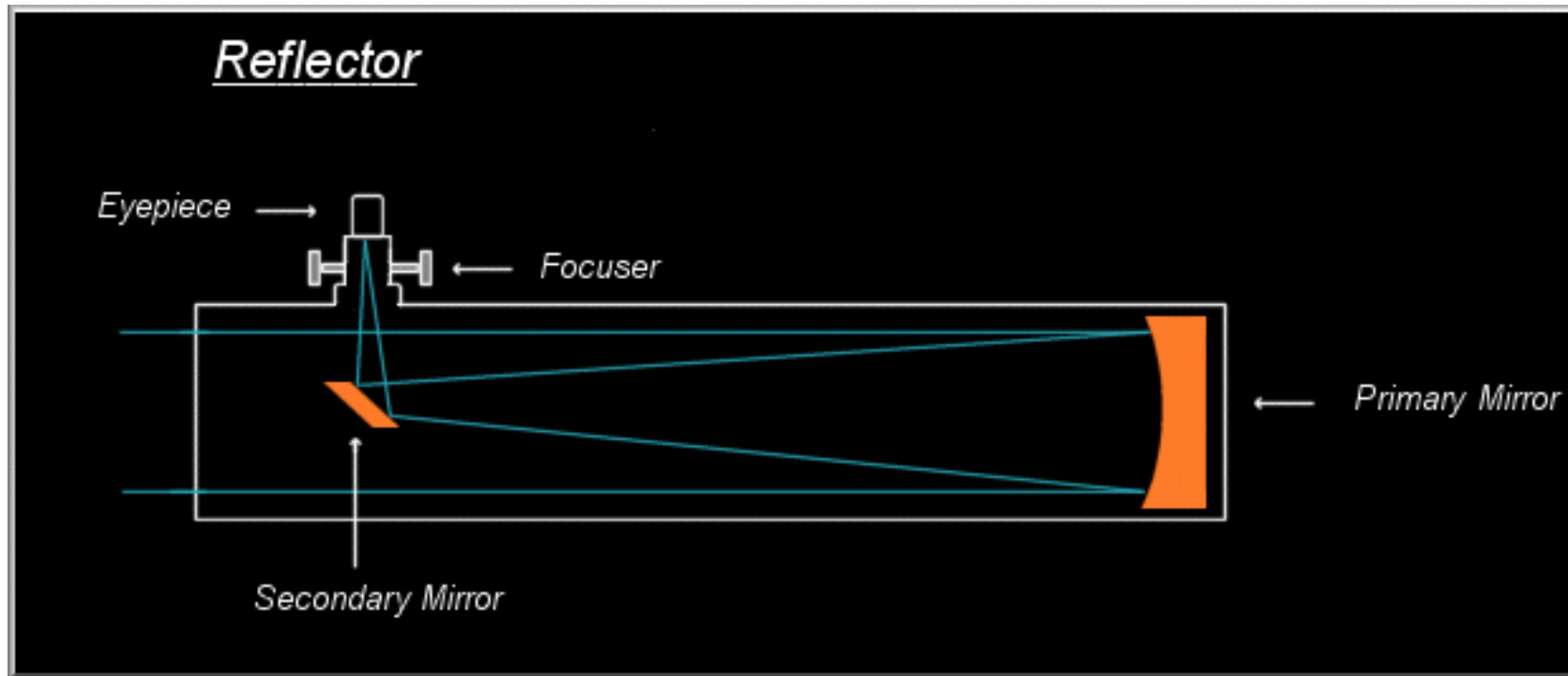
- Jansky
 - 1931 1st
 - 20.5 MHz
 - 100 Feet x 20 Feet
 - Photo of Replica



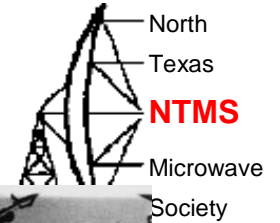
Telescope Basics



- Reflector



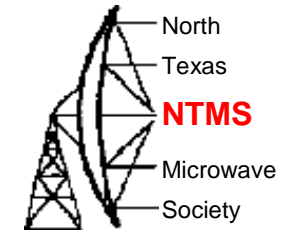
Parabolic Radio Telescope



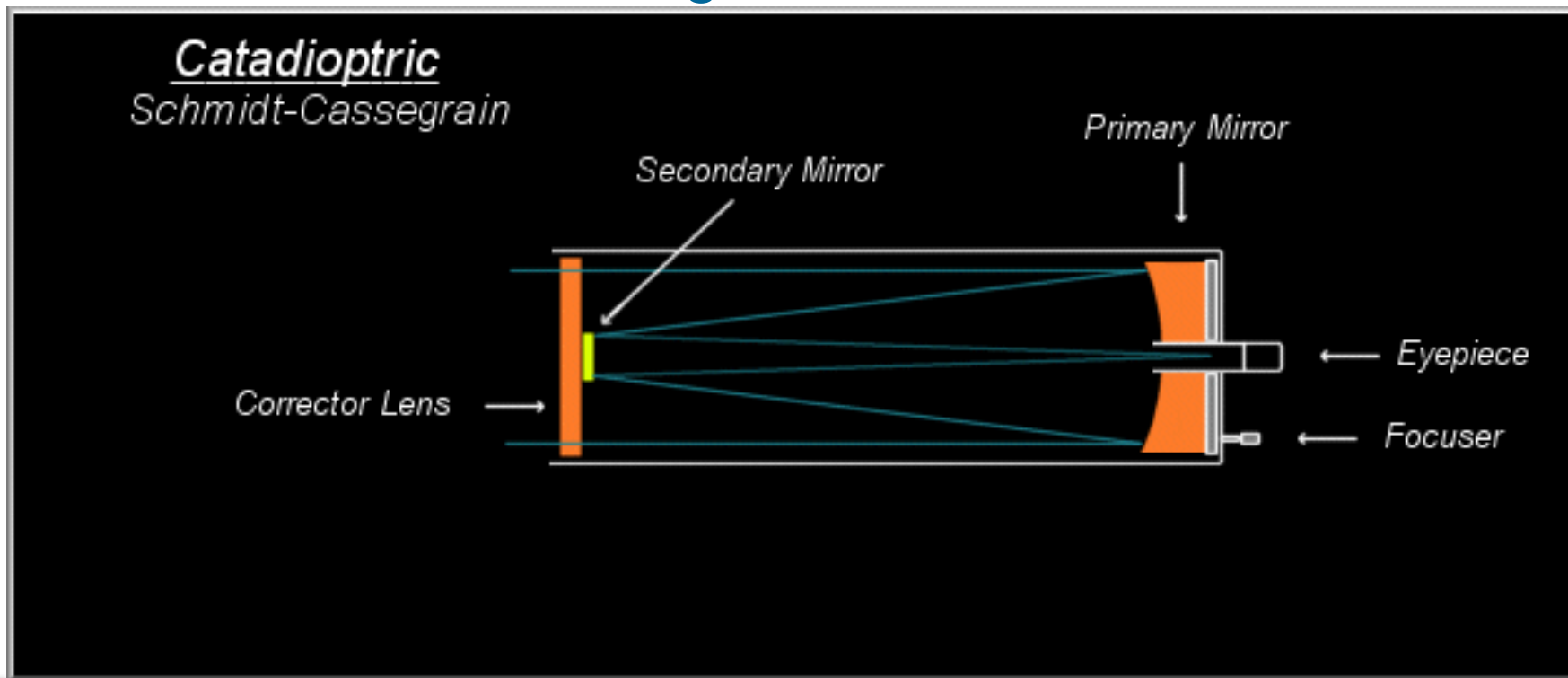
- Reber
 - 1937 Built 1st
 - 9 Meter Diameter
 - Feed @ 8 Feet
 - $f/d = 0.8$
 - Built 3300 MHz and 900 MHz Receivers Failed
 - 160 MHz Receiver Successful
 - Completed RF Sky Map 1941



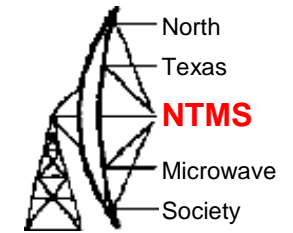
Telescope Basics



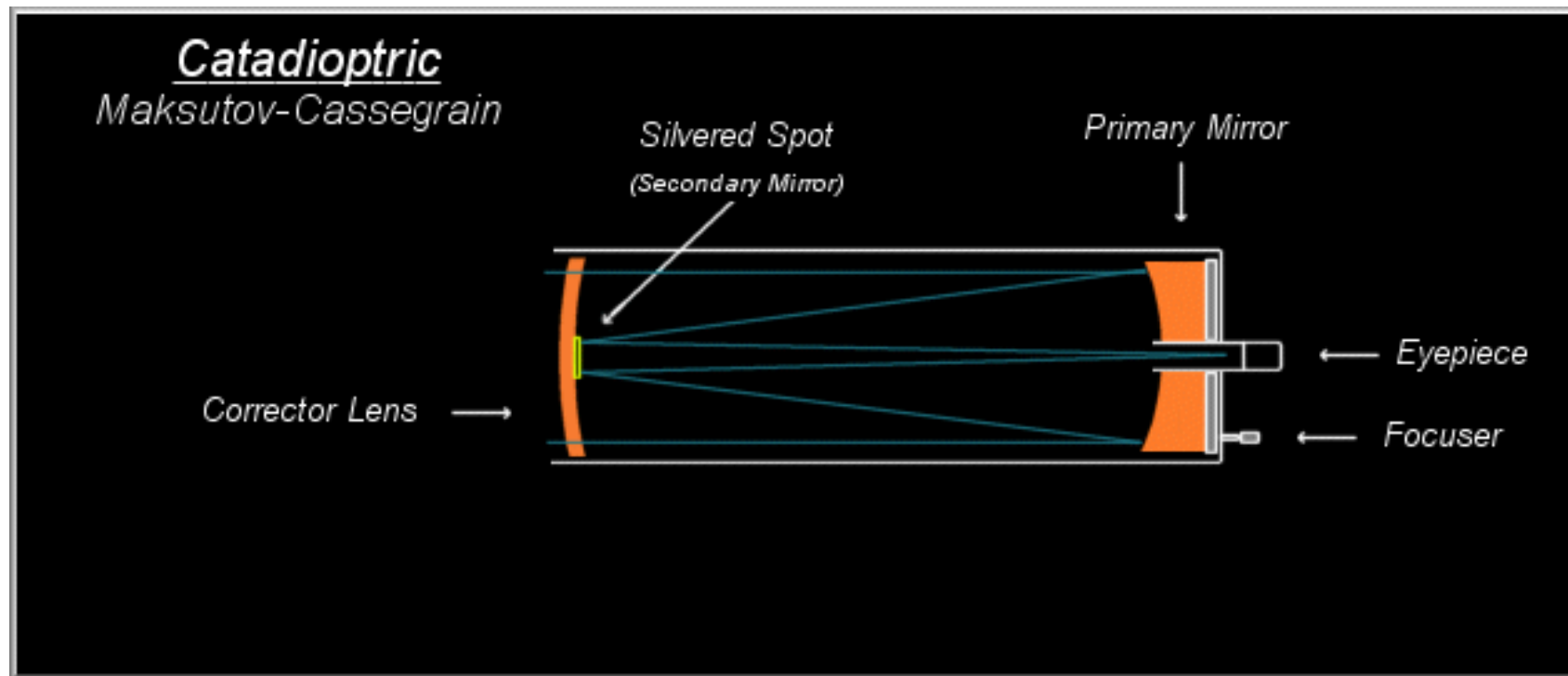
- Catadioptric
 - Schmidt - Cassegrain



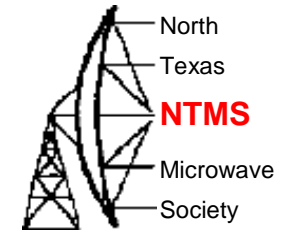
Telescope Basics



- Catadioptric
 - Maksutov - Cassegrain



Mounts

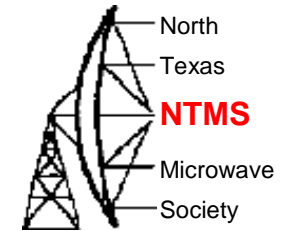


- German Equatorial
 - More Complex Construction
 - Tracking
 - Manual
 - Motor Driven
 - More Expensive Machining
 - Astronomical Use
 - Visual
 - Imaging



German Equatorial Mount

Mounts

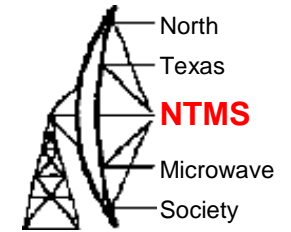


- Dobsonian – DOB
 - Simple Construction
 - Accommodate Large Mirror
 - Tracking
 - Manual Simple – Just Push
 - Automatic Expensive
 - Astronomical Use
 - Visual



Dobsonian Mount

Mounts

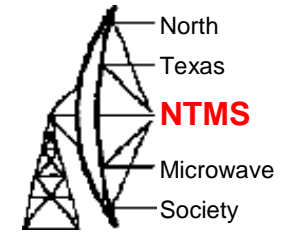


- Alt-Az Mount
 - Relative Simple Construction
 - Light Weight
 - No Tracking
 - Terrestrial Use
 - Inexpensive Mechanics



Altazimuth Mount

Mounts

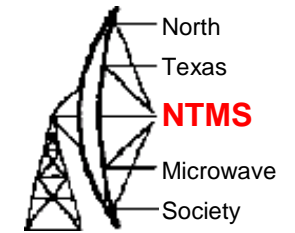


- Fork
 - Altitude Azimuth
 - Expensive
 - Tracking – Motor Driven
 - Astronomical Use
 - Visual
 - Imaging

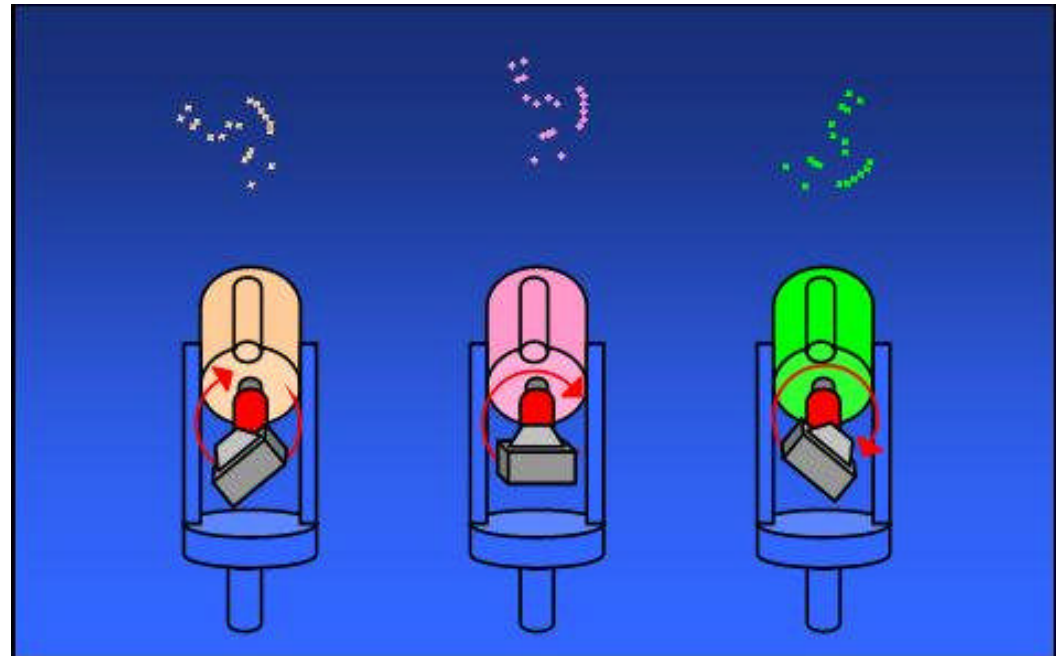


Fork Mount

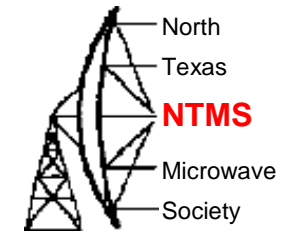
Tracking



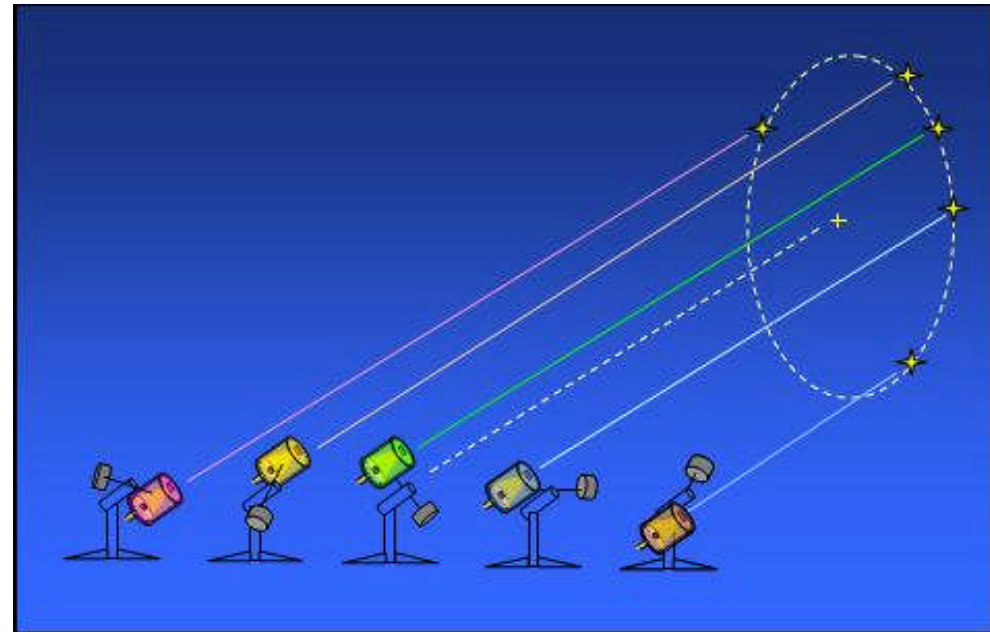
- ALT-AZ Mount
 - Field Rotation
 - Movement in 2 Axis Required



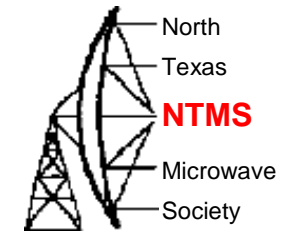
Tracking



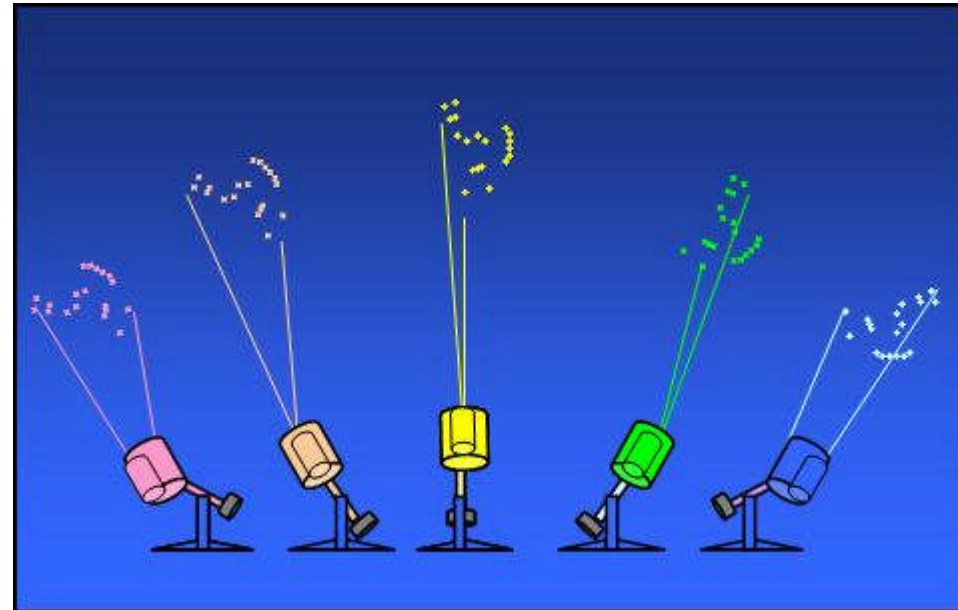
- Equatorial
 - No Field Rotation
 - Accurately Aligned
 - Movement in 1 Axis Only Required



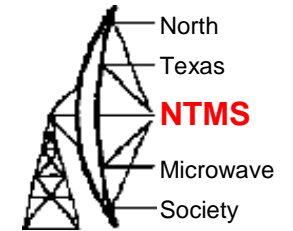
Tracking



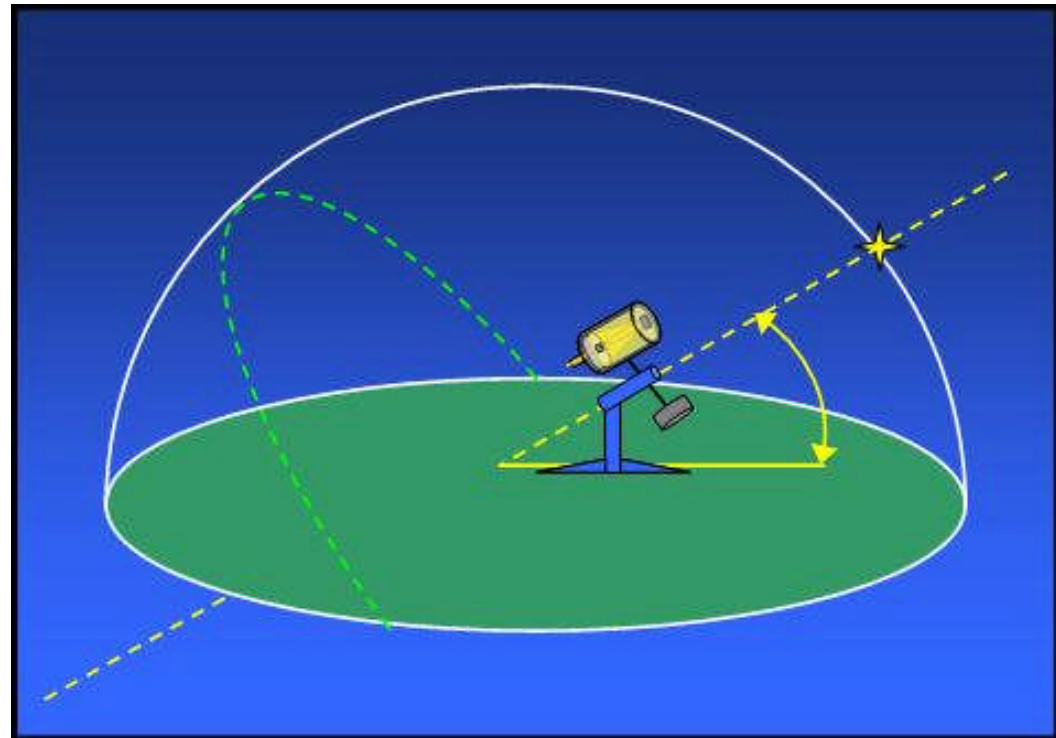
- Equatorial
 - No Field Rotation
 - Requires Accurate Polar Alignment



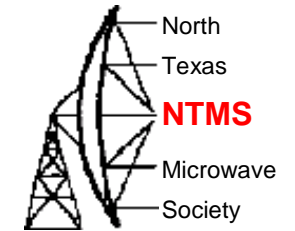
Tracking



- Polar Alignment
 - Equatorial Mount
 - Right Accession Axis Aligned to Celestial North



Tracking



- Polar Alignment
 - Alt-AZ Mount
 - Wedge

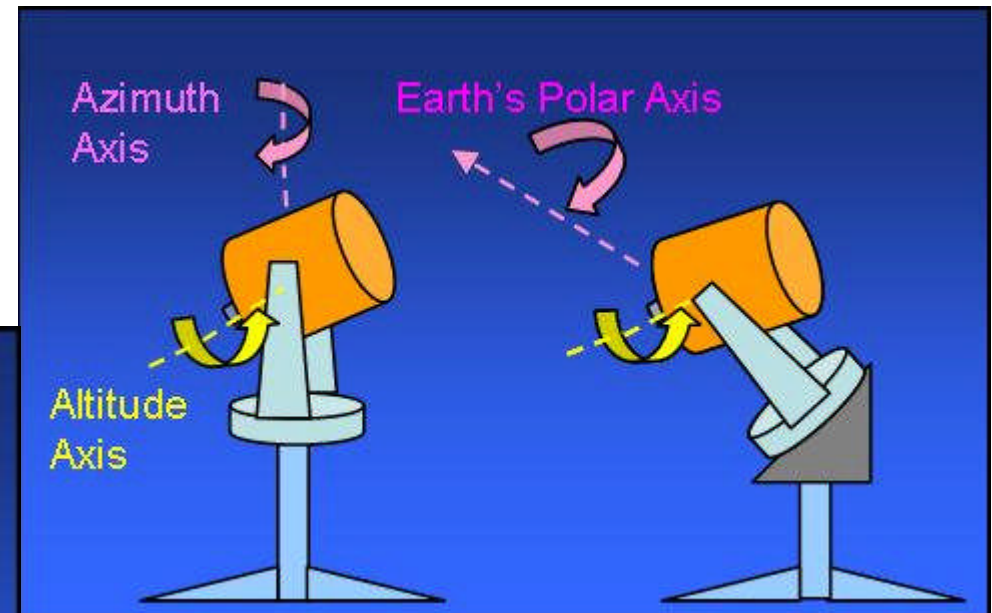
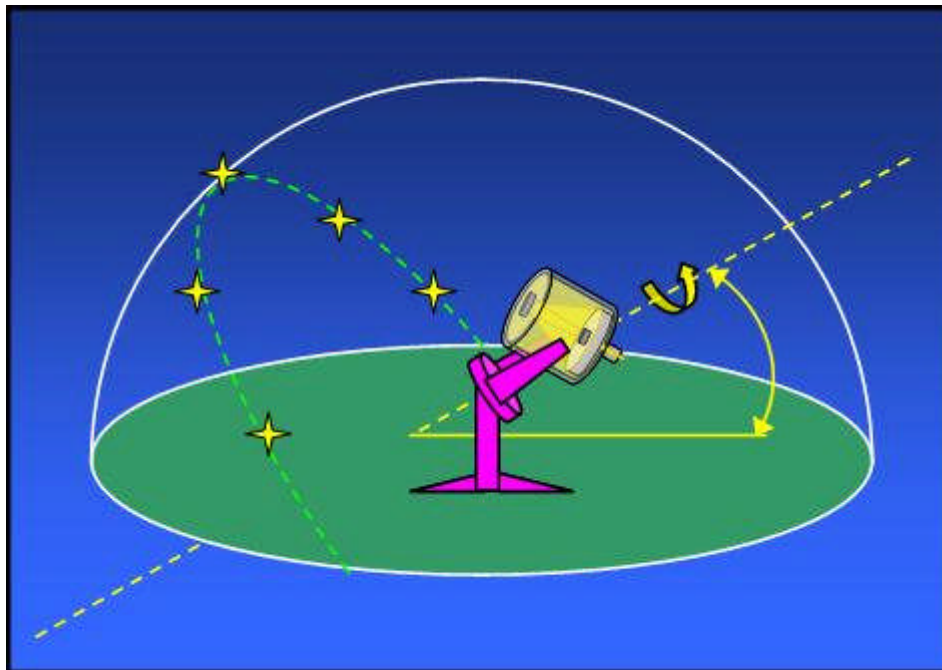
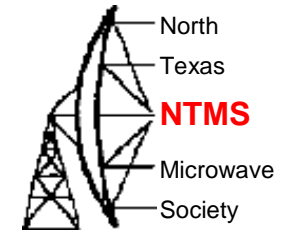


Image Scale



- F = Focal Length
- θ = Angular Size of Object
- d = Image Size @ Focal Distance
- $d = F \times \theta / 57.3$ Radians

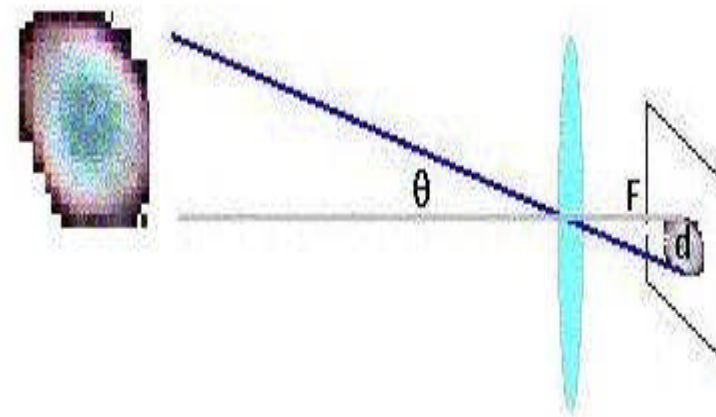
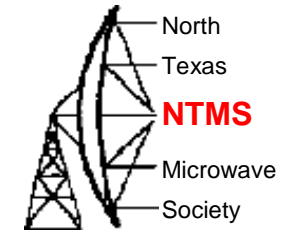


Image Size



- Minolta 50mm Lens

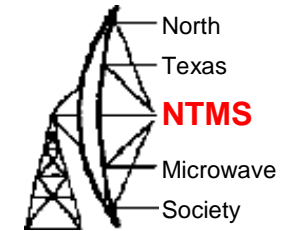
The screenshot shows a Windows desktop environment. In the foreground, there are two windows:

- FOV (Field of View) window:** Displays a star field with a central galaxy. A scale bar at the bottom indicates "10 arcmin - FOV: 85.9min x 107.1min".
- Ron Wodaski's CCD Calculator - Meade DSI 2 PRO window:** A software interface for calculating CCD parameters. It includes the following data:

Telescope	Minolta 50mm Camera Lense
Aperture	100
Focal ratio (f/)	2
Barlow or reducer	1
Focal length	200
Aperture adjust	<input type="radio"/>
Ratio adjust	<input checked="" type="radio"/>
Camera	Meade DSI 2 PRO
Pixel size	8.3 x 8.6
Array size	752 x 582
Bin mode	1x1
Chip size	5mm x 6.2mm
Image scale	8.7 arcsec/pix
Field of view	85.9 x 107.1 arcmin
Exp. Target	N/A
CFZ (microns)	8.8
File	1M51.jpg

The taskbar at the bottom shows several open applications: Start, Inbox - Micro..., Basic Telesco..., NTMS - Wind..., NTMS - Wind..., Microsoft Po..., Ron Wodaski..., FOV, and system tray icons including a clock showing 9:23 PM.

Image Size



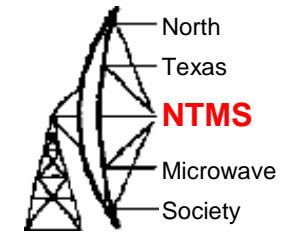
- Vixen 80mm Refractor

The screenshot shows a Windows desktop environment. The taskbar at the bottom includes the Start button, several open windows (Inbox - Micro..., Basic Telesco..., NTMS - Wind..., Microsoft Po..., Ron Wodas..., FOV), and system tray icons (Google, network, volume, clock showing 9:25 PM). The desktop background is a dark space image with a bright star. A window titled 'FOV' displays a galaxy image with a white box around it and a scale bar at the bottom indicating '10 arcmin - FOV: 30.7min x 38.3min'. Another window titled 'Ron Wodaski's CCD Calculator - Meade DSI 2 PRO' is open, showing the 'New Astronomy Press CCD Calculator' interface. The calculator settings are as follows:

Telescope	Chip size
Guide Scope 80 mm	5mm x 6.2mm
Aperture: 80	Image scale: 3.11 arcsec/pix
Focal ratio: f/7	Field of view: 30.7 x 38.3 arcmin
Barlow or reducer: 1	Exp. Target: N/A
Focal length: 560	CFZ (microns): 107.8
Camera: Meade DSI 2 PRO	File: 1M51.jpg
Pixel size: 8.3 x 8.6	Chip compared to 35mm film
Array size: 752 x 582	
Bin mode: 1x1	

The calculator also shows a list of 'Last ten telescopes and cameras' with 'Guide Scope 80 mm' and 'Meade DSI 2 PRO' listed.

Image Size



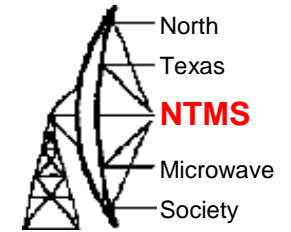
- Celestron 6" (152mm) Newtonian

The screenshot shows a Windows desktop environment. The taskbar at the bottom includes the Start button and several open applications: Inbox - Micro..., Basic Telesco..., NTMS - Wind..., NTMS - Wind..., Microsoft Po..., Ron Wodaski..., FOV, and system tray icons. The main desktop area contains various application icons, including Microsoft Office, Recycle Bin, My Computer, My Documents, E-mail, NOVA.exe, Spectran, W5JT7, MMTTY, EZNEC 3.0, dsicross, dsi2cross, Nebulosity2, DSIdarkman, Shortcut to PolarFinder, PHD Guiding, AIP4WinV2.3, MegaStar V5, Autostar Suite, Countdown Clock, CCDCalc, Adobe Photosho..., Nikon Transfer, Design Manager, Convert, Skype, QuickTime Player, and Google Earth.

Two windows are open:

- FOV**: Displays a galaxy image with a white box indicating the field of view. A scale bar at the bottom indicates 10 arcmin. The text below the image reads: "10 arcmin - FOV: 22.9min x 28.6min".
- Ron Wodaski's CCD Calculator - Meade DSI 2 PRO**: A software window titled "New Astronomy Press CCD Calculator". It contains the following settings:
 - Telescope**: Celestron 6 inch Newtonian
 - Aperture**: 150
 - Focal ratio**: f/5
 - Barlow or reducer**: 1
 - Focal length**: 750
 - Aperture adjust**: (selected)
 - Ratio adjust**:
 - Camera**: Meade DSI 2 PRO
 - Pixel size**: 8.3 x 8.6
 - Array size**: 752 x 582
 - Bin mode**: 1x1
 - Chip size**: 5mm x 6.2mm
 - Image scale**: 2.32 arcsec/pix
 - Field of view**: 22.9 x 28.6 arcmin
 - Exp. Target**: N/A
 - CFZ (microns)**: 55
 - File**: 1M51.jpg
 - Comparison image**: Chip compared to 35mm film
 - Last ten telescopes and cameras**: v. 1.4.15
 - 1. Celestron 6 inch Newtonian
 - 2. Meade DSI 2 PRO

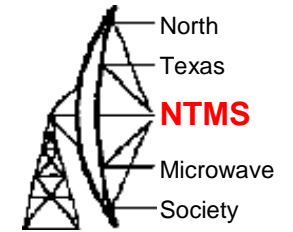
My Mount



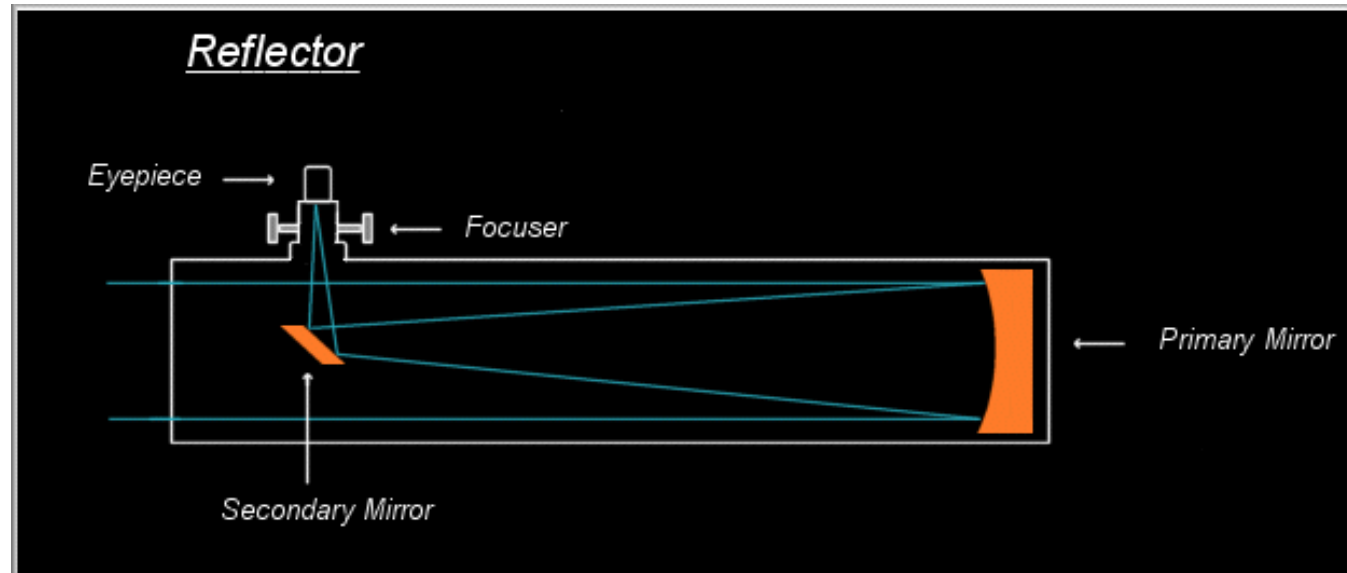
- Equatorial
 - Celestron CI-700
 - Stepper Motor Drive
 - Polar Alignment Scope



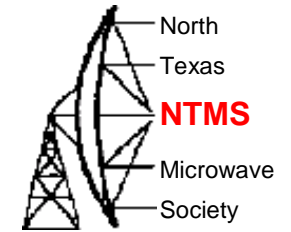
Light Path



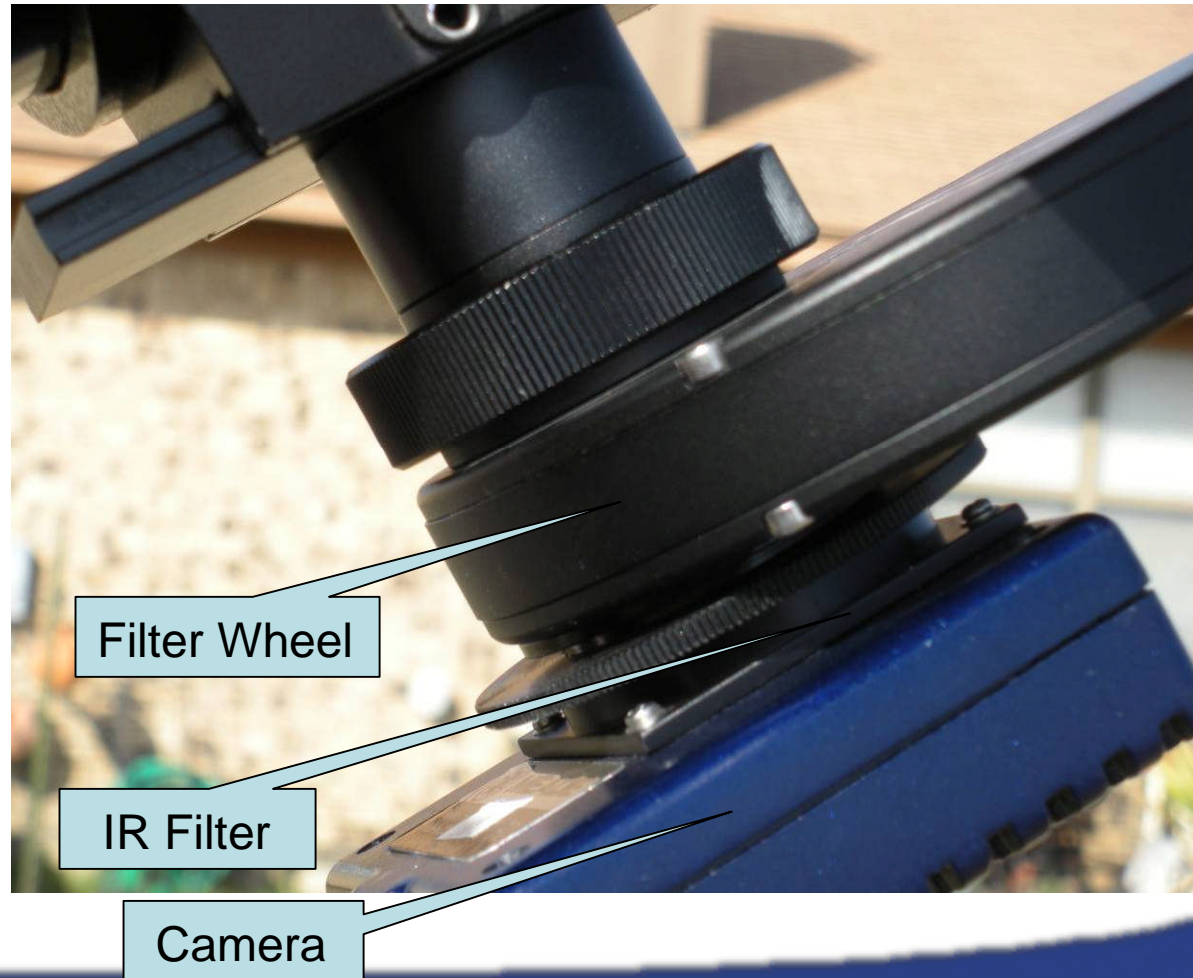
- Celestron 6" (152 mm) Newtonian
 - Primary Mirror
 - Secondary Mirror



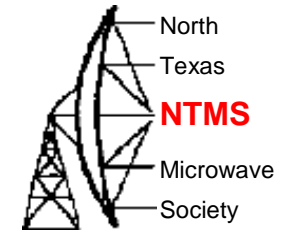
Light Path



- Scope – 6” Newtonian
 - Main Mirror
 - Secondary Mirror
- Filter Wheel
 - Choose L, R, G, or B Filter
- IR Filter
- Camera – Meade DSI II Pro



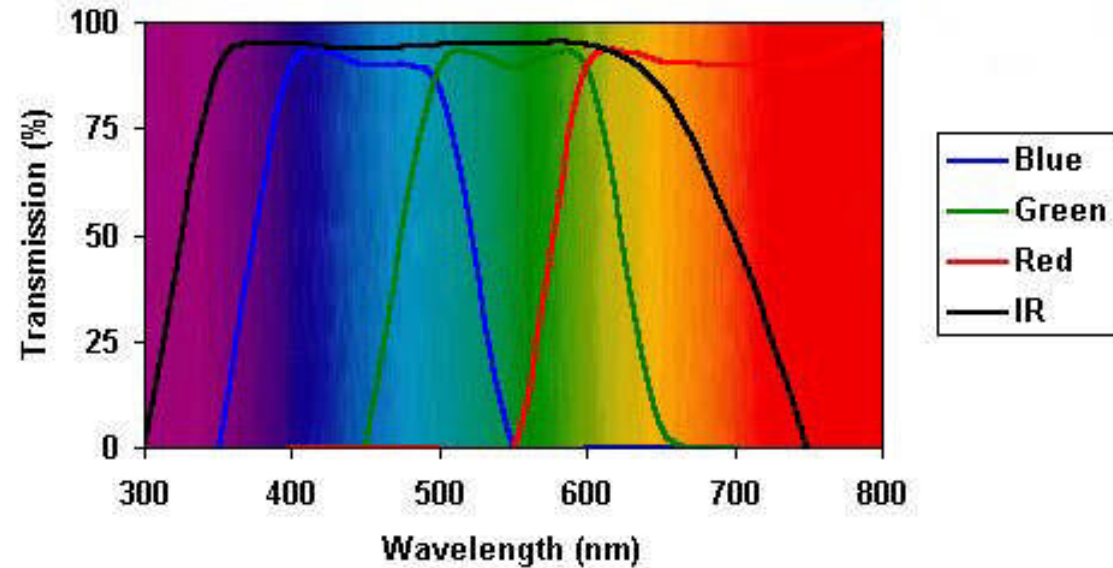
Imaging Filter



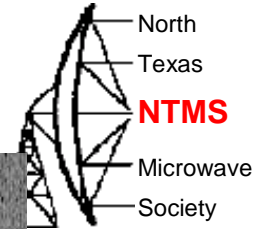
- True Technology Filters

- IR – Infrared
 - 300 – 750 nm
- L – Luminance
 - 300 – 800nm
- R – Red
 - 550 – 800 nm
- G – Green
 - 450 – 650 nm
- B – Blue
 - 350 – 550 nm

True Technology Dichroic Filters



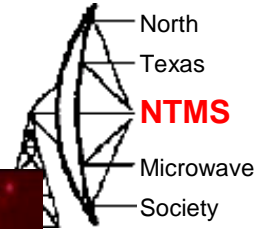
B33 - Horsehead



- Single 2 Minute Frame – Raw Image
- Not Calibrated
 - Noise
 - Dust
 - Hot Pixels



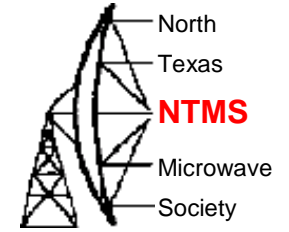
B33 – Horsehead Nebula



- 44 Stacked 2 Minute Frames
- Calibrated
- Vixen Super Polaris Mount
- Unguided
- False Color
- 8 x 6 arcmins
- 1200 Light Years
- Reflection Nebula



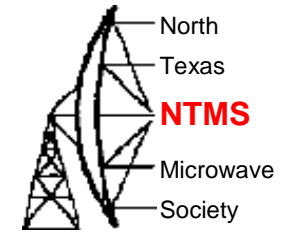
M16 – Eagle Nebula



- 12 Stacked
2 Minute
Frames
- Unguided
- ½ Degree
Diameter
- 7000 Light
Years



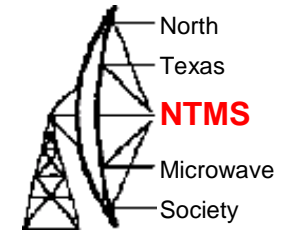
NGC 7000 – North American Nebula



- 13 Stacked 5 minute Frames
- 2200 Light Years
- 30 arcmins
- 50 mm Camera Lens
- Unguided



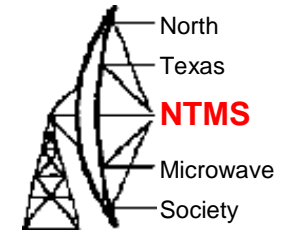
M57 – Ring Nebula



- LRGB – 50
Stacked 2
minute
Frames
 - L= 20, R=
10, G= 10,
B= 10
Minutes
Each
- 4100 Light
Years
- 230 x 230
arcsecs



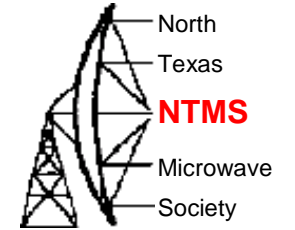
NGC 1977 – Running Man Nebula



- 49 Stacked 1 Minute Frames
- 1500 Light Years
- 40 x 25 arcmins
- Guided



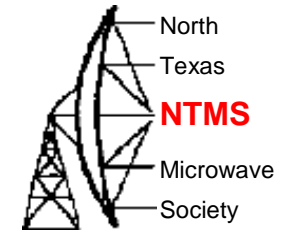
NGC 253 – Sculptor Galaxy



- 16 Stacked 5 Minute Frames
- 11.4 Million Light Years
- 27.5 x 6.8 arcmins



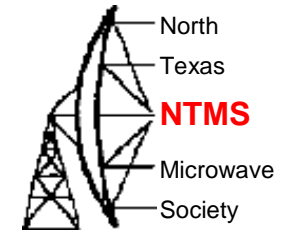
M51 – Whirlpool Galaxy



- 27 Stacked 1 Minute Frames
- 23 Million Light Years
- 11.2 x 6.9 arcmins



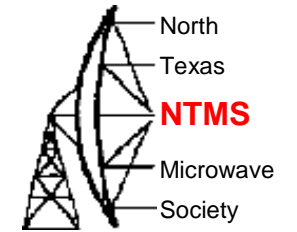
NGC 891 – Edge on Galaxy



- 25 Stacked 2 Minute Frames
- 27.3 Million Light Years
- 13.5 x 2.5 arcmins
- Unguided



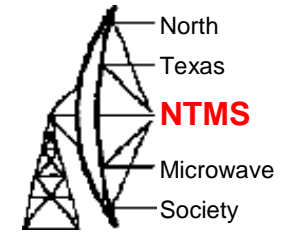
Star Party Setup



- Windshield
- Laptop Shield



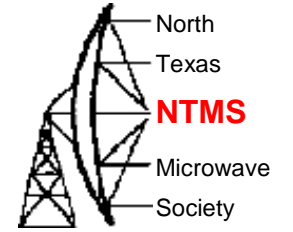
Star Party Setup Okie-Tex 2008



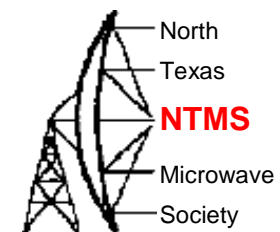
- Campsite
- Windshield Frame
- Johns Scope Trailer
- My Popup Trailer



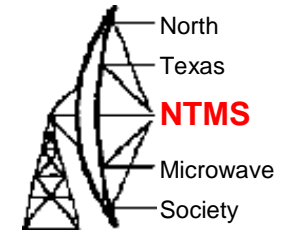
Star-Gazers Group Okie-Tex 2008



Okie-Tex Overview



Local Groups



- Texas Astronomical Society
 - <http://www.texasastro.org/>
- Star-Gazers
 - Yahoo Group – Star-Gazers