Eclipse Imaging Software

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Topics

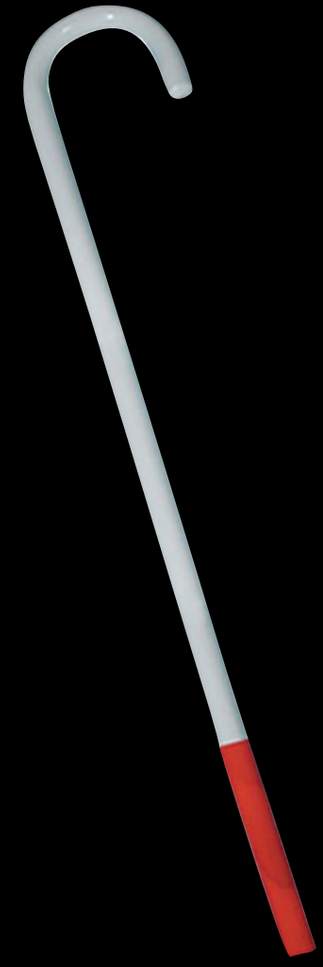
- Safety Disclaimer
- Netting it out - the problem & solution
- Essential Gear
- Software & Features
- Eclipse Basics
- Scripts
- Demo
- Q & A

Safety

Safety

Have and use these
during the eclipse…

…to avoid needing one of these
after the eclipse.



Any Questions?

Netting it Out

The “Problem”

- The entire eclipse will require several different exposures for
  - The Chromosphere
  - Shadow Bands
  - Diamond Ring
  - Baily’s Beads
  - The Solar Corona
  - Don’t forget shots of the crowds (and maybe even you)

The “Problem”

- Odds of getting all these exposures right on your first attempt?
- How much time will you need to dedicate with your head in your gear?
- Think you’ll still experience and enjoy the live event?

The “Solution”

- Automation of exposure adjustments for image acquisition across multiple cameras
- Automatic control of precise timing of image capture for each phenomena
- This sounds a lot like the sort of problem that computers can handle.
- … *if only software existed that did this.*

It does exist!

Windows

- Eclipse Orchestrator
  - Free (with limited capabilities for noncommercial use)
  - Pro (license unlocks full functionality)
  - $109 USD for Pro

Mac

- Solar Eclipse Maestro
  - Freeware (for non-commercial use)
  - Donations Accepted
  - Full functionality in free version
  - 100€ full license

How it Works (Simplified)

- Critical exposures are based around amount of sun covered by moon at any given point in time.
- Exposures are well understood based on timing of the “Contacts”
- Timing can be worked out to astonishing precision *if* your precise location and time of day are also known to a high degree of precision.

Essential Gear

Compatible Camera

Check the supported camera list.

Most Canon or Nikon DSLR models are supported.
Other brands are not supported.

Memory Cards

Camera Limits Card Types and Sizes Supported
Cameras supporting SD**HC** can support up to 32GB
Cameras supporting SD**XC** can support up to 2TB

Fresh Batteries

Insert fresh batteries before the eclipse to insure that you have enough power to last through the entire event.

Camera Tethering Cable(s)

Tether Tools 15’ USB
Tether Cable $50
(available on Amazon)

Monoprice 15’ USB
Tether Cable $10
(available on Amazon)

Preferably longer than the factory USB cables that probably came with your camera.

Computer
(and an adequate way to power it)

It may be possible to get a power adapter that will run your laptop on 12v battery power if your internal laptop battery is not adequate.

Total Eclipse duration from 1st Contact to 4th Contact is about 3 hours.

GPS

Garmin 18x
USB GPS
Recommended

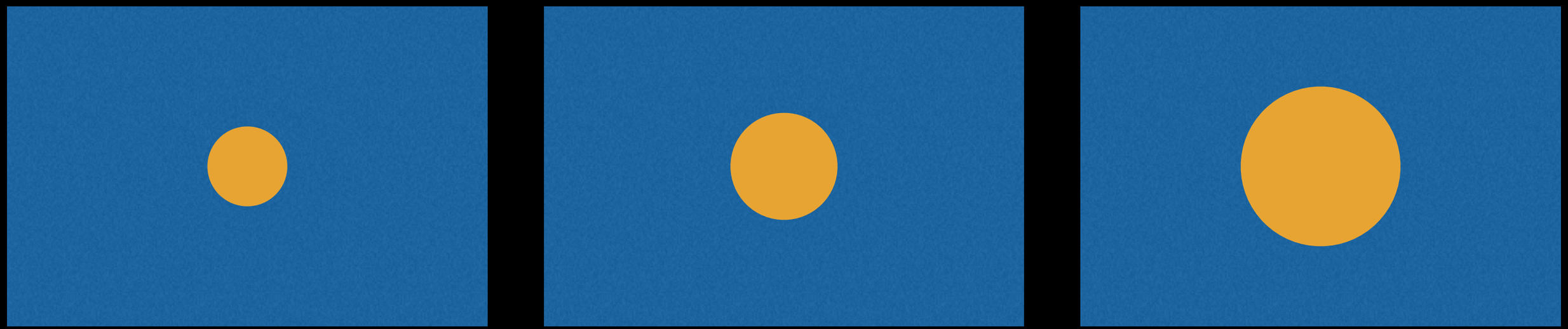
About $75
(available on Amazon)

USB Hub*

About $10
(available on Amazon)

*If your computer doesn’t have enough available USB ports.

Camera Lens(es) or Telescope (with appropriate focal length)



1/4
Minimum

1/3
Nominal

1/2
Maximum

	Minimum	Nominal	Maximum
Full Frame	~625mm	~850mm	~1250mm
APS-C	~400mm	~525mm	~800mm

Using a Tele-Extender
Exercise Caution: Here be dragons!

	Minimum	Nominal	Maximum
Full Frame	~625mm	~850mm	~1250mm
APS-C	~400mm	~525mm	~800mm

Tele-extenders can create internal reflections. While usually not visible in ordinary photography, the intense brightness of the sun may reveal these and ruin your photos.

Test: Shoot a crescent moon at +6 to +10 stops with moon near edge of frame. If tele-extender creates internal reflections, they should be visible on opposite side of image.

Solar Filters

- Preferably ND 5.0 (software must support ND factor)
- Cap style: Filter's inner-diameter must be fractionally larger than outer-diameter of lens or telescope barrel.
- Thread style: Filters are available in several common camera thread sizes.

Tracking Mounts

Sky Watcher

Star Adventurer (11 lb payload)

~$290 USD Motor Base Only

~$425 USD Nicely Equipped*

* with wedge and counterweight system

Does NOT include tripod or ball head

Tracking Mounts

iOptron
SkyGuider Pro (11 lb payload)

~$398 USD Motor Only
~$548 USD Nicely Equipped*

* with wedge and
counterweight system

Does NOT include
tripod or ball head

Tracking Mounts

Move-Shoot-Move
NOMAD (7.7 lb payload)

~$209 USD Motor Only
~$389 USD Nicely Equipped*

*with wedge and accessories
no counterweight option

Does NOT include
tripod or ball head

Tracking Mounts

- Motorized (tracking) telescope mounts will, of course, also work.
- Make sure you have appropriate adapter to attach camera to your scope and that camera can achieve focus*.

*often a problem with scopes using Newtonian reflector design.

Software & Features

Windows
Eclipse Orchestrator

- Written to run with Windows

Feature	Free	Pro
Simultaneous Camera support	1	16
Max frames per second	~0.3	Unlimited
Script Wizard phenomena	2	10
GPS time accuracy	< 1 sec	< 0.1 sec
Bulb support	no	yes
Mirror lock-up support	no	yes
Live-view support	no	yes

Mac
Solar Eclipse Maestro

- Written to run with macOS 10.14 (Mojave)
- Intel only (will not work on ARM macs (M1, M2, M3))

Feature	Freeware	Paid
Simultaneous Camera support	4	4
Max frames per second	Unlimited	Unlimited
Script Wizard phenomena	10	10
GPS time accuracy	< 0.1 sec	< 0.1 sec
Bulb support	yes	yes
Mirror lock-up support	yes	yes
Live-view support	yes	yes

iPhone / Android Phone Solar Eclipse Timer

- No direct camera control - information only
- Calculates contact times based on location
- Generates list of specific capture times
- “Talks” you through important events
- $1.99 USD (Free to test with historical eclipses. Payment required to use with future eclipses.)

- Available on iOS App Store and Google Play Store

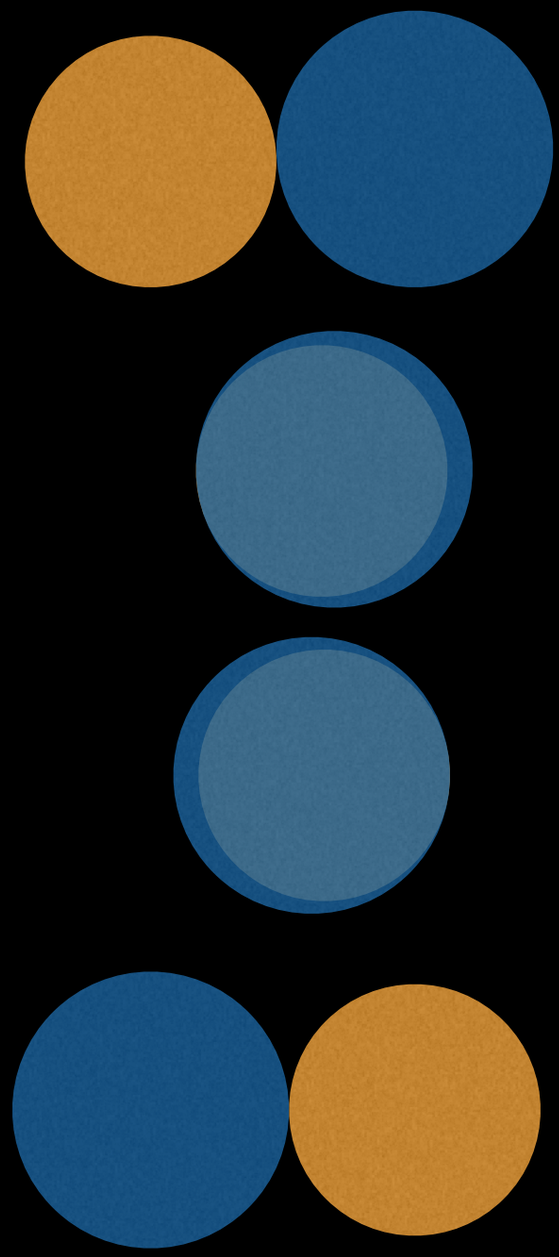
Eclipse Basics

Eclipse Basics

- Sun's diameter is about 400x larger than moon's diameter.
- Sun is also about 400x farther away than moon.
- This means Sun & Moon both appear to be similar size (1/2° from edge to edge)
- Moon distance varies from 356,000km to 406,000km (about 50,000km)
- This determines if eclipse is annular vs. total and length of totality.

Events Based on Time-offsets from Significant Contacts

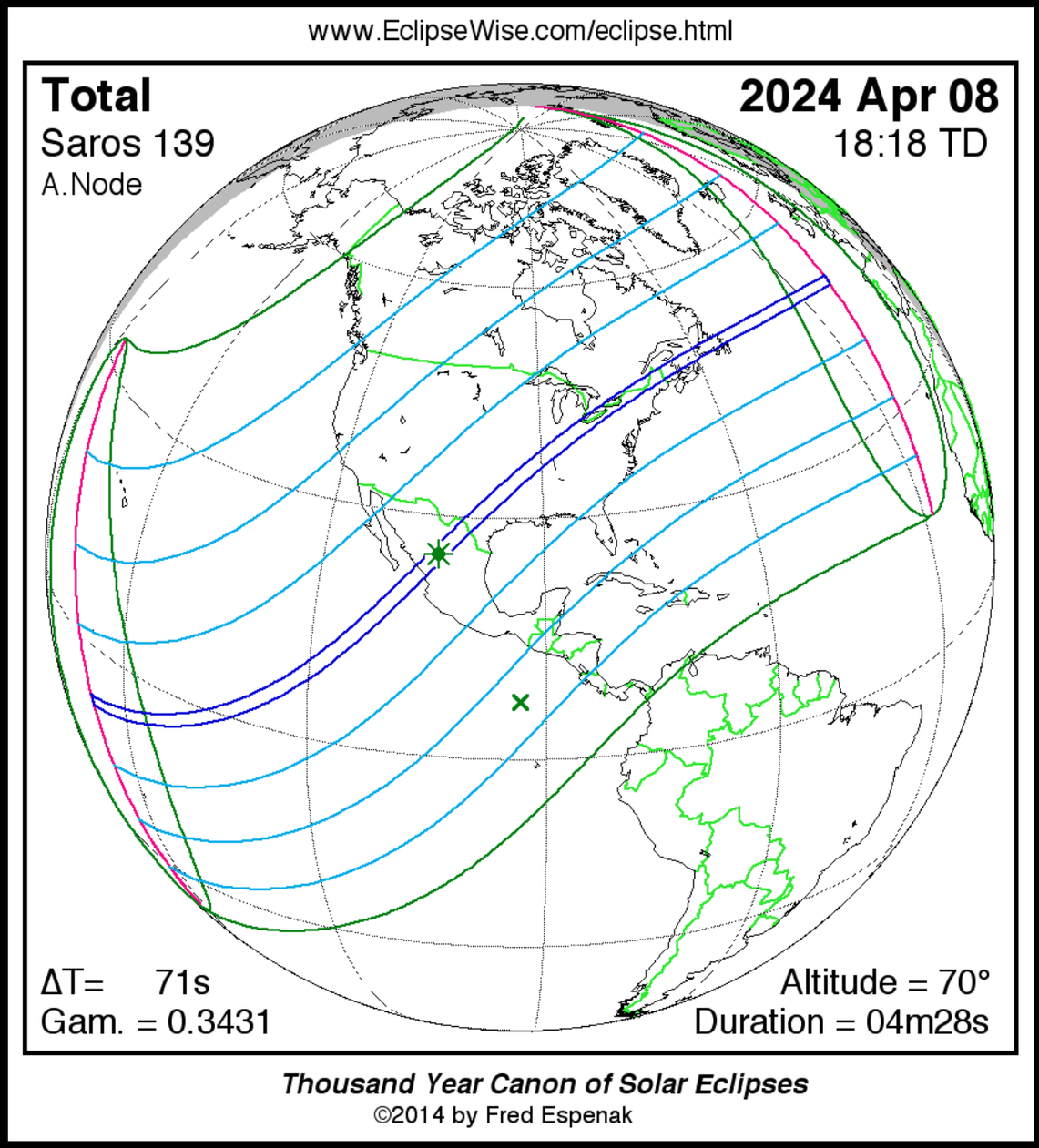
- C1 - Moon first touches Sun's disk - Eclipse begins
- C2 - Moon fully covers Sun's Disk - totality begins
- C3 - Moon finishing covering Sun's Disk - totality ends
- C4 - Moon exits Sun's disk - End of eclipse



Eclipse Simulation

What the software does - Part 1
Determine Precise Time for Each Contact

- Need precise latitude, longitude & altitude.
- Need precise time of day.
- Can then calculate precise moment of C1, C2, C3, & C4



What the software does - Part 2
Scripted capture of phenomena based on time relative to the contact events

- Periodic images of partial eclipse phases before & after totality between C1 & C2 and again between C3 & C4

- Diamond Rings
  9 seconds before C2
  9 seconds after C3

- Baily's Beads
  1.5 seconds before C2
  1.5 seconds after C3

- Solar Corona
  between C2 and C3 (exposing about 12 stops worth of dynamic range)

- Yell at photographer to remove and later re-attach filters
  at just the right moments before C2 and after C3 (Very important!)

Exposure Examples
Before & After Totality

- Diamond Rings
  9 seconds before C2
  9 seconds after C3

- Chromosphere
  3 seconds before C2
  3 seconds after C3

- Baily's Beads
  1.5 seconds before C2
  1.5 seconds after C3

ISO	f-stop	Shutter Speed
200	f/8	1/250
200	f/8	1/5000
200	f/8	1/1000

Exposure Examples During Totality

- Prominences
  9 seconds after C2
  9 seconds before C3

- Corona Bracketing
  Bracketed sequence of at least 12 stops of exposure

- Earthshine
  Immediately following corona series

ISO	f-stop	Shutter Speed
200	f/8	1/500
200	f/8	1/1000 … 2 secs
200	f/8	4 secs

Scripts

Automation is primarily script-driven

- Configuration wizard will typically auto-generate an initial script (*usually for one camera only*).
- Script is just a text file. You can edit this with any text editor.
- You should review and modify the script as desired (*especially if you have multiple cameras*).

Script Format

TAKEPIC,MAX,-,00:49.2,Canon 60Da,1/640,8.0,200,0.000,RAW,None,N,Solar corona Rs = 0.1

Action,Reference Event or Date,Offset Sign,Time,Camera Name,Shutter Speed,Aperture,ISO,Mirror Lock-Up Time,Image Quality,Image Size,Incremental,Comment

Action: What do you want it to do?
Reference Event: RISE, C1, C2, MAX, MID, C3, C4, SET
Offset Sign: +, - (relative to reference event)
Time: Offset time relative to reference event
Camera name: Which camera are we using for this action?
Shutter speed: Duration of exposure in seconds
Aperture: f-stop (for lenses with automatic aperture control)
ISO: Camera ISO setting
Mirror Lock-Up Time: Allow vibrations to settle after raising reflex mirror before capturing exposure.
Image Quality: You will only ever want to use 'RAW'
Image Size: You will use 'None' (camera will shoot at native size)
Incremental: Y, N Should it only update the setting which has changed from previous exposure?
Comment: Notes so you can remember why you wanted this line in the script

What does this do?

TAKEPIC,C2,-,00:09.0,Canon 60Da,1/80,8.0,200,0.000,RAW,None,Y,First Diamond Ring

`Action`: TAKEPIC = Tell the camera to take a picture
`Reference Event`: C2 = Second Contact (start of totality)
`Offset Sign`: '-' = do this before C2
`Time`: 00:09.0 = do this 0 minutes and 9 seconds before totality
`Camera name`: Using the camera named 'Canon 60Da' (you choose the name)
`Shutter speed`: 1/80 = Take a 1/80th second exposure
`Aperture`: 8.0 = Use f/8
`ISO`: 200 = Use ISO 200
`Mirror Lock-Up time`: 0.000 = Don't wait for vibrations to settle (no mirror lock-up delay)
`Image Quality`: RAW = Use 'RAW' format (instead of JPG)
`Image Size`: None = Don't resize
`Incremental`: Y = Only tell camera what changed for this exposure relative to last exposure
`Comment`: First Diamond Ring = Note to self on why I put this line in the file

What does this do?

PLAY,C2,-,00:00:20.1,Filters_Off.wav, , , , , , , ,'Filters off' voice prompt

Action: PLAY = Play a ".wav" file (audio clips)
Reference Event: C2 = Second Contact (start of totality)
Offset Sign: '-' = do this before C2
Time: 00:00:20.1 = do this 0 hours 0 minutes and 20.1 seconds before totality
Camera name: Filters_Off.wav (used for file name since this isn't a camera command)
Shutter speed: n/a
Aperture: n/a
ISO: n/a
Mirror Lock-Up time: n/a
Image Quality: n/a
Image Size: n/a
Incremental: n/a
Comment: Note to self on why I put this line in the file - yell at photographer

Lots of Commands

- Commands are available for numerous scripted actions…
  - Shoot live-video (movies)
  - Take bracketed sequences
  - Take burst sequences
  - Execute ‘loops’
  - And much much more (see documentation for full details)

General Setup & Use

- Establish location (lat/lon/alt position)
- Define gear (cameras)
- Choose the eclipse (software knows about many events)
- *Recommend setting Solar Radius at 1 AU to 959.98”*
- Create script & edit to taste
- Load Script (open/edit scripts doesn’t necessary “load” them into the simulation engine. *You must “load” the script to test it or use it.*)
- Use simulation mode to test

Simulation Mode

- Intended to help you practice. Validate that everything works as expected.

- Set a simulation time typically based on Contacts (C1, C2, C3, C4), Sunrise, Sunset, or any arbitrary time you choose.

- Script executes and performs actions based on simulated time & location “as if” you are there.

Fred Espenak's Tips - Part 1

- 15 mins before C2 - swap battery & memory card
- 5 mins before C2 - check focus accuracy
- 1 min before C2 - check focus & framing
- At least 10 but not more than 50 secs before C2 remove filters but ***do not look through camera until totality begins***.
- During totality - do not attempt to make changes… enjoy the eclipse.

Fred Espenak's Tips - Part 2

- 10 seconds after C3
    - Replace solar filter immediately after camera captures 2nd Diamond Ring effect
    - Watch moon's shadow recede to the east
- Immediately following conclusion of eclipse
    - Lock & label memory cards
    - Store in a safe place
    - Make plans for next eclipse.

Fred Espenak's Tips - Part 3

- Place a tarp on the ground and set up a yellow caution tape around the tarp to establish a boundary.
- My "virtual tarp" are sequentially numbered labels & tags on every box, bag, case, or item that needs to be packed so I can validate nothing is missing.
- Do not approach eclipse photographers closer than 6' unless they invite you.

Fred Espenak's Tips - Part 4
Eclipsis-Ineruptis

- Do not stand between someone's camera or telescope and the Sun
- Do not interrupt someone who is busy adjusting his/her gear
- Do not disrupt others with questions during totality
- Do not ask for the time or how much time is left during totality
- Do not play music

Demo