DIY Astronomy

Raspberry Pi Telescope Control

Phase I

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Why Raspberry Pi?

Option 1 – Laptop Control:

- Expensive
- Long durations in the ‘elements’
  - Dew
  - Possible rain
  - Cold / hot
- Have to sit outside to operate & monitor

Option 2 – Raspberry Pi:

- Low Cost: $35
- Not worried about it being in the elements
- Can operate & monitor from remote location (in the house)

Initial concerns:

1. Too slow? Nope
2. Too little storage for imaging? Nope

What does the configuration look like?

Shoe box –
- Able to open & close
- Run cables through hole in bottom

Power Supply –
- USB output Cell Phone type
- Requires 2A version

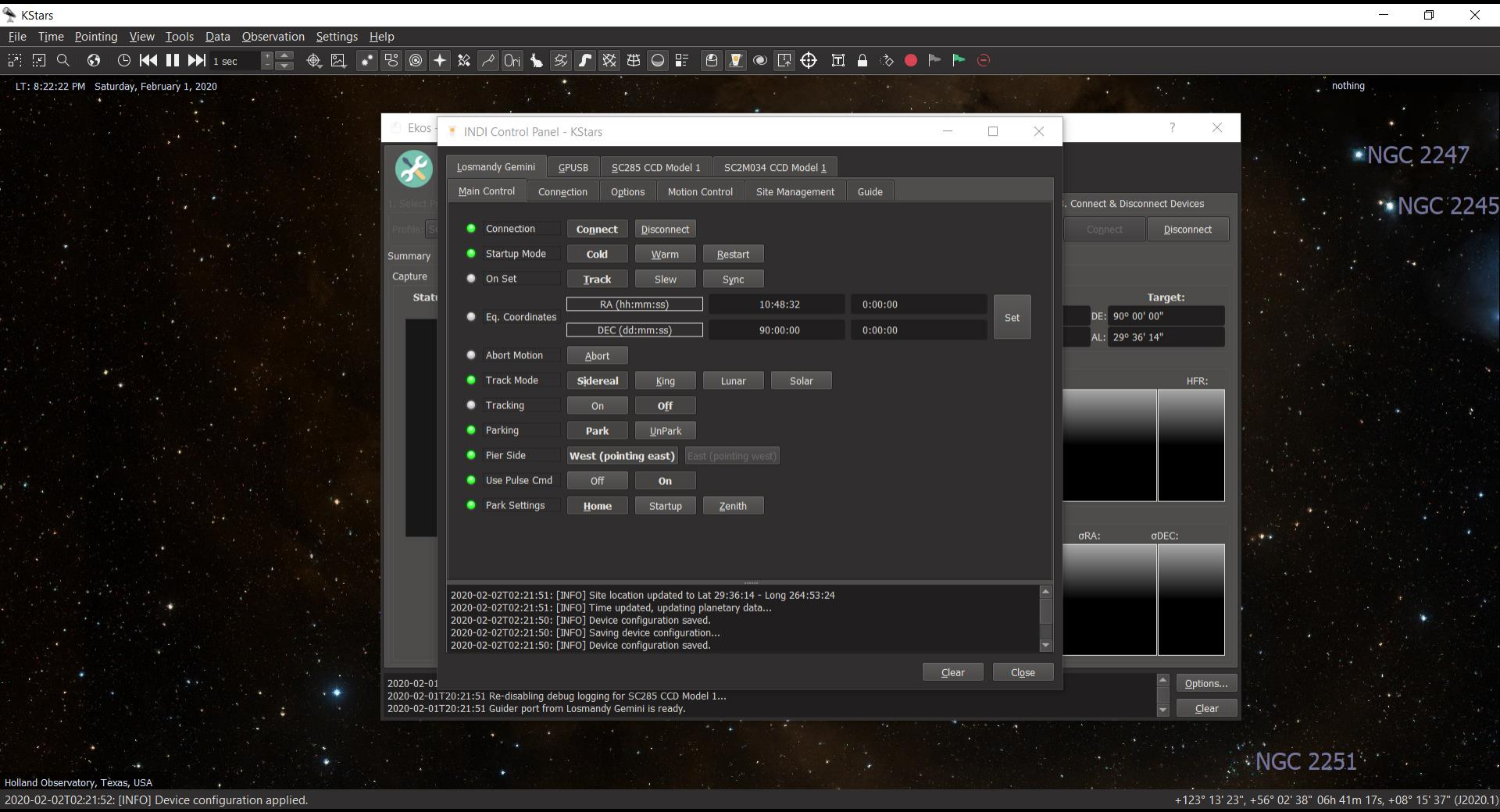
Raspberry Pi 3B+
(and case)

GPUSB – for guiding
[Shoestring Astronomy]

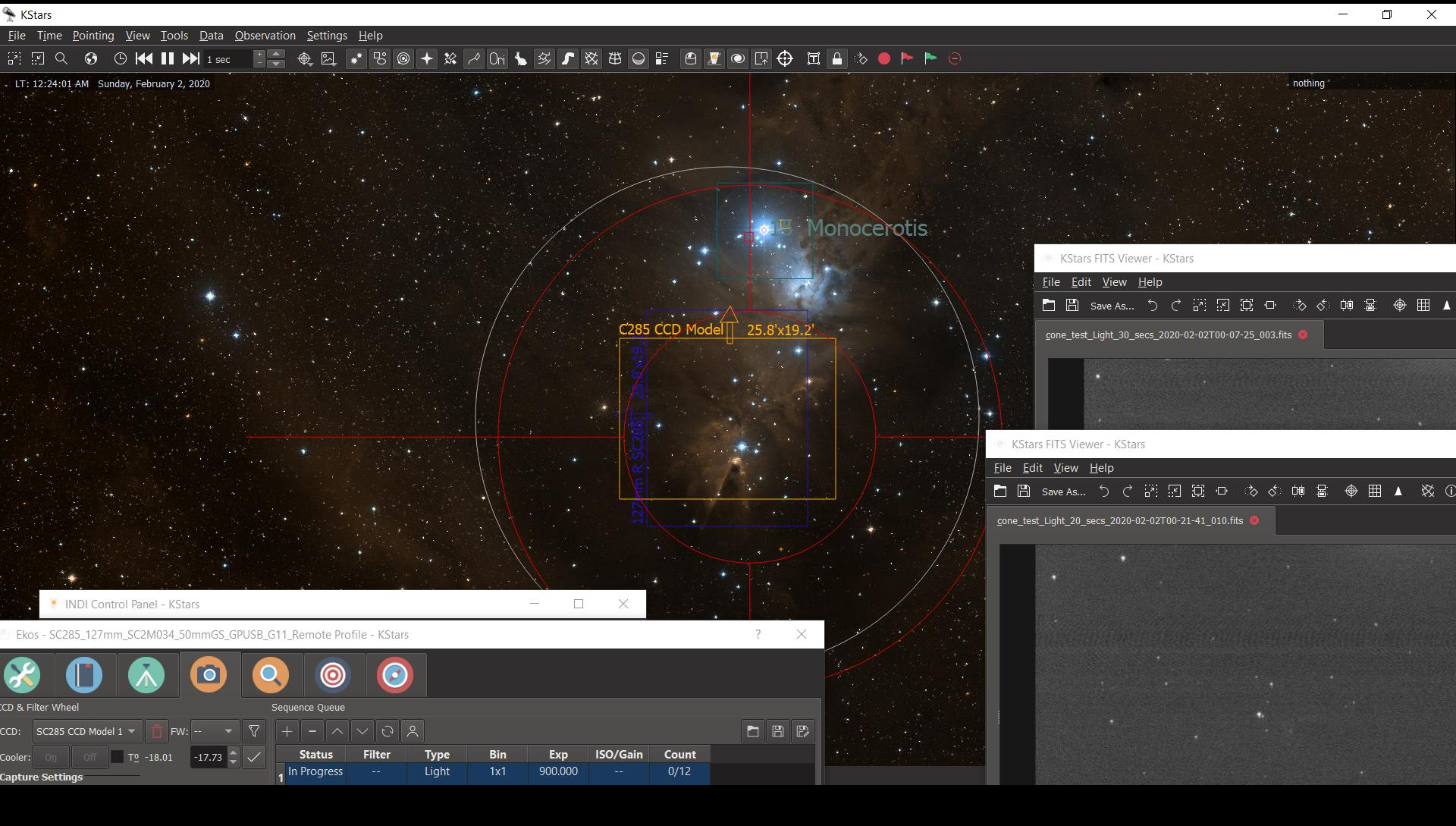
What does it look like when it is operating?

Raspberry Pi Outside ⇔ Laptop Inside

Connect your equipment

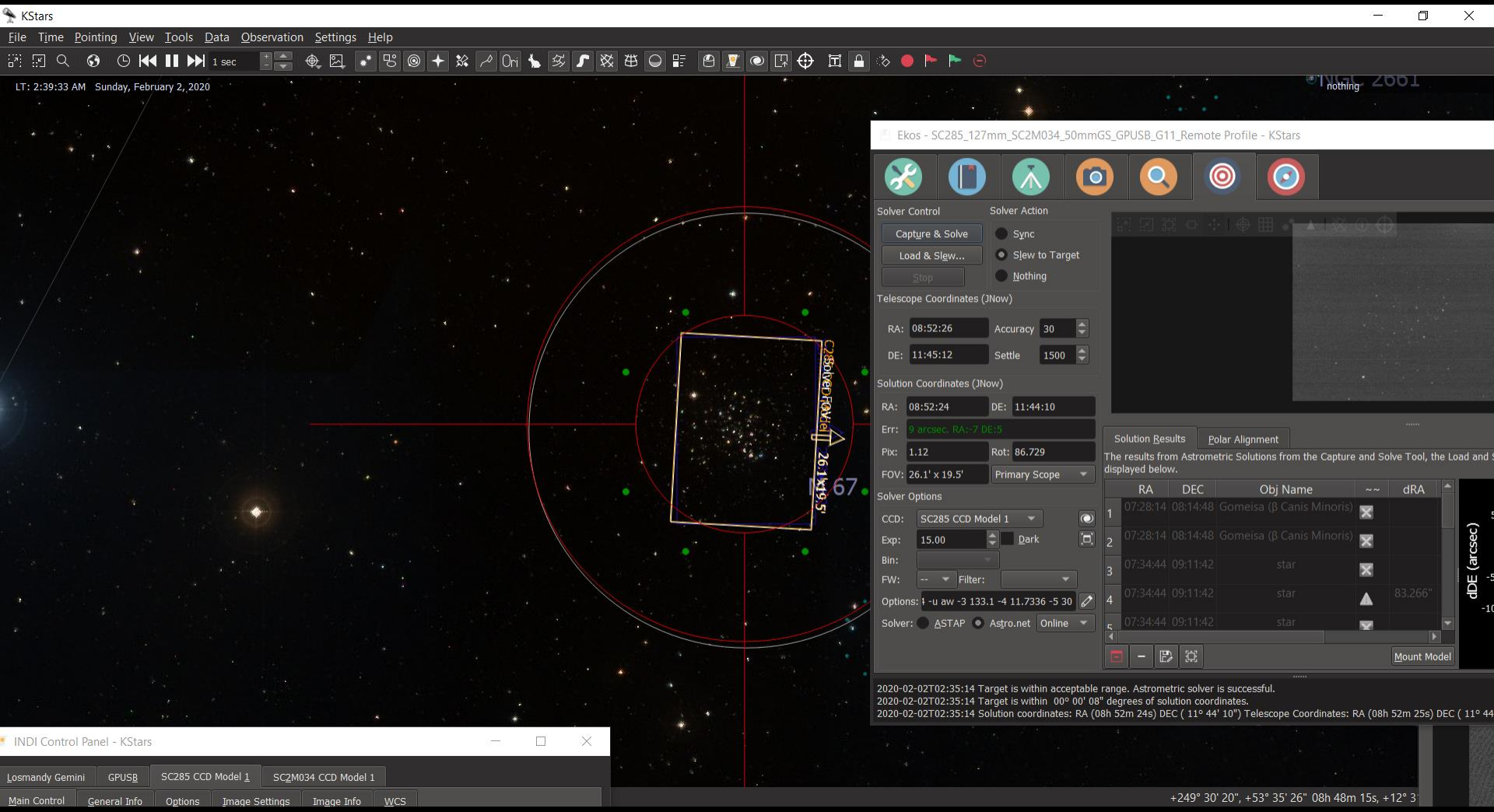


GO TO your target
Deep Sky Survey (DSS) overlay of images



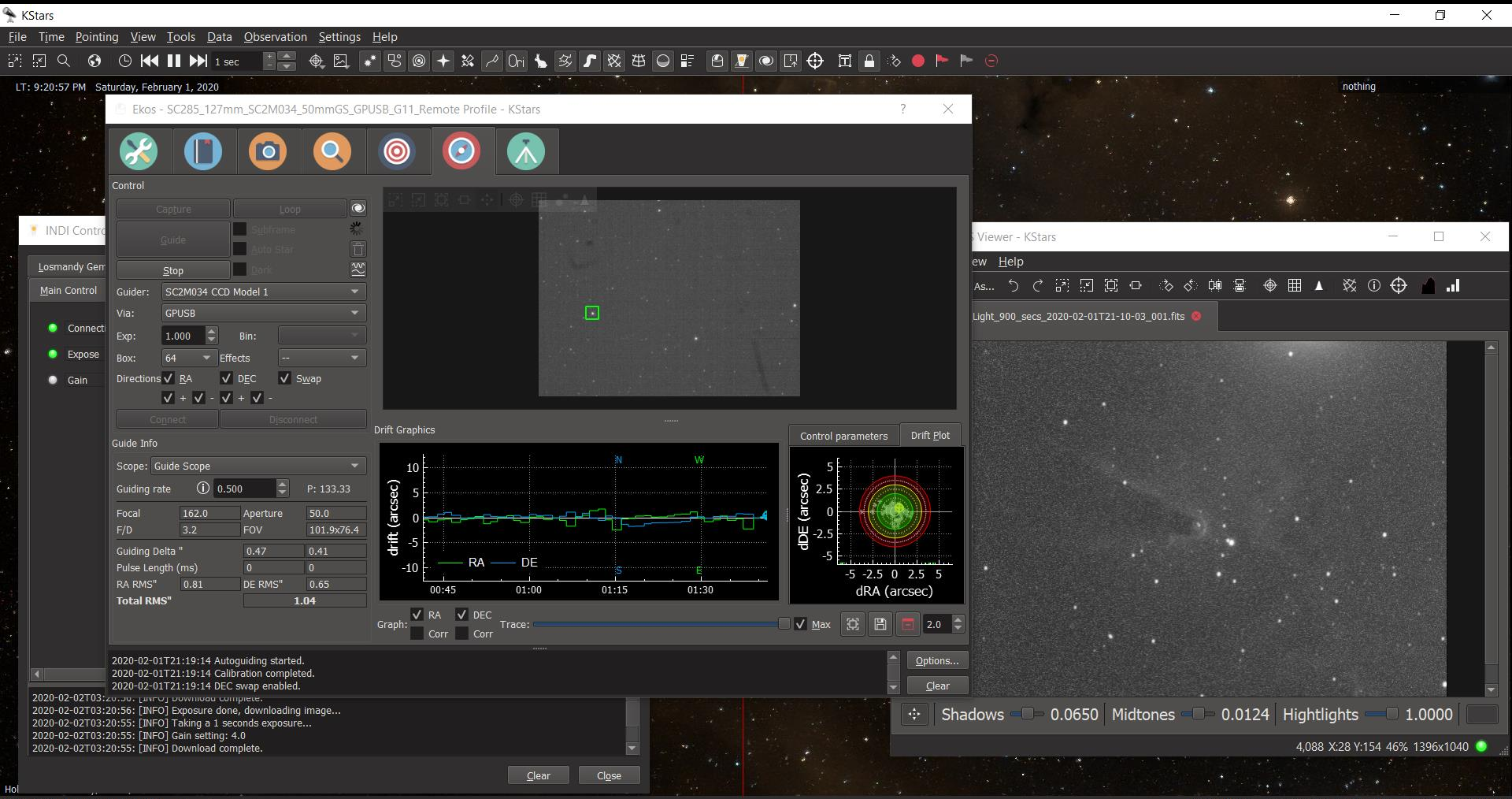
Astrometry / Plate Solving

- For image framing and refining GO TOs



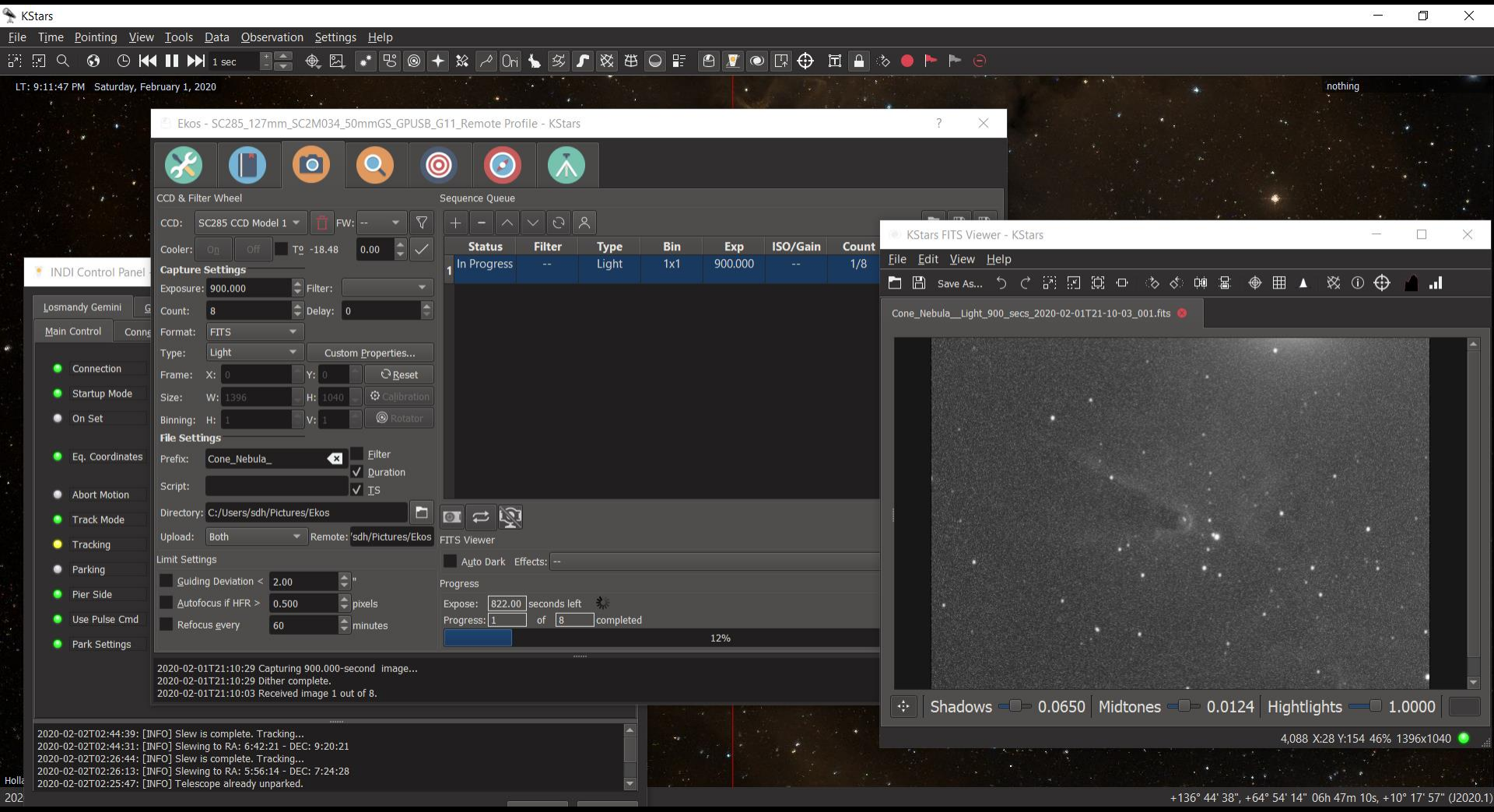
Autoguiding

- Internal Guider or PHD2 or Linguider



Imaging Sequence Generation –

- Includes dithering between images
- Can set entire imaging run of: Lights, Darks, Flat Lights, Bias



How does this configuration work?

OUTSIDE (40^{o})

Raspberry Pi 3B+

- Ubuntu Operating System (OS) [Linux type OS]
- Operates as INDI device driver server – connects to devices (telescope, cameras), communicates through WiFi to laptop
  - INDI = Instrument Neutral Distributed Interface (like ASCOM but for Linux type OS)

INSIDE (70^{o})

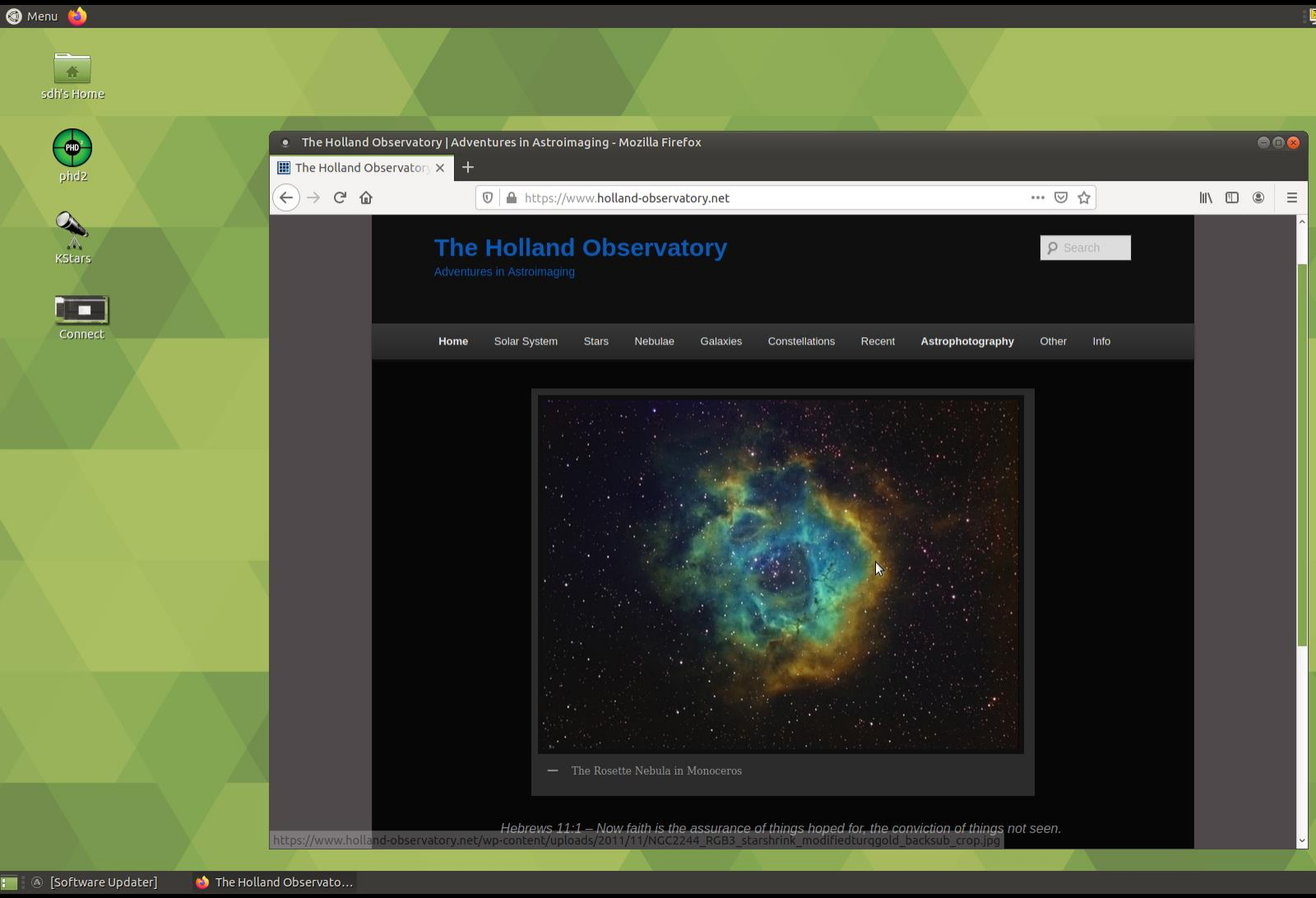
Laptop

- Windows 10 OS
- Operates as Client
- Uses *free* KStars Planetarium Program & Ekos imaging control
- Communicates via WiFi

Info about Ubuntu OS

Very similar to windows with similar capabilities

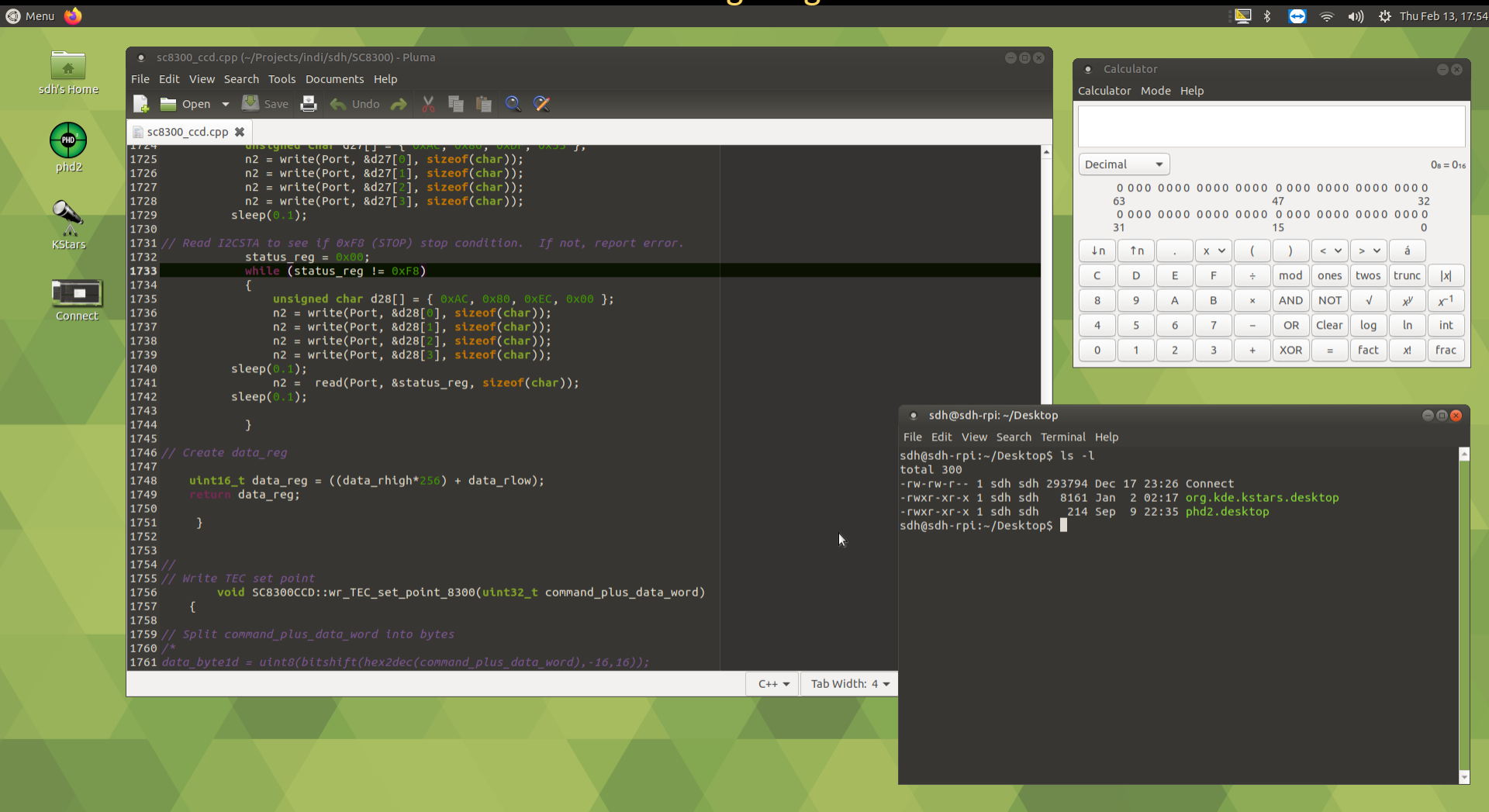
Comes with: Web browser (Firefox)



Programming Editor
Calculator
Command Window (Terminal)

Word Processor
Presentation Creator
Spreadsheet Program
Drawing Program

Image Viewer
Audio & Video Player
Etc., Etc.



All Free – Why am I paying for Windows?

How well does work?

- INDI Drivers available for most common astronomy equipment
- All free
  - Online user & developer community
  - Borderline support available
- Fairly complicated to figure out
- Once figured out, works well

- Storage – Raspberry Pi supports up to 128GB SD card (I think)
  - Had 32GB SD card – Still plenty of space left (Efficient OS)

- Speed – OS is very efficient and primary storage is SD card (SSD)
  - Download speed and communications to laptop is fast
    - 0.5 Sec to download astroimage
    - No perceivable lag in autoguiding monitoring

- KStars Planetarium Program – very capable and free
  - Can download and use for other purposes

One more thing – Off topic: Length of subs

12x10min = 2 hours

Shorter subs:

1. More read noise (more images)
2. Less signal per image
3. Decreased risk of tracking errors

8x15min = 2 hours

Longer subs:

1. Less read noise (less images)
2. More signal per image
3. Increased risk of tracking errors

The End