

# DBSP (Double Spectrograph)

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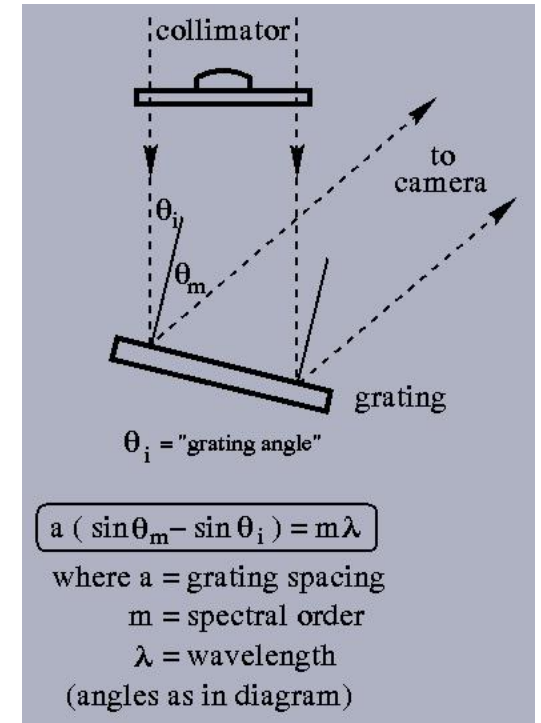
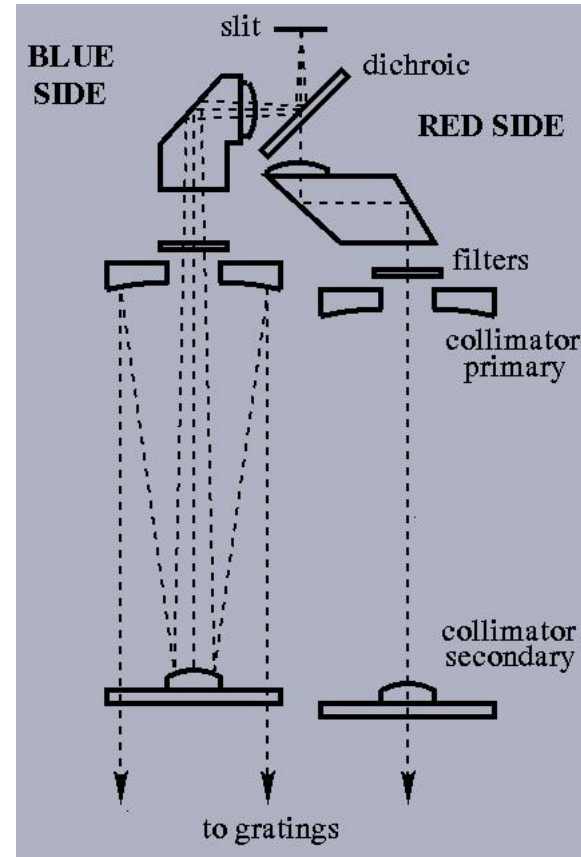
# What is DBSP?

- DBSP is a low-to-medium resolution grating instrument operated at the Cassegrain focus of the 200-inch telescope.
- It uses a dichroic (at, e.g., 5500 Å) to split into separate red and blue channels (observed simultaneously).
- DBSP is used to obtain optical spectra from a variety of astronomical objects from AGN to NEAs.
- It can be easily used with a camera/imager at the main focus, like WIRC or WaSP (to simultaneously obtain an image and a spectra).



# DBSP – Key Characteristics

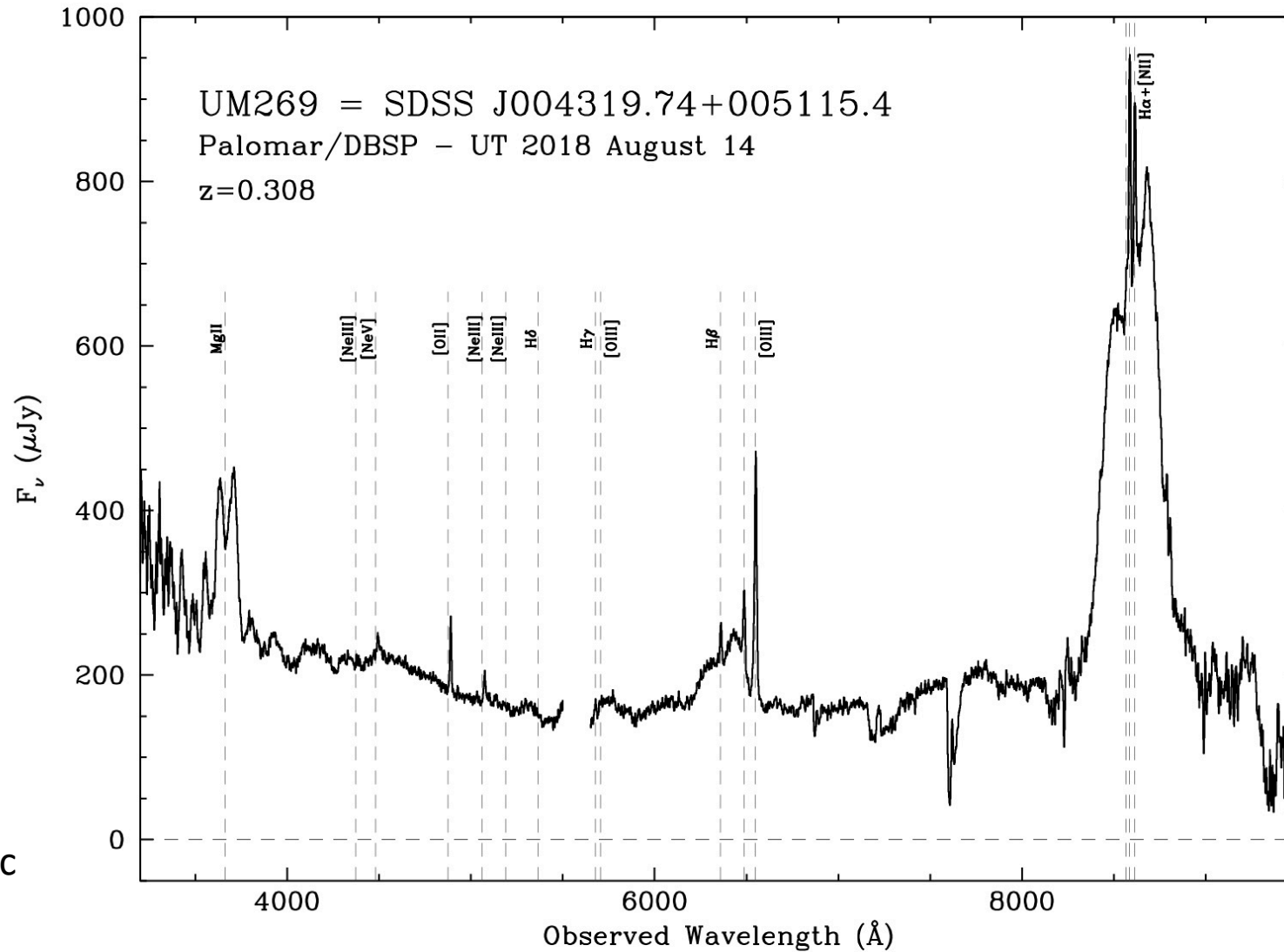
- Wavelength Range  
Red [4700 Å – 11000 Å]  
Blue [~ 3000 Å – 7000 Å]
- Resolution ~ 1,000 – 10,000
- Single Slit:  
Length - 128"  
Width - ½", 1", 1.5", 2", 4", 6", 8", 10"
- Many different Dichroics and Gratings available  
*(there is an online grating angle calculator for use in setting up observations)*



# DBSP – Things to know

- Great documentation available at Palomar instrumentation site:  
<http://www.astro.caltech.edu/palomar/observer/P200observers.html#instruments>
- Lots of online tools to help set-up observations!  
*(grating angle calculator, cookbook, )*
- Quicklook Data Reduction Pipeline  
*(really useful for checking spectra mid-observation)*
- Standard set of nightly calibrations  
*(bias, lamps, flats, etc.)*
- Observations are very straight forward.  
Easy to use GUIs, Slit Viewer camera, can view exposures in IRAF and DS9

# DBSP – Sample Data



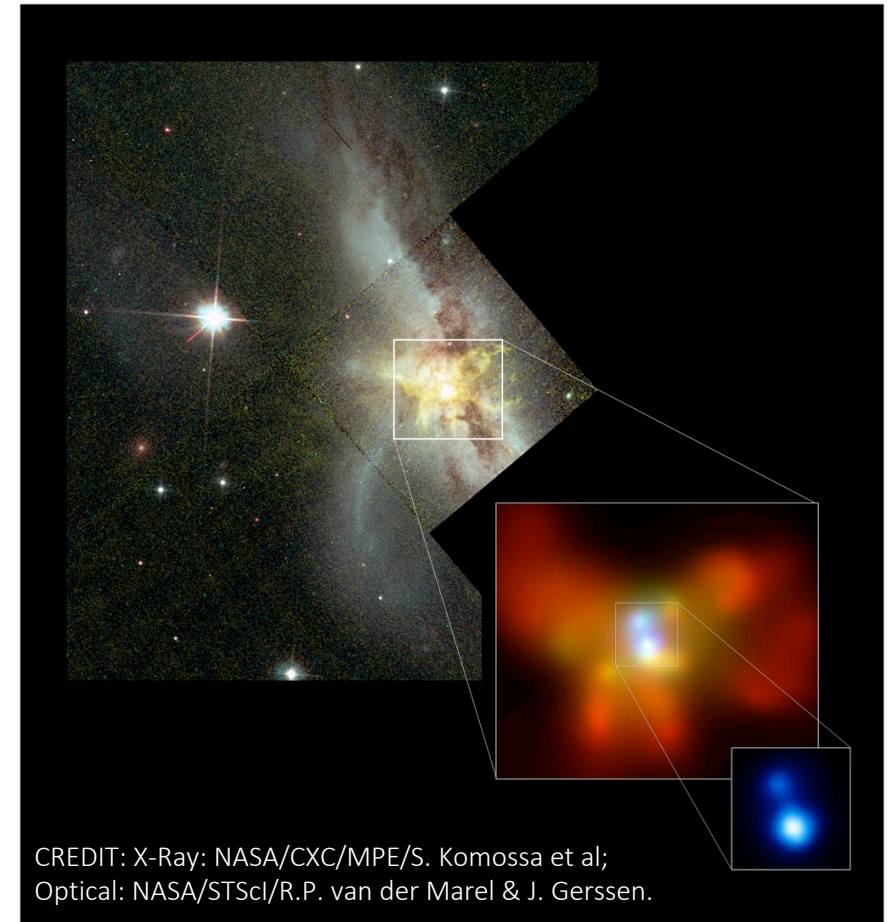
Specifics:

$V_{\text{mag}}$ : 17.8

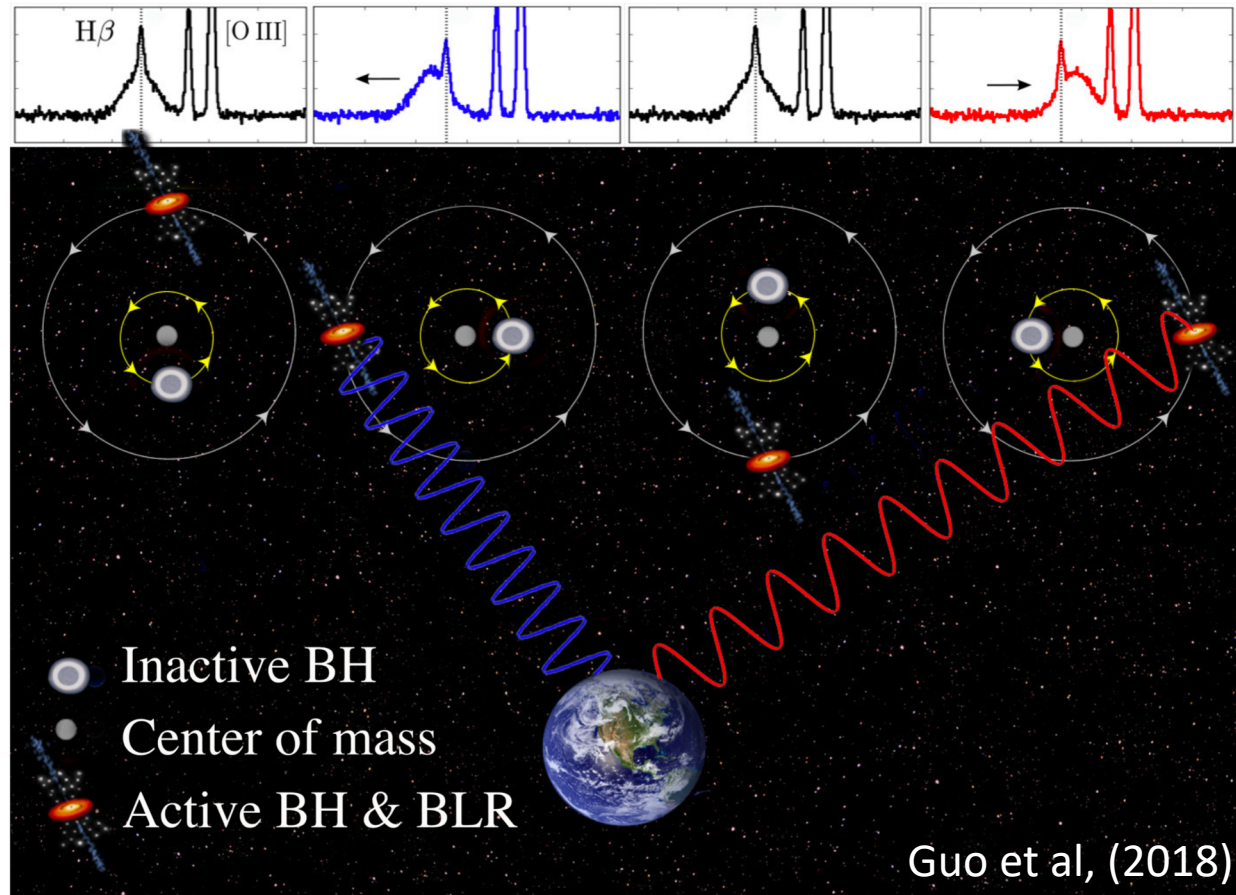
$T_{\text{exp}}$ : 1200 sec

# DBSP – Searching for Binary Supermassive Black Holes

- Binary SMBHs are predicted by hierarchical structure formation. Late-stage galaxy mergers should form a binary SMBH, which evolves to coalescence and emits strong gravitational radiation.
- Binary SMBHs are primary sources of gravitational radiation in the frequency range for both Pulsar Timing Arrays and LISA.
- No direct evidence for binaries at sub-parsec separations (yet)!



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## On-going Observations:

- Following-up candidates identified with optical variability in PTF
- Monitoring candidates identified with velocity offset BLRs in SDSS

