DQSO presentation

Slide 1 (Background)

* Supermassive black holes at center of host galaxy
* The massive gravitational force forms a planar rotating accretion disk
  + Interstellar gas and dust
  + Light days to light months across
  + Viscosity between accelerated matter in adjacent radii produces huge amount of energy (10E38-10E40 watts)
  + Most quasars at high redshift
  + Distinct spectrum, with identifiable emission lines at extreme redshifts (ultraviolet redshifted to infrared)

Slide 2 (DQSOs)

* Two quasars in close proximity, gravitationally bound
  + 10 pc to 10 kpc (1 pc = 3\*10E16 m = 3.25 light years)
* Commonly thought that DQSOs form through mergers
* Important because of gap in galactic evolutionary theory explaining giant ellipticals
* Because DQSOs are identifiable at high redshifts due to their immense luminosities, they allow us to observe merger mechanics much deeper in space and time
* DQSOs are currently quite rare, but if these theories were to be verified, there should be many more undiscovered DQSOs

Slide 3 (Summer research)

* We theorized that there were many DQSOs that had been mislabeled as single quasars, due to low resolution of ground telescopes.
* Past summer, built an algorithm in Python that scoured Hubble Space Telescope archives, creating contour plots of the positions of known quasars. Filtering through these contour plots, we procured a handful of potential DQSO candidates
* These candidates were chosen merely off of visual characteristics – the next step was mathematical modeling
* In deciding which systems to model, we had to consider PSFs 🡪

Slide 4 (PSFs)

* At its most simple, a PSF is the pattern of how a camera’s aperture and image construction mechanism distort a single point source of light.
* Had to consider preexisting PSF generation techniques for each HST camera – while there are different techniques for each camera, program TinyTim makes great PSFs for ACS images. Chose to observe candidates imaged with ACS camera.
* Built PSFs with TinyTim for three candidates, inputted various cosmological parameters including quasar spectrum

Slide 5 (GALFIT)

* Software package used to extract information about interstellar objects using parametric function to model objects
* Optimizes parameters (position, surface brightness magnitude, half-light radii, etc) of inputted component functions to best fit an input image
* Using PSF (quasar) and Sérsics(host galaxies) components, we developed a general modeling procedure with 8 phases

Slide 6 (statistics)

* How GALFIT optimizes? L-M algorithm, or damped least-squares method, to minimize the chi-squared value. Sums the pixel magnitude difference between matching model and input image pixels over all pixels
* L-M algorithm (good at finding solutions even if it starts very far away from the minimum)
* GALFIT computes a chi-squared value and the degrees of freedom for each fit
* Comparing these between fits, we computed an F-value, which we used in an f-test to determine the relative improvement of a new fit

Slide 7 (results)

* Touch on each column

Slide 8 (4c24.10)

* Two PSFs embedded in Sérsic host galaxies, with two nearby Sérsic elements
* Most likely gravitational lens

Slide 9 (COSM J10020)

* Good fit and bad fit – compare residual images
* Very good candidate, DQSO model had the lowest chi-squared value, but was not significantly better when compared to next best model in an F-test
* Fit hurt by potential tidal arm – good evidence of merger!

Slide 10 (PSS J2322)

* The DQSO model was clearly not the best here
* Instead, our best model (h2) suggested a single quasar, with an unaffiliated galaxy and star nearby