PHY-765 SS18: Gravitational Lensing. Worksheet Week 1

1 Searching the astronomical literature

Throughout the GL course, searching the astronomical literature will be a valuable skill to have. Both for future exercises and assignments, but also in case you should want to know more about a certain topic. Navigating the literature is also essential for (any) research-based work or problem-solving. The following set of exercises, should give you a crash course on how to find what you need. There are two main repositories for astronomy and astrophysics papers:
https://ui.adsabs.harvard.edu/ (ADS)
https://arxiv.org/archive/astro-ph/ (astro-ph)
The former mirrors the latter, with added information and cross-references. The latter presents daily "fresh off the press" papers and results, that are not necessarily refereed.

1.1

What is the difference between the "new" and "recent" papers on astro-ph?

1.2

How many papers were released in astronomy the past week?

1.3

How many of these were dealing with the Sun and stars?

1.4

Using ADS, reproduce the histograms showing the statistics of gravitational lensing papers, used for the figures on slide 19 of this week's slides.

1.5

How many papers have been written on the first QSO lens discovered?

1.6

Who has written/contributed to most of these papers?

2 The First Known Gravitational Lenses

A lot of lenses have been discovered. It has become increasingly easier, even though discovery of gravitationally lensed systems is still not trivial. Using your literature search skills just acquired and a bit of googling, the following should give you an idea of the amount of work people have put into lens-searches over the past few decades. Also, a few of the questions below will illustrate that the field of gravitational lensing is in constant movement.

2.1

Find (at least) 3 collections of gravitational lenses and note how many lenses each list contain, what type of lenses they are, and how they were found.

2.2

Schneider, Ehlers and Falco (1992) collected all gravitational lens systems known at the time (incl. QSO lenses, arcs and rings). Their list contains 22 lenses. Several of these systems did not have redshifts assigned to them in 1992. What are the redshifts of source and lens in the systems 0414+053, 1413+117, Cl0024+16, and 0218+357

2.3

Why do you think these redshifts were not known in 1992?

2.4

Schneider, Ehlers and Falco (1992) also present a few lens candidates. Among these are the systems 1146+111 and 3C238. Have these been confirmed as lenses since 1992?

3 How many quasars are out there?

QSOs have been instrumental for increasing the number of lenses and improve our understanding of GL as a phenomenon. In particular QSOs have helped the community get a better handle on lens modeling (as QSOs are 'simple' point sources, yet precise probes of the gravitational potential) and time-delay exploitation (due to the intrinsic variability of QSOs).

However, Schneider, Ehlers and Falco (1992) note that down-sides to using QSOs to find lenses, are the need to get spectroscopic confirmation to distinguish them from stars and their low number statistics. Schneider, Ehlers and Falco (1992) estimate that there are $\sim$20 QSOs per sq. deg brighter than $m_{\rm V} = 20$ in the sky.

3.1

How many spectroscopically confirmed QSOs are (roughly) known today?

3.2

How many non-confirmed (e.g., color-selected) QSOs are known today (hint: SDSS)?

3.3

What is the density on the sky for these two samples of quasars?

3.4

Does this agree with the density on the sky estimated by Schneider, Ehlers and Falco (1992)? Why/why not?

3.5

How many of these do you think are in lensed systems?

4 Questionnaire on GL course expectations

To finish off, I would appreciate if you could please fill out the questionnaire linked to on the course webpage: https://goo.gl/forms/nNQCJeGbFcG7SYem1