A&ARv: Time Delay Cosmography

Review plan

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Deadline: May 15th, 2016

Page limit: 30-40 pages (including figures, tables and references), one full page of text being equivalent to 550 words.

To do:

* Start (public) repository [done]
* Start latex file, including correct style[done]
* Sketch section content [done]
* Decide timeline: February 29 forecast figures. March 15 first draft of our assigned sections. Complete draft April 15, PDF advertized to friends. Meet at 1:30pm every other Friday.
* Paste this plan into latex file [TT]
* Make milestones [PJM, done]
* Issue writing tasks [PJM, done]

# Abstract [PJM]

Include blindness

# 1 Introduction [TT]

What is time delay cosmography? Why is it cool? What is it good for? What are the challenges? Blindness: with high precision comes greater responsibility. Extraordinary claims etc.

FIGURE: CARTOON OF LENSING, FROM SPACE WARPS WEBSITE? [PJM]

FIGURE: H0 AS A FUNCTION OF TIME (A CAUTIONARY TALE) [TT]

# 2 A Brief History of Time Delay Cosmography [TT]

Refsdal [60s]

First lensed quasars [70s]

First monitoring [80s]

Controversy about time-delays [90s]

Controversy about mass models (too simple) [00’]

the universe is not exactly homogeneous and isotropic

Modern time delay cosmography [>00]

SN Refsdal [14-15]

FIGURE: HISTORIC TIME DELAY AND IMAGE OF A LENS VS MODERN DATA [TT]

# 3 Theoretical background [PJM]

Lensing, Fermat’s principle and potential.

FIGURE: SCHEMATIC WAVEFRONT DIAGRAM FROM T&E15.

Time delay distance.

Importance of mass distribution in lens. Model (“mass sheet”) degeneracy and its generalizations

Importance of mass along the line sight - the universe is not Friedmann Lemaitre Robertson Walker.

POSSIBLE FIGURE: ILLUSTRATION OF LINE OF SIGHT EFFECTS? CARTOON COMPARING IDEALIZED UNIVERSE TO OVER/UNDER DENSE LINE OF SIGHT [PJM]

# 4 Modern Time Delay Distance Measurement (2010->) [PJM]

Mention importance of blindness in all measurements.

## 4.1 Measuring time delays [PJM]

### 4.1.1 Monitoring Observations

Fassnacht for B1608

COSMOGRAIL.

Others?

### 4.1.2 Lightcurve Analysis

COSMOGRAIL

TDC

## 4.2 Modeling the lens mass distribution [TT]

### 4.2.1 High Resolution Imaging Observations

### 4.2.2 Lens Modeling Techniques

### 4.2.3 The Role of Stellar kinematics

## 4.3 Lens environments and line of sight effects [PJM]

# 5 From time delay distances to cosmography [PJM]

# 6 Outlook [TT]

## 6.1 Precision [PJM]

FIGURE: Forecasts for 10,50,100,1000 lenses for various cosmological models (w, wa+w0, curvature etc etc). CosmoSIS forecasts (ackn. Dave & Elise, ask them).

## 6.2 Accuracy [PJM]

Discussion of systematic uncertainties

Time delay measurement. Light curve quality.

Lens mass modeling. Percent-level systematics due to model assumptions (ie MSD). IFU observations, resolved stellar kinematics. Ensembles.

Environment and line of sight

Time delay perturbations (someone’s noise is somebody else’s signal..)

The importance of blinding

## 6.3 Cosmic complementarity [TT]

What’s the point of doing this? Aren’t other probes already doing it? Our place in the cosmology ecosystem. Discuss place relative to other distance indicators like Cepheids, BAO, SNe. Then, complementarity with growth of structure probes like weak lensing, clusters, etc etc How important is H0?

Importance of multiple INDEPENDENT measurements for discovery of new physics.

# 7 Summary [TT]

REFERENCES. We are using bibtex!!!