A plan for Independent Project of OPTI 523

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1. Introduction

Prof. Dubin et al. tries to measure the Large Synoptic Survey Telescope (LSST) secondary mirror by Fizeau type interferometer with 5mm gap as shown in Figure 1[1]. In this case, the bending of the test plate caused by the gravity becomes a problem, since the test plate is flipped around after polishing the reference surface. Reducing an unexpected bending in the reference surface is significant. For this purpose, vacuuming the air between the test plate and the illumination lens can be useful for compensating the bending caused by the gravity.

The scope of the project is that an effectiveness of compensating the gravity bending by vacuum is examined by simulations and experiments (in 523L). Also, a possibility of applying this technique to the LSST secondary measurement may be discussed.

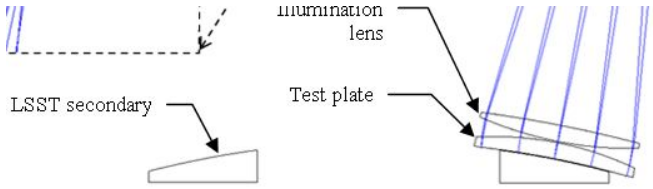

Figure 1. LSST secondary measurement system

2. Key requirements

- Collaboration with 523L experiment
  - Availability of lens, sealing, and equipments
  - Range of vacuum level

3. Procedure for the project

Step 1. Hand calculation on LSST model (Done)
- Check a surface deflection of Test Plate caused by gravity
- Check a surface deflection of Test Plate caused by vacuum
- Summarize an effectiveness of vacuum technique

Step 2. Simulation on a scaled model and a flat surface model (03/22 ~ 03/31)
- Design a scaled model (1/10), and check availability of off the shelf part
- Design a flat surface model (~150mm in diameter, ~5mm in thickness)
- List the Zernike terms depending on pressure [Pa]

Step 3. Experiment on a simple model (in 523L) (04/01 ~ 04/16)
- Set up the vacuum equipment, lenses or flat surface, and sealing material

- Measure the Zernike terms depending on pressure [Pa]
- Show simulation works based on the comparison of simulation data with experimental data

Step 4. Simulation to LSST model (04/17 ~ 04/30)
- Simulate wavefront caused by gravity (Solidworks -> Zemax)
- Simulate wavefront caused by vacuum (Solidworks -> Zemax)
- Show how much uncertainty caused by gravity can be reduced by using vacuum technique

4. Skills refined by the project

- Analyzing skill
  - How to constrain the model in Solidworks
  - How to simulate deflection correctly
- Mechanical support for lens
  - Edge support or radial support

5. Outcome

- How much uncertainty caused by gravity can be reduced by using vacuum technique in flat surface model
- How much uncertainty caused by gravity can be reduced by using vacuum technique in LSST model
- Difference between simulation and experiment (in 523L)

6. Reference

[1] M. B. Dubin, et al., “Fizeau interferometer with spherical reference and CGH correction for measuring large convex aspheres”, Proceedings of the SPIE, Volume 7426 (2009)