Project – Dual Illumination Microscope Source
OPTI 523 – Distance Learning
College of Optical Science
University of Arizona
April 9, 2009

Objective:

Design a dual illumination source, coherent light and white light, for an industrial computer controlled microscope. The light source can switch between white light and laser light while maximizing illumination to the lens. The system needs to occupy the form factor of the original lid of the machine, 6" in diameter and 1" thick.

Requirements:

Performance:

- Coherent Light
  - Wavelength: 635nm
- White Light
  - Color Temperature: ≈3200K
  - CRI: >70%
- Maximum Illumination for each source should be comparable to a 100W Tungsten Bulb run at 9V.
- Illumination should be even across the field of view on the object plane
- Switching between sources
  - Should take less than 2 seconds.
- Environment: Laboratory
- Resonant frequency: > 60 Hz

Survival:

- The light sources in the lid should be able to maintain there position after repeated shock from the lid closing. The lid has a dampened hinge.

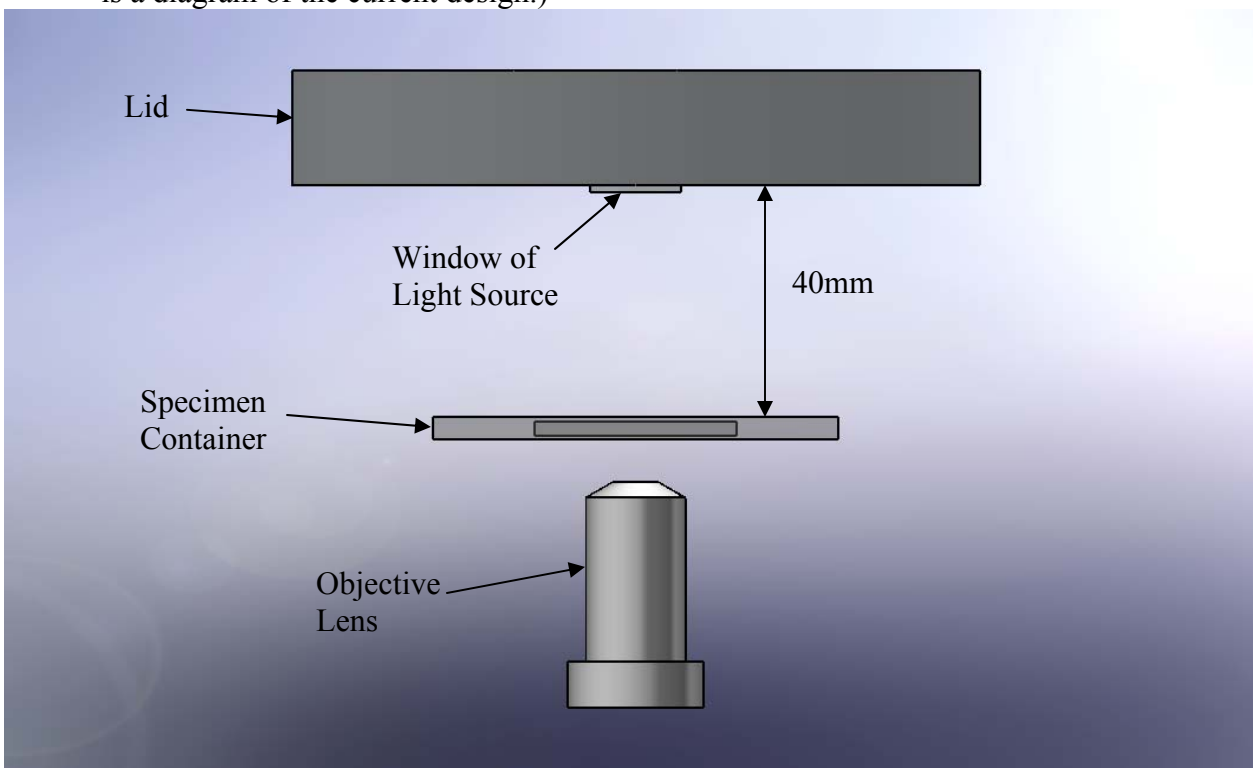
Limitations:

Size:

All components must fit in the current design of the lid 6" diameter by 1" thick.

Interface:

- The light will be traveling down through the microscope stage and objective lens. (Below is a diagram of the current design.)



- Camera: Adimec 4020 with Kodak KAI-4021 CCD sensor

Design Preferences:

- Blue Sky research
- LED white light sources

Existing Parts:

- Lenses should be catalog lenses
- Mirror should be an off the shelf component.
- Mirror transport system should be an off the shelf motorized stage.

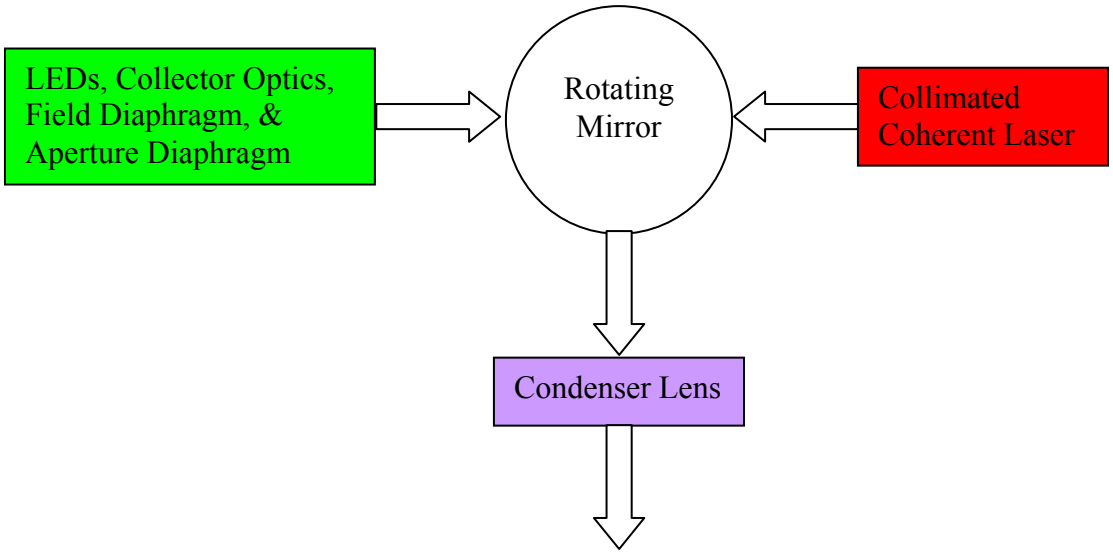
Risk Priorities:

- Assembly should be of limited complexity.

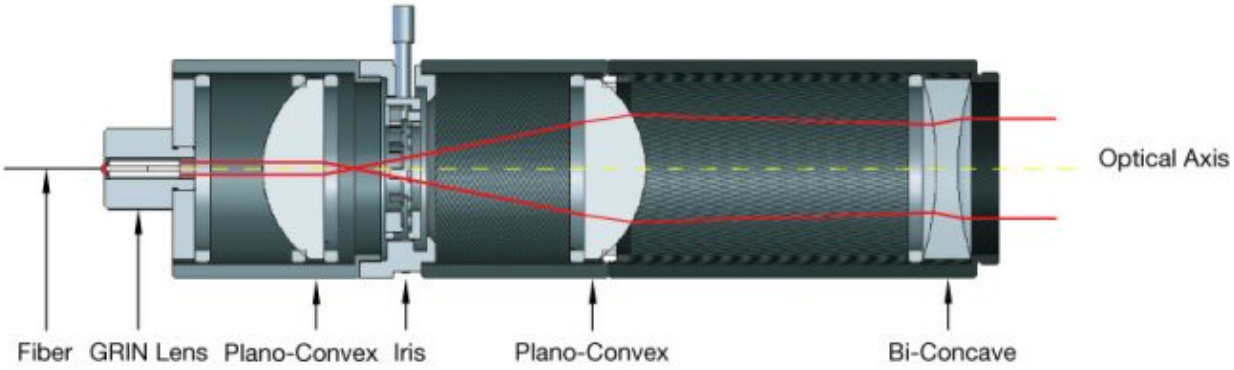
Preliminary Design

Design Concept

- **Break up the optical train into three parts:**
  - Collimated Coherent Laser
  - Kohler Illumination with Bright Warm-White LEDs
  - Condenser Optics

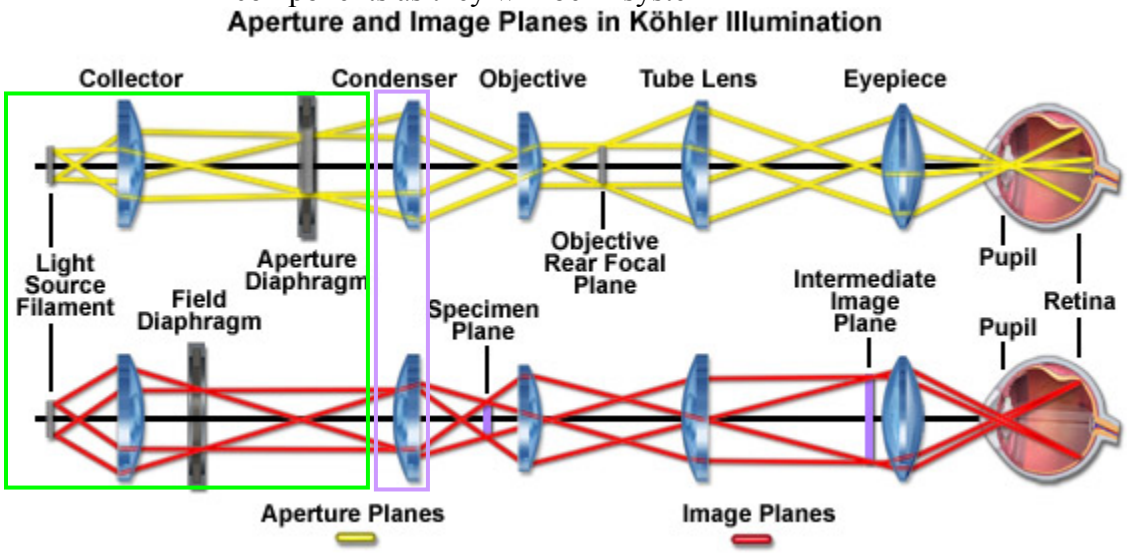


- **Basis for Design:**
  - Collimated Coherent Laser Design based upon Thorlabs ½ Lens Tube System
    - Example of Thorlab Lens Tube System of a Collimated Source

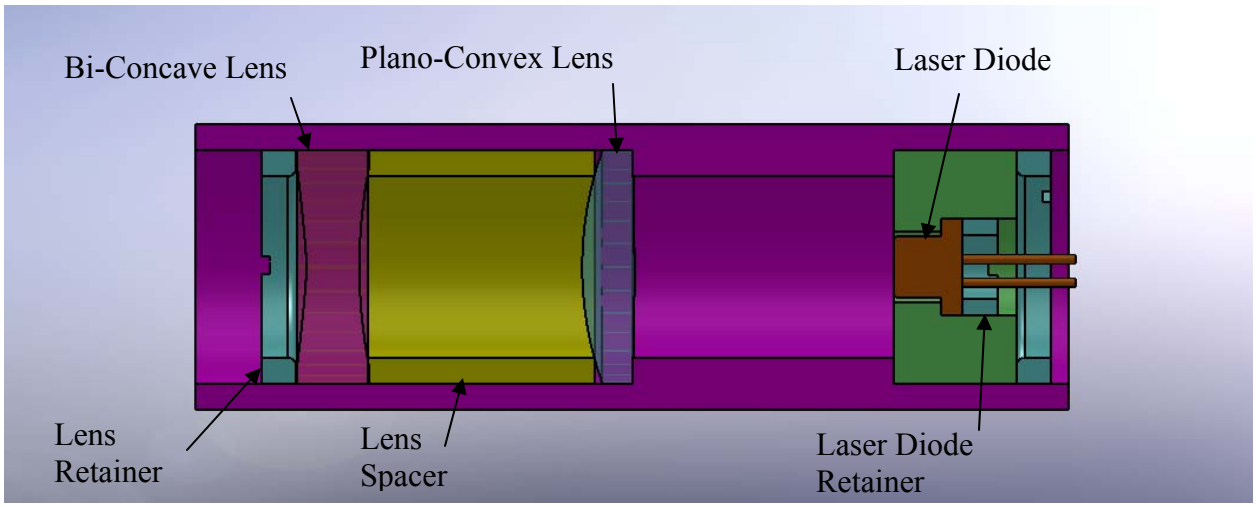


- Example of Thorlabs Laser Diode Holder

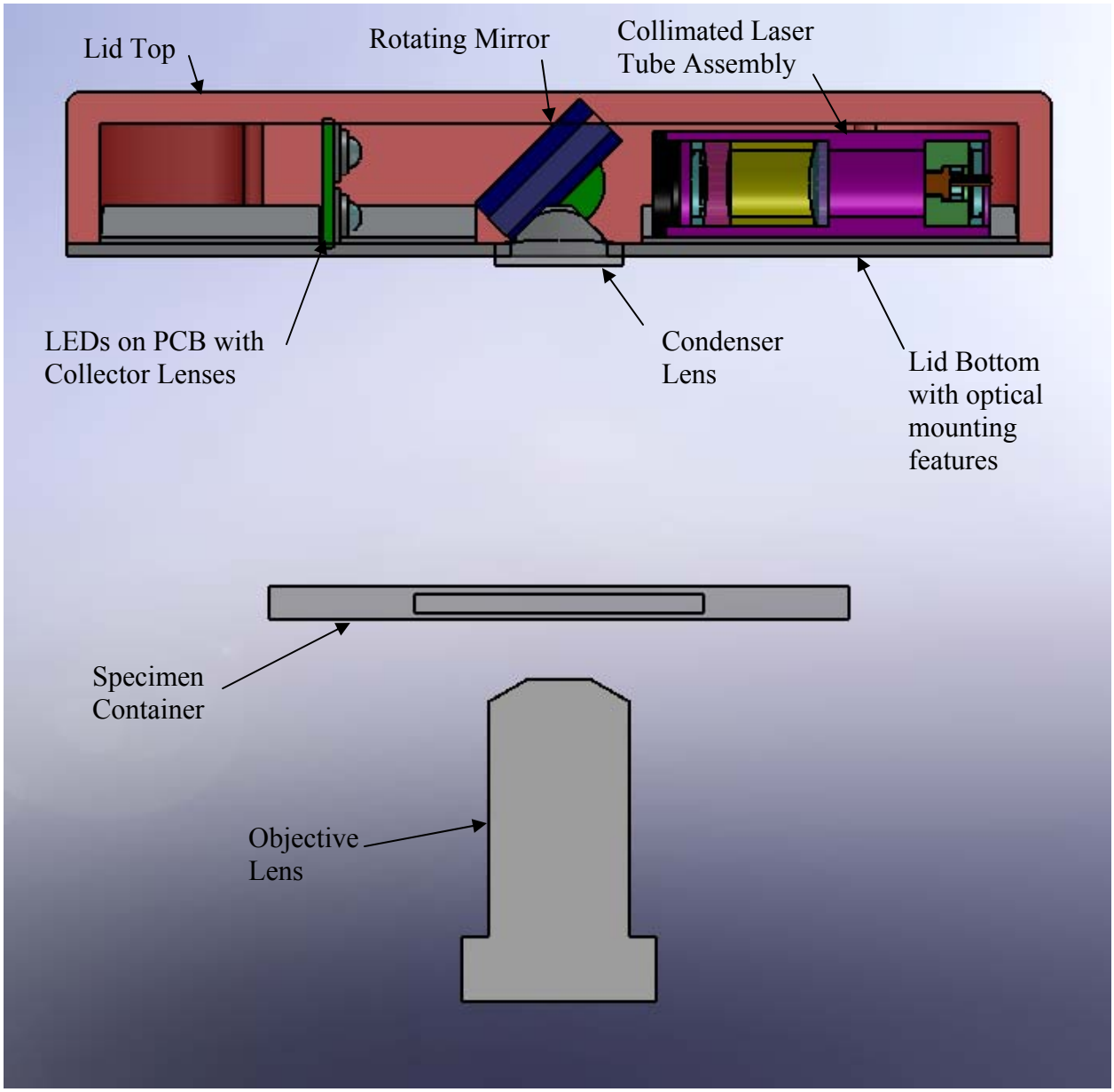
  - Kohler Illuminations and Condenser Optics
    - Complete Layout of Kohler Illumination with boxes separating the components as they will be in system



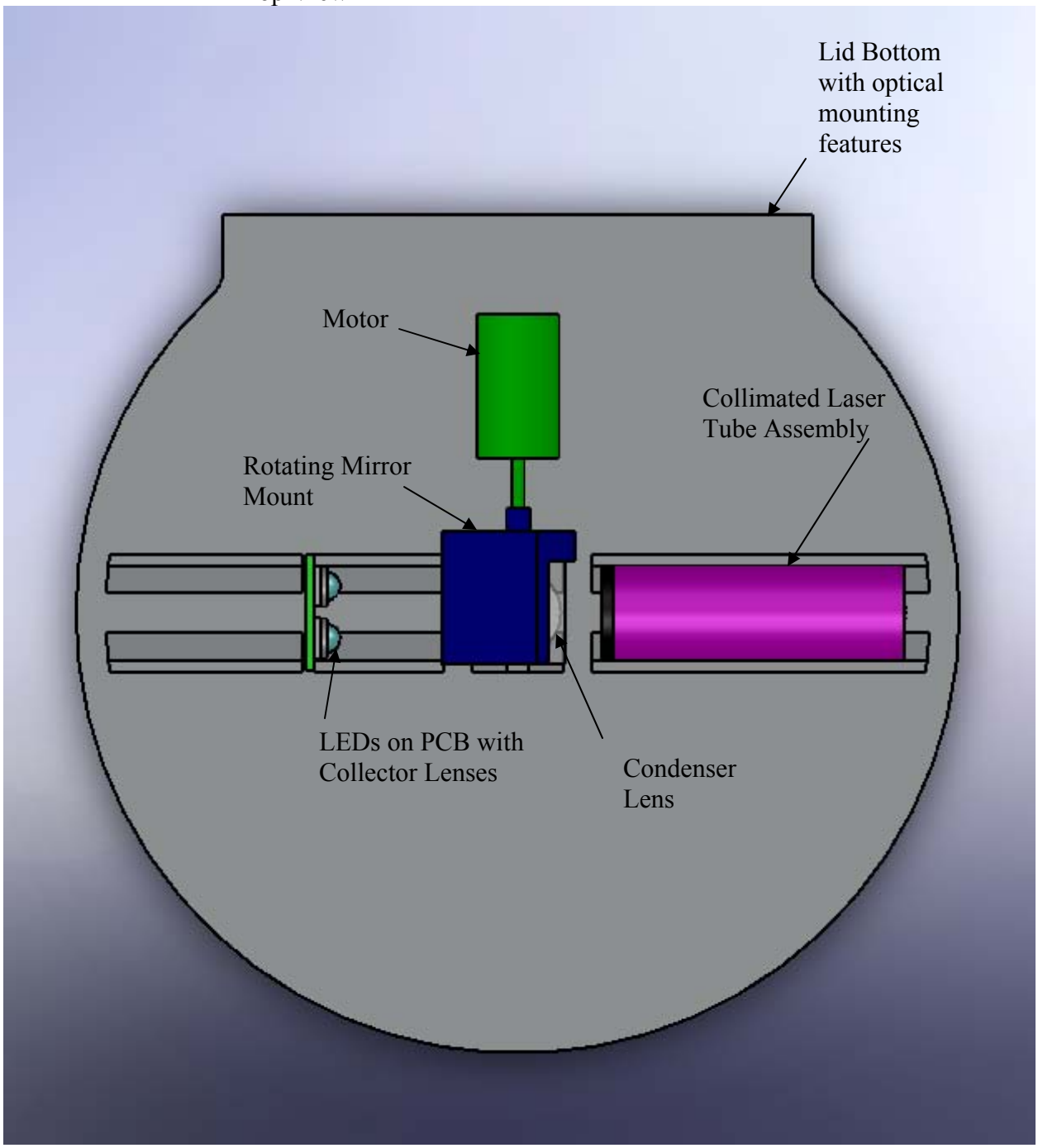
- **Design Sketches:**
  - Collimated Coherent Laser Tube



- Assembly
  - Cross-section



- Top View


Lid Bottom with optical mounting features
Motor
Collimated Laser Tube Assembly
Rotating Mirror Mount
LEDs on PCB with Collector Lenses
Condenser Lens

Design Concept vs. Design Requirements

Design Concept	Design Requirements	Other Benefits/ Drawbacks
Blue Sky Research 635nm diode Laser	Coherent Light Wavelength: 635 nm Fit in current Lid	Virtual Point Source simplifies optics needed to collimate
CREE warm white board level LED	White Light: 3200K & CRI > 70% Fit in current Lid	Can place several on a PCB
Rotating Mirror w/ custom stage	Switch Between Sources Fit in current Lid	Could not find small motorized stage
Kohler Illumination	Even Illumination	
Lens Tubes	Maintain optics position after repeated shock	

Design Concept to Final Design

- Optical Design needs to be completed to begin final opto-mechanical design
- Near final design is needed to determine shock load of lid
- Illumination calculations and Optical Model are needed to determine exact laser diode and number of and model of LED.
- Rotating Mirror Mount needs to be designed for bearings
- Motor needs to be found that fits and can driver mirror at required speed
- Optical Design Tolerances needed to find the tolerances of rotating mirror

Manufacturing Issues

Component	Manufacutrings Issues
Apertures	None- off the shelf @ Thorlabs and others
CREE LED	None – off the shelf @ DigiKey
Blue Sky Research Diode Laser	None – off the shelf @ Blue Sky Research
Lens Tubes	Requires Machining
Lenses	TBD
Lid	Requires Machining
Lid Base	Requires Machining
Rotating Mirror	None – off the shelf @ Edmund Optics, Melles Griot, Newport, etc.
Rotating Mirror Motor	None- off the shelf @ various vendors
Rotating Mirror Mount	Requires Machining
Rotating Mirror Stage	Requires Machining
Rotating Mirror Stage Bearings	TBD

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