Whispering Gallery Mode Resonators

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1. Whispering Gallery Mode Resonators
2. Manufacture
3. Optical Alignment
4. Results
Whispering Galleries

St. Paul’s Cathedral
  - Acoustic Waves
  - Electromagnetic Waves
    - Total Internal Reflection
    - Resonant Modes
  - Spheres or Disks
  - WGMRs

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Applications

Light Storage
Laser Cavity
Non-linear Processes
- Second Harmonic Generation
- Parametric Oscillation

Figure: Experiment Using WGMRs
Applications

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Figure: Experiment Using WGMRRs
Production

Figure: WGMR Disk

Materials
- Glass
- LiNbO$_3$
- LiTaO$_3$, Silica, CaF$_2$
Production

Figure: WGMR on Post

1. Rough-cut Disks from Material
   - Diamond-Tipped Drill Bits
2. Attach to Post for Lathing
   - Heat-Activated Clamp
3. Sand and Polish
   - Lathe
   - Diamond Grit Sandpaper
How to Couple Light Into WGMR

Light Entering Disk Must Refract 90°

- Impossible for $n_1 < n_2$
- For $n_1 > n_2$:
  $\theta_1$ Required Will Result in Total Internal Reflection
How to Couple Light Into WGMR

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How to Couple Light Into WGMR

Solution:
- $n_1 > n_2$
- Total Internal Reflection
- Disk Must Be Within Range of Evanescent Wave

Figure: Coupling
How to Couple Light Into WGMR

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**Figure:** Coupling
Apparatus

Figure: Our Current Apparatus
Apparatus

Photodetector Placement

Figure: Desired

Figure: Current
Results

Uncoupled Disk

Coupled Disk

More Coupling!
Results

WGMR Signals

- Frequency Reference
- WGMR Maximal Coupling
- WGMR Small Coupling
- WGMR Uncoupled
Future Work

- LiNbO$_3$
- Diamond Prism
- New Mounting System

**Figure:** Mount Prototype
Summary

- Have Built WGMRs and Achieved Coupling
- Understand the Techniques Behind Construction
- Non-Linear Media and Future Experiments
  - LiNbO₃
  - New Mount Design
THE END