

High Speed Data Transmission and Processing

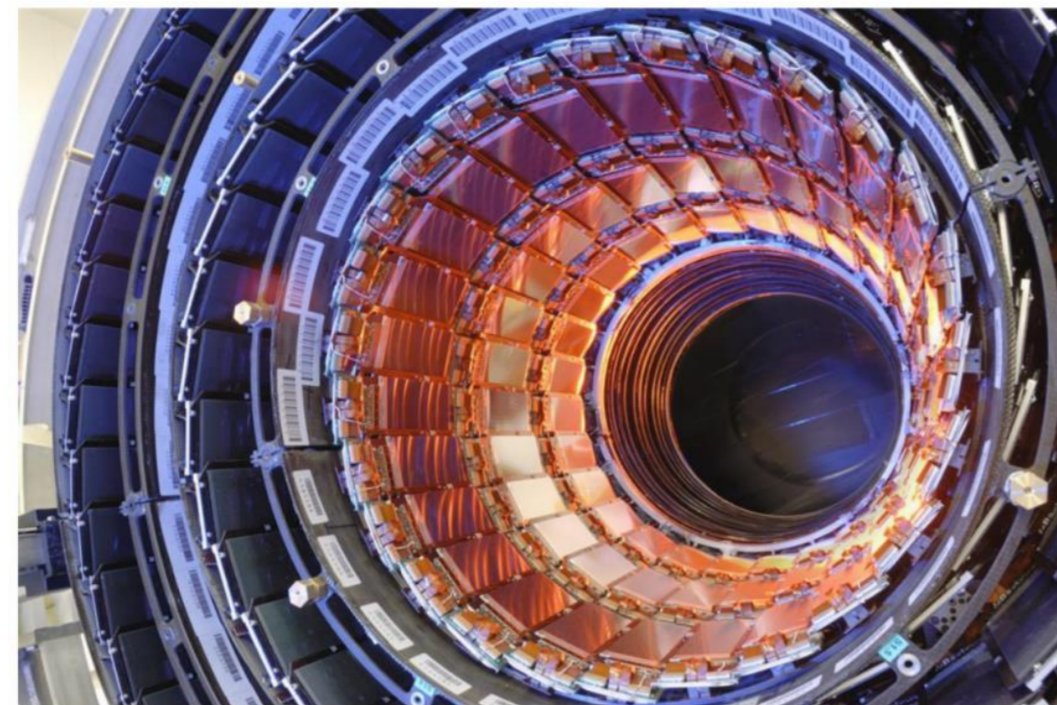
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Objective: Design of Optical wireless communication (OWC) System for high bandwidth data transfer in relation to HEP or Astrophysics.

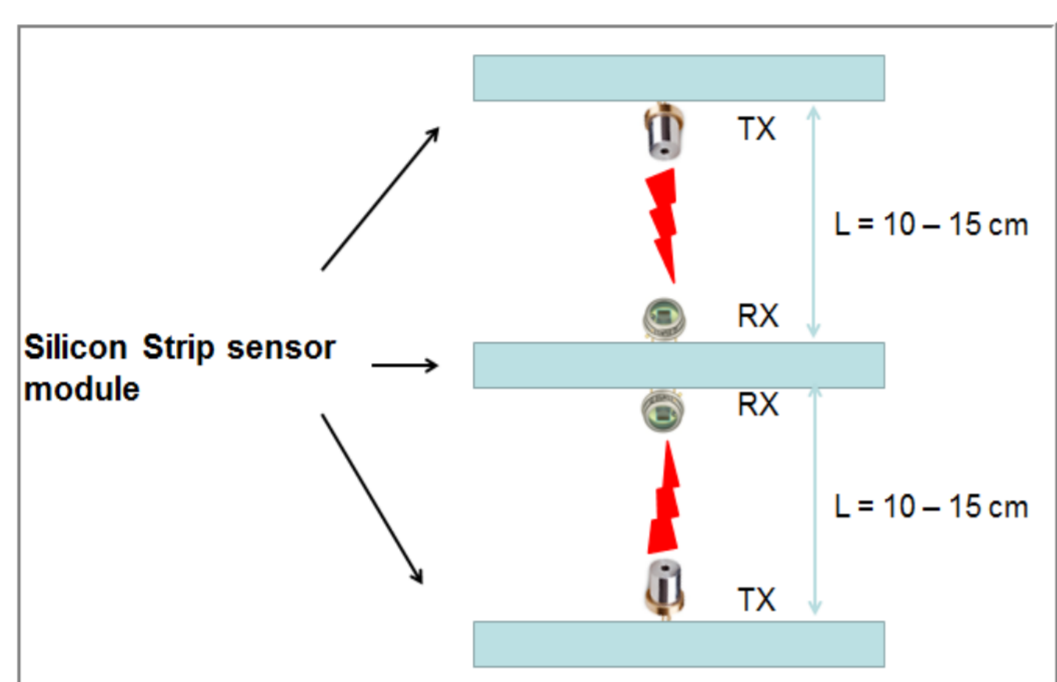
Optical Wireless Transmission System For CMS Tracker

Optical wireless transmission system is proposed to connect the silicon strip modules through Gb connection.



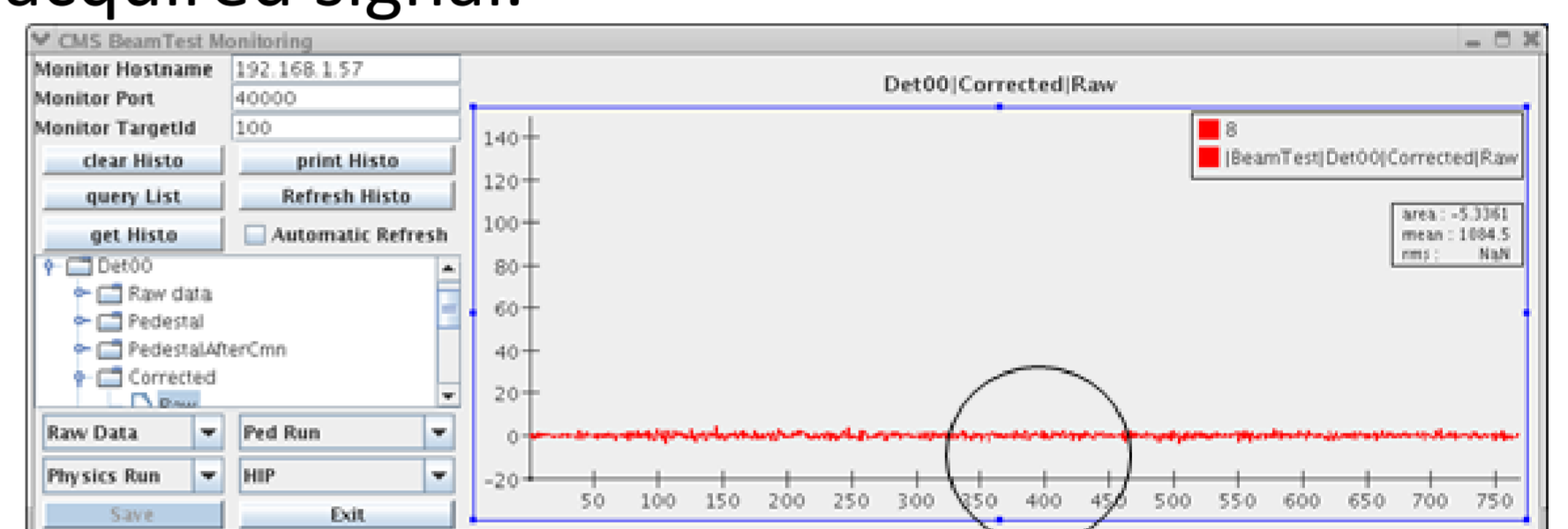
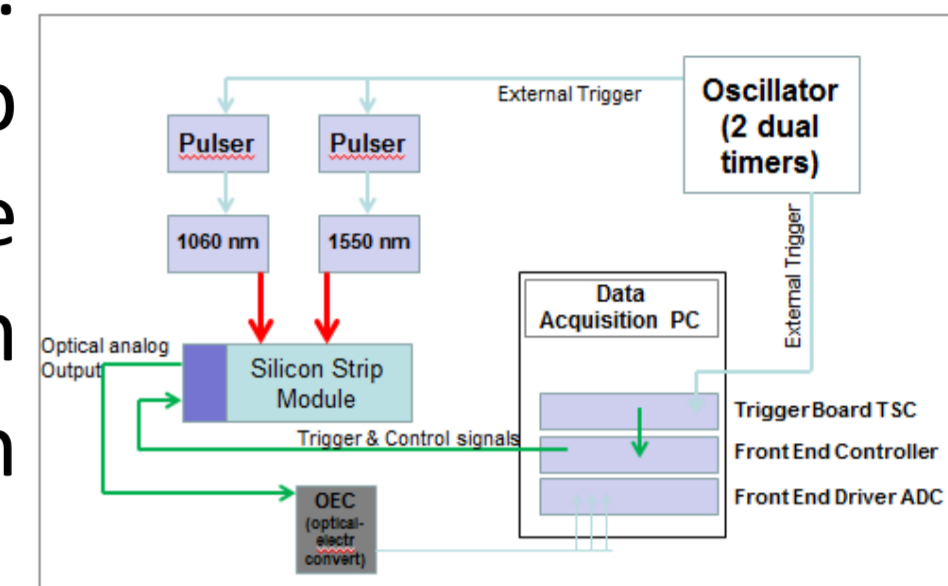
OWC results in :

- No Electromagnetic Interference (EMI) with radio systems.
- To reduce the material budget inside the detector system.



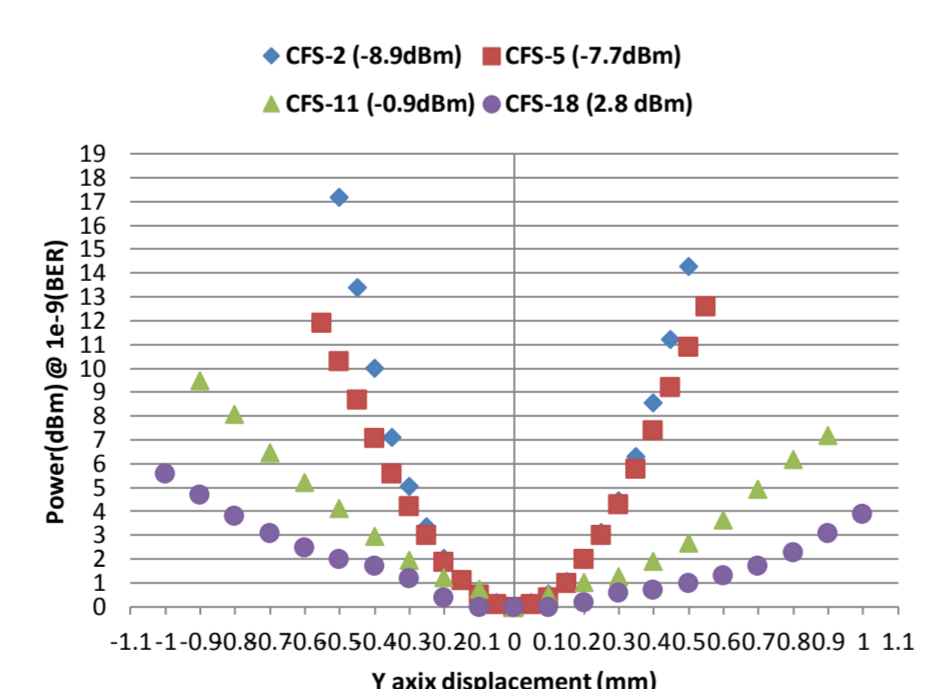
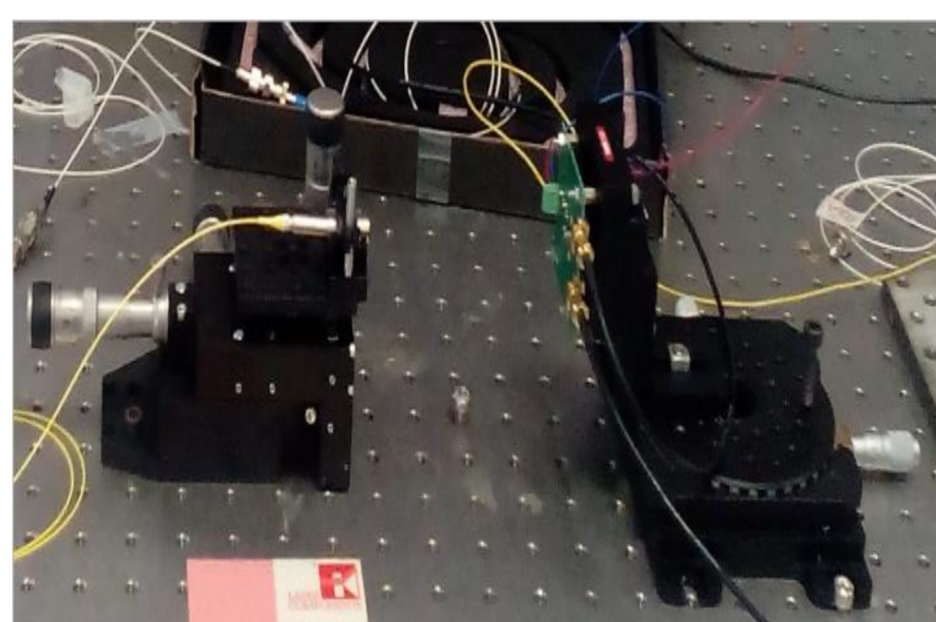
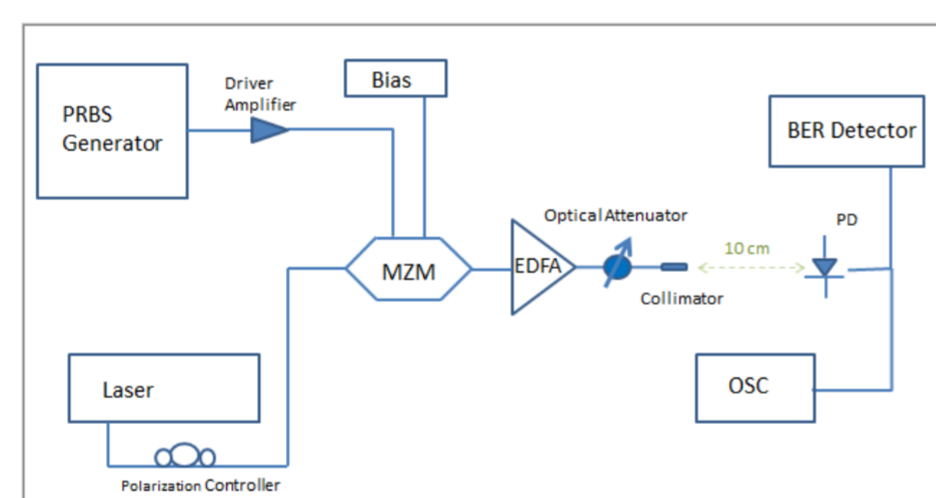
Wavelength Selection

- It was a group activity performed in INFN labs. The experimental setup was made to compare the effect of 1060nm with 1550nm laser on silicon sensor strip
- 1550nm laser does not produce any trace in the acquired signal.



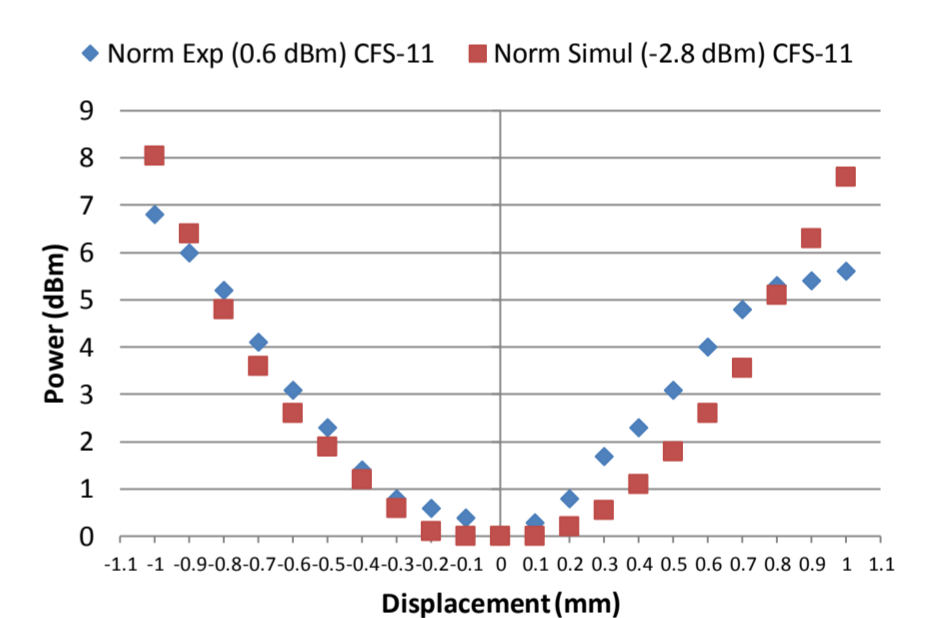
System Tolerance Study

- Experimental activity of Free space Optics (FSO) propagation was performed to study system tolerance due to misalignment.
- Collimators of different beam diameter (0.38mm, 0.87mm, 2.1mm, 3.5mm) and Photodiodes with and without focusing lens (Flat Window or Ball Lens) were used to study tolerance limits.
- It was analysed that collimator (0.38 0.87mm) can provide alignment tolerance of ± 0.25 mm approximately with input



Calibration of Simulator (TracePro)

- Simulations were performed to calibrate the simulator software (TracePro) comparing results with using data acquired in the experimental activity for tolerance study.
- It was found that simulated tolerance values approximate well the experimental data

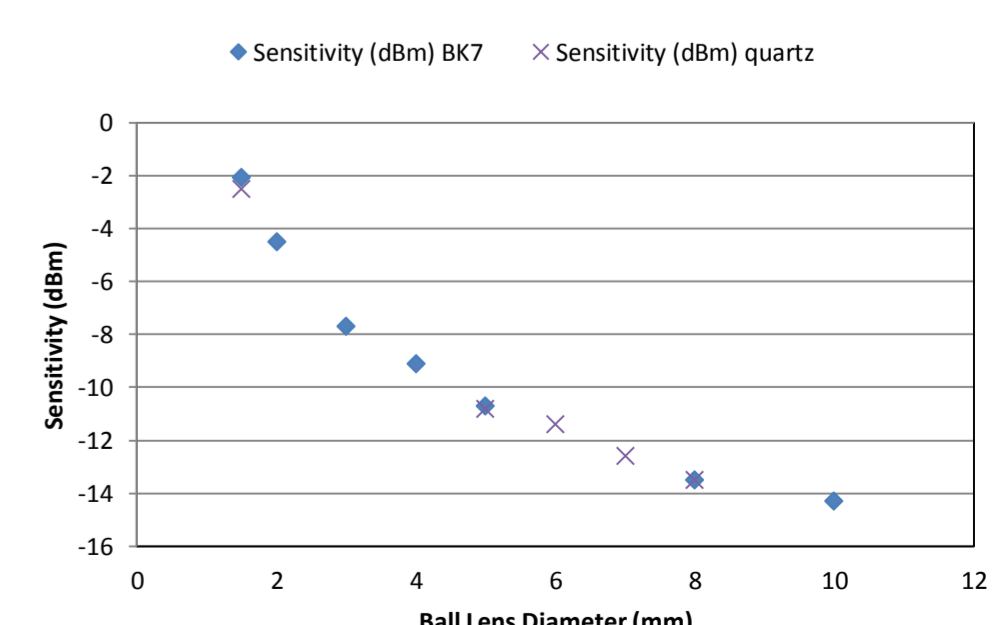


| Collimator | Beam Width(m m) | Experiment | | Simulations | |
|------------|-----------------|--|--|--|--|
| | | Max Displacement (mm)(3dB Point)(Verticle) | Max Displacement (mm)(3dB Point)(Verticle) | Max Displacement (mm)(3dB Point)(Verticle) | Max Displacement (mm)(3dB Point)(Verticle) |
| CFS-2 | 0.38 | 0.25 | 0.2 | 0.2 | 0.2 |
| CFS-5 | 0.87 | 0.25 | 0.25 | 0.25 | 0.25 |
| CFS-11 | 2.1 | 0.55 | 0.65 | 0.65 | 0.65 |
| CFS-18 | 3.5 | 0.9 | 0.8 | 0.8 | 0.8 |

Sensitivity Improvement by Increasing Ball Lens Diameter

- Simulations of transmission system using VCSEL of 1mW output power and distance of 10 cm have been performed.
- Improvement in Sensitivity is observed as the diameter of ball lens is increased at the receiver.
- Similar results were obtain when Quartz, fused Silica, Sapphire lens (Exhibits good radiation hard Properties) are used instead of BK7.

| Lens type | Refractive Index |
|--------------|------------------|
| BK7 | 1.5 |
| Quartz | 1.536 |
| Fused Silica | 1.44 |
| Sapphire | 1.74711 |



Conclusion

Preliminary tasks in order to design the OWC link between Silicon strips sensor are performed. 1550 nm wavelength will be used for transmitter source. Experimental Tolerance study and simulation will be used to design OWC system with required tolerance and transmitter power limitation. Moreover study of radiation hardness of optical components and optics are required.