“Optical Fibre Connection Performance Investigation for BigBOSS”

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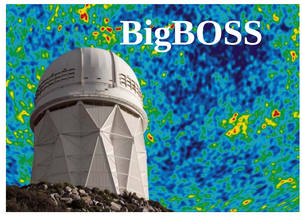
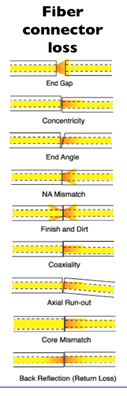


Abstract

Fibre optics connectors with satisfactory performance in terms of throughput and conservation of étendue would be beneficial to many astronomical fibre optic systems. We measure the focal ratio degradation performance of various methods of fibre connections which are commercially available in order to establish a method which will meet the BigBOSS design requirements. These results are then compared to theoretical predictions in order to quantitatively evaluate their performance.

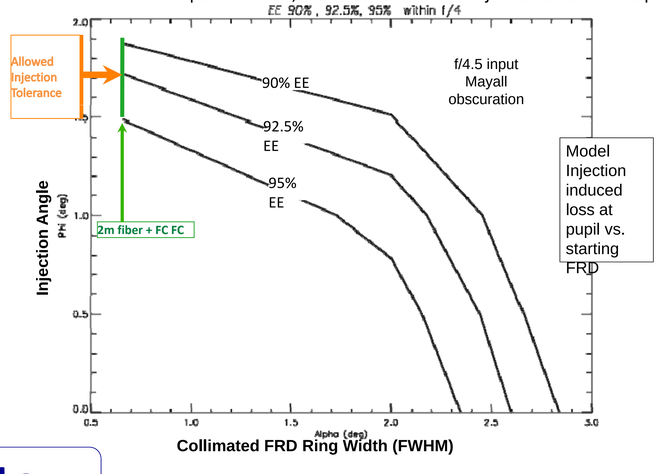
Modelling FRD and injection loss

- In-line connections:
  - Provide for component installation & test
  - Facilitate project fabrication & integration flow
- Possible sources of loss from connections:

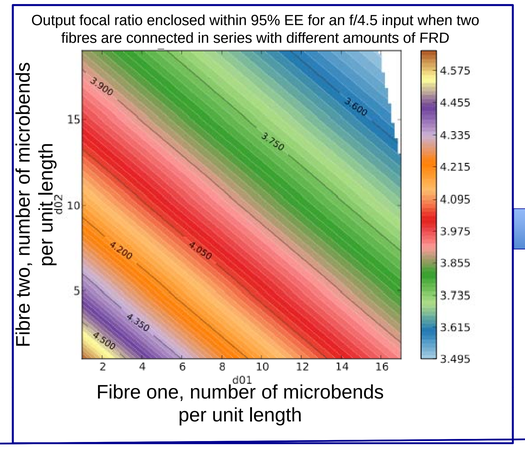


Flux	Immersion Mitigates	Injection Angle
loss fringing	yes	
loss (1% for 1um)		
loss fringing	yes	I.A. +
loss (small)		
loss blue!	yes	
loss (1% for 1um)		
loss fringing	yes	I.A. +
loss (3% for 2um)		
loss (small)	yes	

- If we model the fibre using the standard Gloge[1] model we can perform a trade study which compares the FRD performance of the fibre to the tolerance of the injection angle of the positioners
- If the fibres have a better FRD performance, the tolerances of the injection error on the positioners can be relaxed.



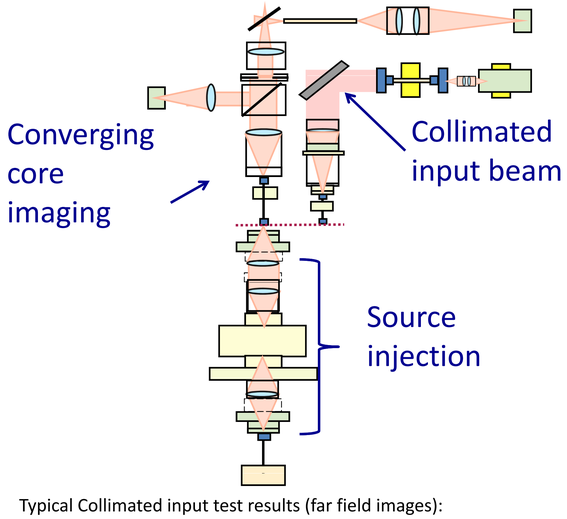
- Since the connectors are simple two fibres in series, we can use the two fibre model[2] to predict the FRD performance of the system if we know the performance of the individual parts.
- The Gloge model assumes that the FRD performance of a fibre is a result of the number of microbends per unit length, d_0. This figure shows the total FRD which manifests as a result of two fibres with differing numbers of microbends per unit length.



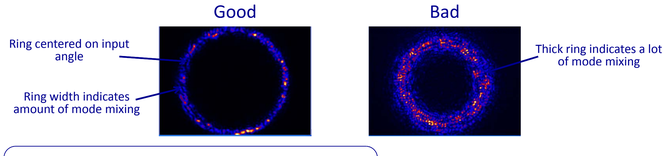
The contours of constant FRD are broadly consistent to straight lines with slope -1

Collimated input test results

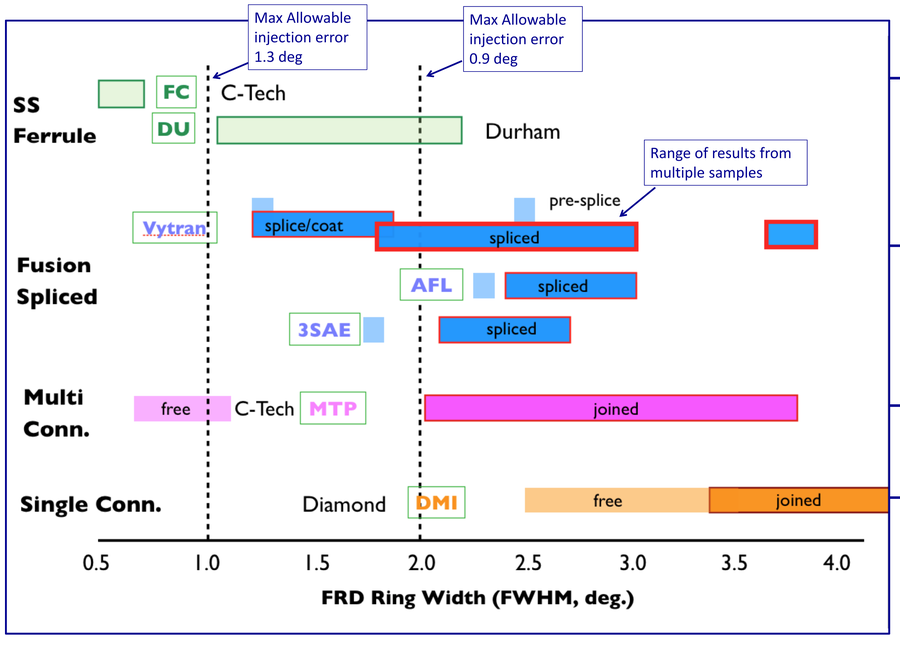
- A test rig has been designed that can perform
  - Collimated input tests
  - Converging beam tests
- To-date, only collimated input tests have been performed



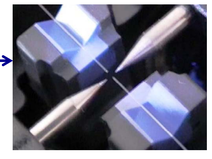
- Typical Collimated input test results (far field images):



- Test results allow us to calculate the injection error tolerance of the positioners using the theoretical model and a requirement that 95% of the enclosed energy falls within f/4

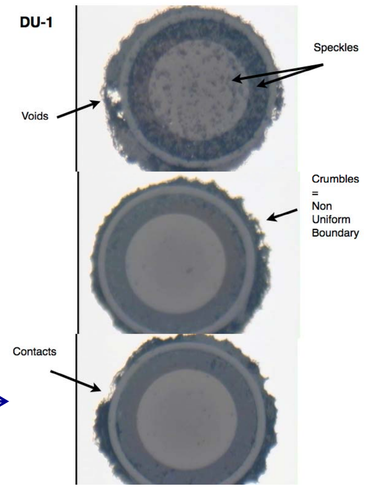


Possible issues with end finish



MTP X 32

DMI 20 x 4.4 mm dia



Conclusions

- Splicing may prove to be a viable, cost effective option when connecting fibres
- We are currently testing more fibres with better initial FRD performance in order to asses how much additional FRD is contributed by the connection
- Converging core input tests are being performed in order to be able to compare theoretical FWHM performance to experimental results

[1] Gloge, D., 1971, Bell Syst. Tech. J., *51*, 229
[2] Poppett C. L., Allington-Smith J. R., 2010, MNRAS, *404*, 1349

BigBOSS

Mapping the Universe

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