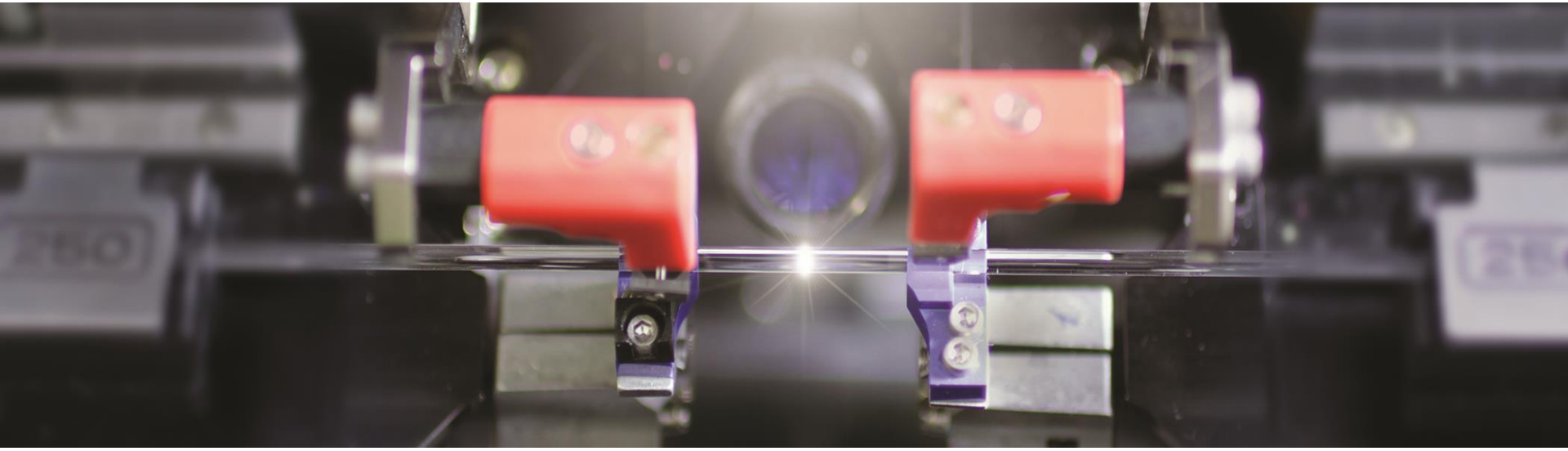
The introduction of advanced optical fiber splicing technology



Tomohiro KONUMA
Fujikura Europe Ltd.

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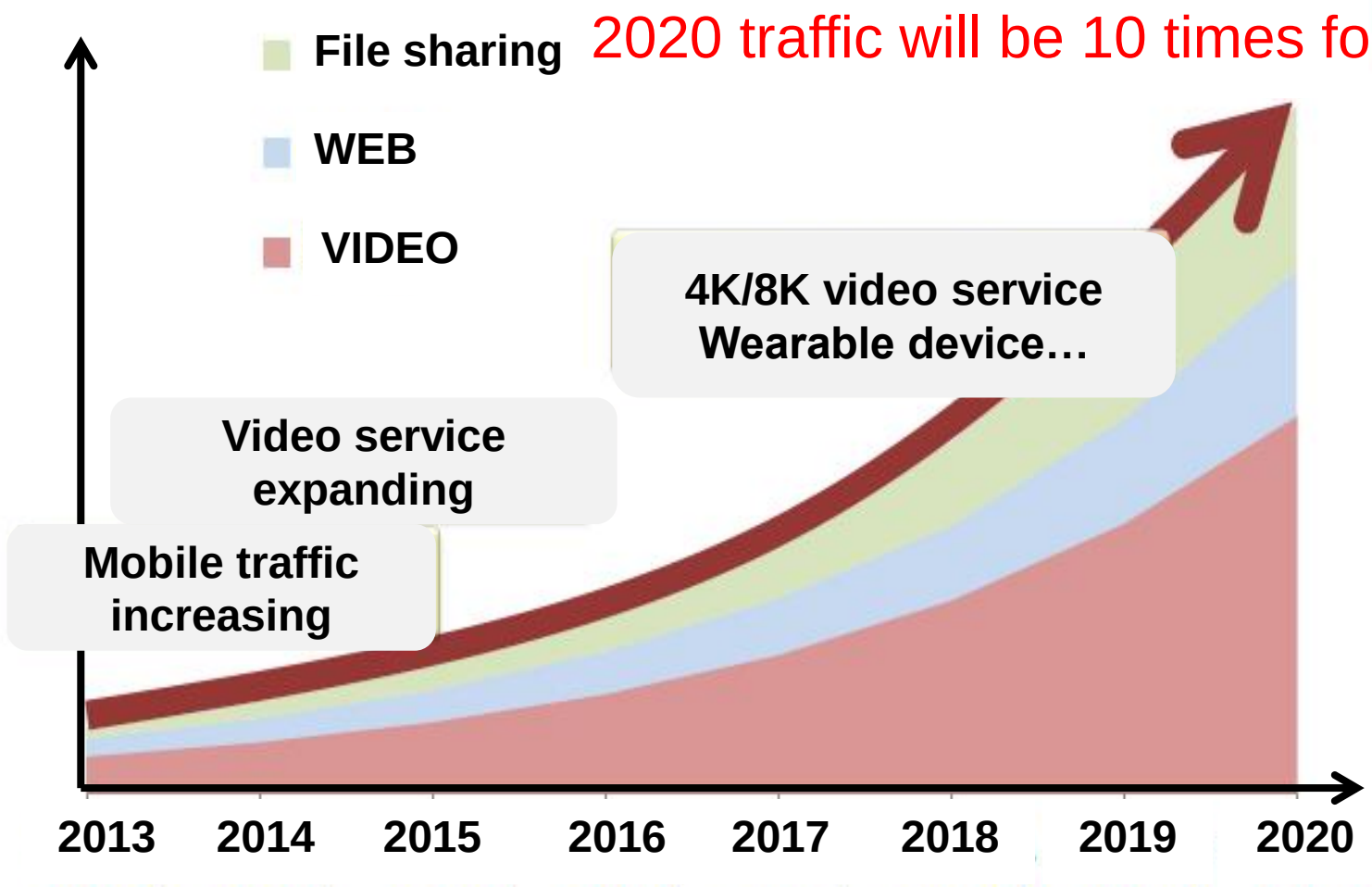
Internet Traffic Volume Trend



✓ Required the solution for the backbone traffic capacity

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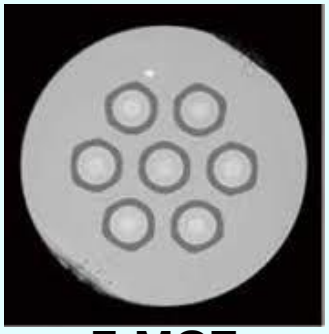
How correspond to traffic increasing?

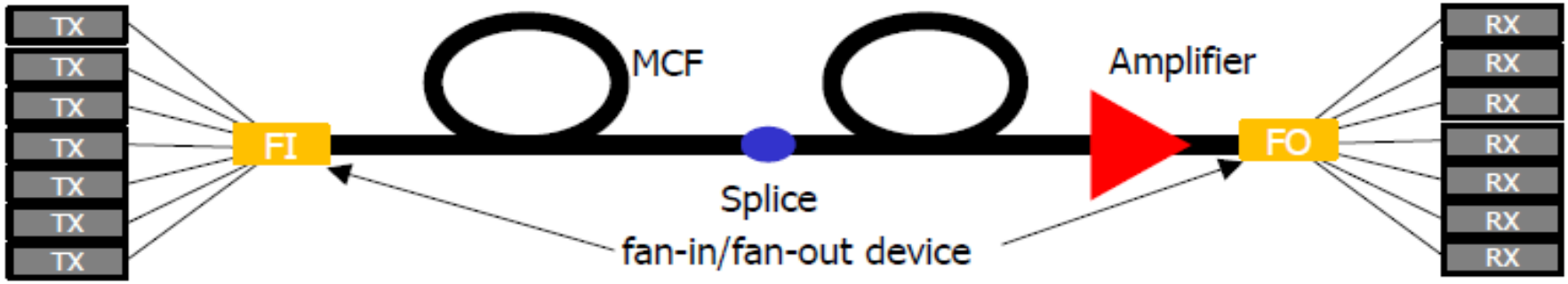
Installing more cable?

Keep the cable size and
increasing the traffic capacity of cable will be our way!

- How to achieve?

➢ Minimize fiber coating(200um coating fiber)
➢ Multi Core Fiber(MCF)


7-MCF



For new fiber,
NEW splicing technology is required!!

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Review of Standard splicer function

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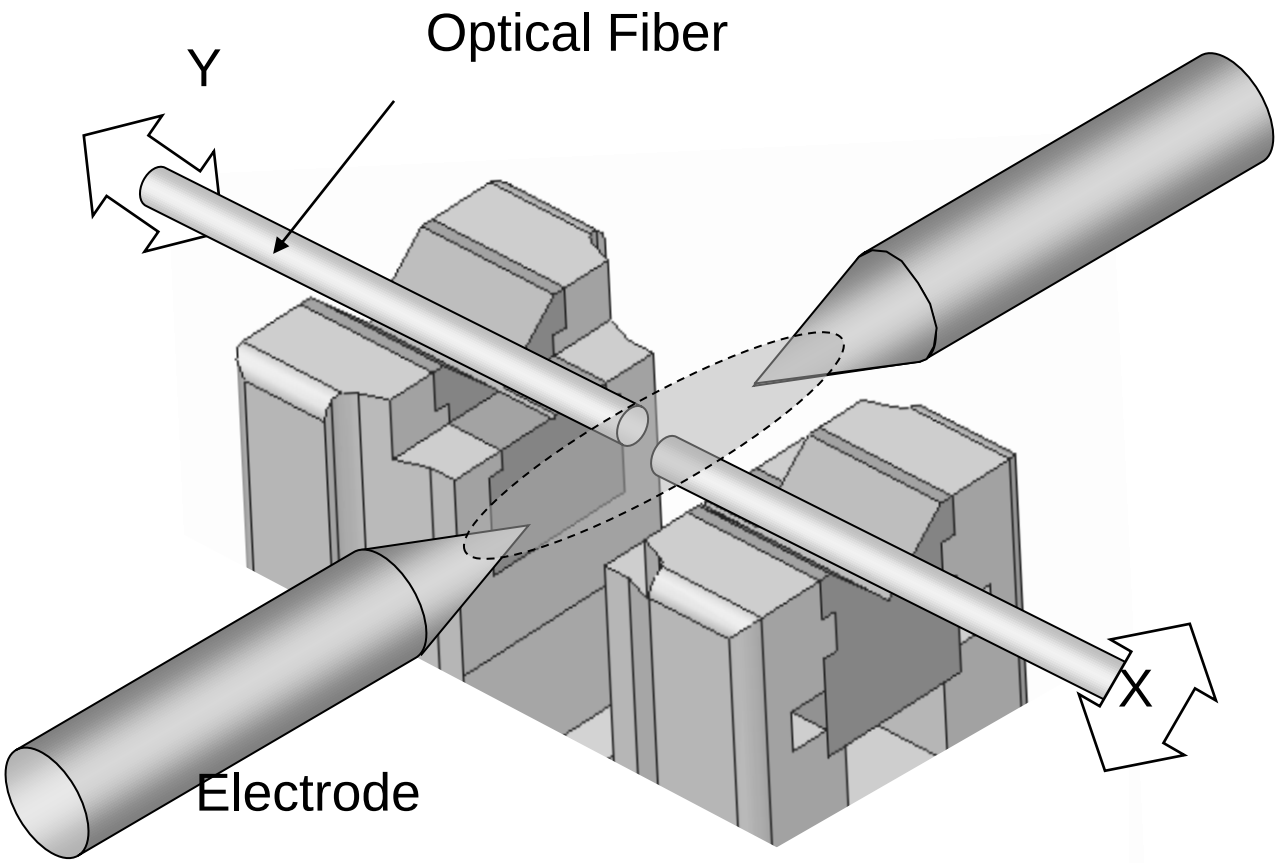
Review of Standard splicer function

Alignment and heating function



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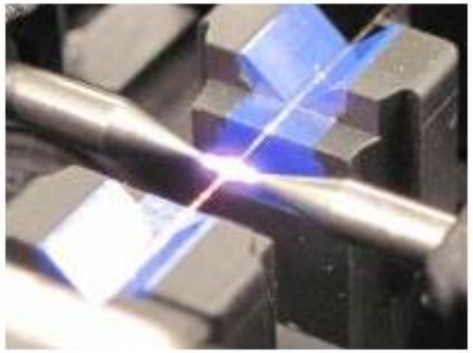
Review of Standard splicer function

X/Y Alignment



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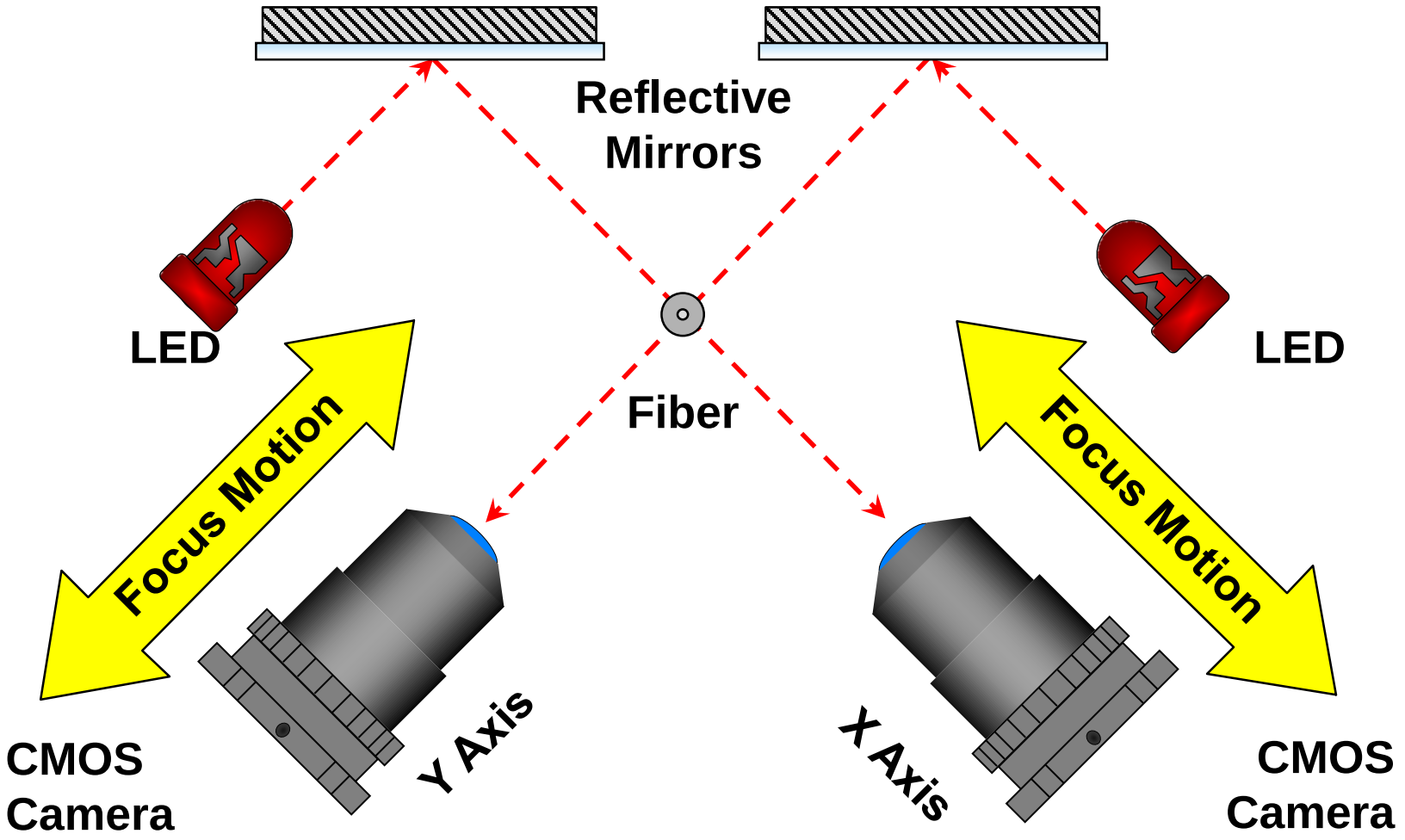
Review of Standard splicer function

Optical Path System



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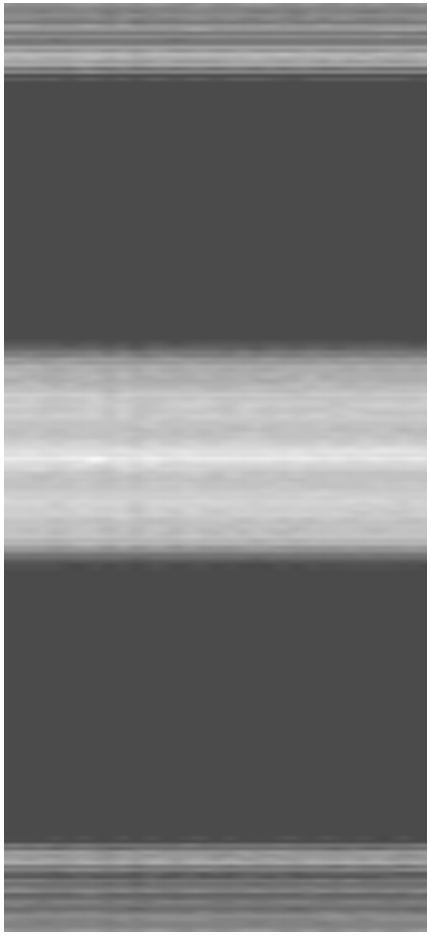
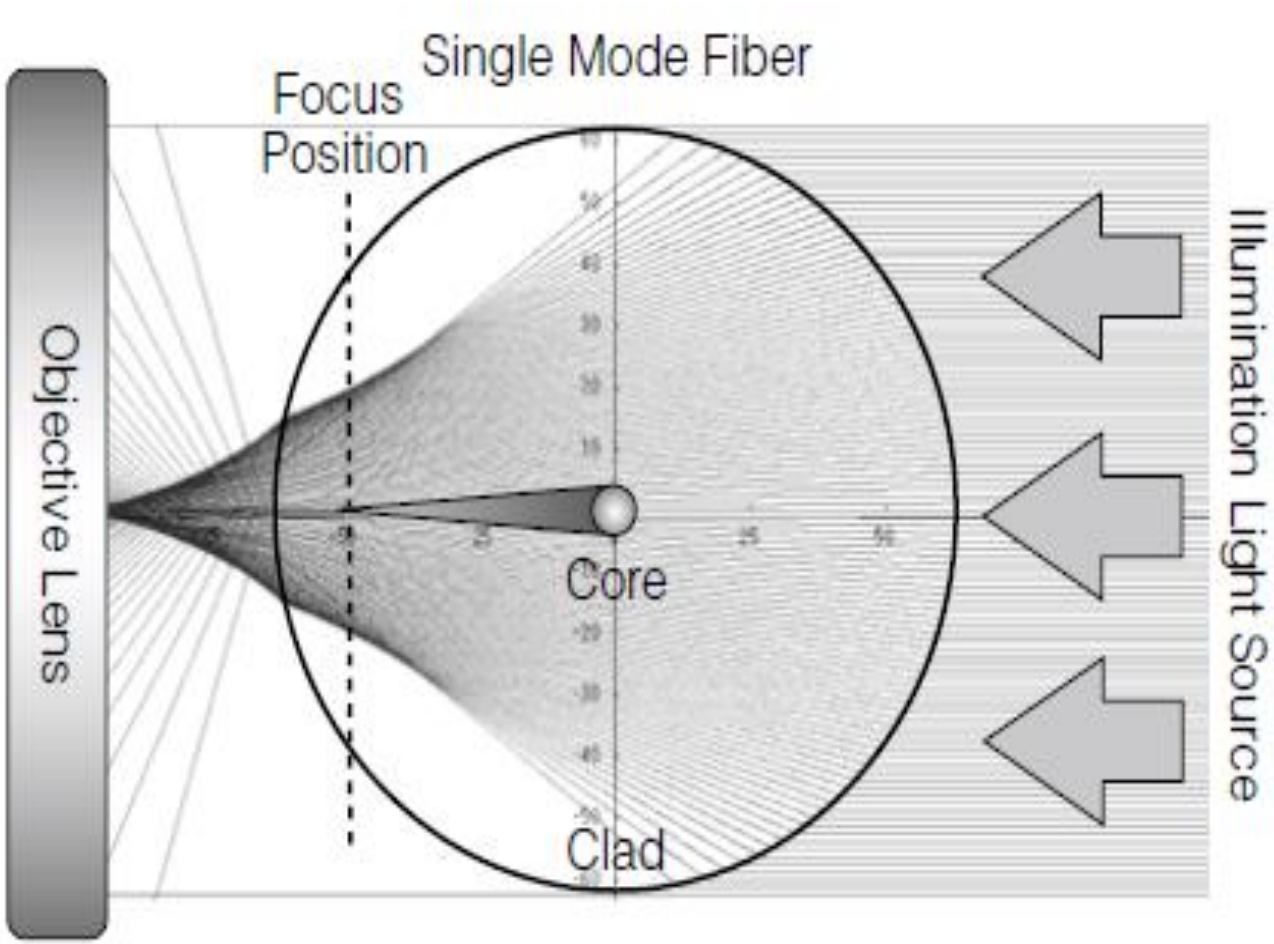
Review of Standard splicer function

Optical Path System



Camera Image



✓***Splicer observe the fiber side view***

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Multi Core Fiber (MCF) Splicing

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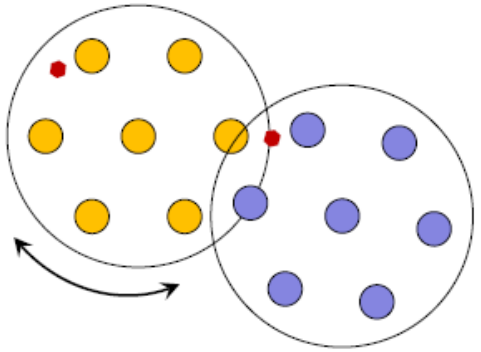
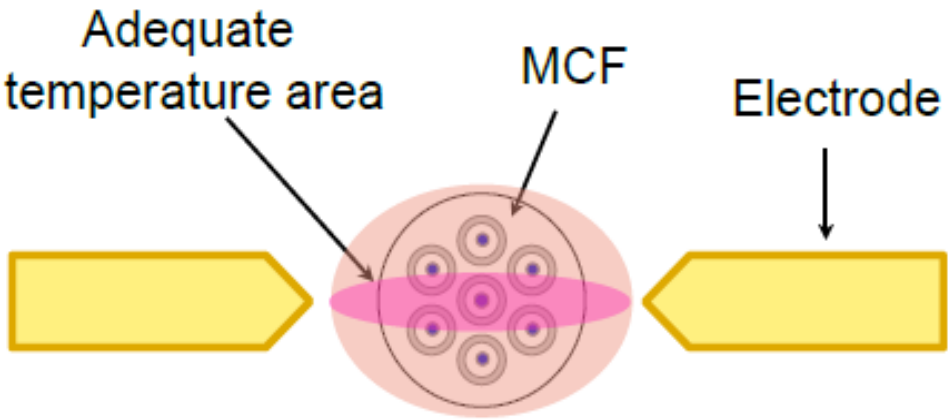
Issues for MCF splicing

Outer cores that locate apart from the center of cladding

1. ***Fiber Alignment***
   - ✓ Fiber rotation for alignment with precise core position detection



2. ***Fiber heating***
   - ✓ Uniform heating for all out side core



**Special Splicer(FSM-100P+)
for MCF splicing**

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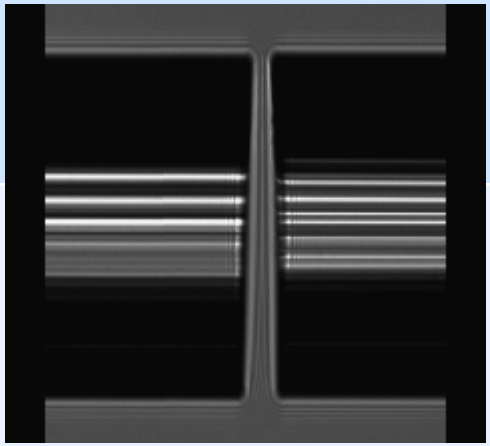
MCF Alignment Issues

Considerable Alignment methods

	Pro	Con
Manual Alignment	• Available current fusion splicer	• Very difficult to recognize the each core position • Performance will depends on operator skill
Automatic Alignment	• Available current fusion splicer • Accurate alignment	• Alignment algorism must be optimized to each fiber structure
Power meter feedback alignment	• Very Accurate alignment	• Measurement system is necessary. (Impractical in filed use)



Side View Image(standard splicer image) is not enough for MCF alignment.

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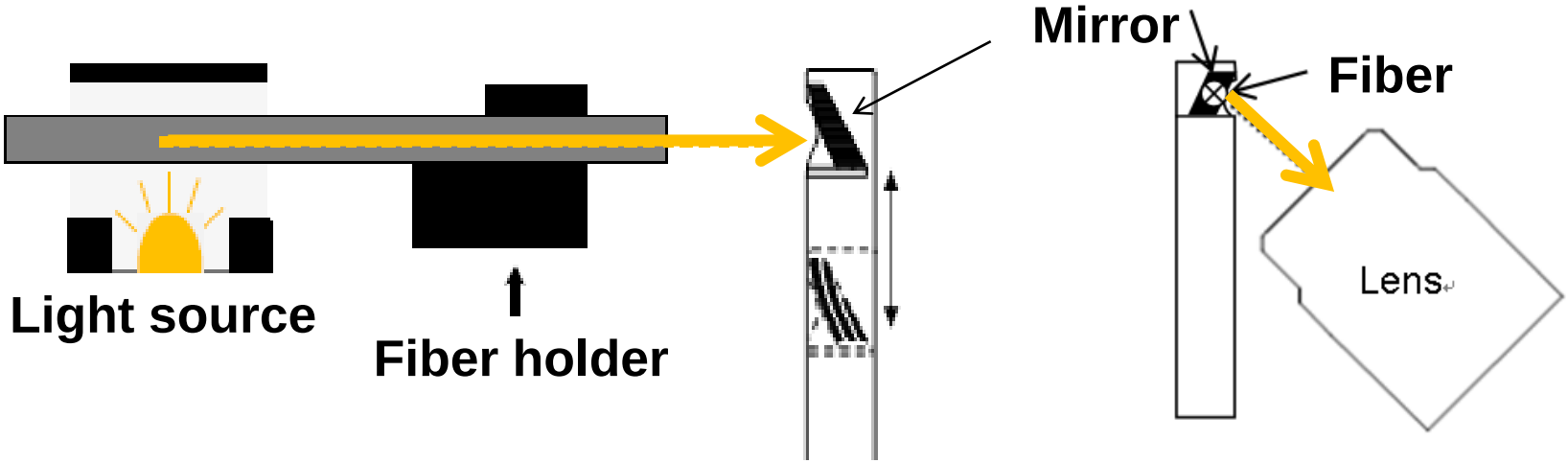
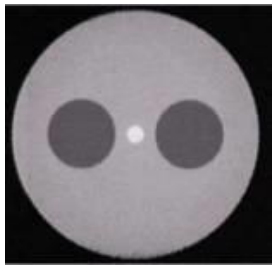
MCF Alignment (End-View)

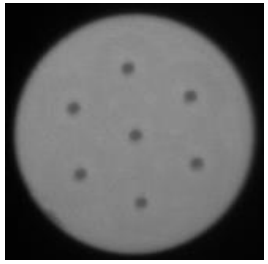
Fiber End-View Observation System



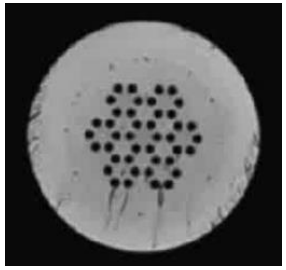
Observed Fiber End-Face image



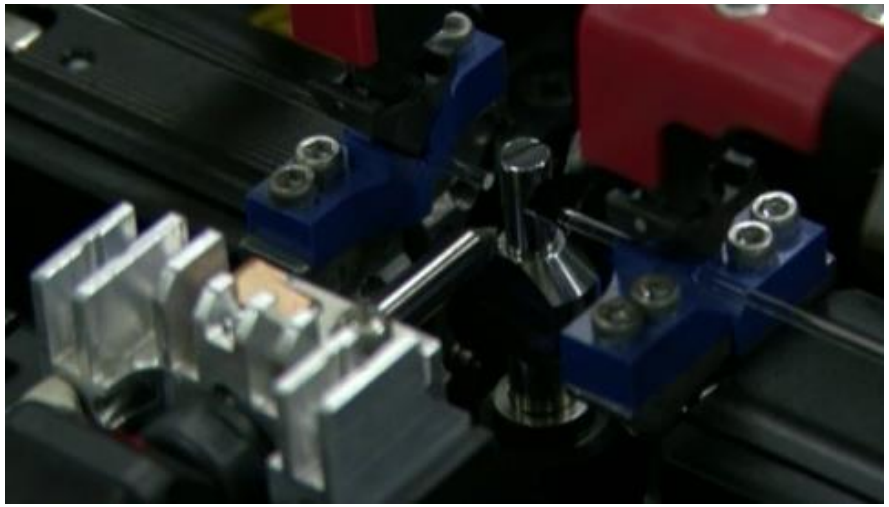
PANDA



7-MCF



7-MCF (PCF)



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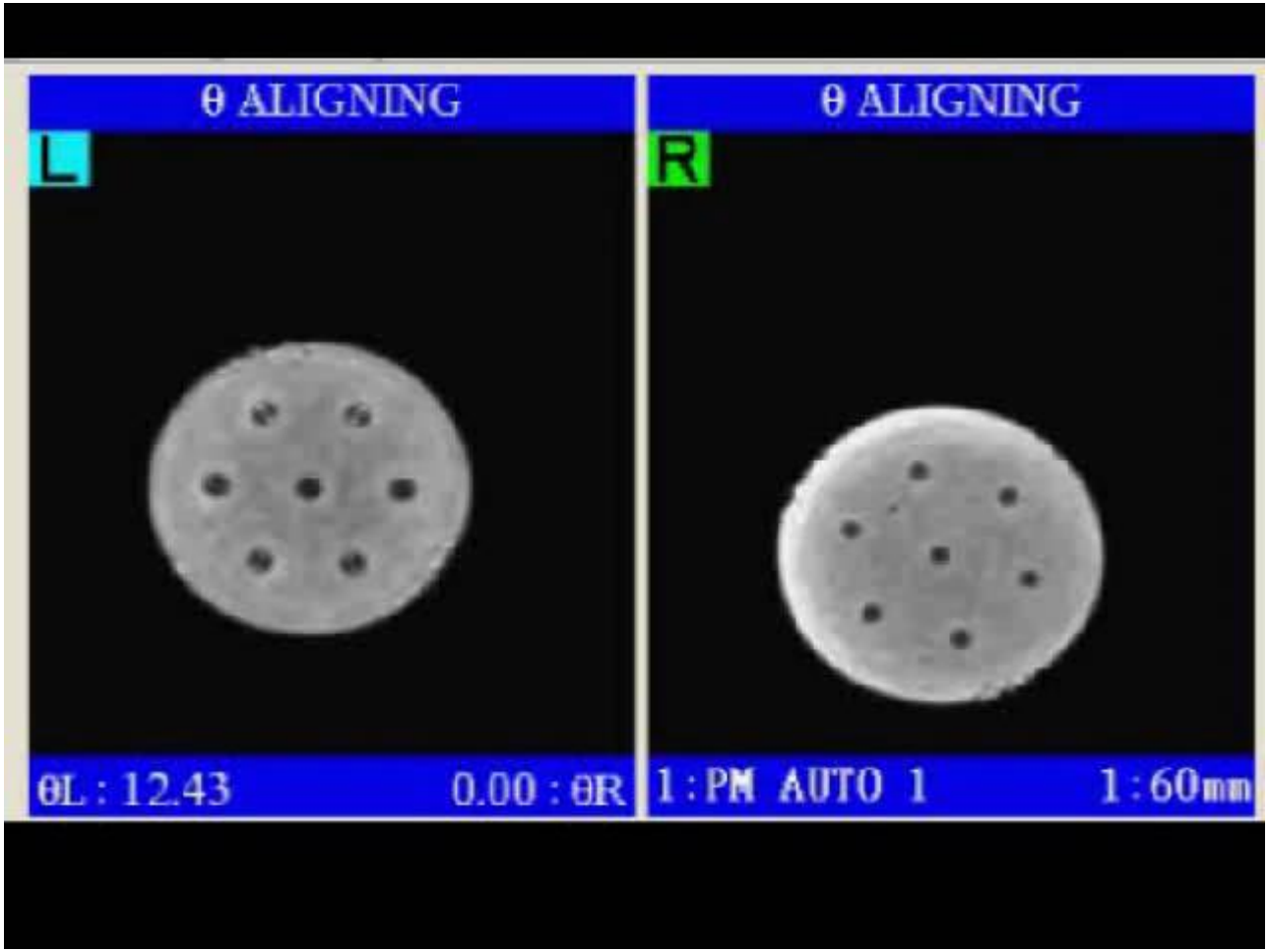
Automatic MCF Alignment

7-MCF Automatic alignment with End-View



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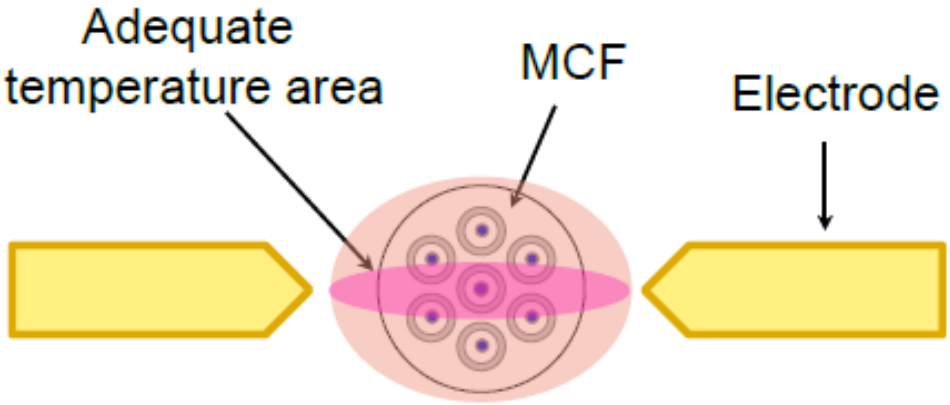
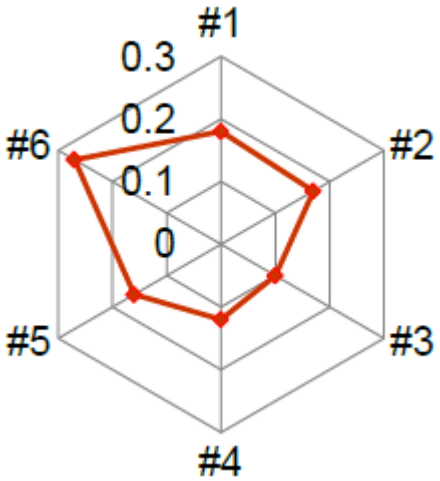
MCF Heating Issues

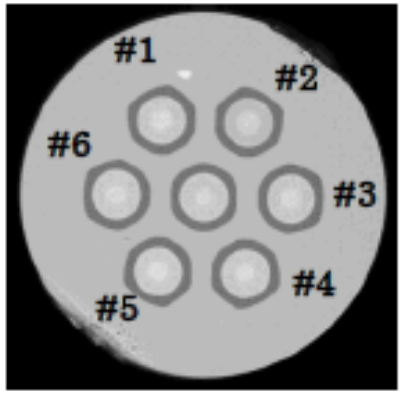
Weakness of static electrodes system for MCF heating



- Adequate temperature region is narrow.
- Temperature of outer cores are unstable.

➢ Splice loss variation depending on the core position





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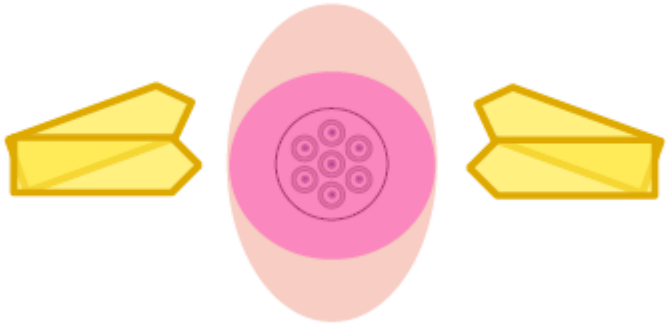
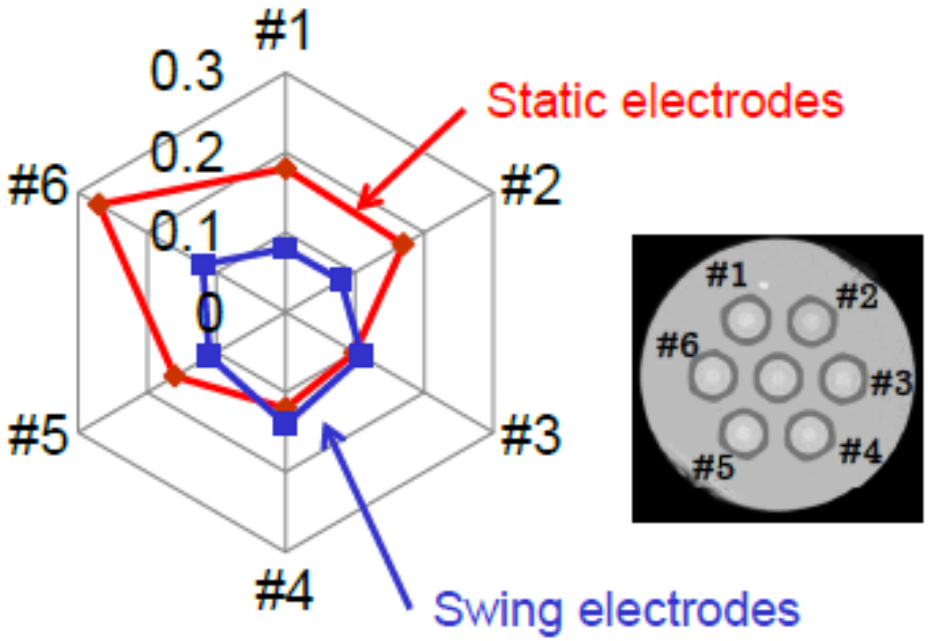
MCF Heating Solution

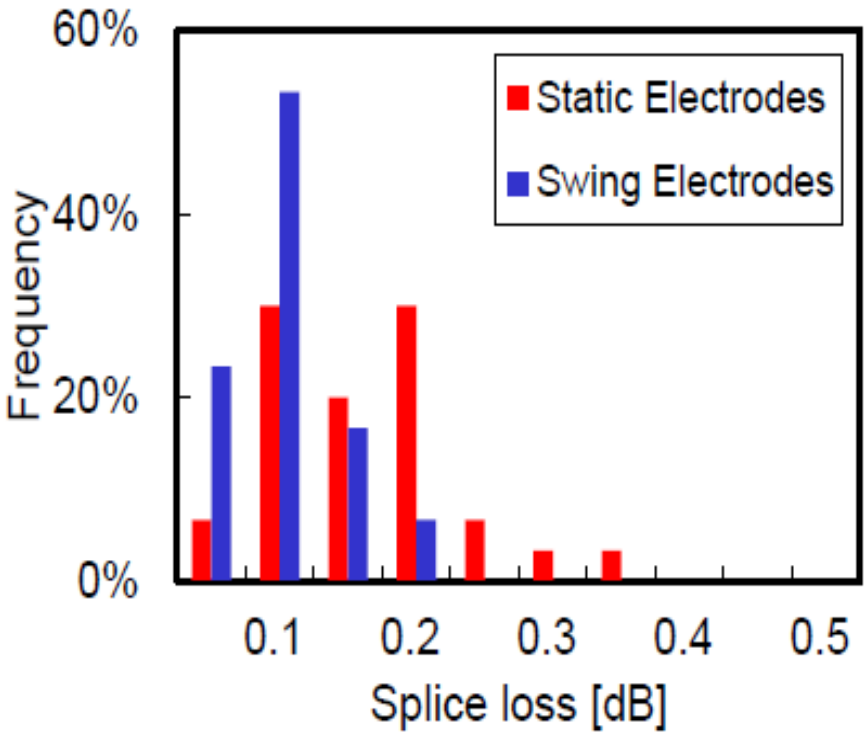
Electrodes Oscillation

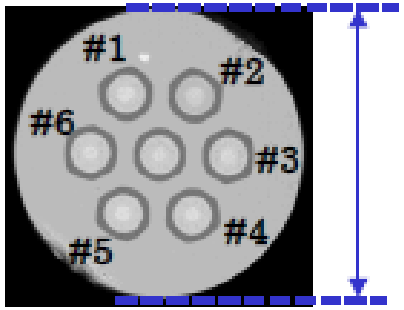
- Adequate temperature region can be enlarged by electrodes oscillation





MCF Splicing Performance





Cladding diameter

Item	Value
Cladding diameter	181 μm
MFD at 1550 nm	12.1 μm
A_{eff} at 1550 nm	112 μm^2

	Splice loss [dB]			Number of data
	Average	Max	Min	
Swing Electrodes	0.08	0.18	<0.01	30
Static Electrodes	0.15	0.35	<0.01	30

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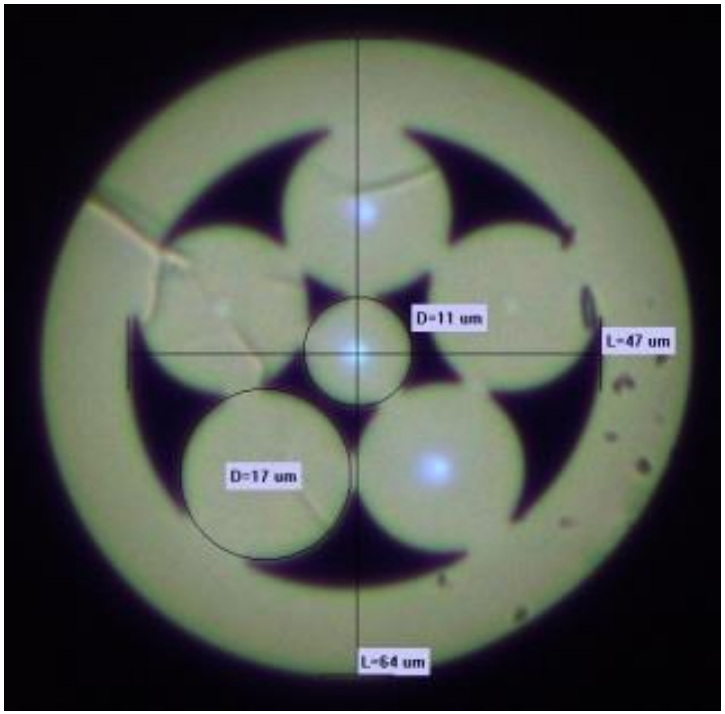
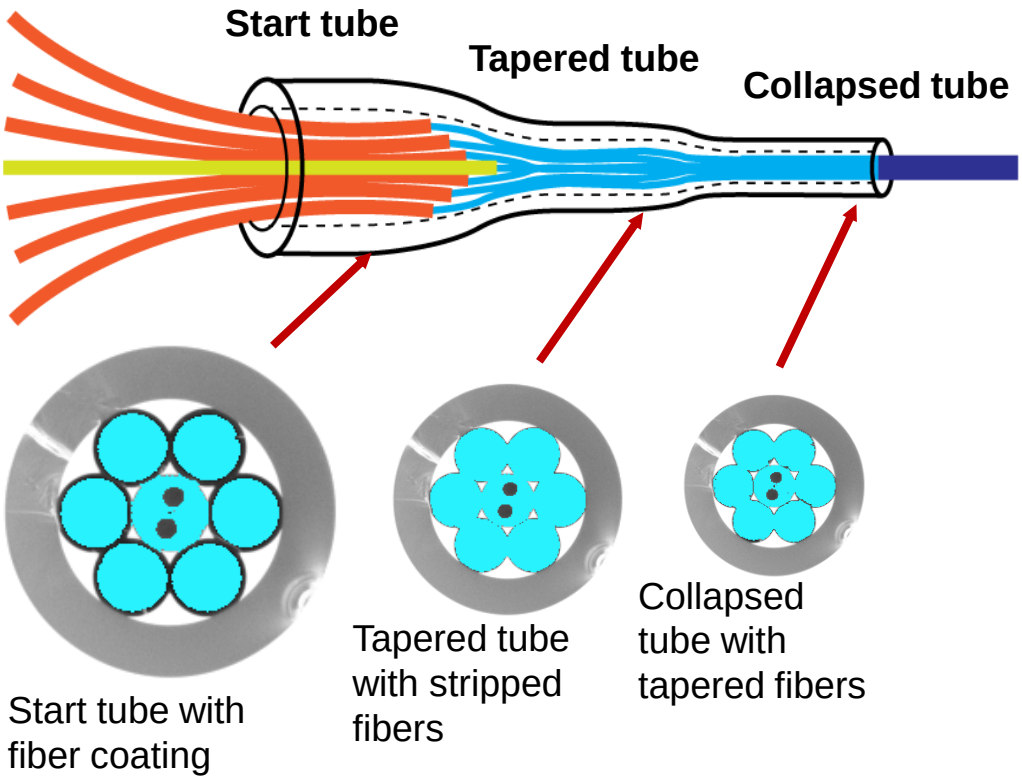
Fan-In/Fan-Out Device by CO2 laser splicer

Splicer is not for splicing but also glass processing!



- 5x 125um SM outer fibers
- 1x 80um SM center fiber



✓ **Fan-In/Out application has developed by LZM-100 CO2 Laser splicer**

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Conclusion

- ✓ ***Fujikura has developed the solution for MCFs connection solution.***
  - End-View function for MCF automatic alignment
  - Electrodes oscillation function for wide-area uniform heating
  - Fan-In/Out application manufacturing

Standard Splicer 70S

Specialty Splicer FSM-100P+

CO2 Laser Splicer LZM-100

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Thank you.

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