

Modal Excitation of Optical Fibers

(5): MPD and $I(r)$ for Small Offset Launches

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1. Summary

The purpose of this note is to give a specific example where a nonmonotonic $I(r)$ occurs with an offset launch of a Gaussian beam even if perfect coupling within mode groups is assumed. This occurs in those cases whose MPD has a maximum at mode 2, a nonradial mode whose power goes to zero at $r = 0$.

2. Theoretical Results

Figure 5.1 shows the calculated MPD for a single mode Gaussian spot at 1300nm launched into a 62.5um 2% Δ fiber with offsets from 5 to 10um. Although the mode power distribution is gradually shifting, the launches at 6-8um have a maximum at Mode Group 2, which is a single nonradial mode with zero power at the center $r = 0$. Mode Group 1 is the fundamental mode, and Mode Groups 3 and 4 each have 2 modes in them.

This model assumes sharing of power within a mode group and hence the coupling into groups 3 and 4 is the average of the coupling into the individual modes of the group.

Figure 5.2 shows the intensity distribution $I(r)$ for the MPDs given in Figure 5.1 Note that the distributions for 6-8um offsets show a small but distinct minimum at $r = 0$, which persists but is decreasing at the larger offsets.

$I(r)$ is approximately a Gaussian centered at $r = 0$ for a zero-micron offset (centered launch), corresponding to near-perfect coupling into the fundamental mode. For larger offsets [1], $I(r)$ is flat out to a certain radius and then tapers down with a 'Gaussian-like' tail (again assuming coupling within a mode group). The plot in Figure 5.2 shows $I(r)$ in the transition region where $I(r)$ is determined by a relatively few number of modes.

3. References

- [1] Abbott, J.S., "Modal Excitation of Optical Fibers. (3): Offset Launch with Gaussian Spot", *TIA 2.2tg Draft Notes* July 1, 1998.

Figure 5.1
 P_m for small offset launches

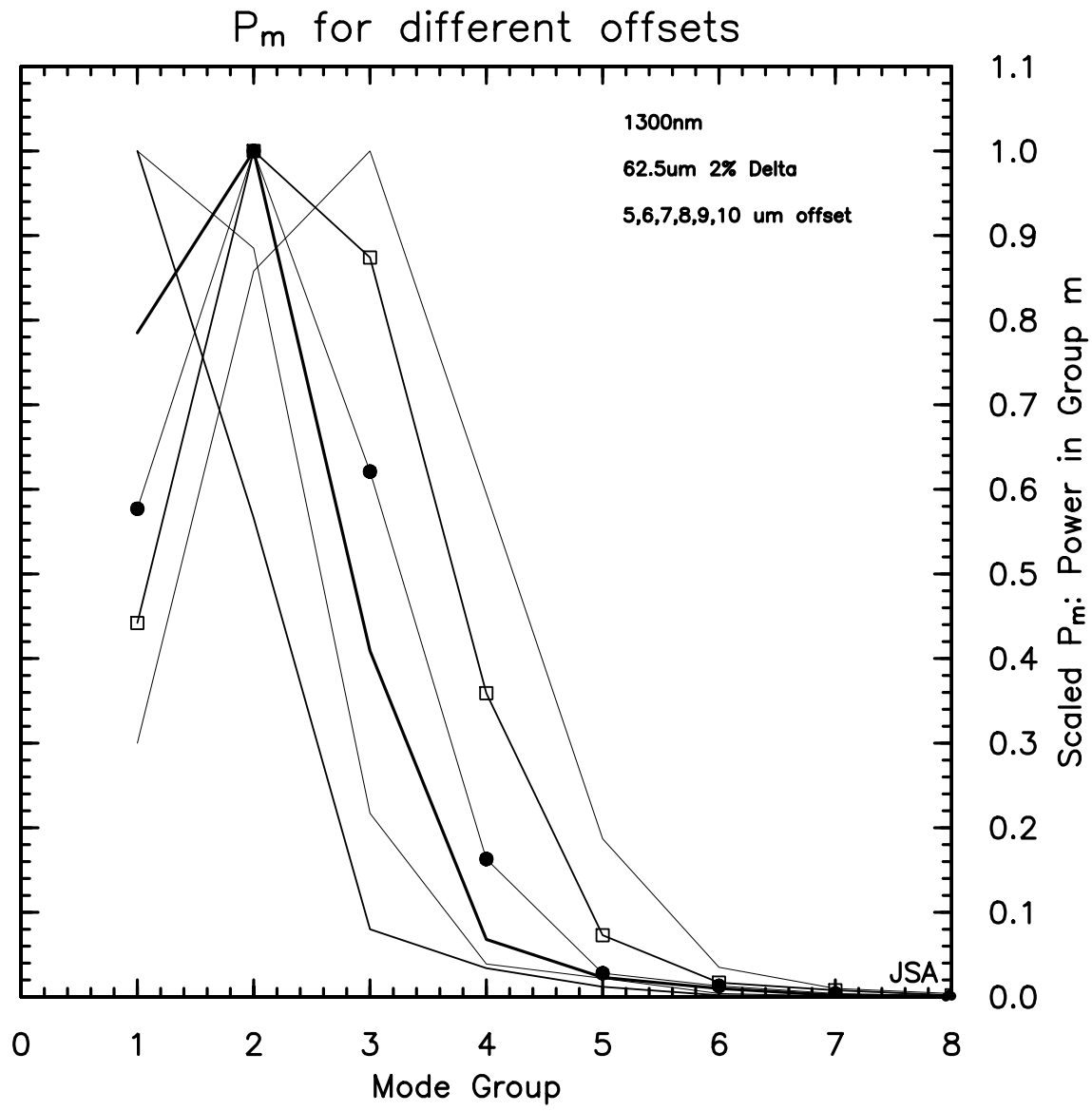


Figure 5.2

$I(r)$ corresponding to the offsets in figure 5.1

Note nonmonotonic behavior for offsets with maximum power at mode 2

