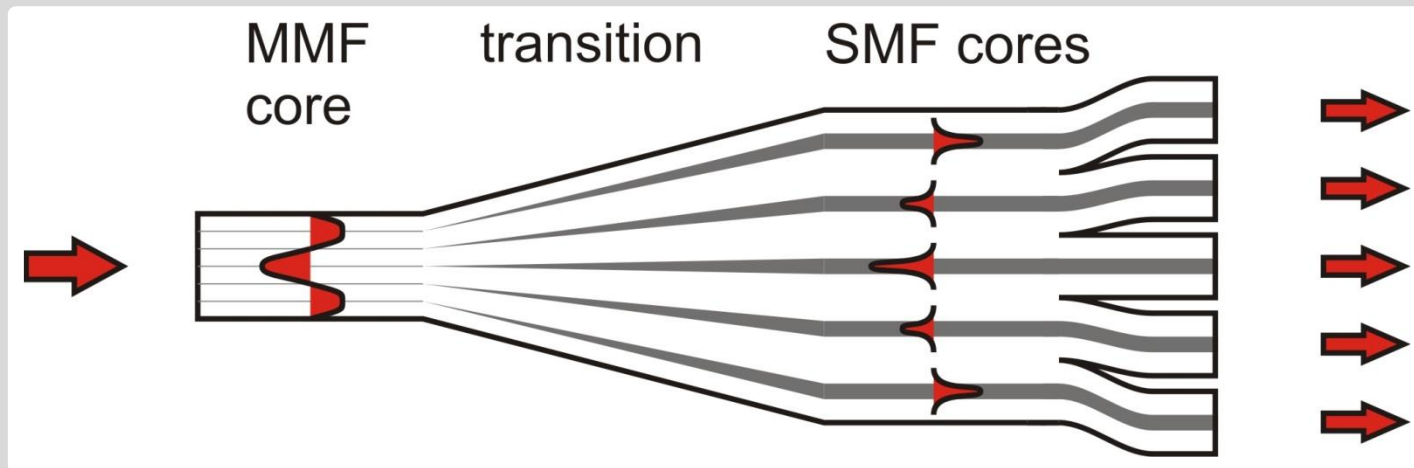


# Photonic lanterns

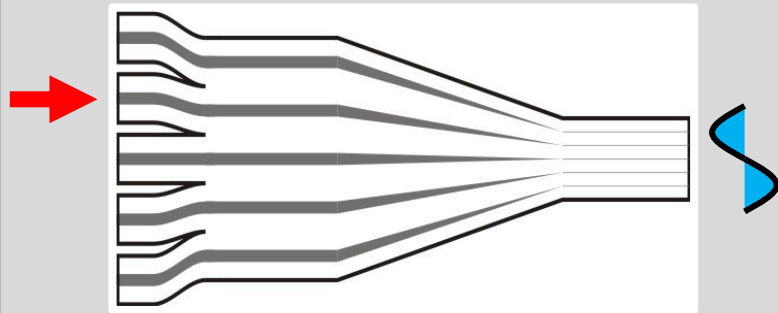
Tim Birks, University of Bath



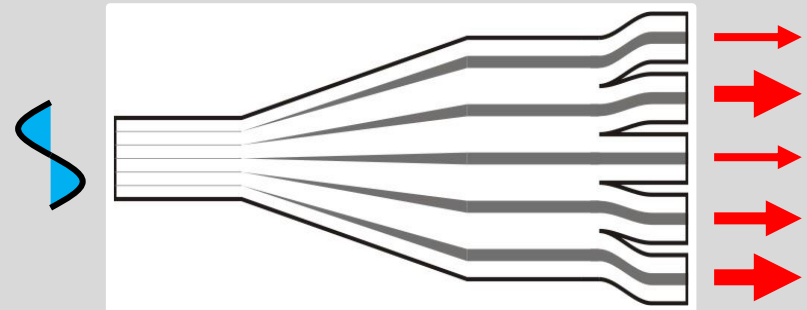
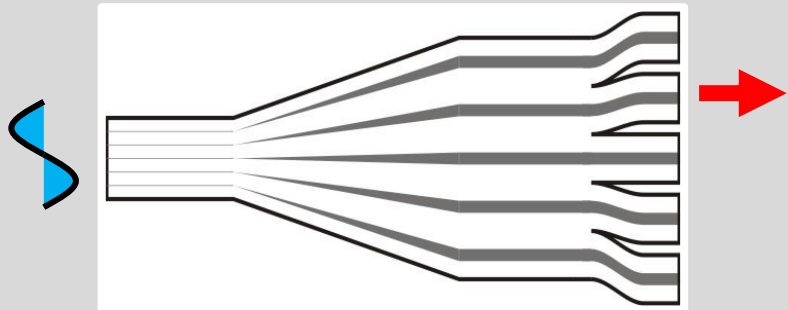
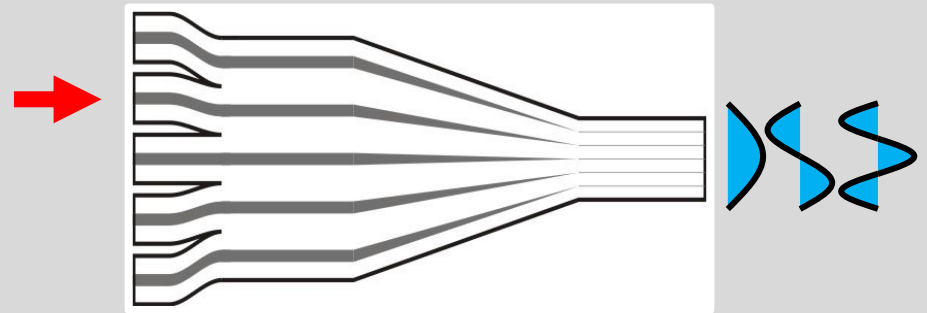
*number of MMF modes = number of SMF cores*

## *Not a (direct) mode multiplexer*

*mode multiplexer*



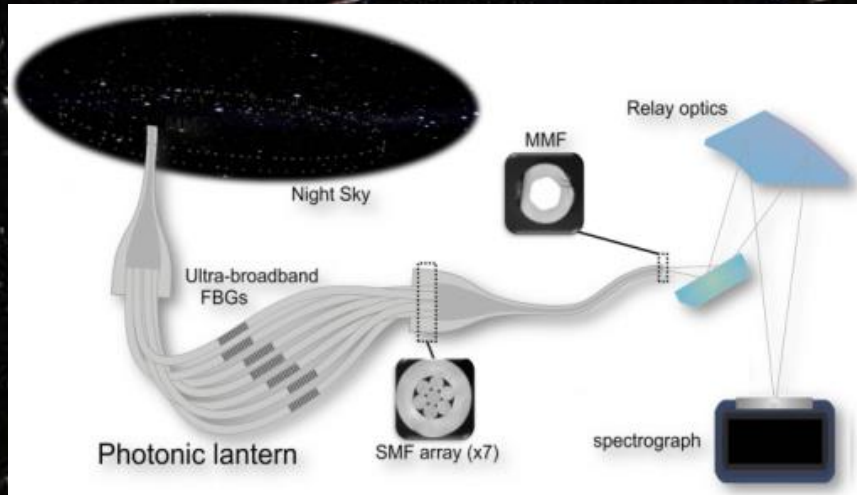
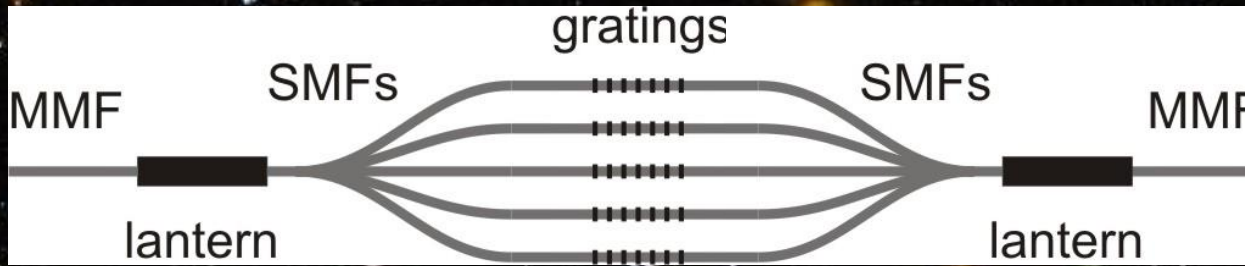
*photonic lantern*



eg, S. Yerolatsitis, ECOC (2013)  
Mo.4.A.4 (17:00 Monday)

# The original application

*interfacing single-mode FBGs to multimode telescope optics:*



why call it a "lantern"?



[www.things-to-make-and-do.co.uk](http://www.things-to-make-and-do.co.uk)

*SG Leon-Saval et al, Opt Lett 30 (2005) 2545*

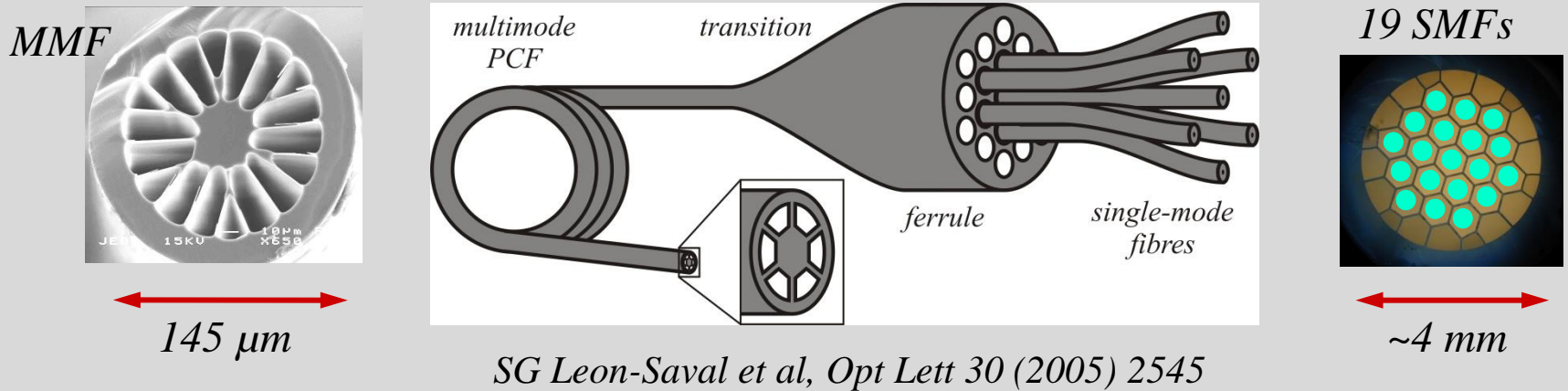
*J Bland-Hawthorn et al, Nature Commun 2 (2011) 581*



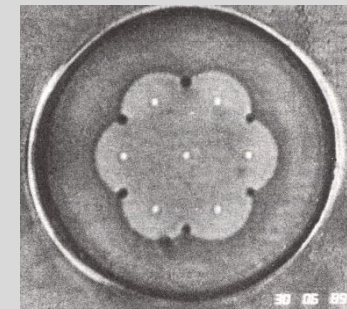
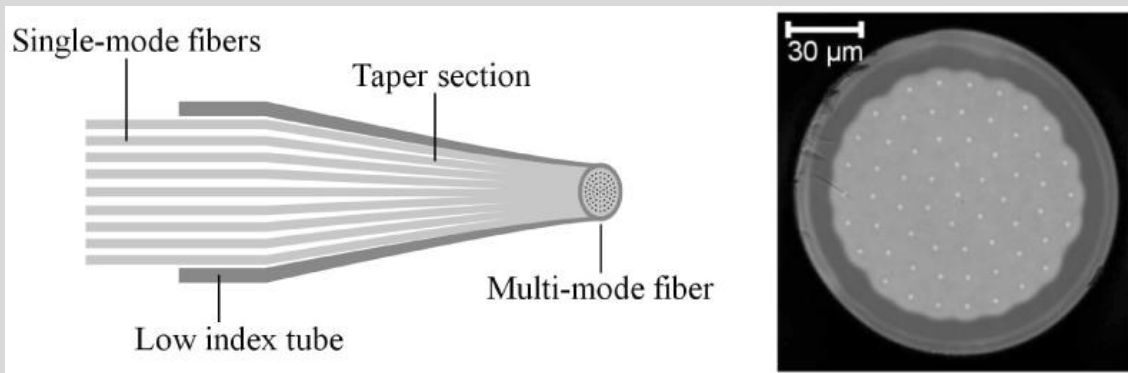
UNIVERSITY OF  
**BATH**

# Four ways to make photonic lanterns

## 1. SMFs tapered in a photonic crystal fibre template

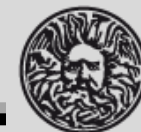


## 2. SMFs tapered in a low-index jacket



*DB Mortimore et al, Appl Opt 30 (1991) 650*

*D Noordegraaf et al, Opt Express 17 (2009) 1988; 18 (2010) 4673*

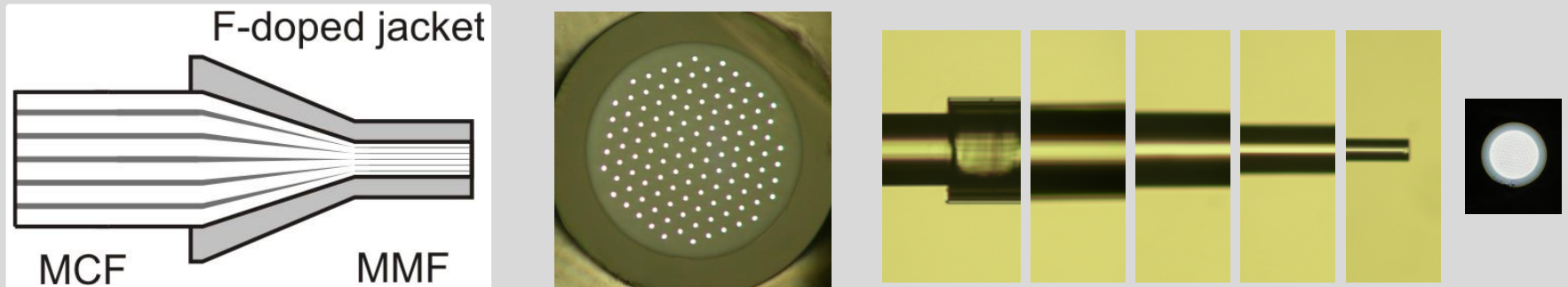


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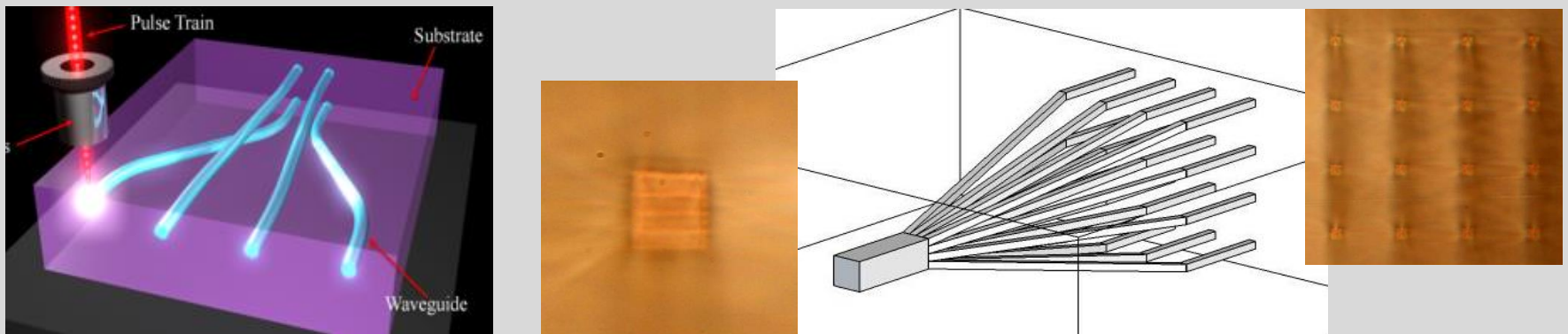
## *Four ways to make photonic lanterns*

### *3. Multicore fibre tapered in a low-index jacket*



*TA Birks et al, Opt Express 20 (2012) 13996*

### *4. Integrated optics written by ultrafast laser*



*RR Thomson et al, Opt Express 19 (2011) 5698*



## Photonic lanterns for SDM

each i/p excites a different orthogonal set of MMF modes

