ADVANCES IN FIBRE DEVICES

David N Payne

Optoelectronics Research Centre
University of Southampton

FIBRE DEVICES

- Low intrinsic losses
- Low coupling losses
- Polarisation independent
- Low manufacturing/assembly costs

But

- Poor electro/acousto/magneto -optic interactions
- Small non-linearity - no $x^{(2)}$
- Long length
- No direct current injection and modulation

APPLICATIONS OF FIBRE NARROW-BAND FILTERS

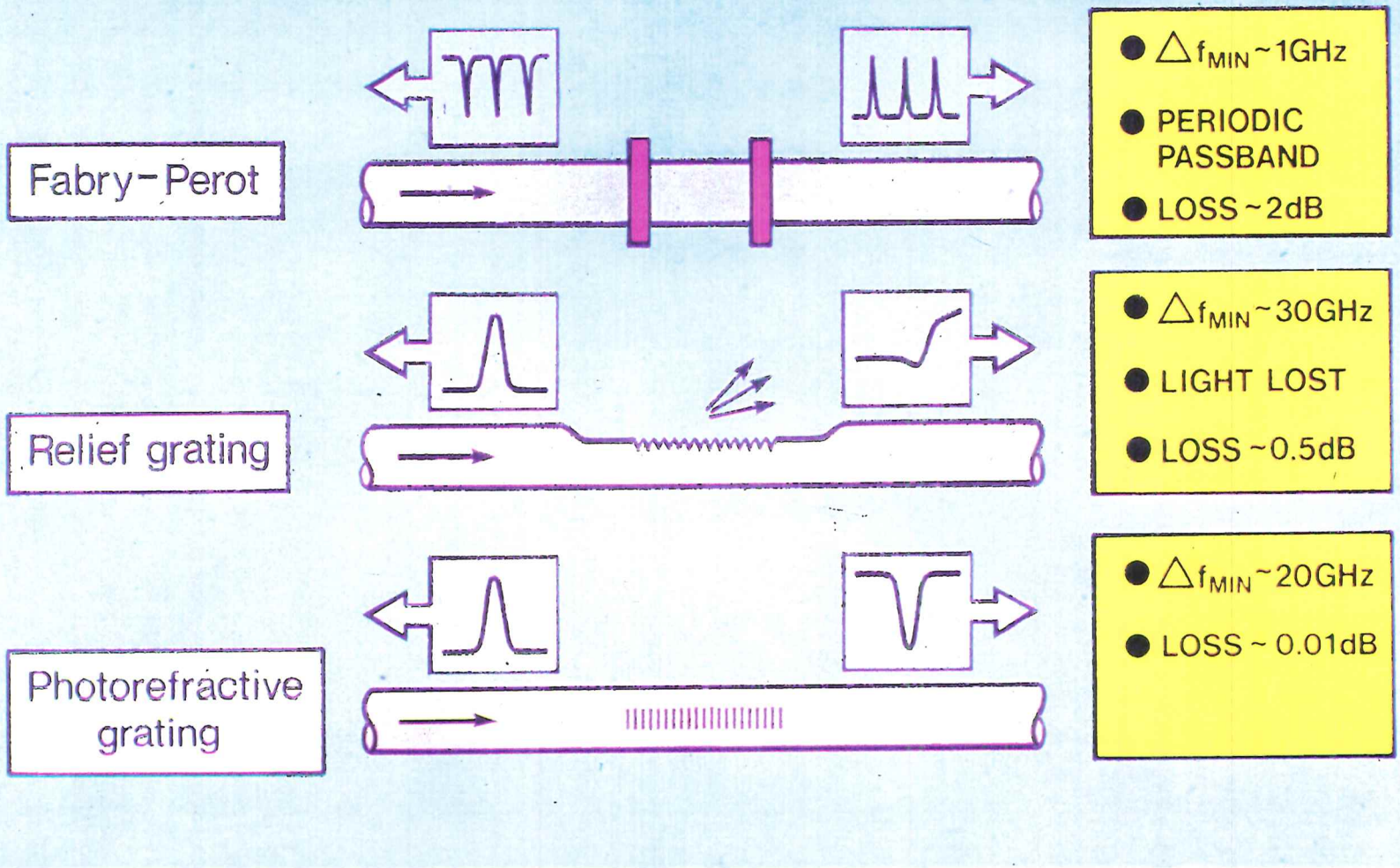
Bandpass (FFP)

- Channel selection in WDM systems
- FSK to ASK conversion
- ASE filtering and noise reduction in optical amps.
- Single-frequency fibre lasers
- Spectral analysis

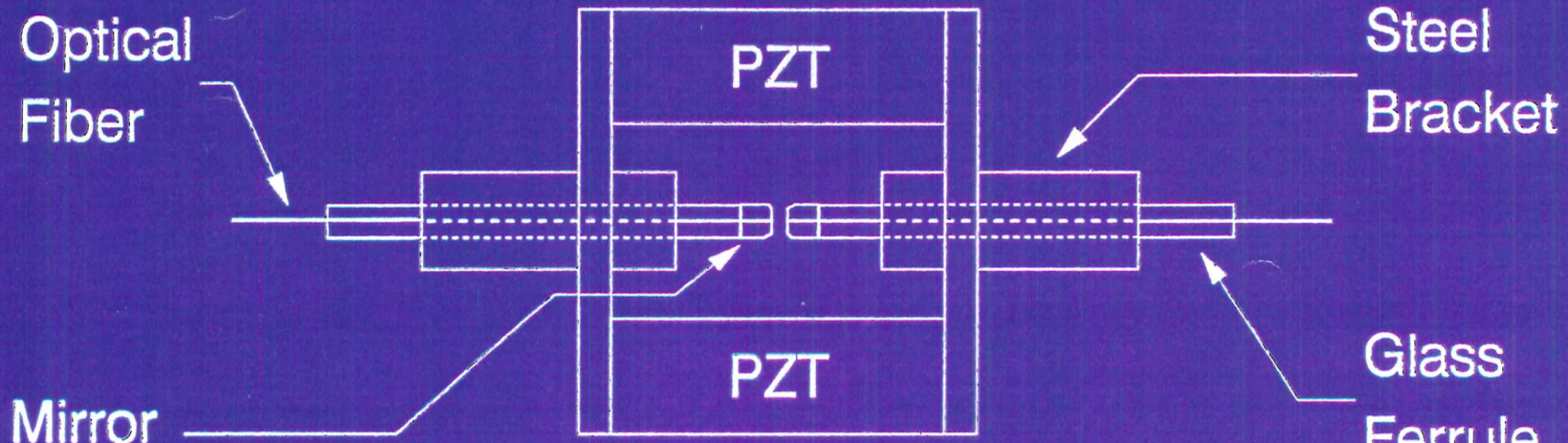
Bandstop (gratings)

- Single-frequency fibre lasers
- Diode laser stabilisation
- Multiplexed sensor systems

COMPARISON OF NARROWBAND FILTERS

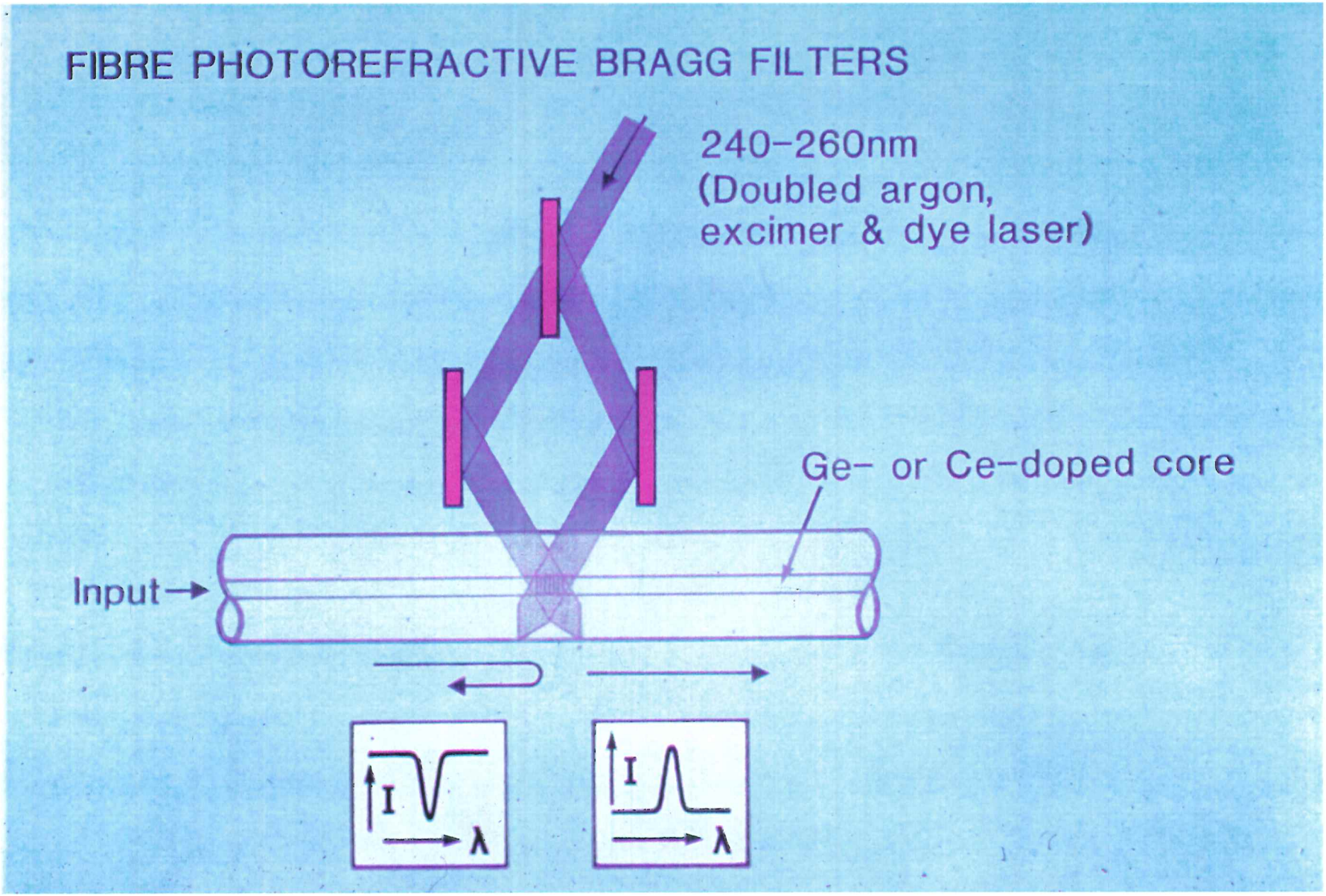


FIBRE FABRY-PEROT FILTER



MICRON OPTICS, INC.

FIBRE PHOTOREFRACTIVE BRAGG FILTERS



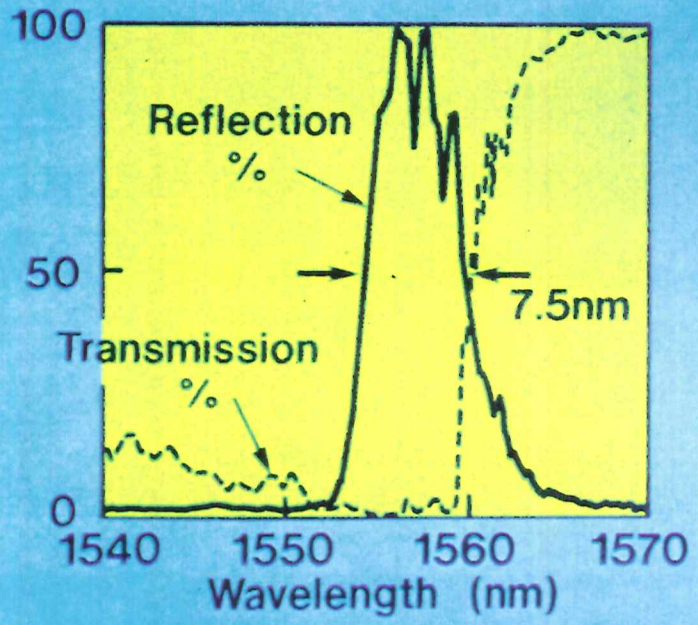
SINGLE-PULSE PHOTOREFRACTIVE BRAGG GRATINGS

- Written with 20ns UV pulses
- > 99.8% reflectivity
- Length 20mm
- Bandwidth 6 - 920GHz

PHOTOREFRACTIVE BRAGG GRATINGS IN Si/Ge FIBRE

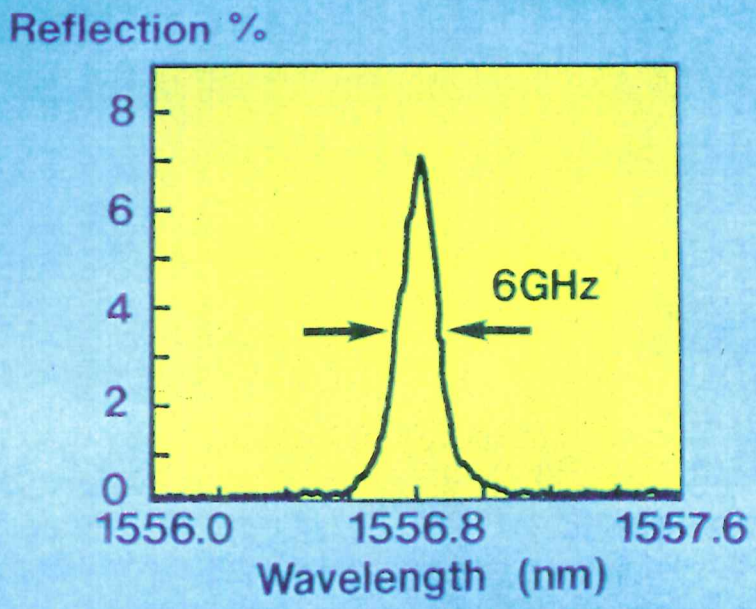
Light

UV Single-shot writing



HIGH-POWER WRITING

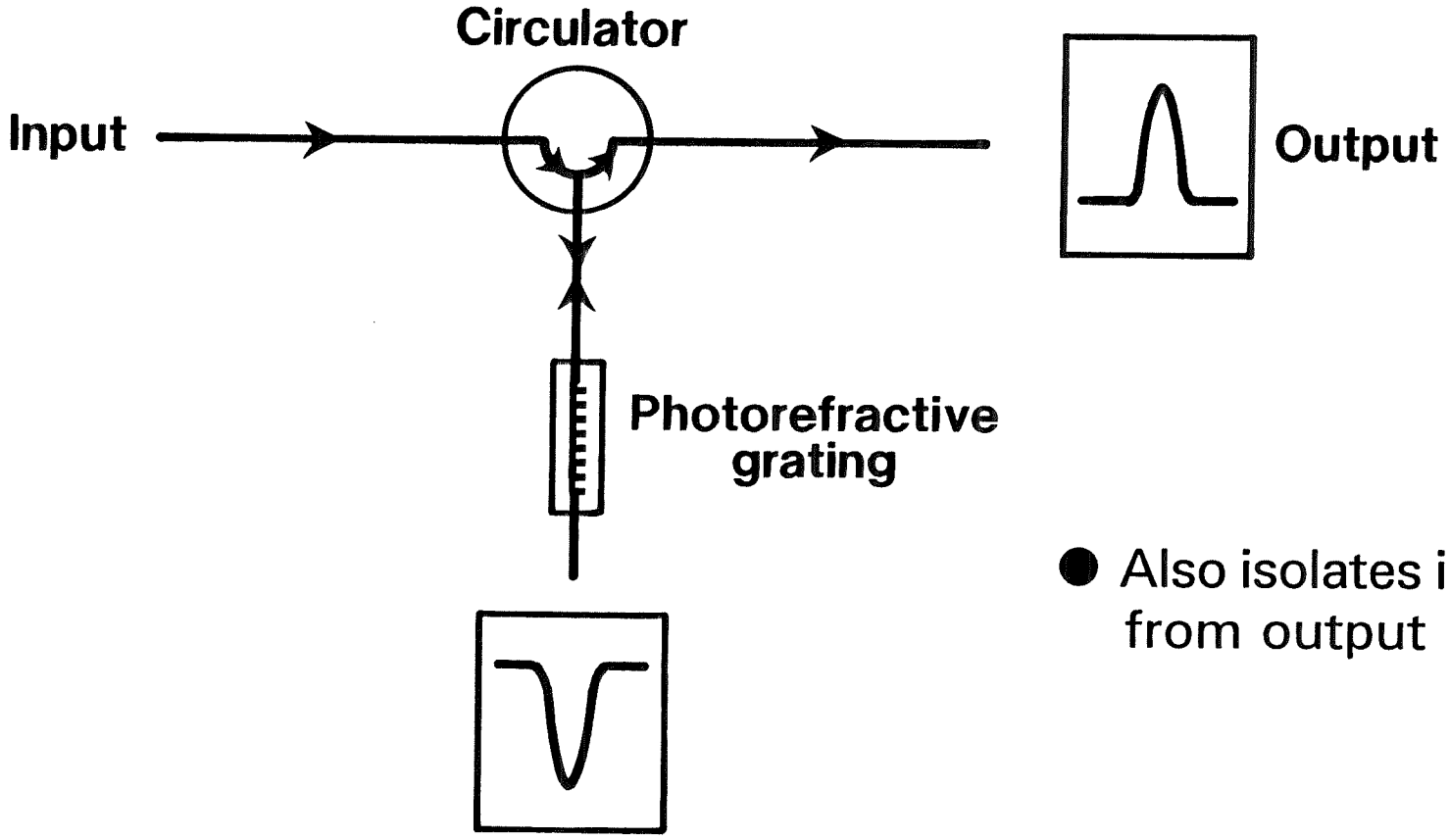
$\delta n \sim 6 \times 10^{-3}$



LOW-POWER WRITING

$\delta n \sim 4 \times 10^{-5}$

BANDPASS TO BANDSTOP FILTER CONVERSION



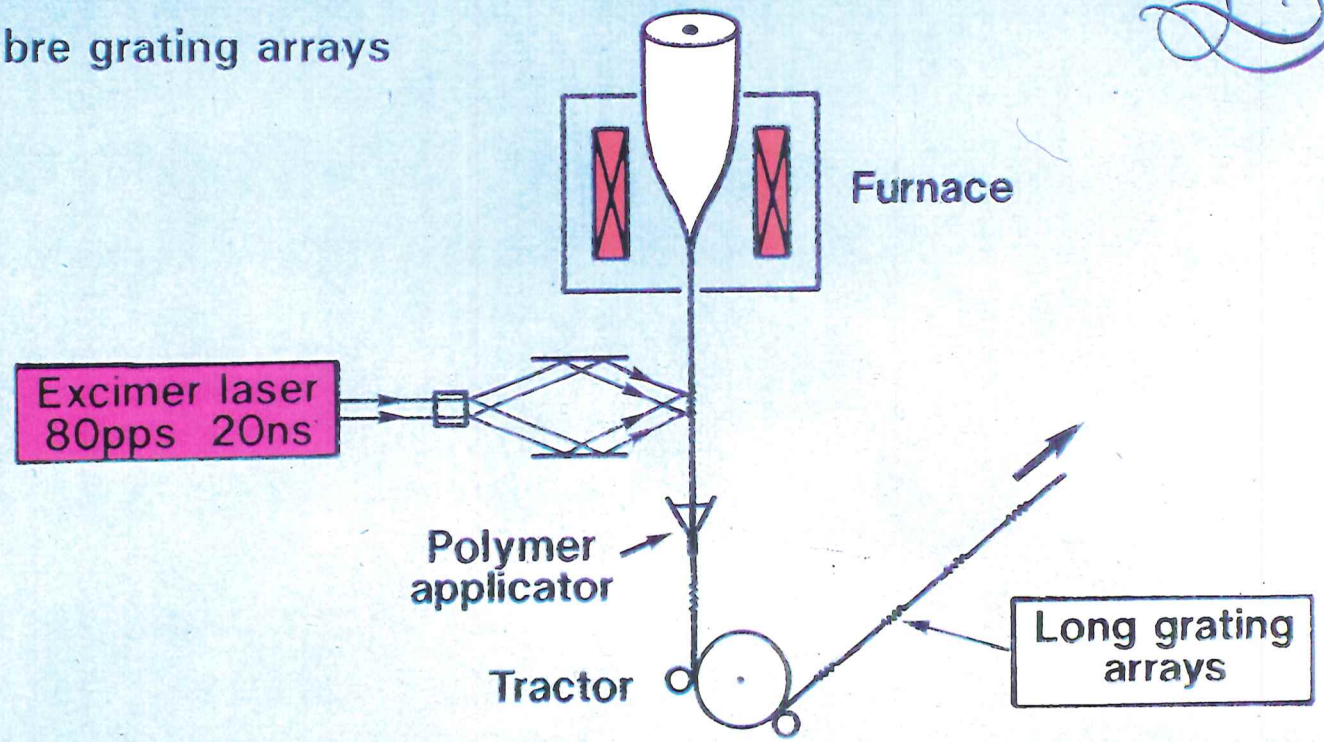
- Also isolates input from output

D.Huber

FUTURE FIBRE DEVICES:

Light

Fibre grating arrays



- Pulling speeds up to 5m/s allowed
- Coating applied after writing
- High strength, low cost

RARE-EARTH-DOPED FIBRE LASERS

- Diode-laser light convertors
- High power outputs (4W cw, 10kW pulse)
- Widely-tunable, quiet light sources
- Narrow linewidth (1kHz)
- Natural mode-locked soliton generators

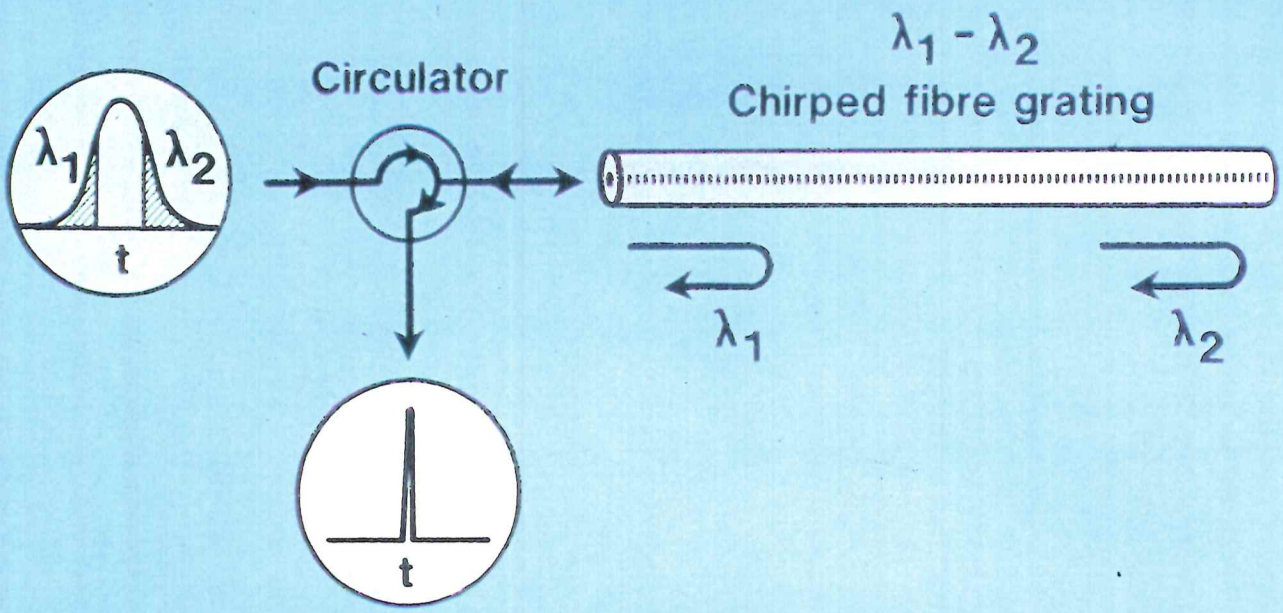
But

- External modulator required
- Hop-free single-frequency difficult

FUTURE FIBRE DEVICES

Light

Dispersion compensators?

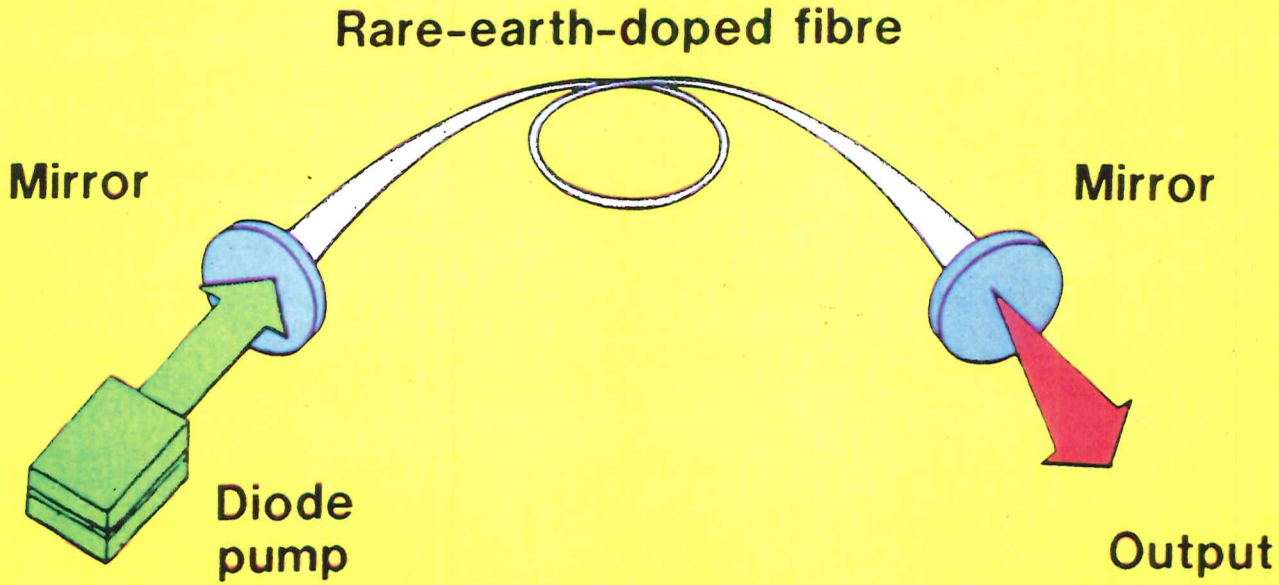


- To compensate 100km of 17ps/nm.km fibre:
  Need 17cm/nm
- Difficult to write gratings > 1cm at present

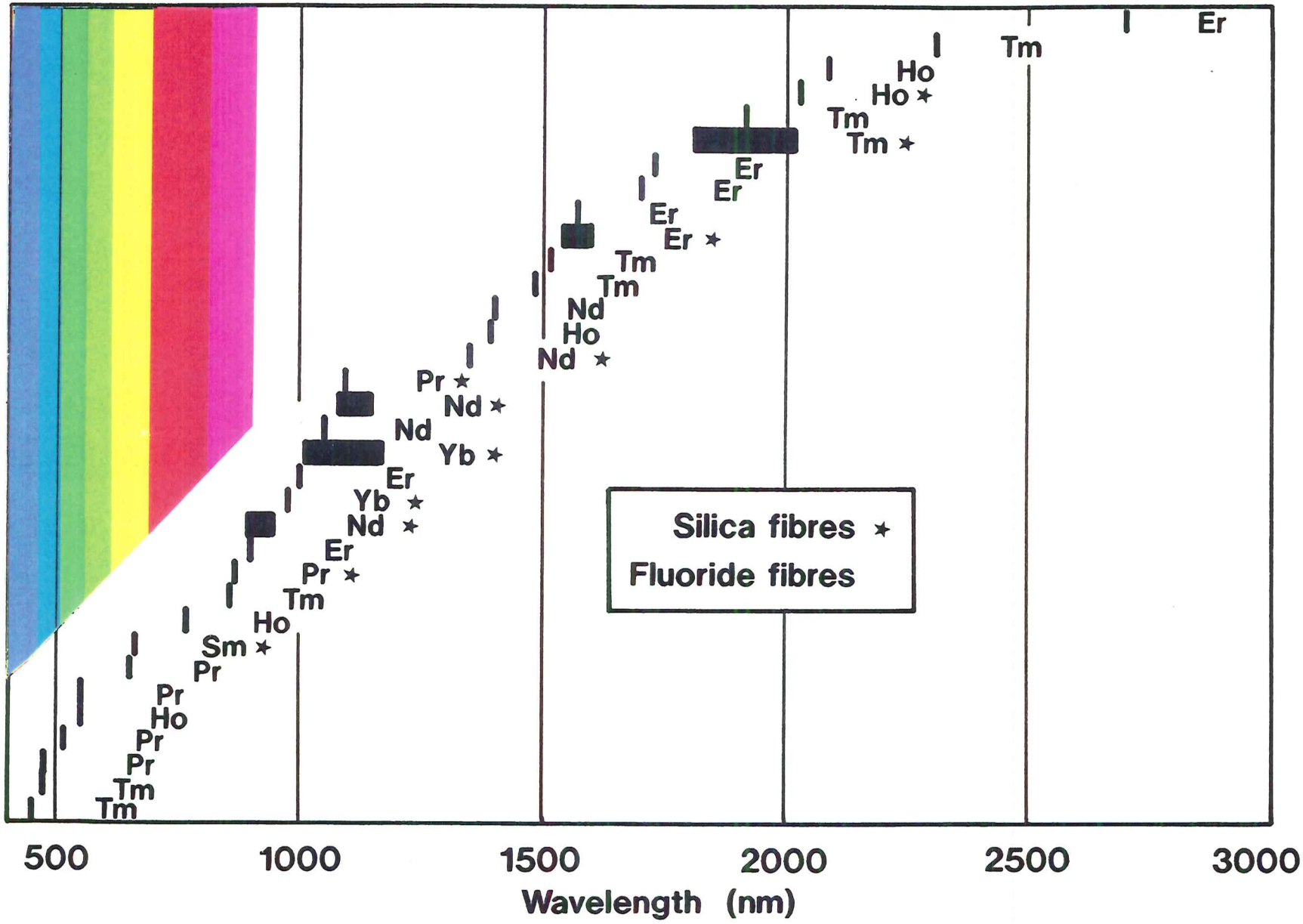
The fibre laser

Light

Fibre laser = waveguide + gain medium



FIBRE LASER WAVELENGTHS



CLADDING PUMP FOR HIGH POWER FIBRE LASER