

ACIGA HIGH POWER LASER PROPOSAL

- an ADELAIDE/LIGO/STANFORD COLLABORATION

MAIN FEATURES

- T-I-R ZIG-ZAG Nd:YAG SLAB
- BREWSTER-ANGLED ENTRANCE AND EXIT FACES
- PUMP FROM BOTH SIDES USING FIBRE-COUPLED DIODES
(270 W/side into 20mm long x 3.3mm high x 3.0mm wide region)
- SIDE-COOLED USING WATER
- RESIDUAL VERTICAL TEMPERATURE GRADIENT CONTROLLED USING PELTIER CELLS
- STABLE RESONATOR IN HORIZONTAL DIRECTION
- UNSTABLE RESONATOR ($M = 1.3$) IN VERTICAL DIRECTION

LIGO-G980049-27-M

OPTIMUM GAIN MEDIUM

- HOST: YAG IS BEST
- DOPANT: Nd BETTER THAN Yb

ADVANTAGES: Nd is 4-level, Yb is quasi-3-level

$$\sigma\tau_{Nd} \sim 3 \times \sigma\tau_{Yb}$$

DISADVANTAGES: Nd requires AlGaAs (rather than InGaAs) pump diodes
quantum defect of Nd $\sim 2.7 \times$ quantum defect of Yb

POSSIBLE PUMP CONFIGURATIONS

- EXTEND CONCEPT TO BE USED IN PROOF-OF-PRINCIPLE EXPERIMENTS?

ADVANTAGES: uniform pumping of surface
pump distribution flexible

DISADVANTAGE: 432 fibres/side!

- STACKED, MICROLENSSED CW ARRAY (from GPC) & NON-IMAGING LENS DUCT - adapt Payne et al. in IEEE JSTQE 3, 71 (1997)

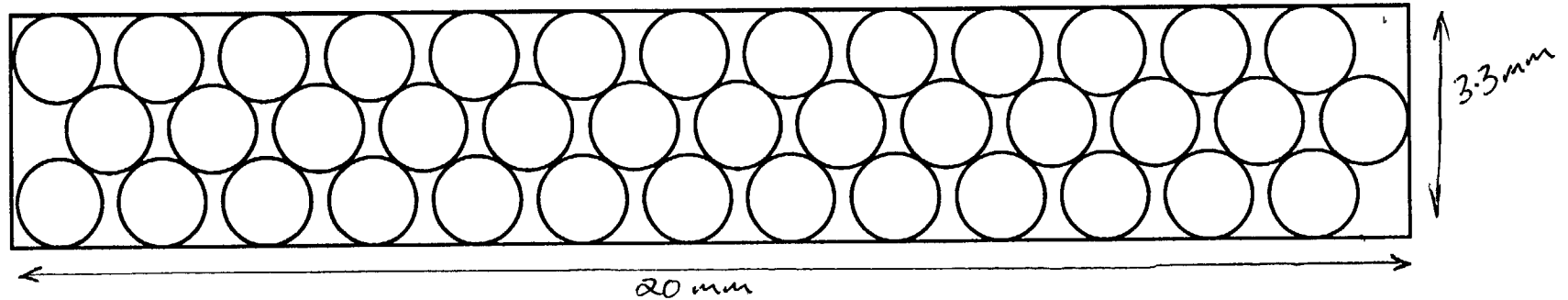
ADVANTAGE: no fibres

DISADVANTAGE: diodes are not modular
water seal around duct?

- ADAPT STANFORD APPROACH
 - pump with fewer high power fibres

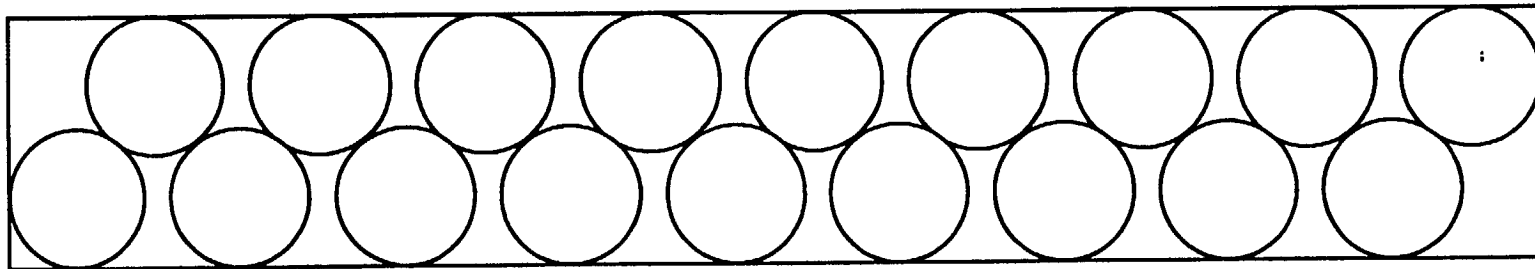
HIGH POWER FIBRE PUMPING CONFIGURATIONS

7 W FIBRE-COUPLED DIODES (39 per side - 13x3 array):



- maximum fibre diameter = 1.25 mm (OPC-A007: 1.0 mm ϕ bundle, 0.1 NA)

15 W FIBRE-COUPLED DIODES (18 per side - 9x2 array):



- maximum fibre diameter = 1.81 mm (OPC-BO15: 1.16 mm ϕ bundle, 0.1 NA;
SDL-3460: 600 μm ϕ , 0.2 effective NA)

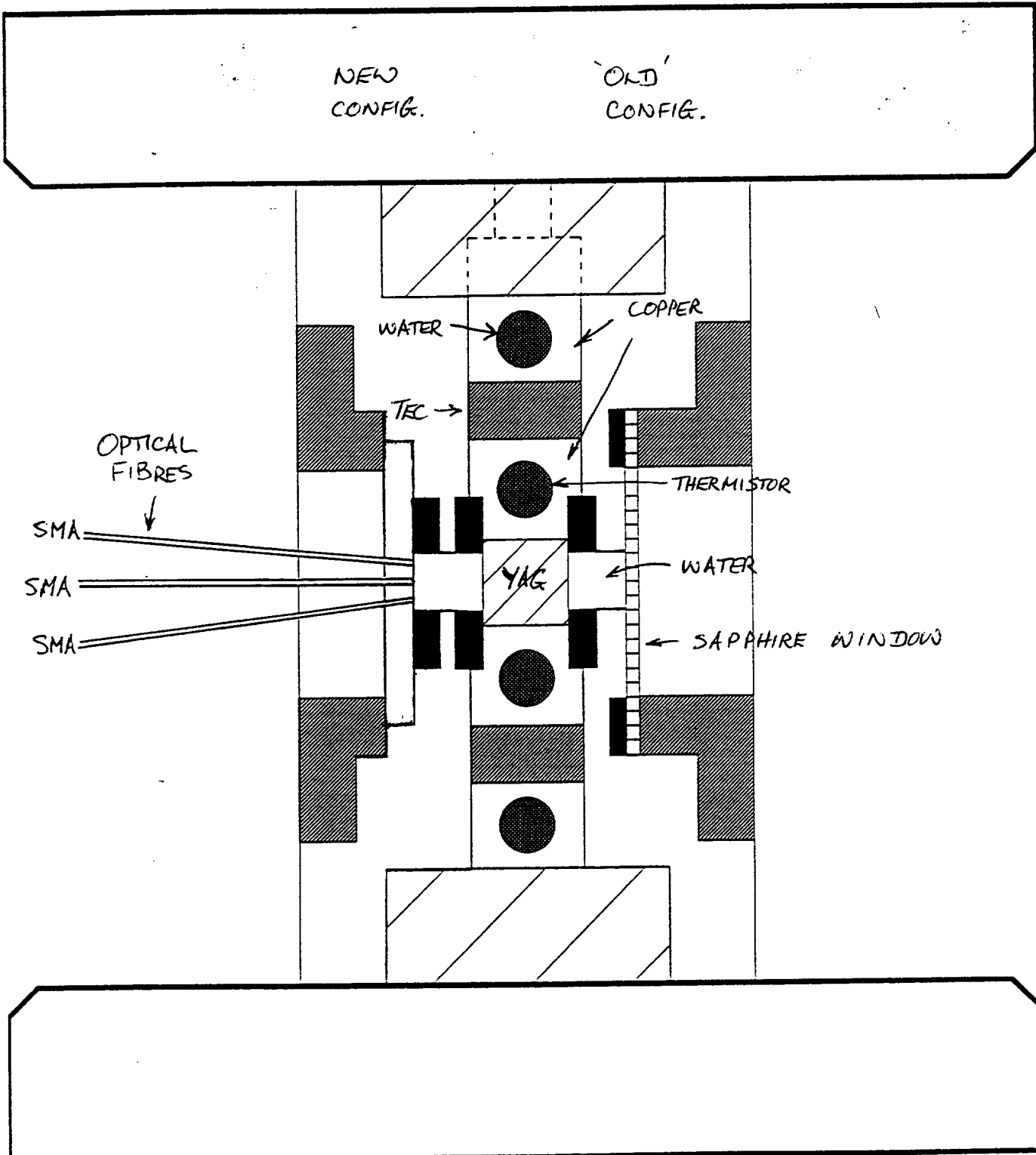
FIBRE MOUNTING

- BOND MATCHING FIBRES INTO COUPLING PLATE
(AS IN FIBRE CONNECTORS)
- POLISH FIBRES AND PLATE
- SMA CONNECTOR ON FREE END

ADVANTAGES: easier to assemble laser head in clean room
diodes interchangeable
no sapphire window

HIGH POWER LASER HEAD

- PROPOSED CONFIGURATION



EXPECTED PERFORMANCE

MINIMUM: $540 \text{ W} \times 20\% = 108 \text{ W} ?$

BEST POSSIBLE: 540×0.92 (Fresnel losses)
x 0.9 (10% of pump not absorbed)
x 0.76 (quantum defect)
x 0.84 (losses are ~16% of average outcouple)
= 270 W

ASSUMING SUFFICIENT DIODES ARE AVAILABLE.

Note 1, Linda Turner, 04/21/98 09:10:51 AM
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