

NOTES ON SOME IDEAS BEHIND THE 2KM

INTERFEROMETER.

(RONALD DREVER)

① A POTENTIAL PROBLEM IN PLANNING LIGO:
RATE OF SPURIOUS PULSES LIKELY HIGHER
THAN BARS - AND NOT PREDICTABLE.

TARGET RATE FOR COINCIDENCE EXP.
1 PULSE / 10 YEARS. (DESIRABLE)

MAY NOT BE PRACTICABLE WITH
2 COMPLETE INTERFEROMETERS IN
OWN TUBES, ETC.

E.G. SINGLES RATE 10/HOUR
GIVES ACCIDENTAL RATE ~ 6/YEAR
TOO MUCH!

② Low-cost fix? 2 INTERFEROMETERS IN
ONE PIPE?

BUT OBJECTIONS: IF IDENTICAL, COMMON DISTURBANCES

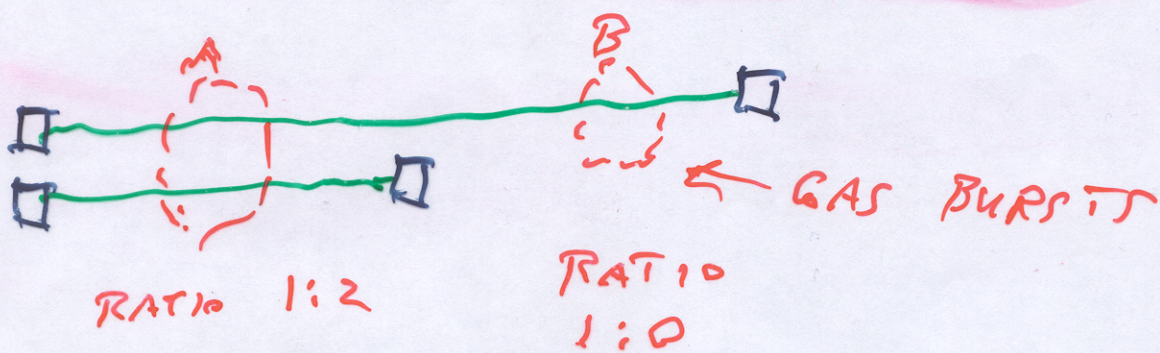
- E.G. GAS BURSTS,
- SEISMIC,
- PICK UP
- LIGHT CROSS-COUPLING. ??

CAN AVOID MOST OF THIS IF LENGTHS DIFFER.

2:1 A GOOD RATIO.

R.W.P. DREVER

NOTE: IF MAKE STORAGE TIMES EQUAL
 IN 2KM AND 4KM SYSTEM, THEN -
 GRAVITY-WAVE SIGNALS EQUAL IN
 SIZE AND SHAPE
 MANY DISTURBANCES ARE UNEQUAL.
 (S/N RATIOS MAY DIFFER)



(GRAVITY-WAVE IS 1:1)

(SEISMIC DISTURBANCES SIMILAR)

SO IF SELECT EQUAL SIGNALS - GET
 APPROXIMATION TO INDEPENDENT DETECTORS,
 (IF S/N RATIO LARGE ENOUGH)

→ THEN BIG REDUCTION IN ACCIDENTALS
 BY TRIPLE COINCIDENCE.

E.G. SINGLE RATE 10 / HOUR

→ COINC. RATE

5×10^{-4} / YEAR

VERY GOOD!

(SEVERAL)
POSSIBILITIES THE 2 KM MAY GIVE US (3)

1/ REDUCED ACCIDENTAL RATE

IMPROVED TOLERANCE TO SPURIOUS
BURSTS.

2/ EXPERIMENTAL TEST OF

G.W. ACCELERATION OR SEPARATION
(STRAIN IN DBP. OF D IF ≤ 1)

3/ HIGH FREQUENCY STOCHASTIC

MEASUREMENT - USING 2 KM - AND

4 KM AT SAME LOCATION.

(OVERLAP FUNCTION = 1)

BUT ALL DEPENDS ON EXPERIMENTAL
FINDINGS - SINGLES RATES, COUPLINGS
FOR SPURIOUS EFFECTS, ETC

POSSIBLE LIMITATIONS TO THIS ECONOMICAL

(4)

IDEA :-

① SENSITIVITY LOSS ?

BUT NOTE LOSS ONLY FACTOR 2 IN

A FEW CASES. (E.G. NARROW BAND OPERATION - BUT LESS APPROPRIATE THEN ANYWAY.)

FOR BURST COINC. SEARCHES

WITH A 4 KM (OR TWO OF THEM)

SENSITIVITY LOSS 10% - 20% IF

ANALYSIS OPTIMIZED - IN TYPICAL CASES
(SEE PAPERS BY GURSEL, FINTO)

② SEPERATION NOT PERFECT ?

REQUIRES EXPTL. DATA.

BUT NOTE HUGE ADVANTAGE IN
BACKGROUND RATE

CONCLUSION

THE 2 KM MAY GIVE IMPORTANT IMPROVEMENT IN BACKGROUND RATES + SOME UNIQUE EXPERIMENTAL POSSIBILITIES.

HOW VALUABLE THESE BENEFITS WILL BE DEPENDS ON DATA FROM INTERFEROMETERS WHEN NEAR DESIGN SENSITIVITY.

ONLY THEN CAN REAL VALUE BE COMPARED WITH POSSIBLE ALTERNATIVES.

EXAMPLES OF ACCIDENTAL RATES

(N_{ACC})

6

2 INTERFEROMETERS, (ONE EACH SITE)

$$N_{ACC} \sim 2 (\tau_P + \tau_D) \cdot N^2$$

τ_P = PULSE WIDTH

~ 2.5 ms AT 200 kHz

FOR $N = 10$ / HOUR
 $N_{ACC} = 6$ / YEAR

τ_D = TRAVEL TIME BETWEEN SITES
= 10 m sec.

N = SINGLE RATE

$2 + \frac{1}{2}$ INTERFEROMETERS

$$N_{ACC} \sim 4 \tau_P (\tau_P + \tau_D) \cdot N^3$$

FOR $N = 10$ / HOUR

$$N_{ACC} = 5 \times 10^{-4} / \text{YEAR}$$

SUMMARISE :

ADDING 2 KM GIVES IMPROVEMENTS —

FOR $N = 10$ / HOUR

FROM 6 / YEAR ACCIDENTAL
TO 5×10^{-4} / YEAR

FOR $N = 100$ / HOUR

FROM 600 / YEAR
TO 0.5 / YEAR