OPTIMIZATION OF GRAVITATIONAL BURST DETECTORS USING PIEZOELECTRIC TRANSDUCERS

D. MAEDER

Département de Physique Nucléaire et Corpusculaire, Université de Genève, CH-1211 Genève 4, Switzerland

Abstract. A general approach to overall system optimization is developed using the concepts of mechanical and electrical signal-to-noise ratios (MSNR and ESNR). These are proportional to $\sqrt{Q_{sys}/n}$ and to $\sqrt{\mu n}$, respectively, where Q_{sys} = mechanical Q of the complete detector, μ = (transducer mass/metal mass), and n = resolving time in units of one-half of the detector fundamental period. The overall SNR becomes a maximum for $n = n^*$ = optimum resolving time; this procedure yields MSNR* = = ESNR* = $\sqrt{2}$ SNR* $\propto \sqrt{Q_{sys} \cdot \mu}$ whereas $n^* \propto \sqrt{Q_{sys}/\mu}$.

Application to 'strong-coupling' type antennae (such as divided-cylinder systems) gives a high SNR* which depends very little on μ if $\mu > 0.01$. Q-factor and coupling efficiency relations were checked for 22 kg-prototypes using $\mu = 0.26\%$, 0.9%, and 1.8%. Two new detector configurations are suggested: the 'bridged-tube' allows strong-coupling for very long detectors; the 'folded-tube' operates at lower frequencies for a given length.

Reference

Maeder, D. G.: 1973, 'Matching Conditions in the Design of Gravitational Detector Systems', to be published in Compte-rendus du Colloque International C.N.R.S. No. 220, *Ondes et radiations gravitationnelles*, Paris.

C. DeWitt-Morette (ed.), Gravitational Radiation and Gravitational Collapse, 52. All Rights Reserved.

https://doi.org/10.1017/S0074180900235997 Published online by Cambridge University Press