Integration Time, Measurement Time: Standardized Definitions

Alex Abramovici

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There is a perceived need to use standardized terminology inside the group. Also, it is desirable that the terms be used in a way consistent with the meaning atributed to them by the scientific community at large. I suggest we use the following definitions:

1. **Integration time** is the time constant T_{int} of an elementary integrator. For example, if the integrator is implemented as an RC network, then $T_{int} = RC$. The bandwidth associated with the integration time T_{int} is:

$$\Delta f_{int} = \frac{1}{2\pi T_{int}} \tag{1}$$

2. **Measurement time** is the time T_{meas} during which data are taken, i. e. data taking starts at time 0 and ends at time T_{meas}. The corresponding bandwidth is:

$$\Delta f_{meas} = \frac{1}{T_{meas}} \tag{2}$$

The above is relevant to our present activities. Thus, the caption of Fig. A-4b in the December 1987 Proposal (Appendix A, p A12) quotes an integration time of 10^7 s, when in fact measurement time was meant. The bandwidths corresponding to the two terms differ by a factor 2π. The immediate consequence is that the vacuum required to achieve the projected shot noise limited performance[1], for the periodic case, has to be upgraded by the same factor 2π. Corrected vacuum requirements, for the periodic case, as well as the unmodified requirements for the burst case, are shown in Tables 1, 2.

Freq. (Hz)	h	H_2 (torr)		H_2O (torr)	
		Pipe	Tank	Pipe	Tank
10	10^{-27}	$3.7 \cdot 10^{-7}$	$5.1 \cdot 10^{-7}$	$3.8 \cdot 10^{-8}$	$1.8 \cdot 10^{-7}$
100	$1.1 \cdot 10^{-28}$	$4.3 \cdot 10^{-9}$	$5.7 \cdot 10^{-5}$	$4.6 \cdot 10^{-10}$	$2.1 \cdot 10^{-5}$
215	$5.5 \cdot 10^{-29}$	$1.1 \cdot 10^{-9}$	$3.3 \cdot 10^{-4}$	$1.1 \cdot 10^{-10}$	$1.1 \cdot 10^{-4}$
1000	$5.5 \cdot 10^{-29}$	$1.1 \cdot 10^{-9}$	$1.6 \cdot 10^{-1}$	$1.1 \cdot 10^{-10}$	$4.8 \cdot 10^{-2}$

Table 1: Maximum pressure specification for detecting periodic sources. The strain sensitivity h assumes 10^7 seconds measurement time.

Freq. (Hz)	h	H_2 (torr)		H_2O (torr)	
		Pipe	Tank	Pipe	Tank
10	$1.3 \cdot 10^{-23}$	$6.1 \cdot 10^{-7}$	$2.6 \cdot 10^{-6}$	$6.3 \cdot 10^{-8}$	$8.5 \cdot 10^{-7}$
50	$6.5 \cdot 10^{-24}$	$3 \cdot 10^{-8}$	$8 \cdot 10^{-5}$	$3.2 \cdot 10^{-9}$	$2.7 \cdot 10^{-5}$
100	$1.1 \cdot 10^{-23}$	$4.4 \cdot 10^{-8}$	$1.8 \cdot 10^{-3}$	$4.5 \cdot 10^{-9}$	$6.1 \cdot 10^{-4}$
1000	$1.1 \cdot 10^{-22}$	$4.4 \cdot 10^{-7}$	180	$4.5 \cdot 10^{-8}$	61

Table 2: Maximum pressure specification for detecting burst sources. The best strain sensitivity h is near 50 Hz.

[1]see A. Abramovici, *Pressure Specification for LIGO*, February 1989