

## Lock Acquisition

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Lock acquisition is decided by relation between momentum of test mass and impulse due to actuator.

Momentum of test mass

$$P = mv$$

Impulse due to actuator

$$P' = F \times dt$$

Force

$$F = \frac{2}{3} \frac{mg}{\lambda} \times D$$

Error signal is correct during a time;  $dt = \frac{\lambda}{Finesse} \div v$

Acceptable velocity is calculated from an equation  $P = P'$ .

$$v = \sqrt{\frac{2}{3} \frac{g}{\lambda} D \frac{\lambda}{Finesse}}$$

## Acceptable velocities

	$m$ : mass [kg]	$l$ : length of pendulum [m]	$D$ : dynamic range [mm]	<i>Finesse</i>	$v$ : velocity [ $\mu\text{m/s}$ ]
80m	20	0.06	4	1,000	20
300m	1	0.25	0.26	500	4

## Actual velocities

Estimation for ACIGA 80m

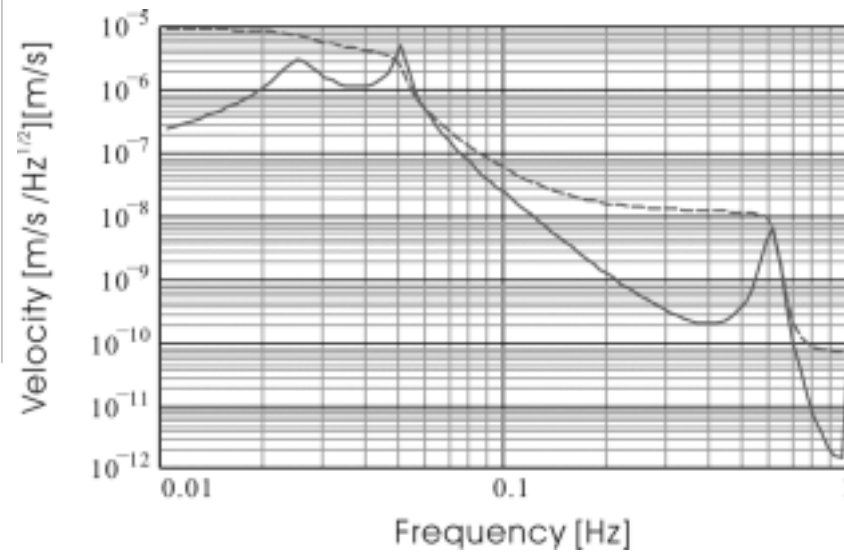
Measurement in TAMA 300m

	>0.2Hz [ $\mu\text{m/s}$ ]	>0.01Hz [ $\mu\text{m/s}$ ]	With CMR [ $\mu\text{m/s}$ ]	Lost CMR [ $\mu\text{m/s}$ ]
80m	0.01	10	0.1	10?
300m	3	3	3	5

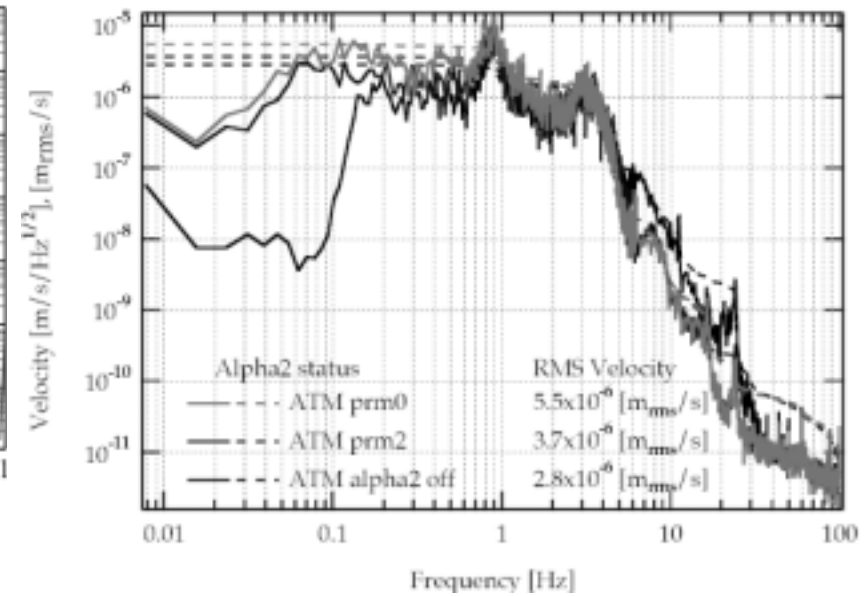
Actual velocity is comparable with acceptable one • "No problem

# Actual Velocities

Estimation for AD GA 80m



Measurement in TAMA 300m



Suspended short cavity referred to stabilize the frequency

Fluctuation of the suspended mass is enhanced in the main cavity.

	<b>MC</b>	<b>Enhanced velocity [<math>\mu\text{m/s}</math>]</b>	<b>Lock acquisition using only test mass</b>
<b>80m</b>	<b>12m</b>	<b>67</b>	<b>Difficult</b>
<b>300m</b>	<b>10m</b>	<b>150</b>	<b>Impossible</b>