Alternatively, we could have instead chosen a gaussian transverse wave propagating in the $-x$ direction as time increases. Mathematically, such a wave would be described as $y(x, t) = y_o \, exp\{-(x + v_x t)^2\}$. The longitudinal velocity of such a left-moving wave on the x-axis is $v_x = -1.0$ *m*/*sec*.

In general, when we speak of arbitrarily-shaped, propagating transverse traveling waves, for an arbitrarily-shaped *right-moving* transverse traveling wave, described by the function $y(x, t) = f(x - v_x t)$, the x-position of a given point on the waveform *increases* as time, t increases. This wave propagates with longitudinal wave velocity $+v_x$ *m*/*sec* in the $+x$-direction. For an arbitrarily-shaped, *left-moving* transverse traveling wave, described by the function $y(x, t) = f(x + v_x t)$, the x-position of a given point on the waveform *decreases* as time increases. This wave propagates with longitudinal wave velocity $-v_x$ *m*/*sec* in the $-x$-direction.

Note that the *argument*, $(x \pm v_x t)$ of the arbitrary function, $f(x \pm v_x t)$ that mathematically describes the transverse wave - as a function of x, for a given time, t, propagating with longitudinal wave velocity $\pm v_x$ in the x-direction is a *constant*. For example, if $(x - v_x t)$ = constant = K, then as the time, t increases, then x must also *increase*, so that $(x - v_x t) = K$. If $(x + v_x t) = K'$, then as the time, t increases, then x must *decrease*, so that $(x - v_x t) = K'$.

In the above figure with $v_x = +1$ *m*/*sec*, for $t = -5$, 0, and +5 seconds, the *peak* of the transverse displacement of the right-moving waveform in each case was at $(x - v_x t) = K = -5$, 0, and +5 meters, respectively. However, for a *different* x-position along the waveform, say at $x = -6$, -1, and +4 meters, at times $t = -5$, 0, and +5 seconds, respectively, the argument of <u>*this*</u> function, $f(x - v_x t)$ describing a right-moving gaussian-shaped transverse traveling wave has $(x - v_x t) = K' = -1$. Note also that (here) the argument, $(x - v_x t)$ of the function $f(x - v_x t)$ that mathematically describes the transverse displacement of the waveform as a function of position, x and time, t has dimensions of *length* (here, in *meters*).

Note that for a transverse traveling wave propagating *e.g.* in the $+x$-direction, the actual motion of the displacement of the string is in the y-direction, transverse (*i.e.* perpendicular) to the x-axis of the string. Thus, for an infinitesimally small segment of the string, of length dx, the motion of that portion of the string is only up and down, in the y-direction as the transverse wave disturbance passes by, propagating along the string in the x-direction. If we imagine taking a snapshot at time $t = 0$, then for a transverse wave propagating in the $+x$-direction, the *leading* edge of the waveform is moving up, away from the x-axis at that instant in time, and the *trailing* edge of the waveform is moving down, back towards the x-axis, at that instant in time. The *peak* of the waveform at that instant in time is stationary - it is not moving up or down at all.

Thus, we can describe the transverse motion of the string as a function of position and time with the notion of a *transverse* velocity, $u_y(x, t)$ of the string at any given point, x and time, t. Formally, the transverse velocity, $u_y(x, t)$ of the string at any given point, x and time, t is the time-rate of change of the y-position of the string at the point x at time t.