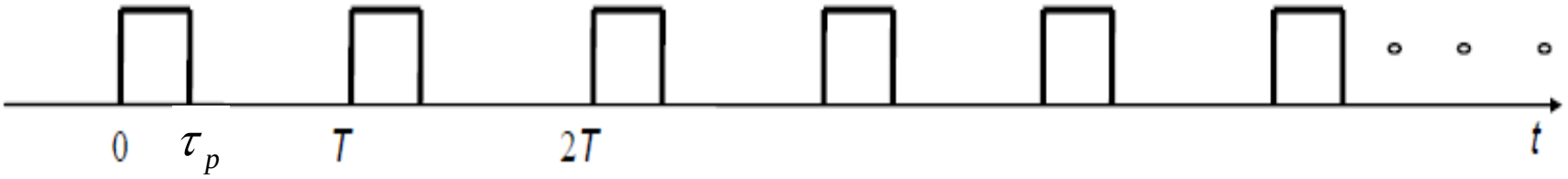
Funzione di ambiguità della sequenza di impulsi coerente

Pierfrancesco Lombardo

Sequenza coerente di impulsi

- **Sequenza coerente di N impulsi** di durata τ_p e tempo di ripetizione (PRT) T:

$$s_{0N}(t) = \sum_{n=0}^{N-1} s_0(t - n \cdot T) \qquad s_0(t) = \frac{1}{\sqrt{\tau_p}} e^{j\phi(t)} \, rect_{\tau_p}(t - \frac{\tau_p}{2})$$



- **Filtro adattato alla sequenza di N impulsi**

$$\left|\chi(\tau,\nu)\right| = \left| \int_{-\infty}^{\infty} s_{0N}(t) \; s_{0N}^{*}(t+\tau) \; e^{j2\pi\nu t} dt \right|$$

Funzione di ambiguità della sequenza (I)

$$\left|\chi_N(\tau,\nu)\right| = \left| \int_{-\infty}^{\infty} s_{0N}(t)\; s_{0N}^{*}(t+\tau)\; e^{j2\pi\nu t} dt \right| = \left| \int_{-\infty}^{\infty} \sum_{n=0}^{N-1} s_0(t-n\cdot T) \sum_{k=0}^{N-1} s_0^{*}(t+\tau-k\cdot T)\; e^{j2\pi\nu t} dt \right| =$$

$$= \left| \sum_{n=0}^{N-1}\sum_{k=0}^{N-1} \int_{-\infty}^{\infty} s_0(t-n\cdot T)\, s_0^{*}(t+\tau-k\cdot T)\; e^{j2\pi\nu t} dt \right| =$$

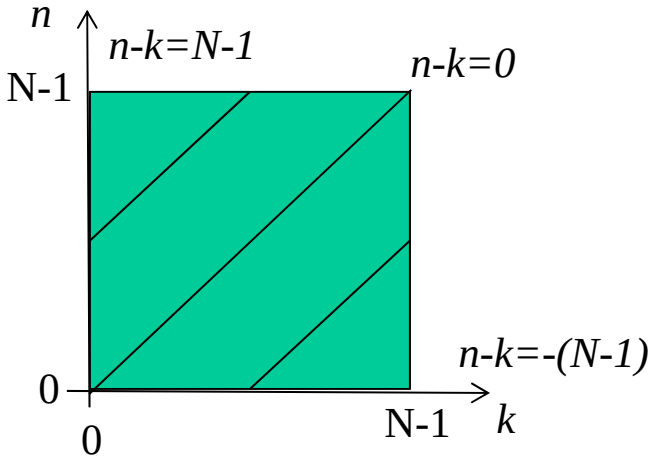
$$= \left| \sum_{n=0}^{N-1}\sum_{k=0}^{N-1} e^{j2\pi\nu nT} \int_{-\infty}^{\infty} s_0(t')\, s_0^{*}[t'+\tau+(n-k)\cdot T]\; e^{j2\pi\nu t'} dt' \right| = \qquad \begin{array}{l} 0 \le n \le N-1 \\ 0 \le k \le N-1 \end{array}$$

$$= \left| \sum_{n=0}^{N-1} \sum_{n-k=-n}^{N-1-n} e^{j2\pi\nu nT}\, \chi[\tau+(n-k)T,\nu] \right| = \qquad -(N-1) \le n-k \le N-1$$

$$= \left| \sum_{r=-(N-1)}^{N-1} \sum_{n=\max\{0,\, r\}}^{N-1-\min\{0,r\}} e^{j2\pi\nu nT}\, \chi[\tau+rT,\nu] \right| =$$

$$= \left| \sum_{r=-(N-1)}^{N-1} \frac{\sin[\pi\nu(N-|r|)T]}{\sin[\pi\nu T]}\, \chi[\tau+rT,\nu] \right| =$$

$$= \left| \sum_{r=-(N-1)}^{N-1} \frac{\sin[\pi\nu(N-|r|)T]}{\sin[\pi\nu T]}\, \chi[\tau-rT,\nu] \right|$$

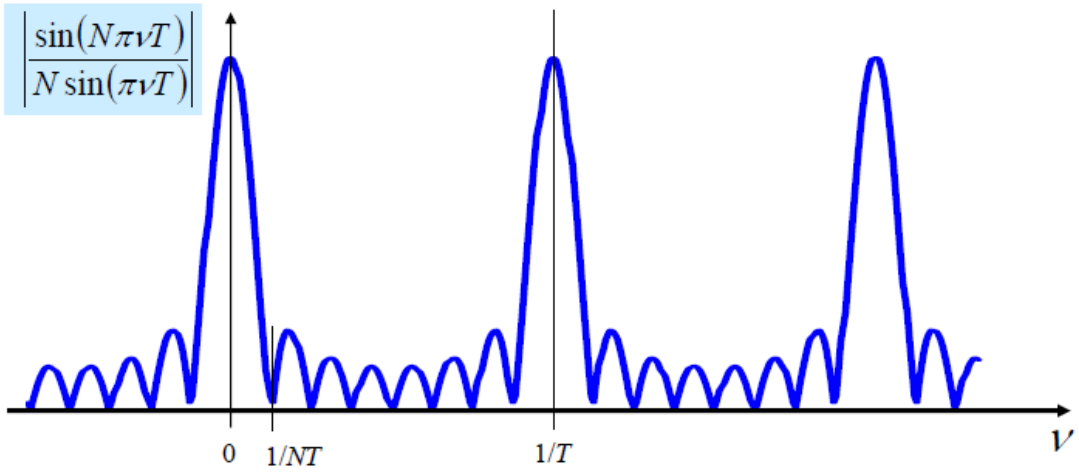


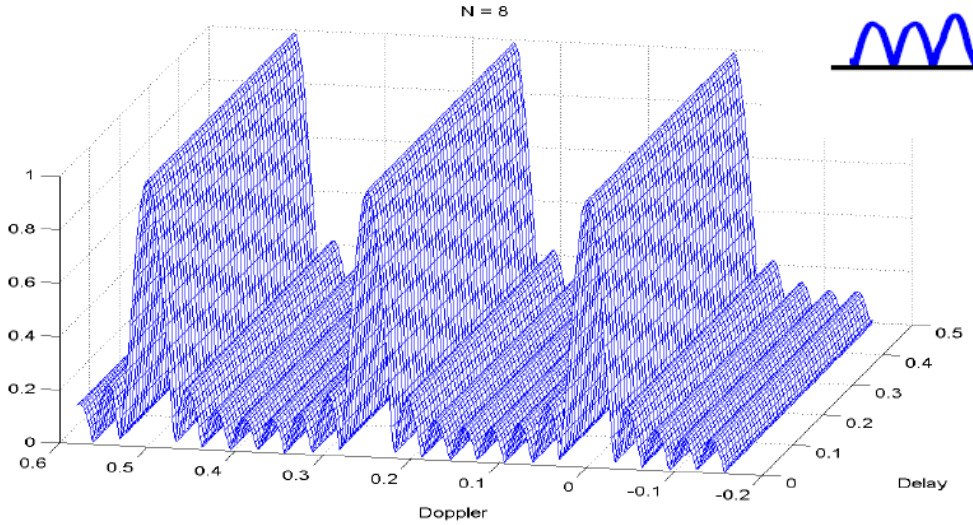
Funzione di ambiguità della sequenza (II)

$$\left|\chi_N(\tau,\nu)\right| = \left| \sum_{r=-(N-1)}^{N-1} \frac{\sin[\pi\nu(N-|r|)T]}{\sin[\pi\nu T]} \chi[\tau - rT, \nu] \right|$$

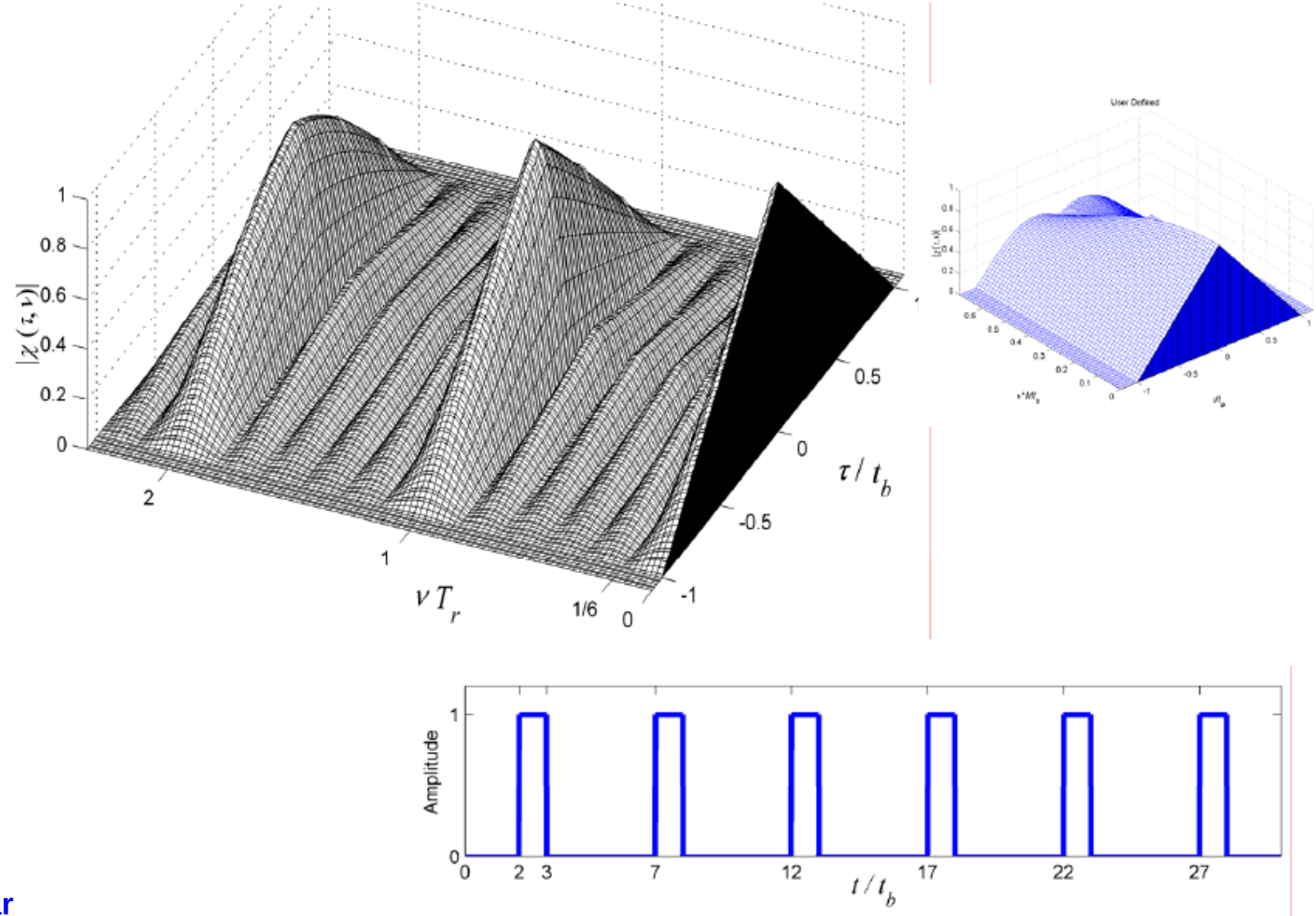
$$\tau \le T - \tau_P \quad \Leftrightarrow \quad k = 0$$

$$\left|\chi_N(\tau,\nu)\right| = \left| \frac{\sin[\pi\nu N)T]}{\sin[\pi\nu T]} \right| \cdot \left| \chi[\tau,\nu] \right|$$

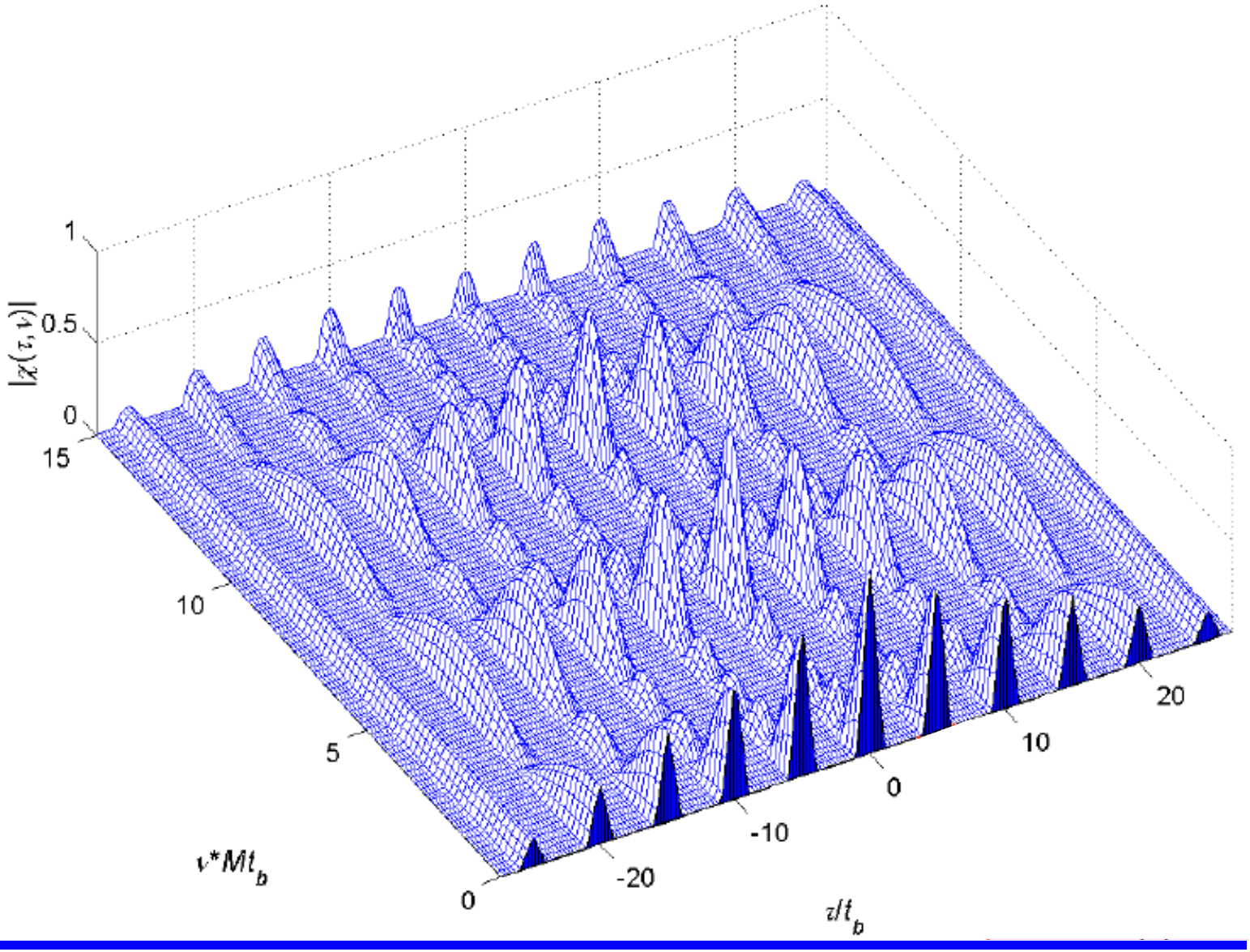




Funzione di ambiguità della sequenza (III)



Funzione di ambiguità della sequenza (IV)



Funzione di ambiguità della sequenza (IV)

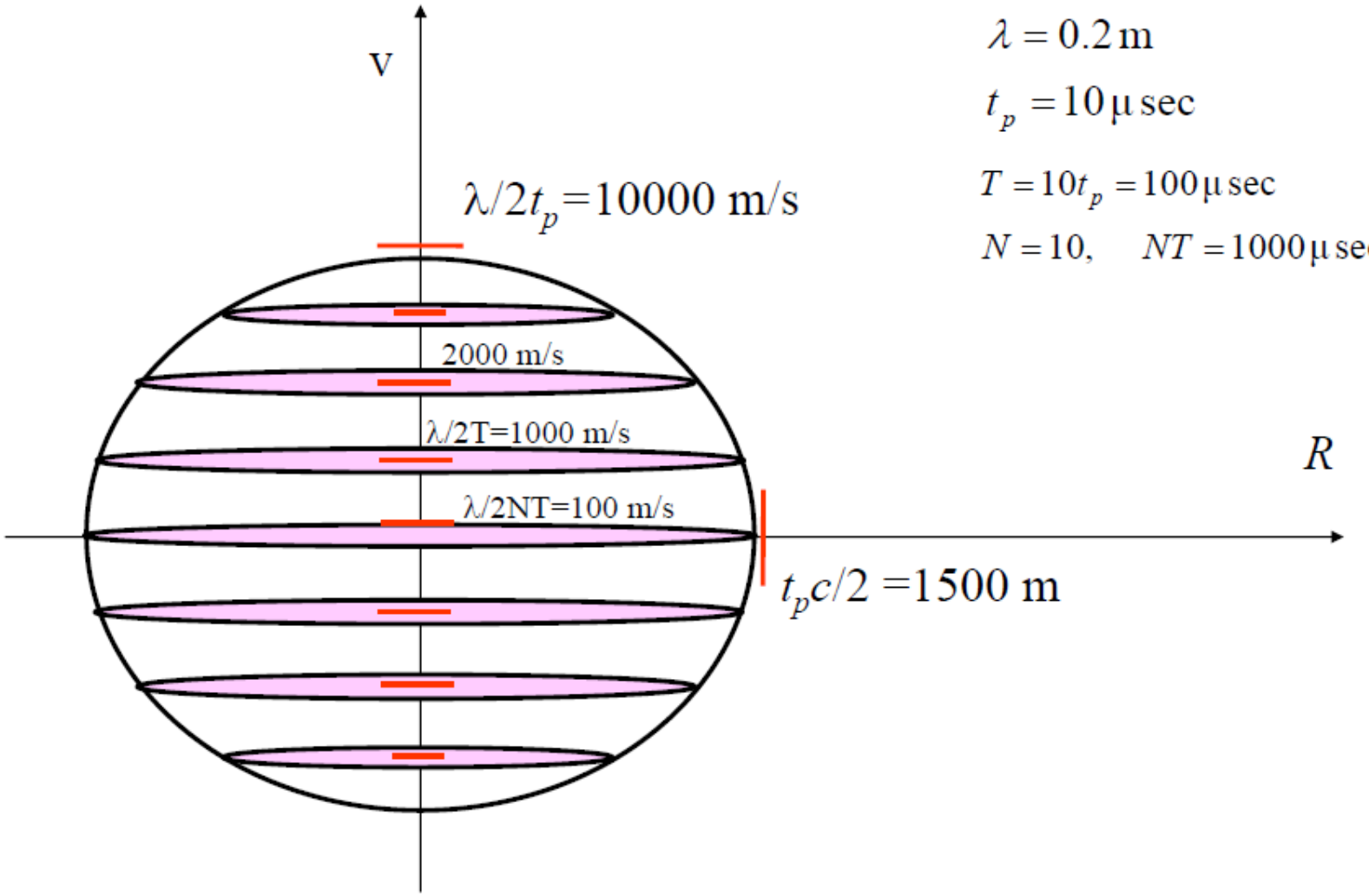
$f_c = 1500\,\text{MHz}$

$\lambda = 0.2\,\text{m}$

$t_p = 10\,\mu\text{sec}$

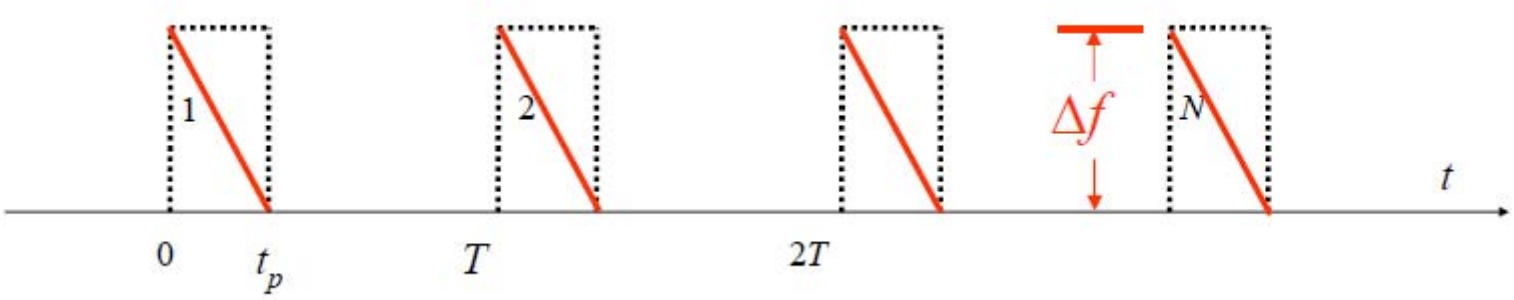
$T = 10t_p = 100\,\mu\text{sec}$

$N = 10, \quad NT = 1000\,\mu\text{sec}$



Funzione di ambiguità della sequenza (V)

Sequenza di chirp

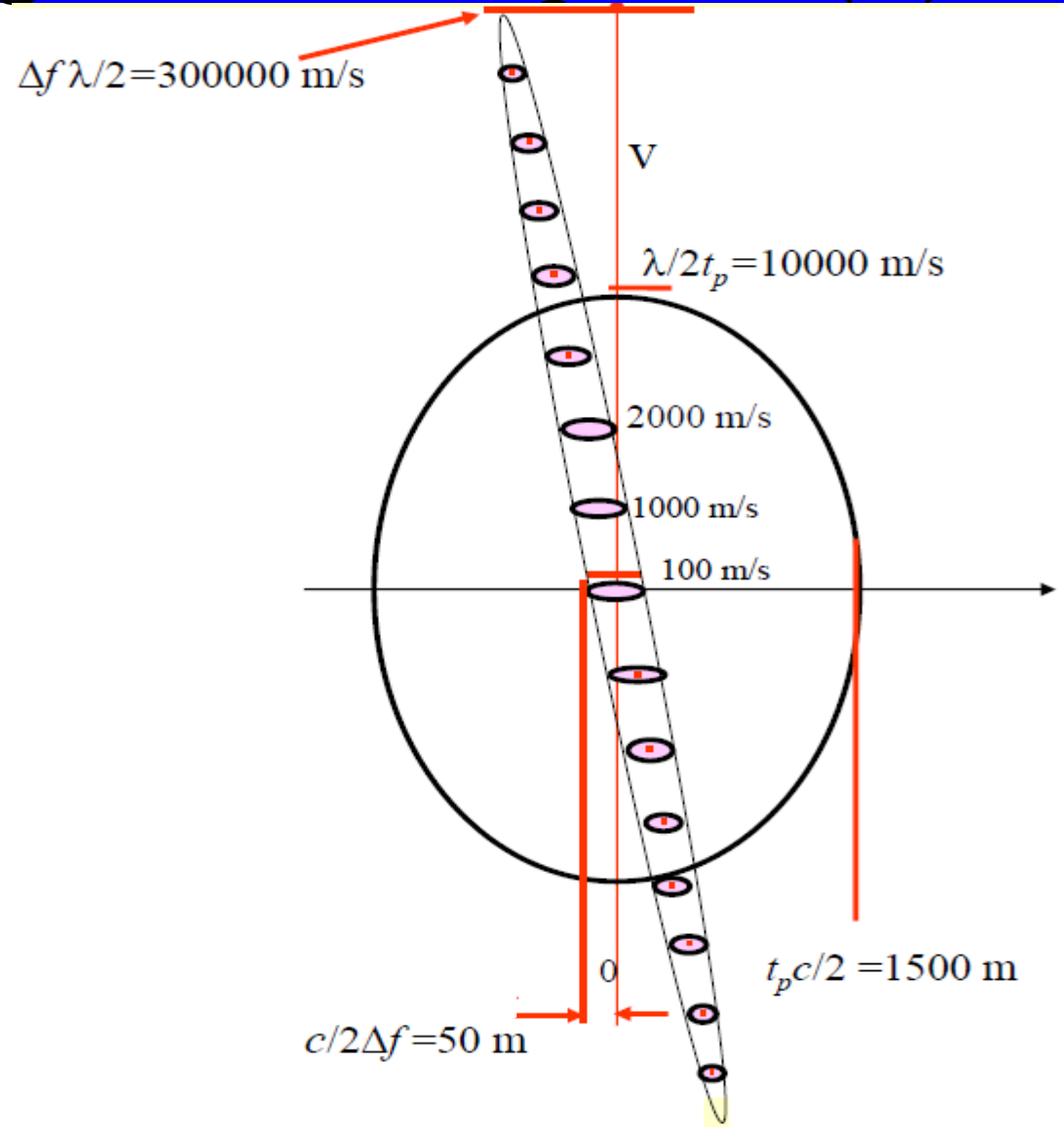


$$\text{Compression ratio} = t_p \Delta f = 30$$

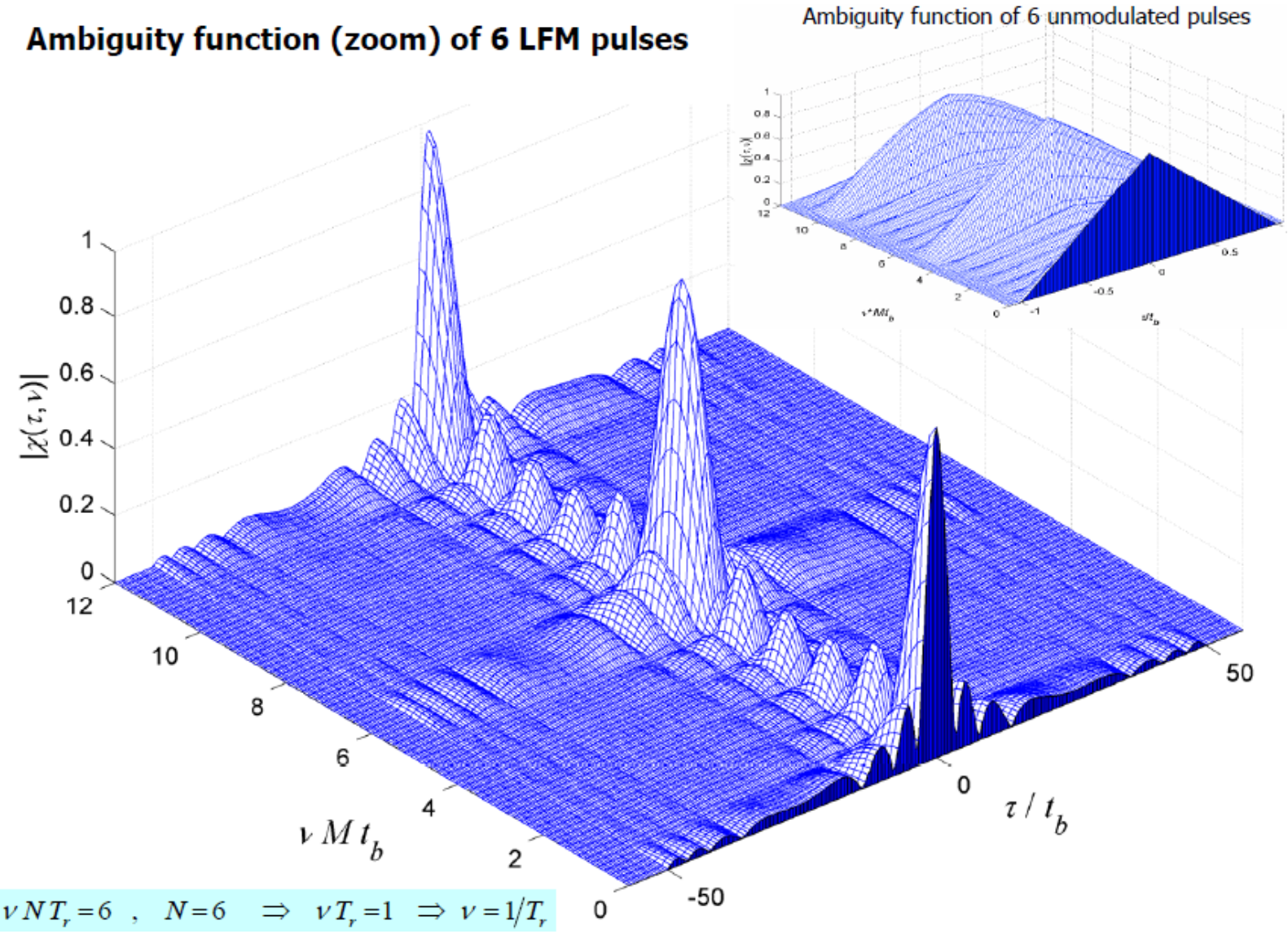
$$\Delta f = 30 / t_p = 30 / 10^{-5} = 3\,\text{MHz}$$

Funzione di ambiguità della sequenza (V)

Sequenza di chirp

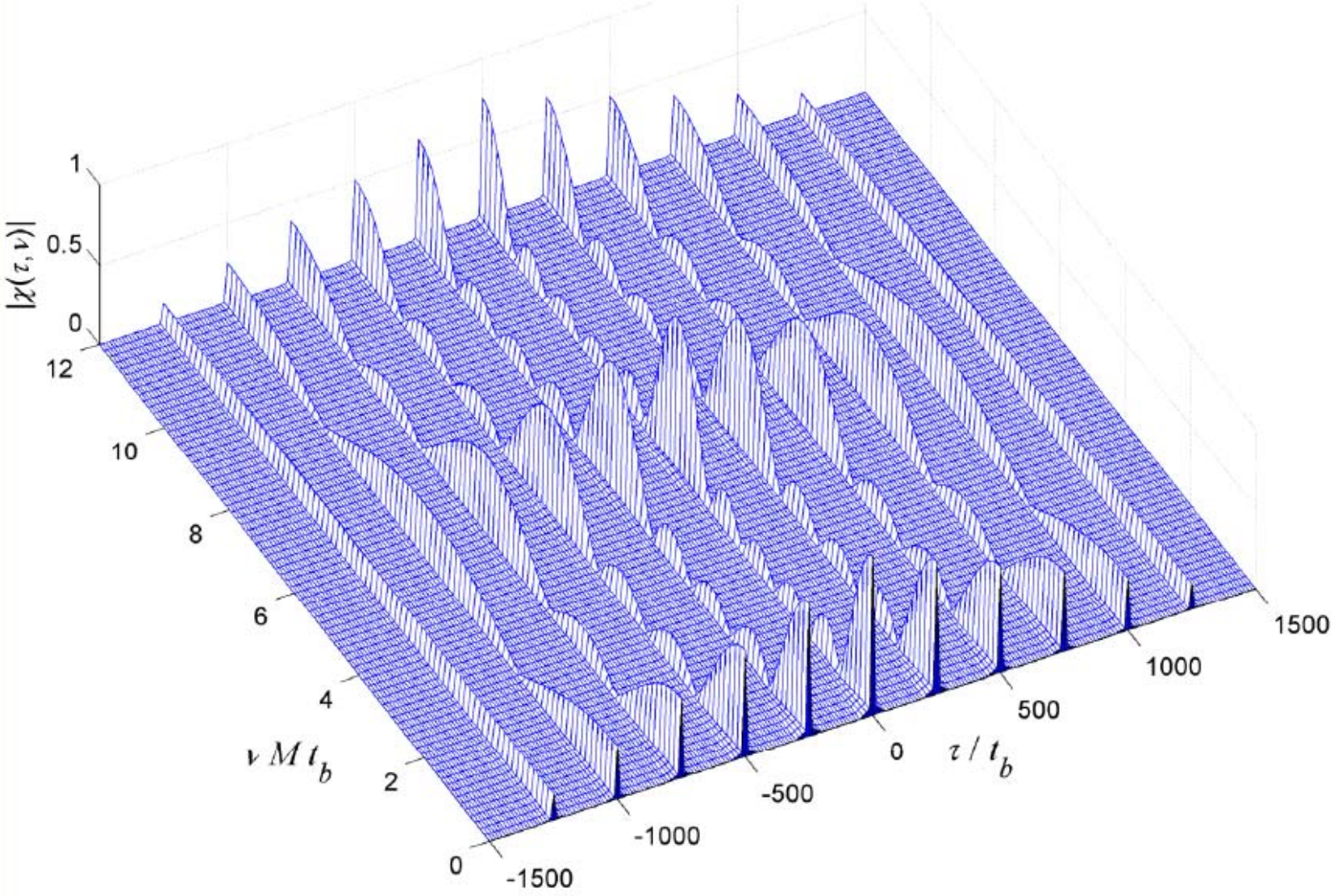


Funzione di ambiguità della sequenza (V)



Sistemi Radar $\nu N T_r = 6 \;,\; N = 6 \;\Rightarrow\; \nu T_r = 1 \;\Rightarrow\; \nu = 1/T_r$

Funzione di ambiguità della sequenza (V)



Funzione di ambiguità della sequenza (V)

N >> 1