# Speed of EMW on Cable

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For the course "**Communications**"

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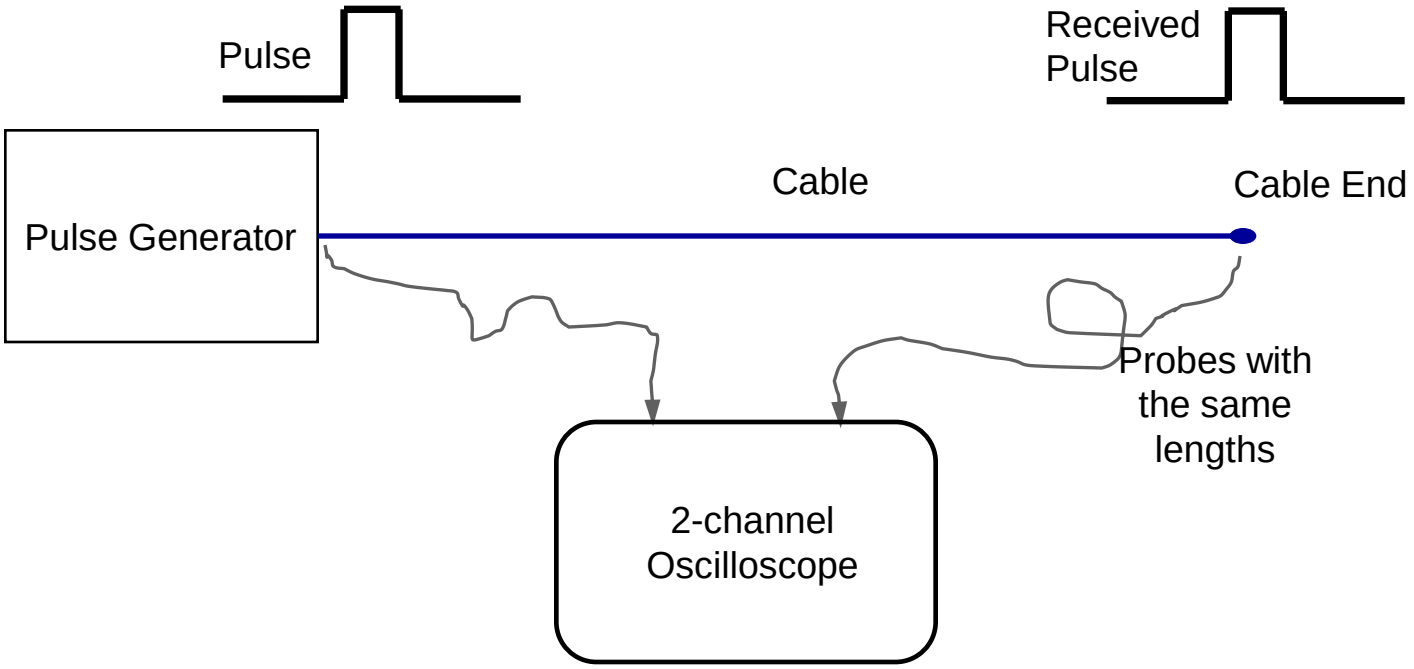
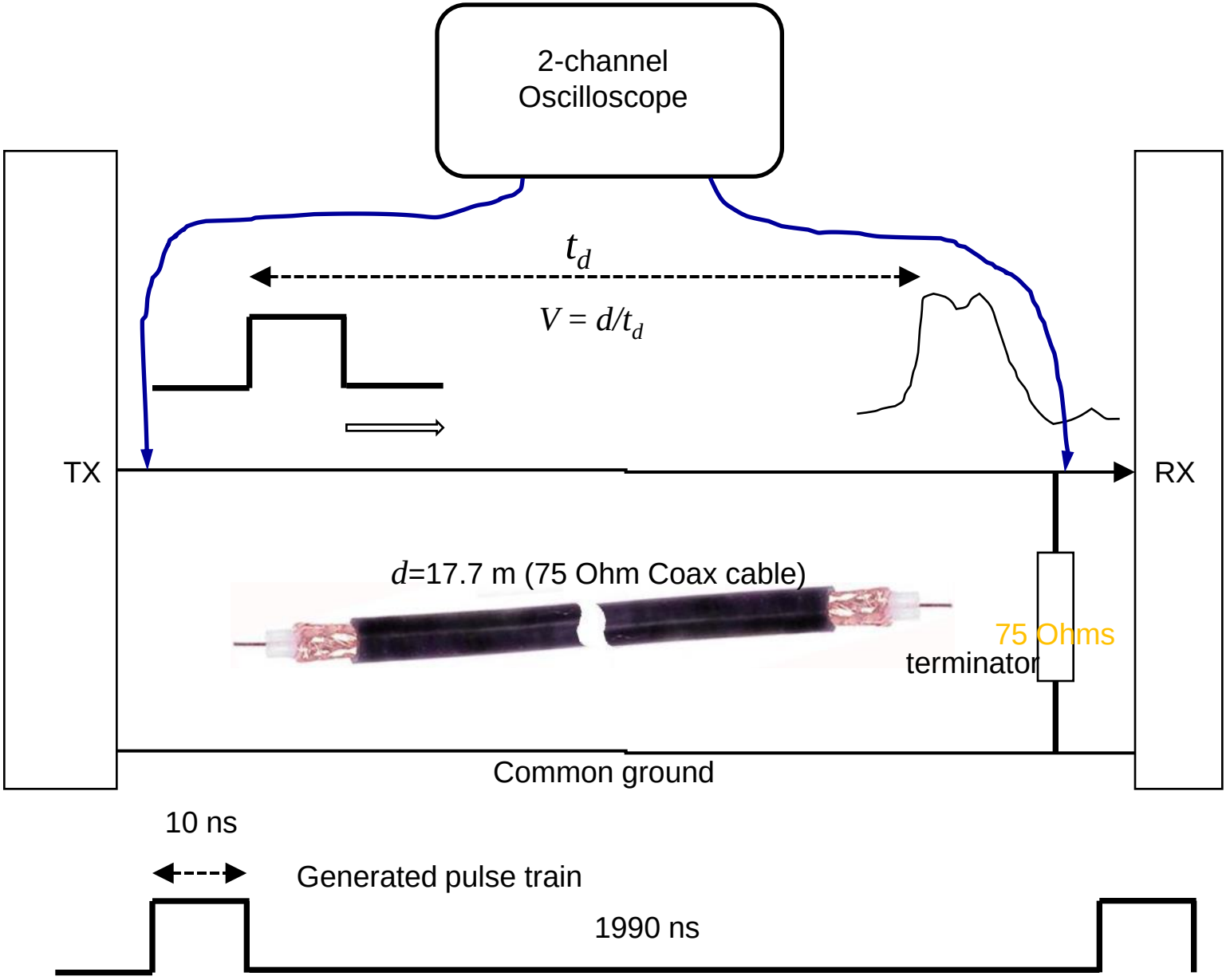
Finding out Speed of Electromagnetic Wave Travelling on Coax Cable

A Simple Demonstration

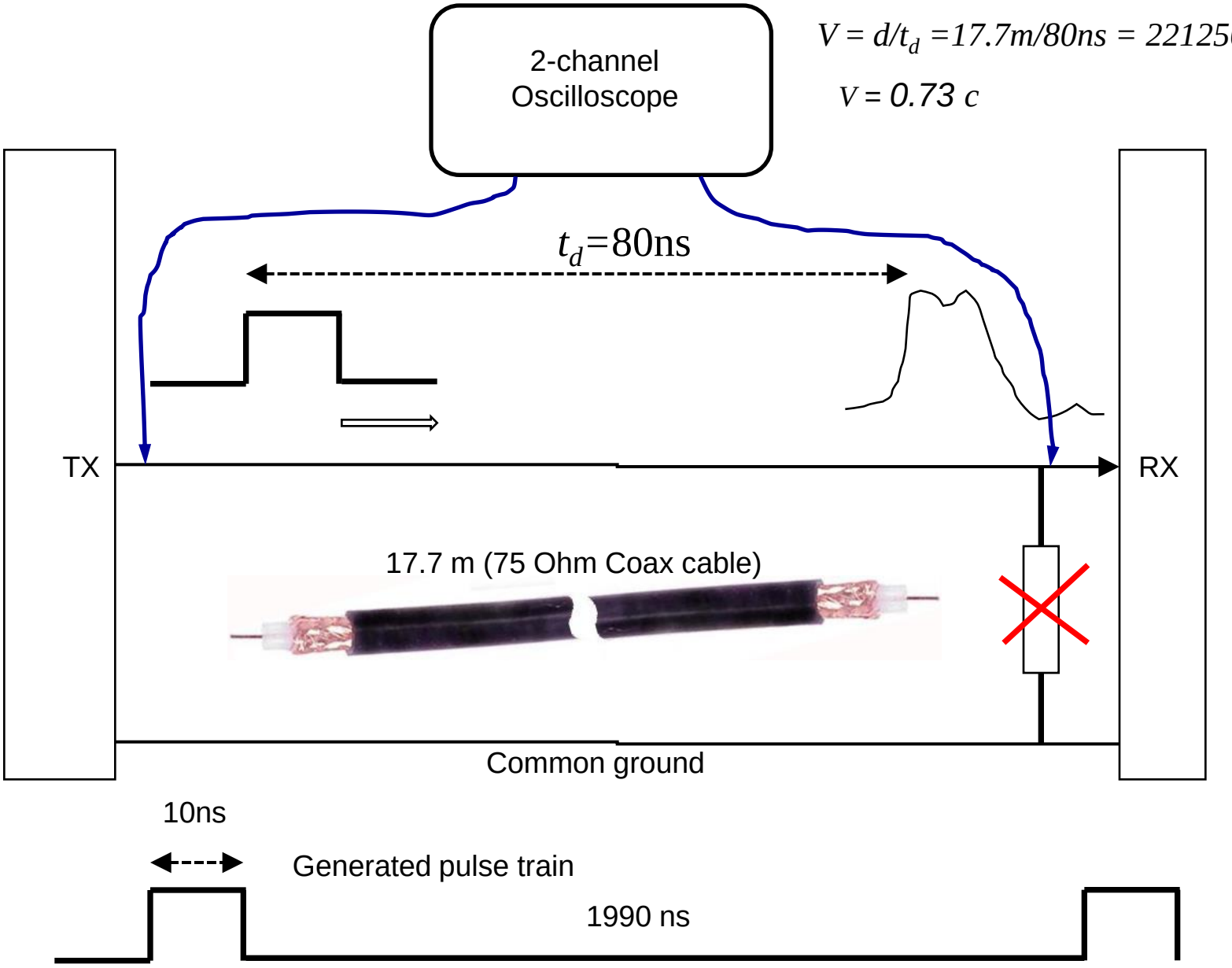
Why? : Just to be a reminder that receivers always receive a delayed signal

Setup : Send a pulse along the cable and see both sent and received signals.
Also see that the wave is reflected from impedance mismatches

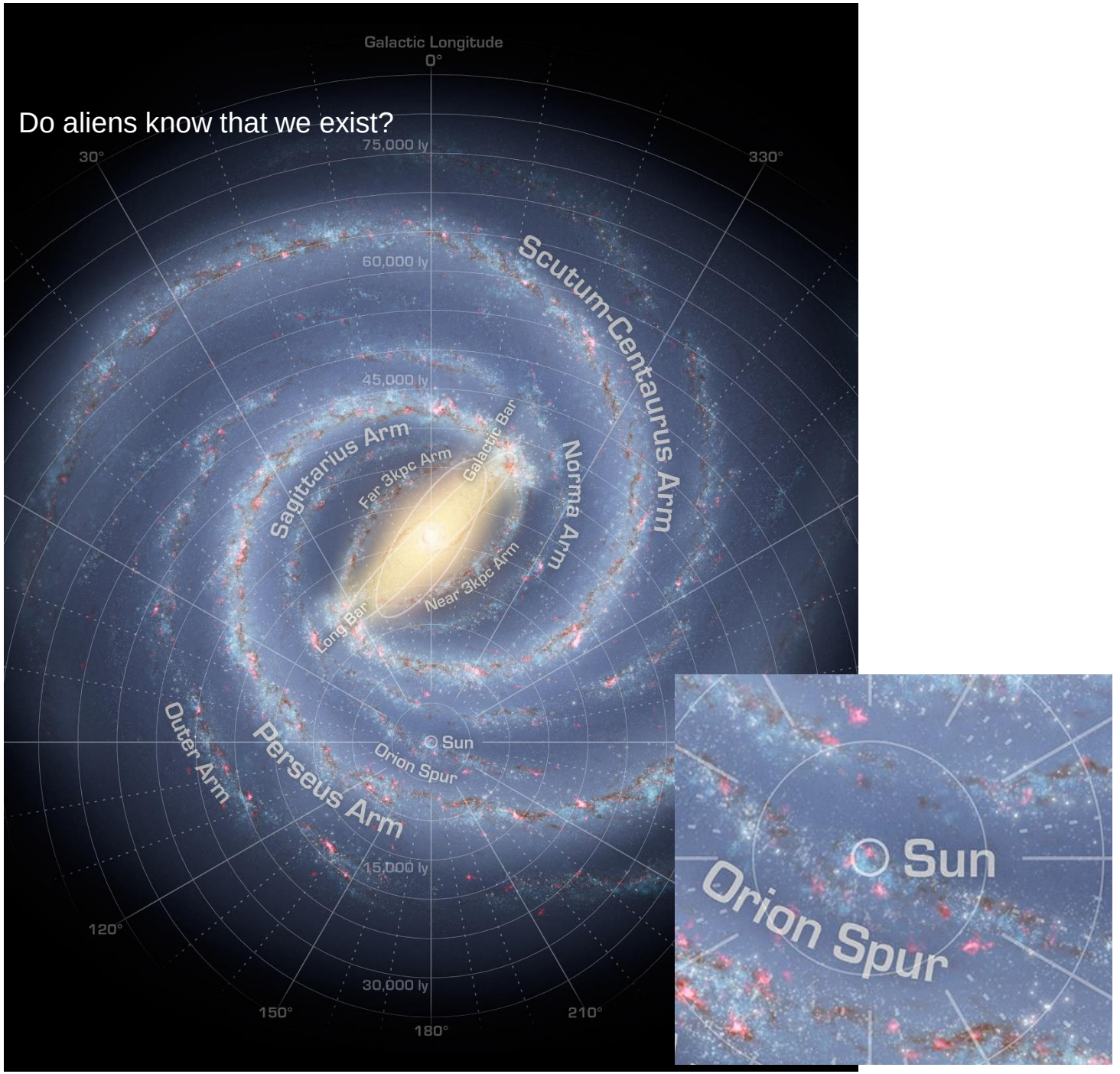





Video link: https://drive.google.com/file/d/15V8MTQE2Ihivi4h88Ys-uDddGq9-3qrI/view?usp=sharing


2-channel
Oscilloscope
$V = d/t_d$ =17.7m/80ns = 221250 km/s
V = 0.73 c
$t_d$=80ns
TX
RX
17.7 m (75 Ohm Coax cable)
Common ground
10ns
Generated pulse train
1990 ns

## Corollary


Do aliens know that we exist?
Galactic Longitude
0°
30°
330°
75,000 ly
60,000 ly
45,000 ly
15,000 ly
30,000 ly
120°
150°
180°
210°
Scutum-Centaurus Arm
Sagittarius Arm
Norma Arm
Perseus Arm
Outer Arm
Far 3kpc Arm
Near 3kpc Arm
Galactic Bar
Long Bar
Sun
Orion Spur
Sun
Orion Spur

# How Long?

How long does it take to receive a cable signal from Istanbul?

Distance = 200 km (approx.)

Speed = 221250 km/s

Time = 200 km/221250 km/s ≈ 900 μs

How long would it take a pulse to travel 1cm ?

Speed = 221250 km/s (approx. for copper)

Time = 1 cm/221250 km/s ≈ 0.45 ns (very dependent on the material/insulation/etc)

How long would it take a pulse to travel 1cm within a silicon chip?

$v = \frac{c}{\sqrt{\epsilon_r}}$ where $\epsilon_r \cong 11.7$ for silicon $\Longrightarrow$ $t \cong 114\, ps$

Result: With approx. 10 GHz rectangular pulses (clock signal) we would receive the opposite duty cycle of the clock on the other hand of the chip (provided that there are no other delays).

END