

Inspecting Signals

From Shock Collars to Satellites

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Inspecting Signals: From Shock Collars to Satellites

Today's Tour



Wireless Waves

What makes a wave, a wave.



Saving the Signal

How to save a continuous signal (and some of the consequences of doing so)



Shaping the Signal

How to change (modulate) waves over time to send information.



EM Spectrum

Radio waves are part of the EM spectrum.



Ones and Zeros

Once you have demodulated a signal, get ones and zeros



Shock Collars and Satellites

Hands-on wireless exercises using various tools

DEMO SLIDE

Inspecting Signals

Unit One

Wireless Waves

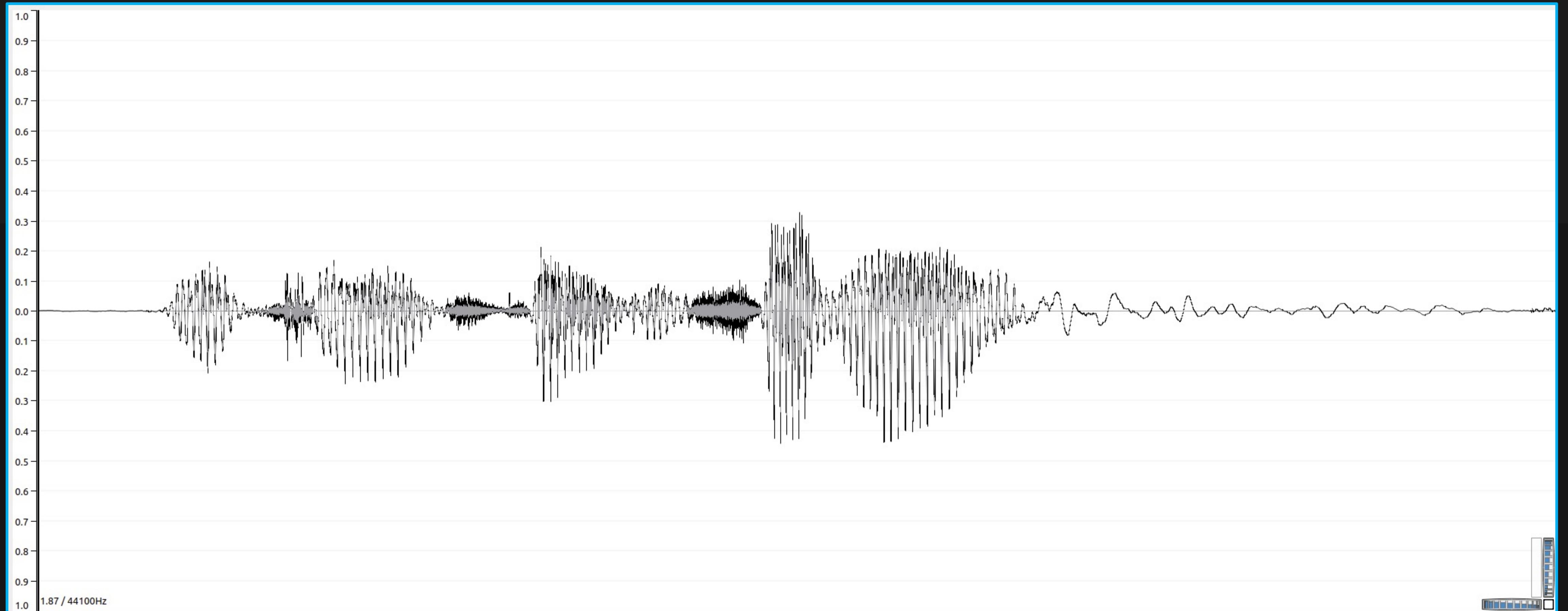
SignalLabs.net

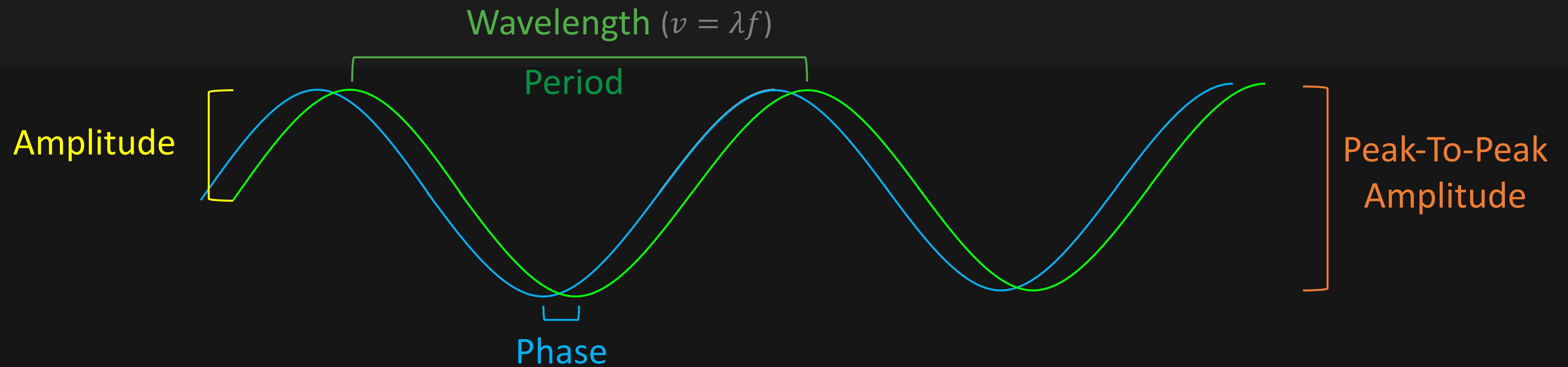
How do you define a wave?

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

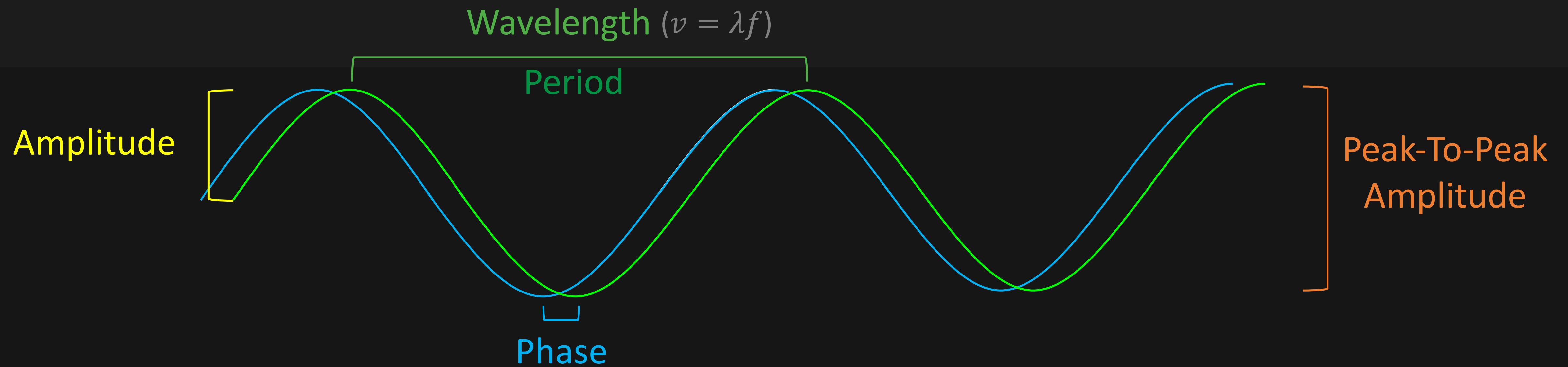
A wave is a disturbance that can travel
without the transfer of matter

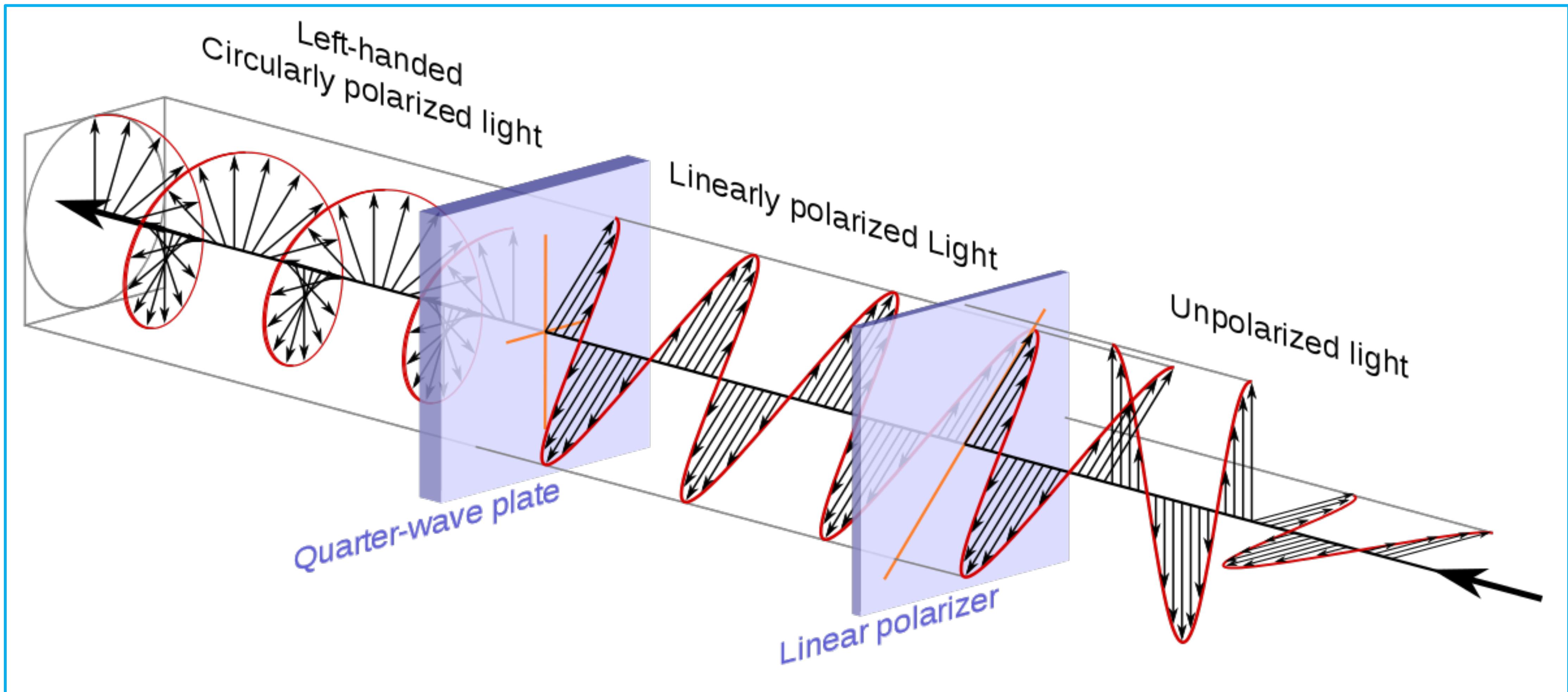
Inspecting Signals



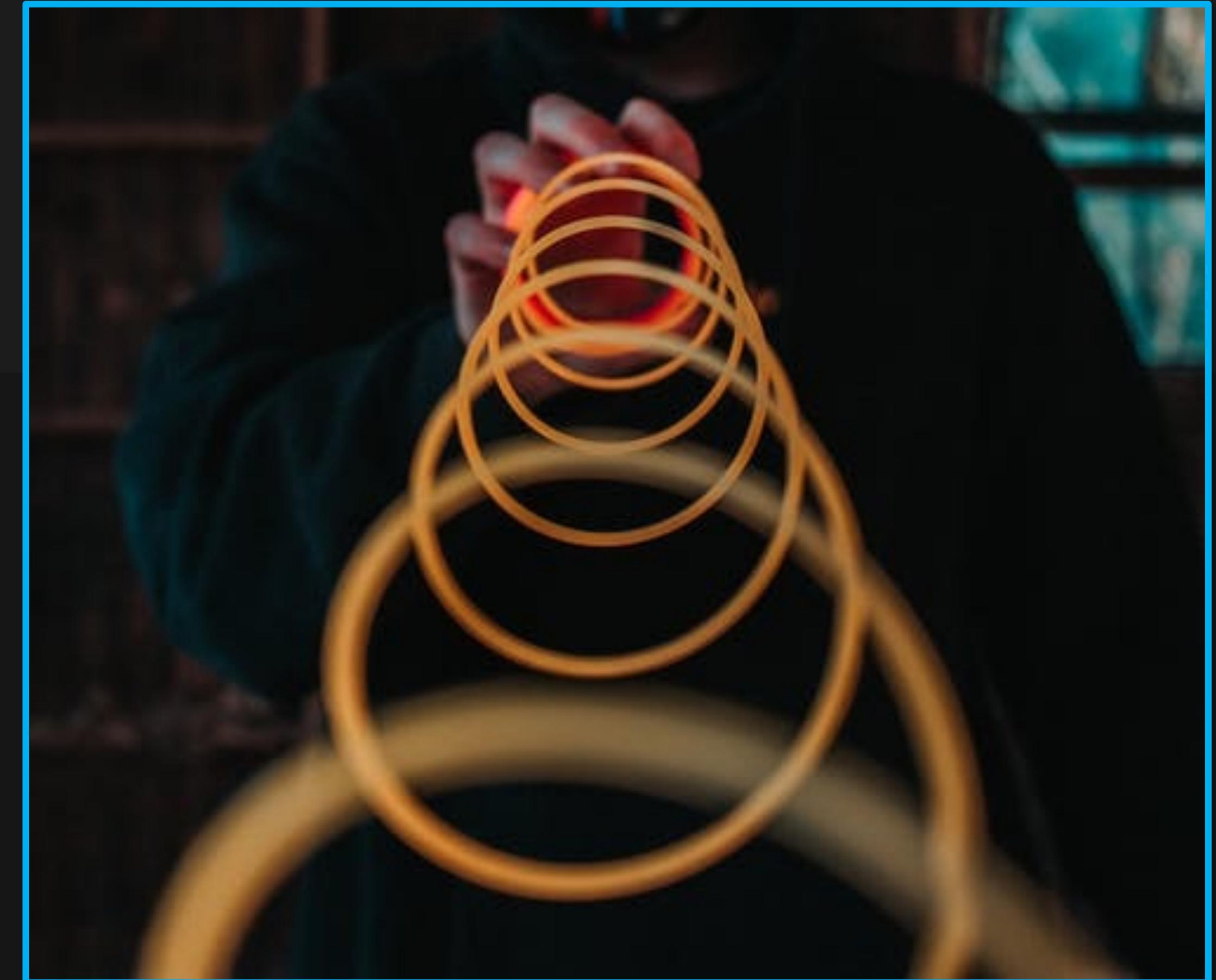


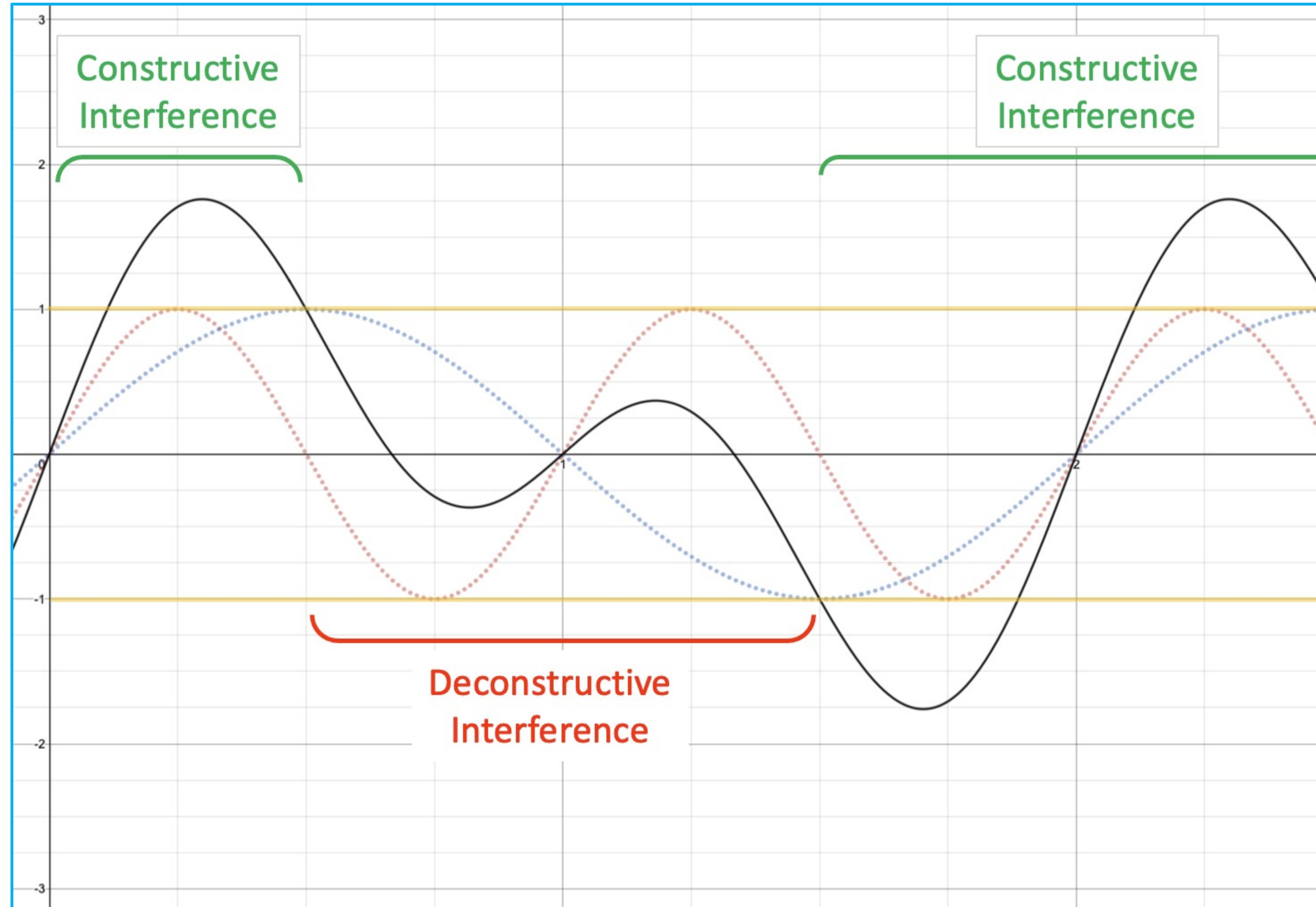
$v = \lambda f$



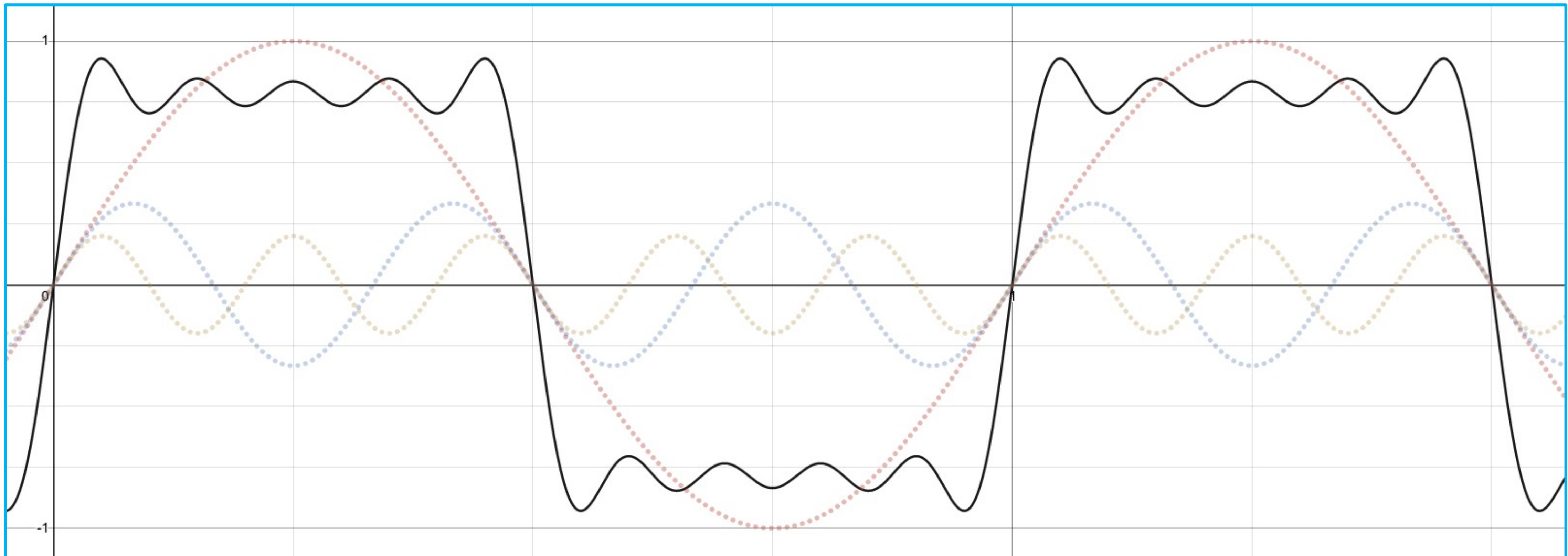


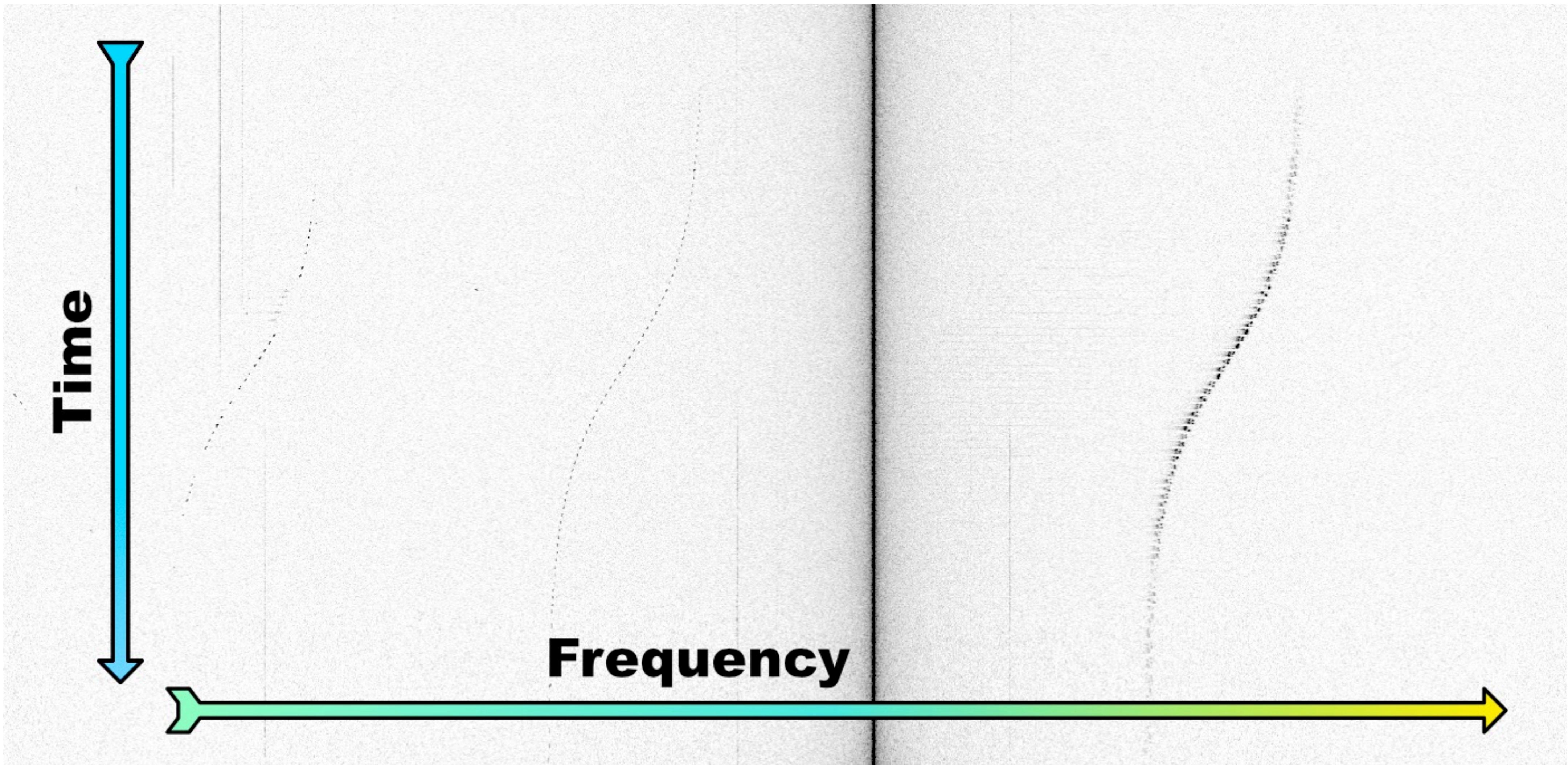
SLINKY DEMO





Inspecting Signals



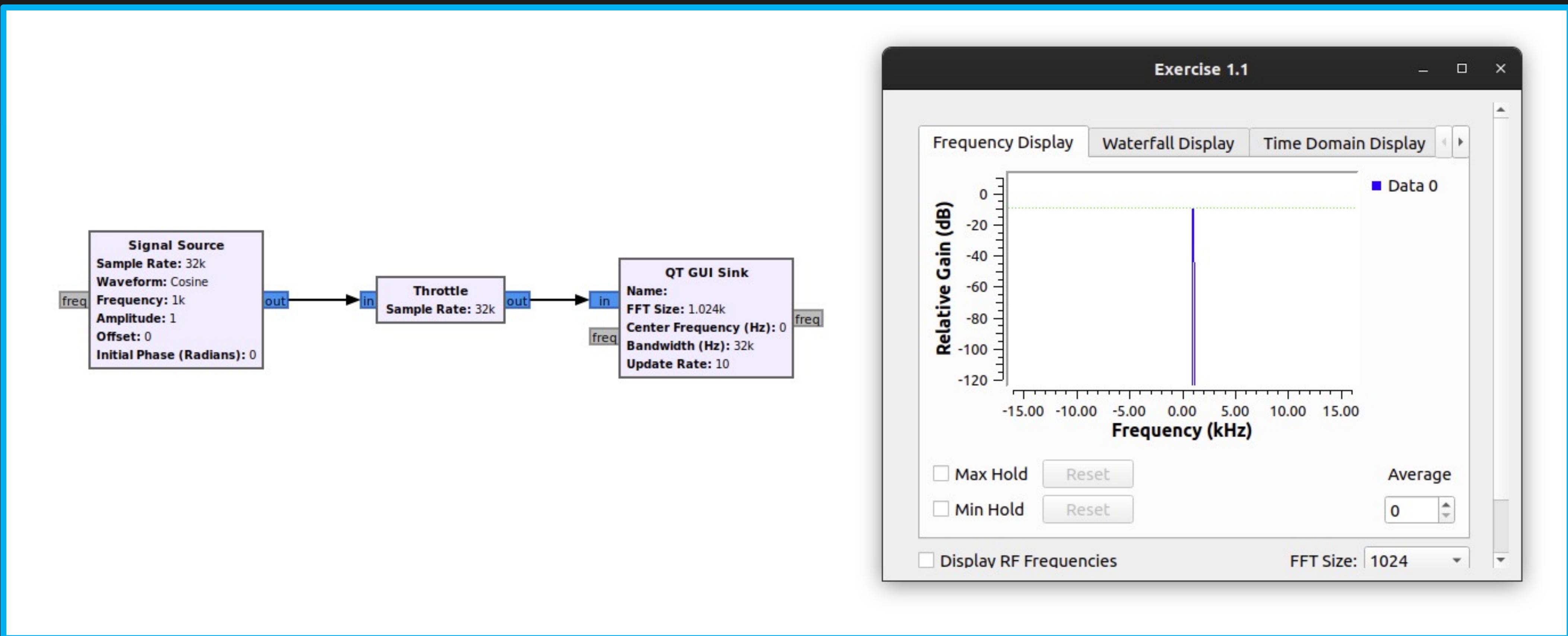


SO MUCH NOISE DEMO



EXERCISE 1.1

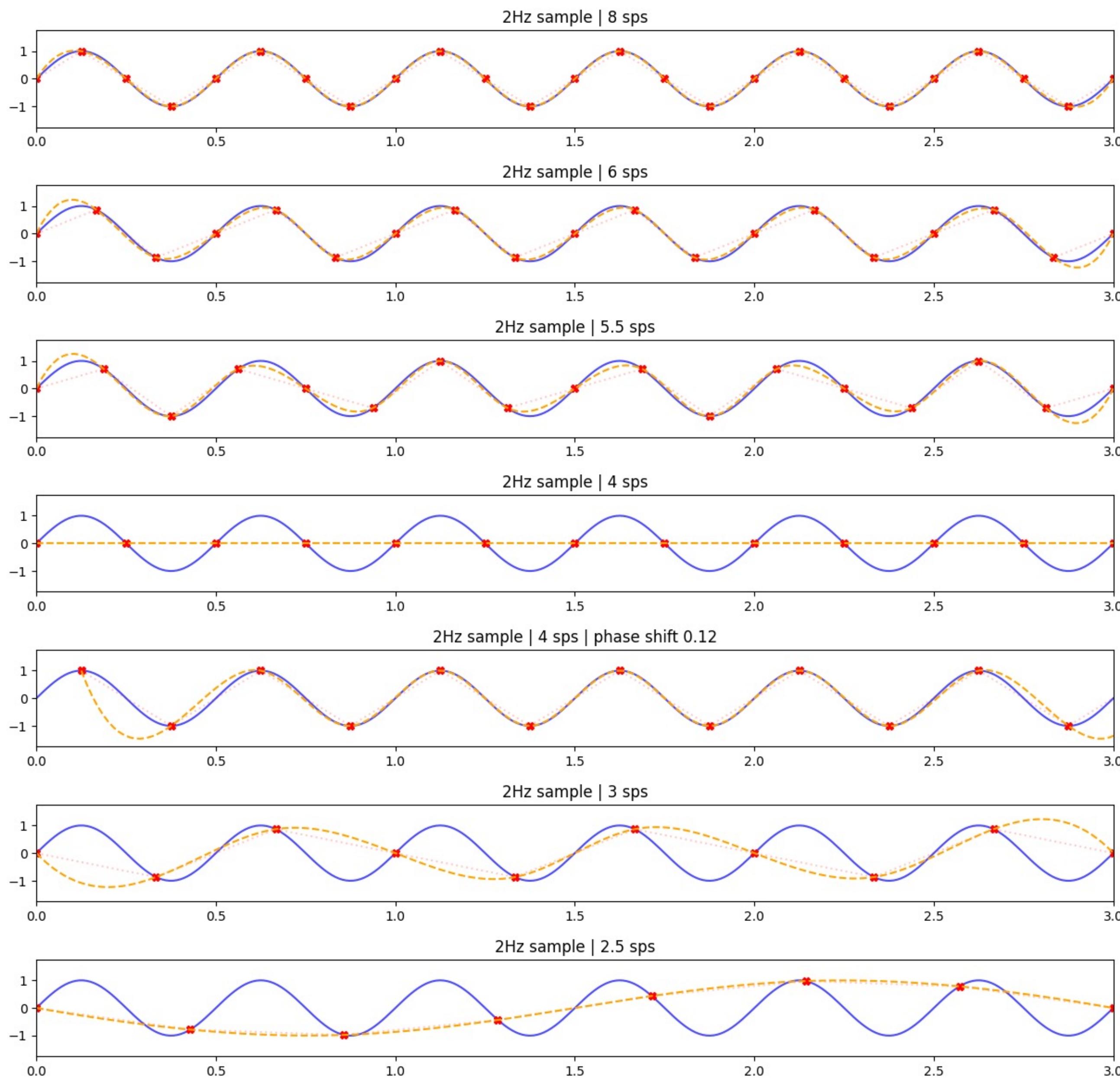
Right to the Source of the Signal



Unit Two

Saving the Signal

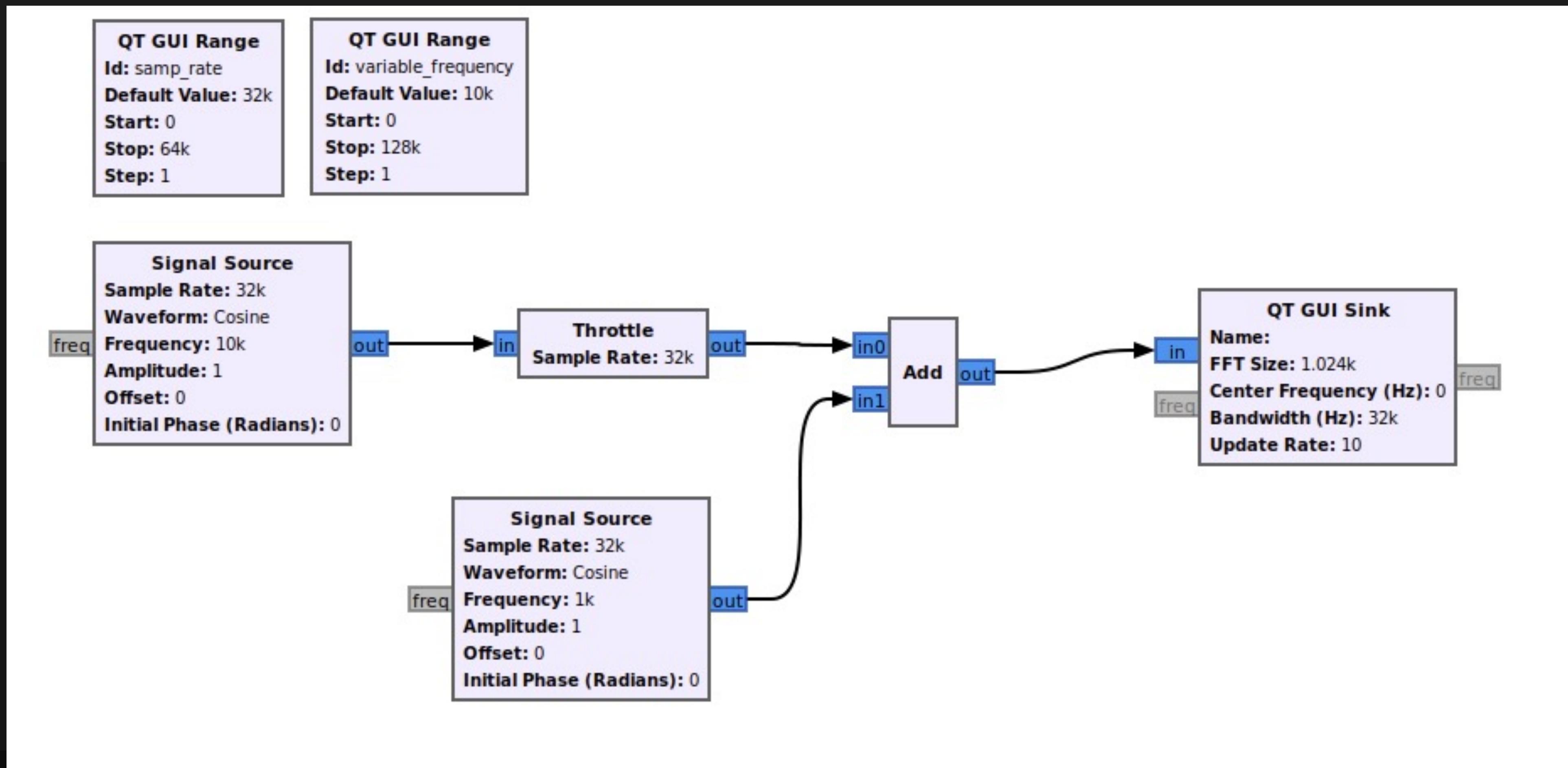
Inspecting Signals



“If a function x contains no frequencies higher than B hertz, it is completely determined by giving its ordinates at a series of points spaced $\frac{1}{2B}$ seconds apart.”

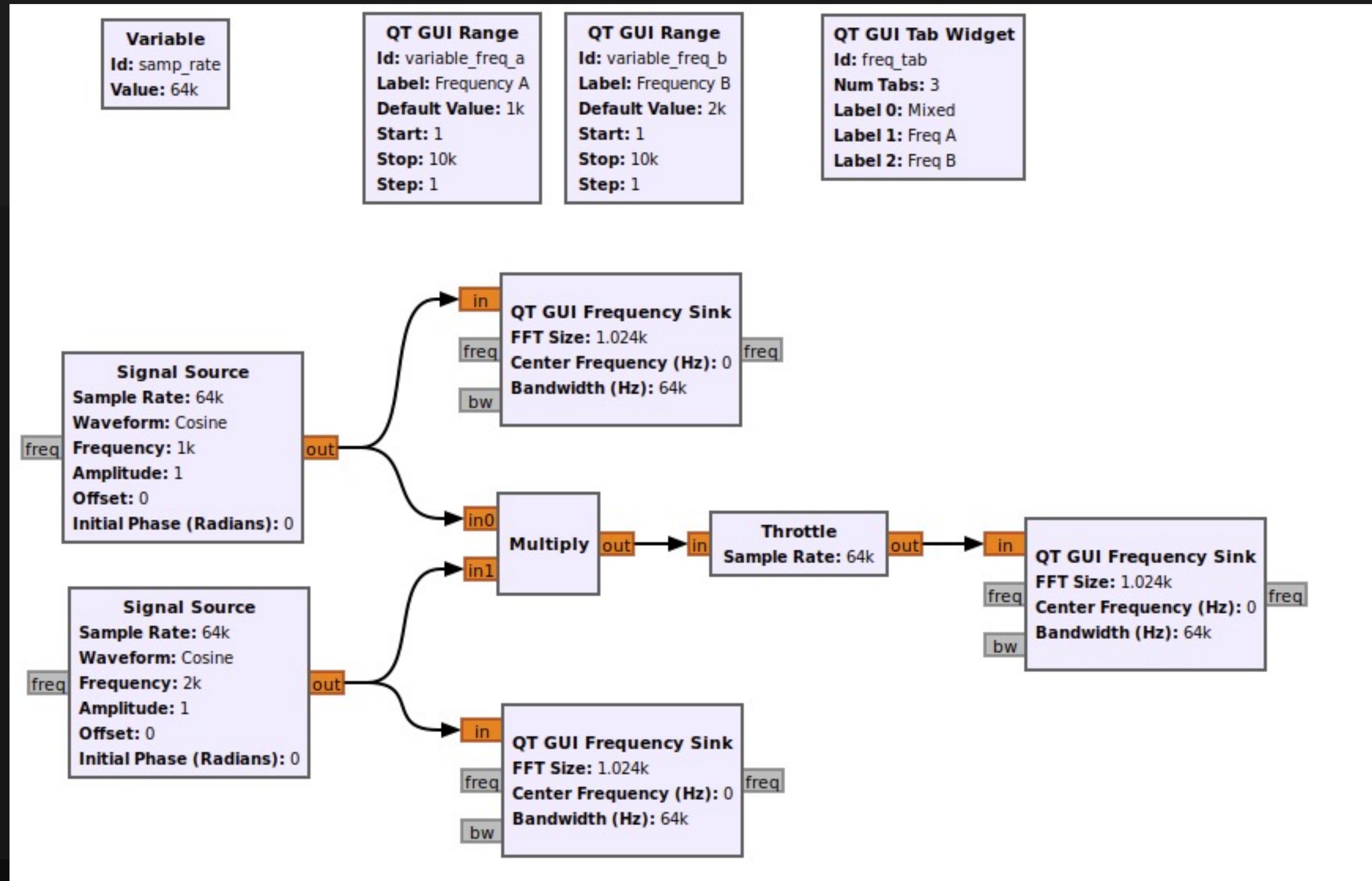
- Claude Shannon

Finding the Alias

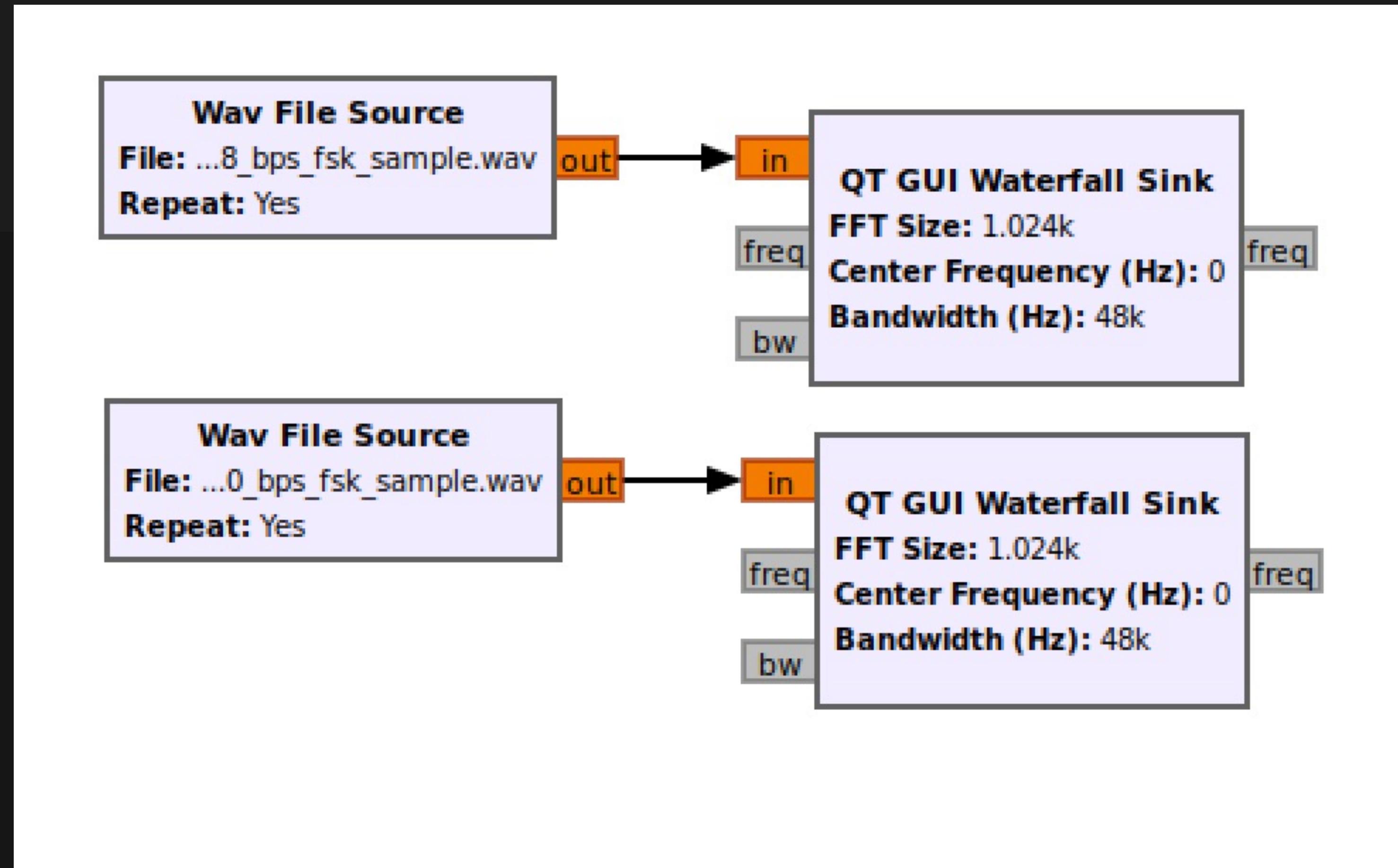


EXERCISE 2.2

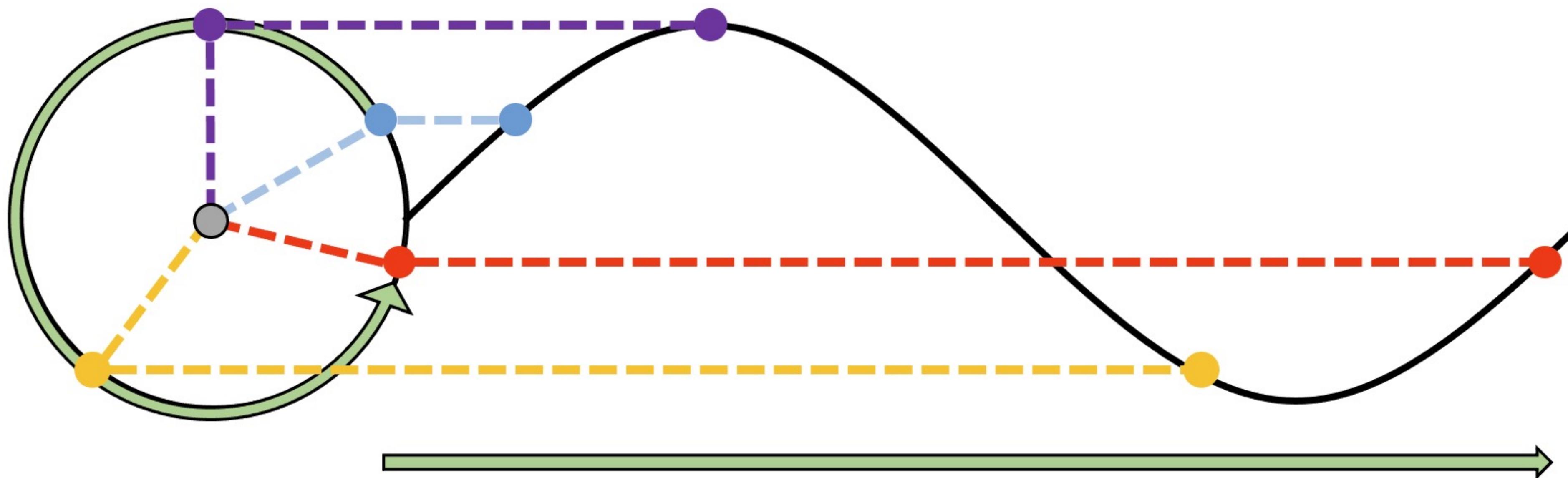
Sending Mixed Signals



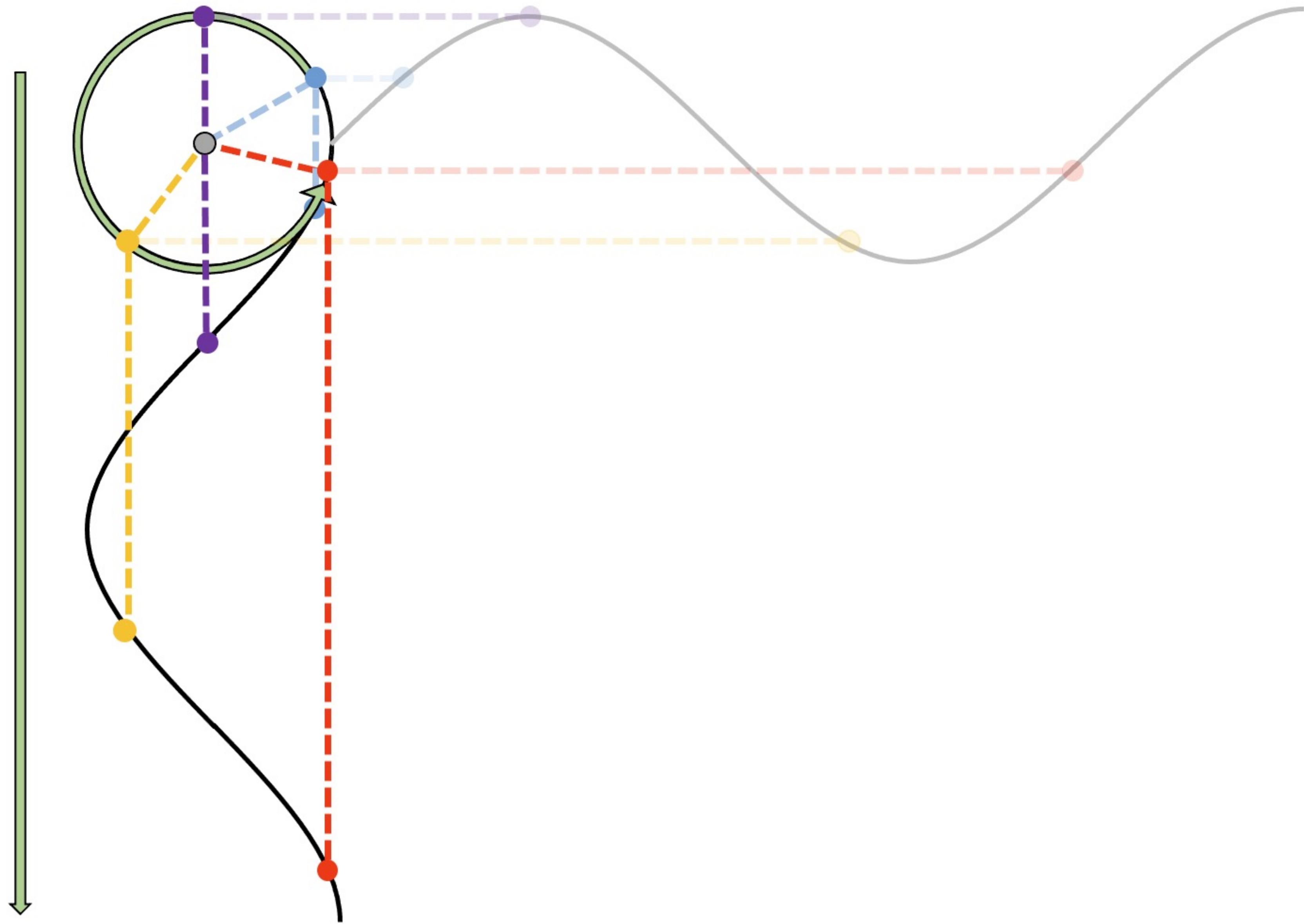
Moving Fast

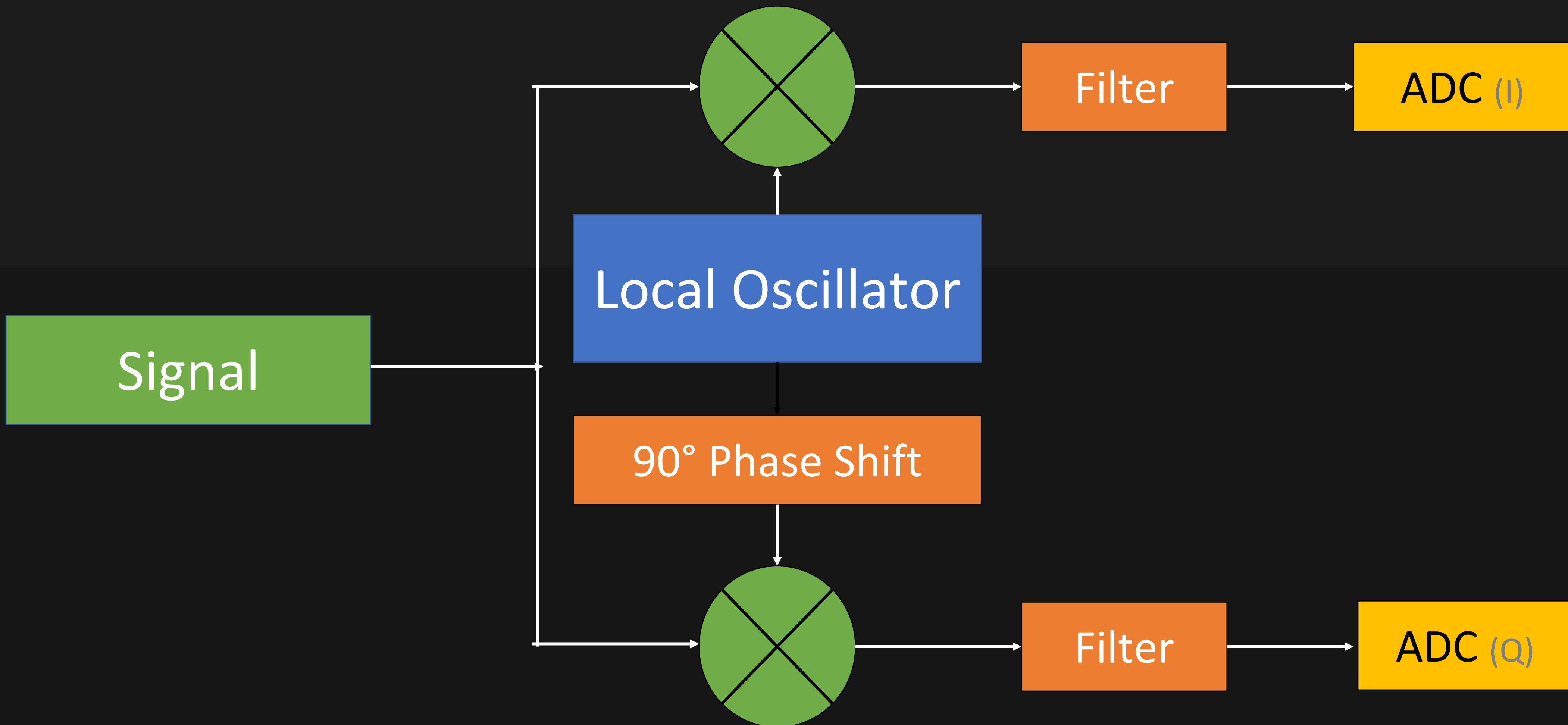


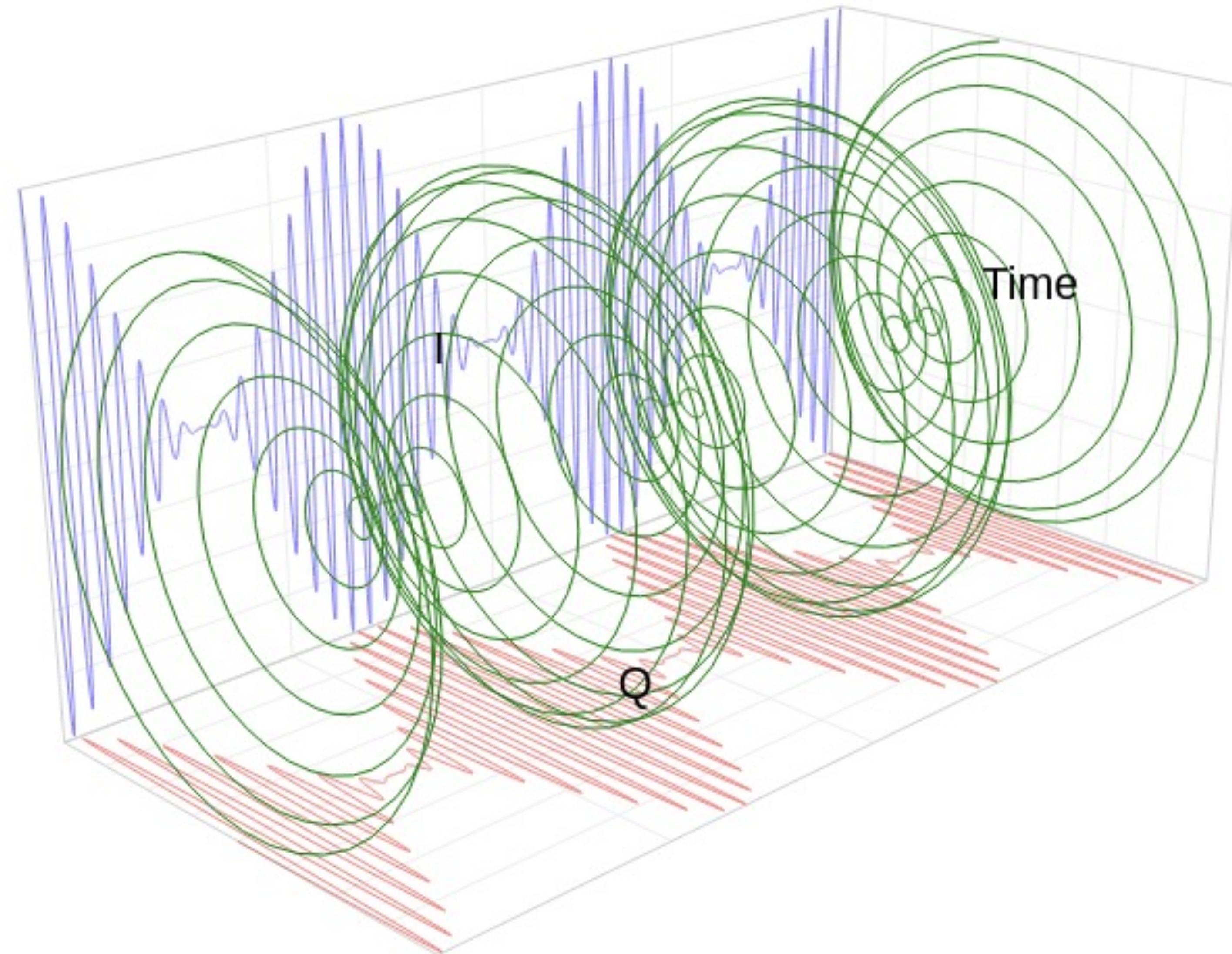
Inspecting Signals



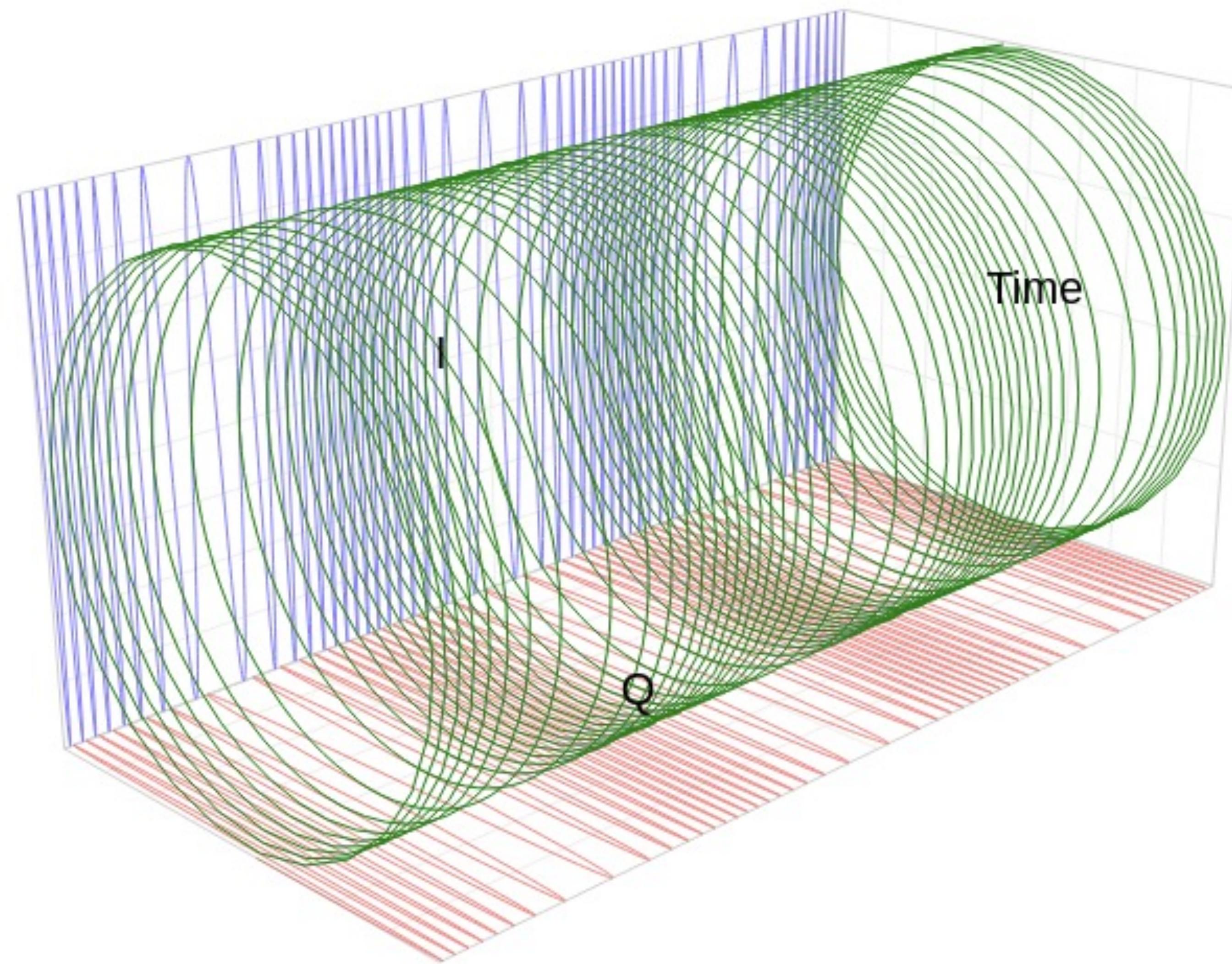
Inspecting Signals





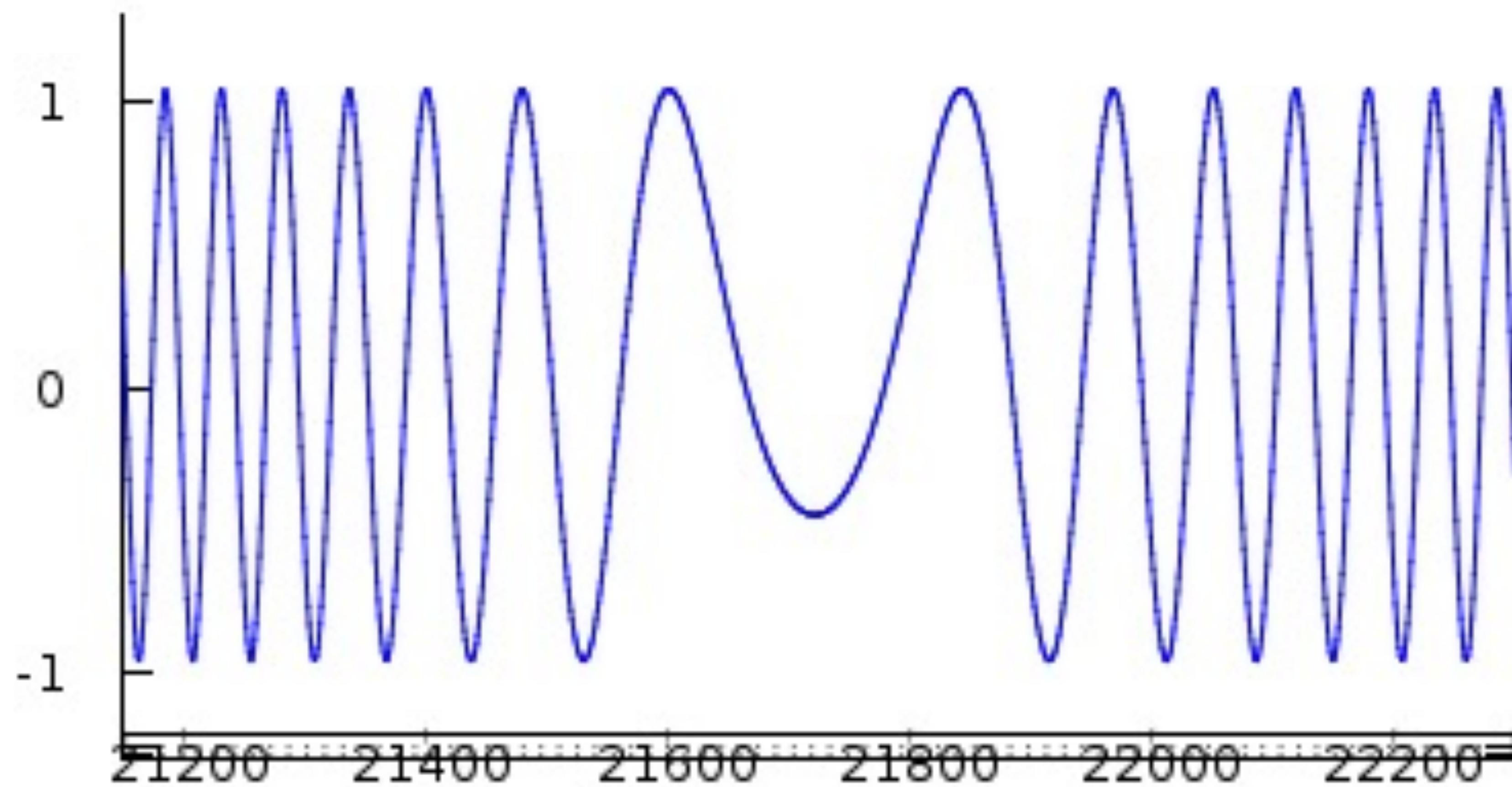


Source: https://arachnoid.com/software_defined_radios

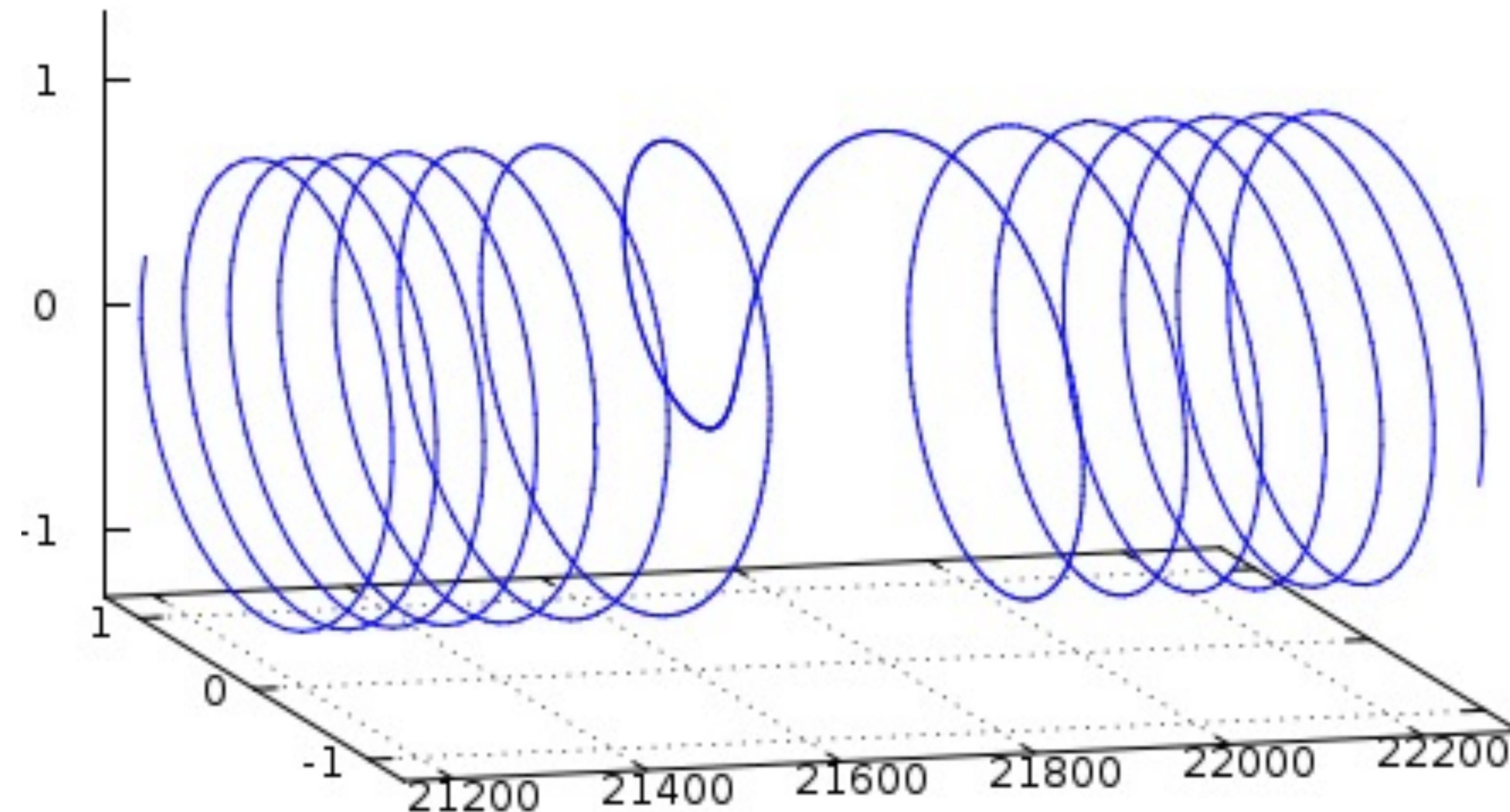


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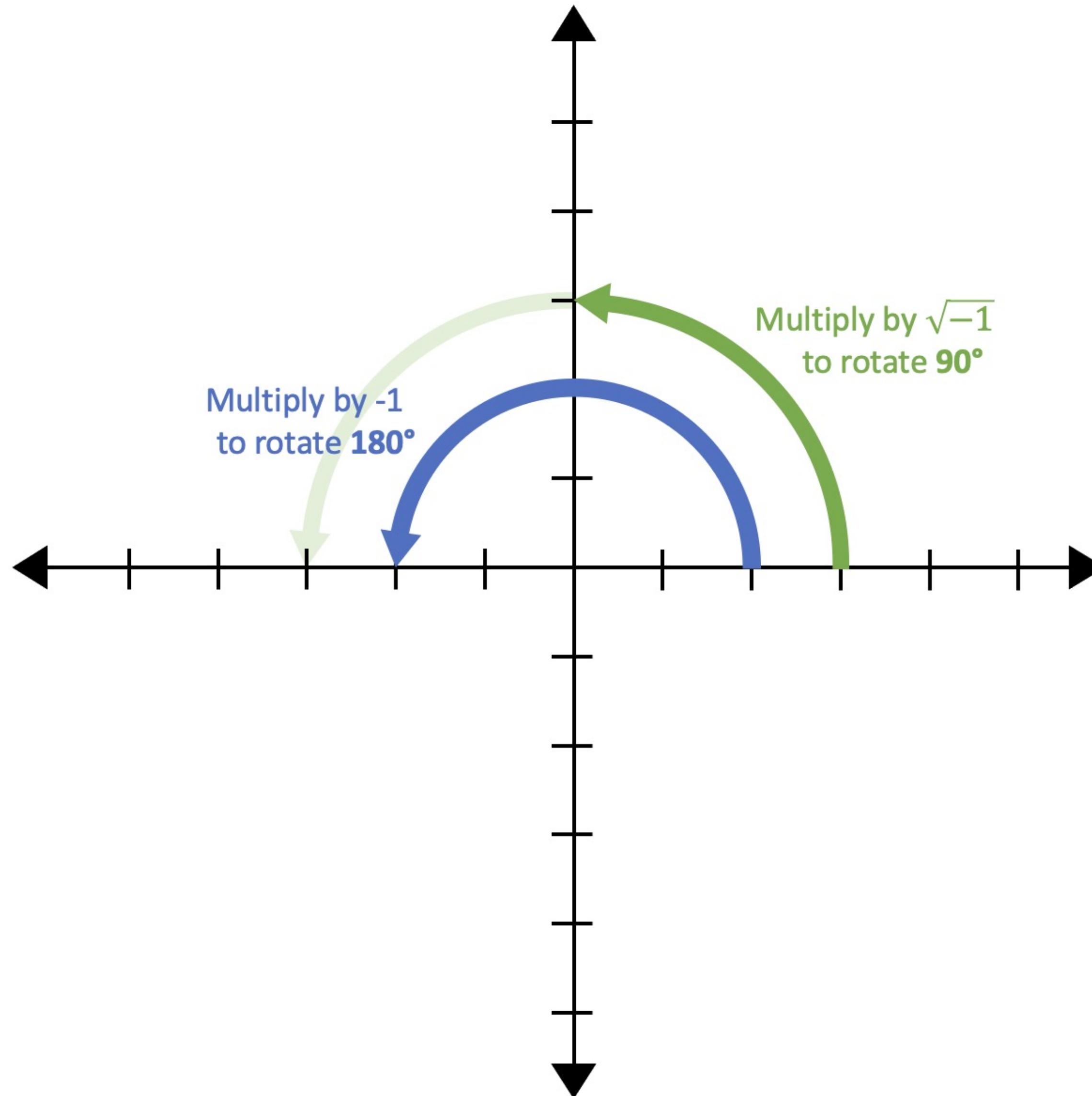
Inspecting Signals

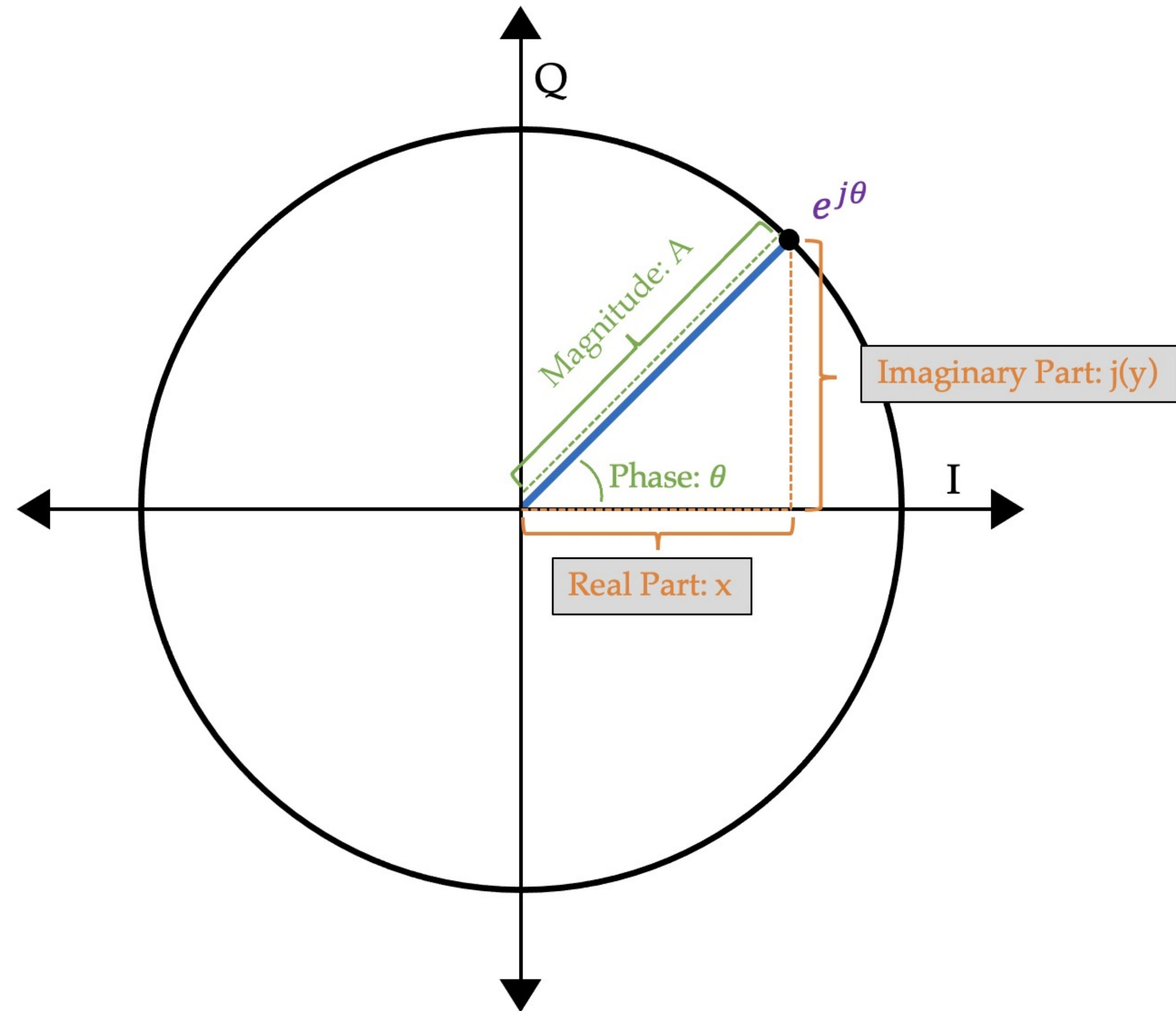


Source: <http://whiteboard.ping.se/SDR/IQ>



Source: <http://whiteboard.ping.se/SDR/IQ>





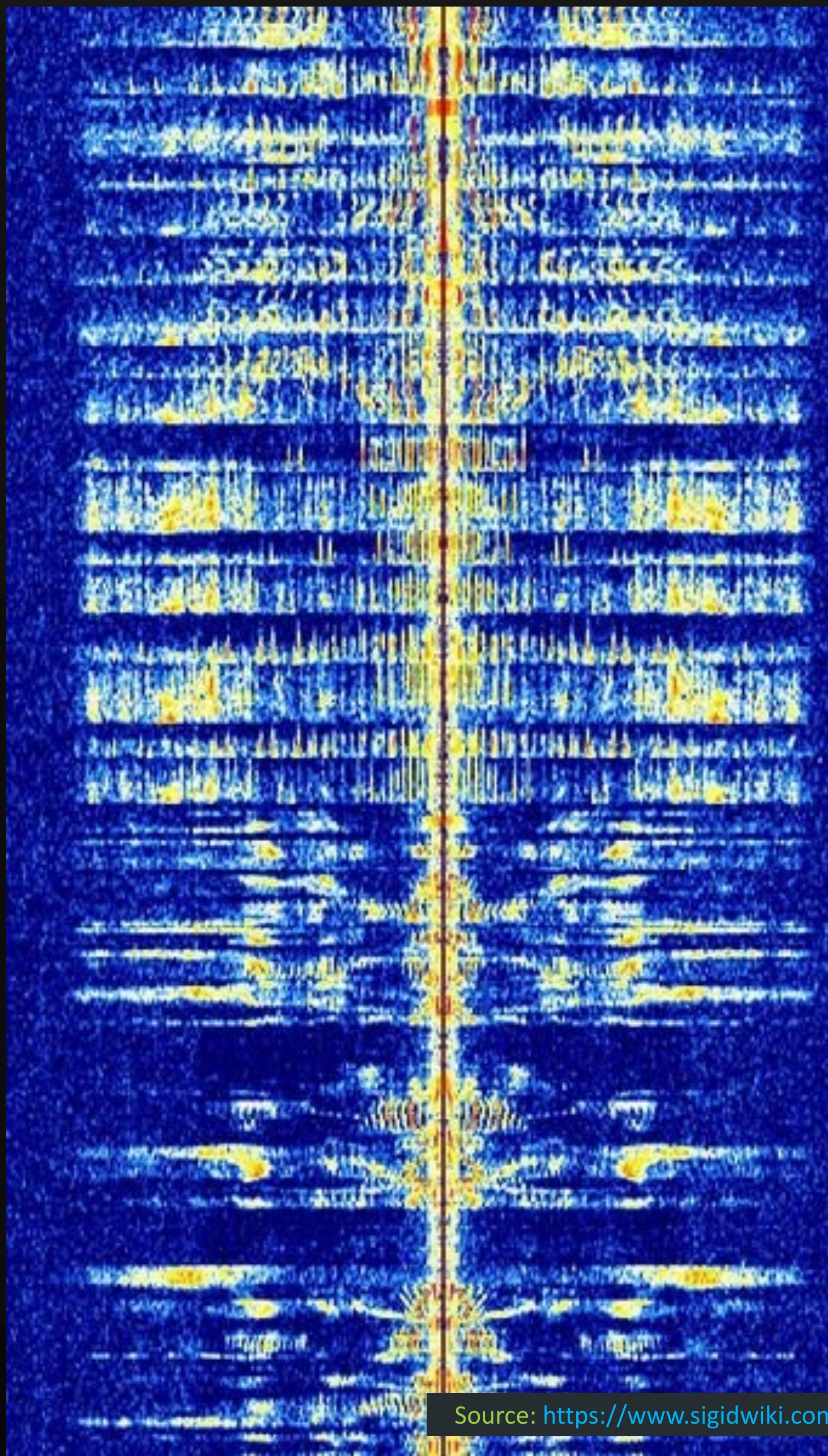
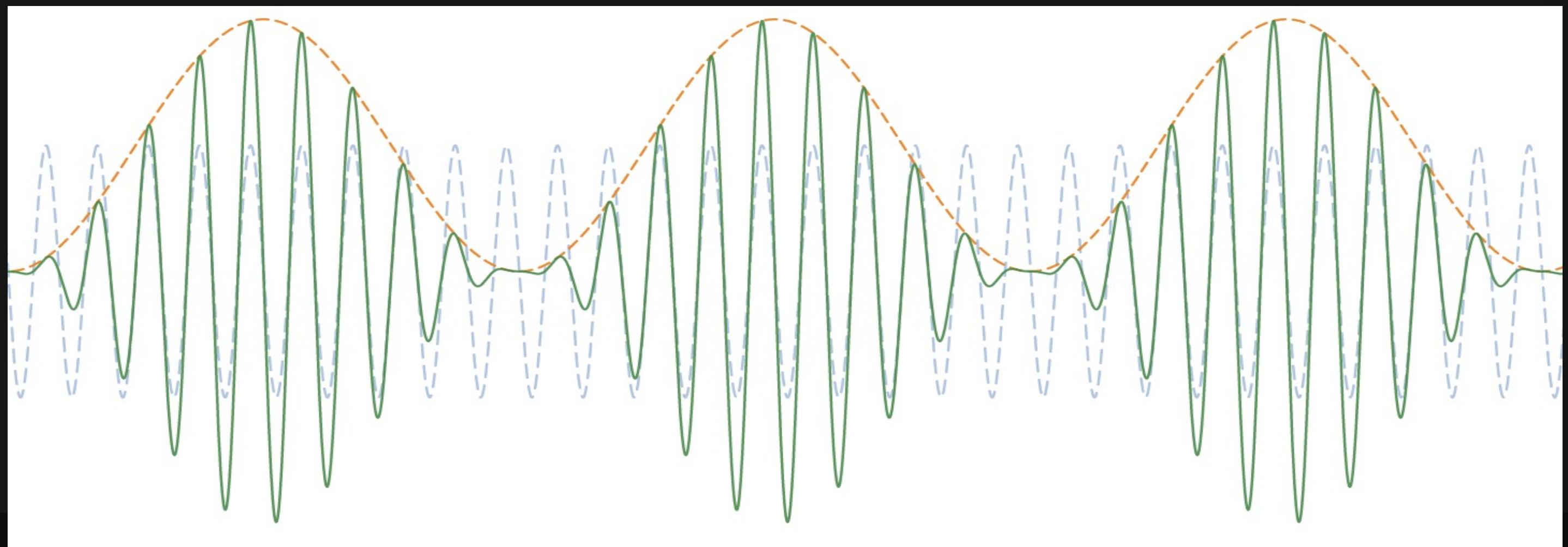
DEMO SLIDE

Inspecting Signals

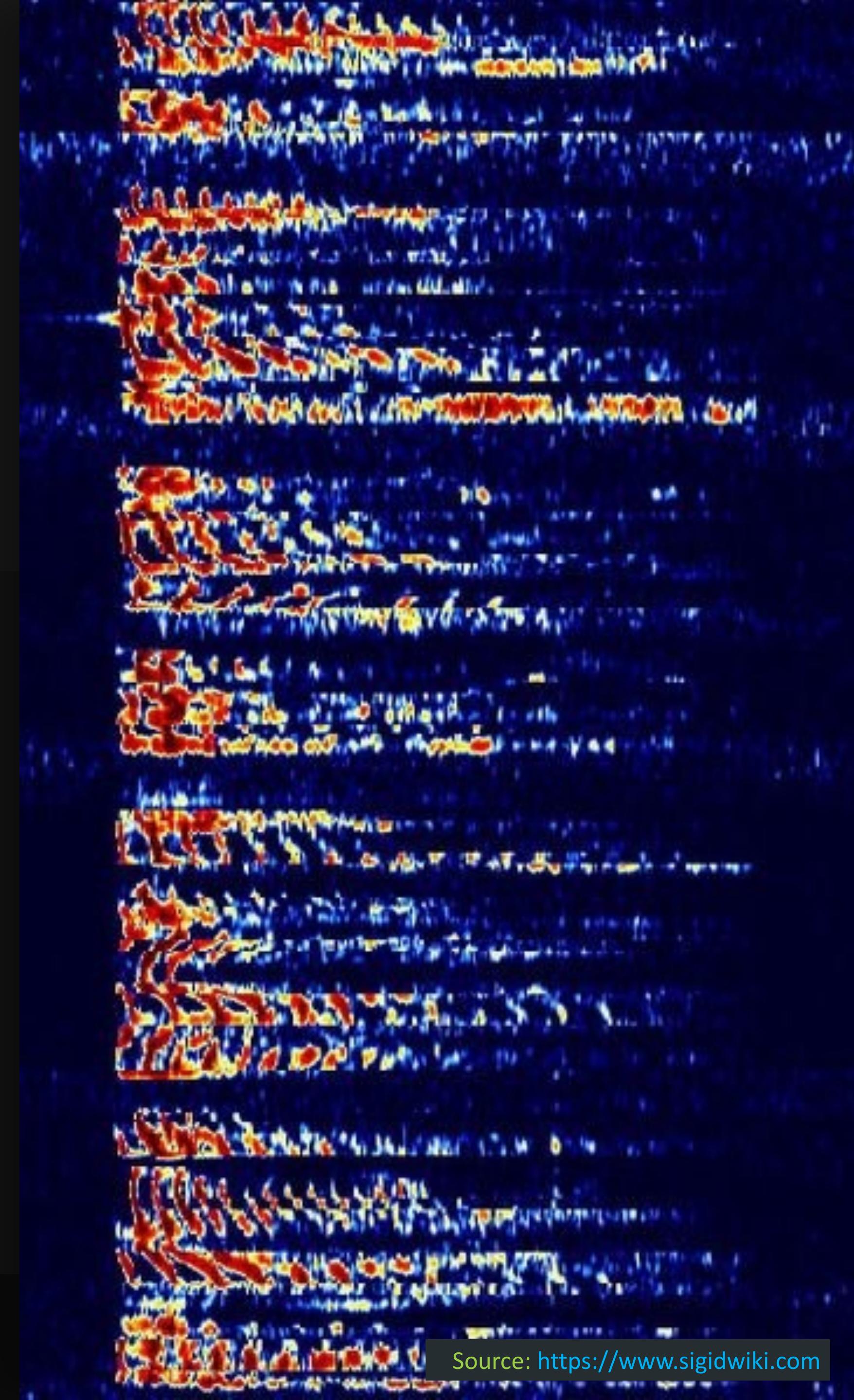
Unit Three

Shaping the Signal

AMPLITUDE MODULATION (AM)



UPPER SIDEBAND (USB)

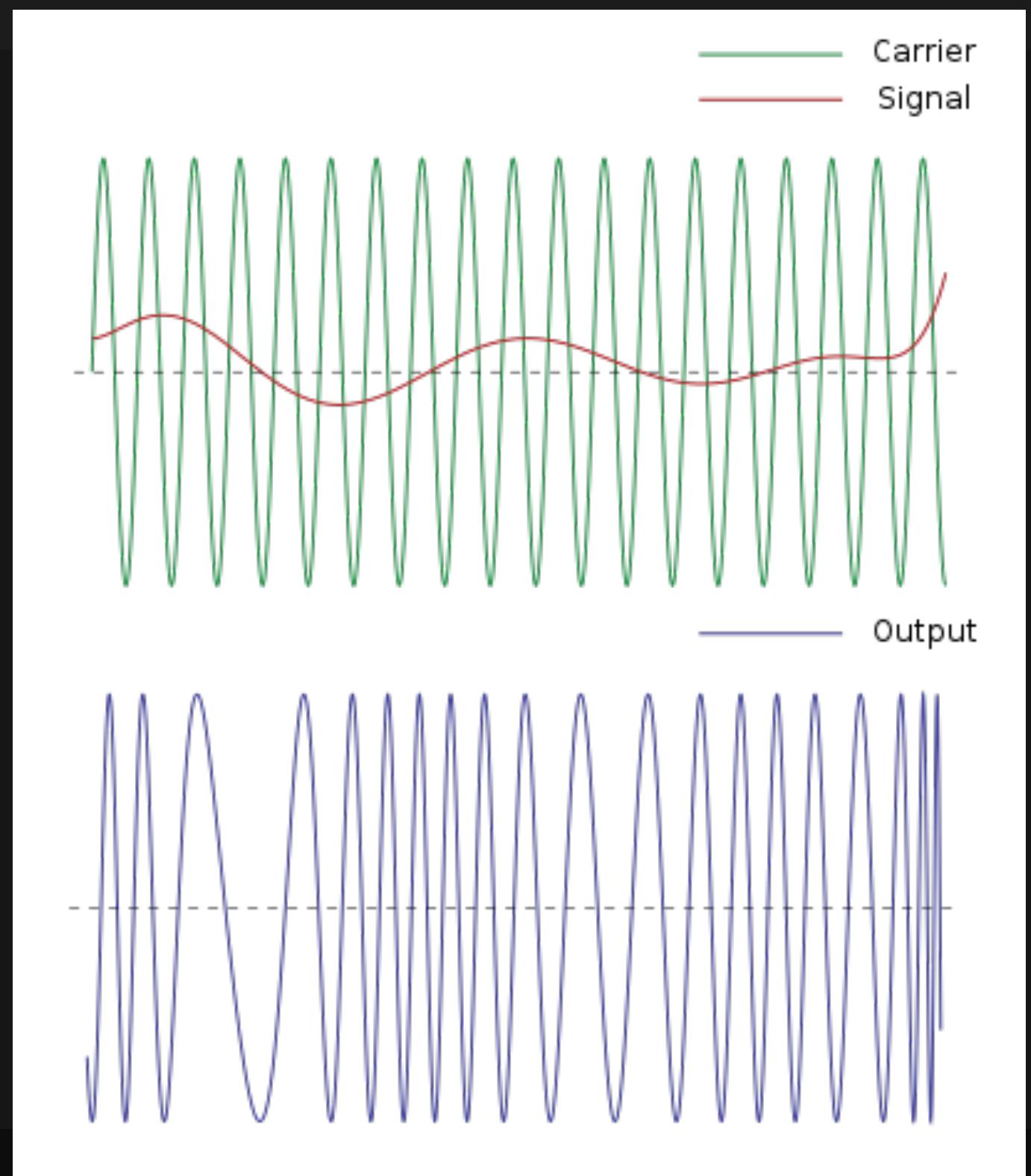


DUAL-TONE FREQUENCY MODULATION (DTFM)

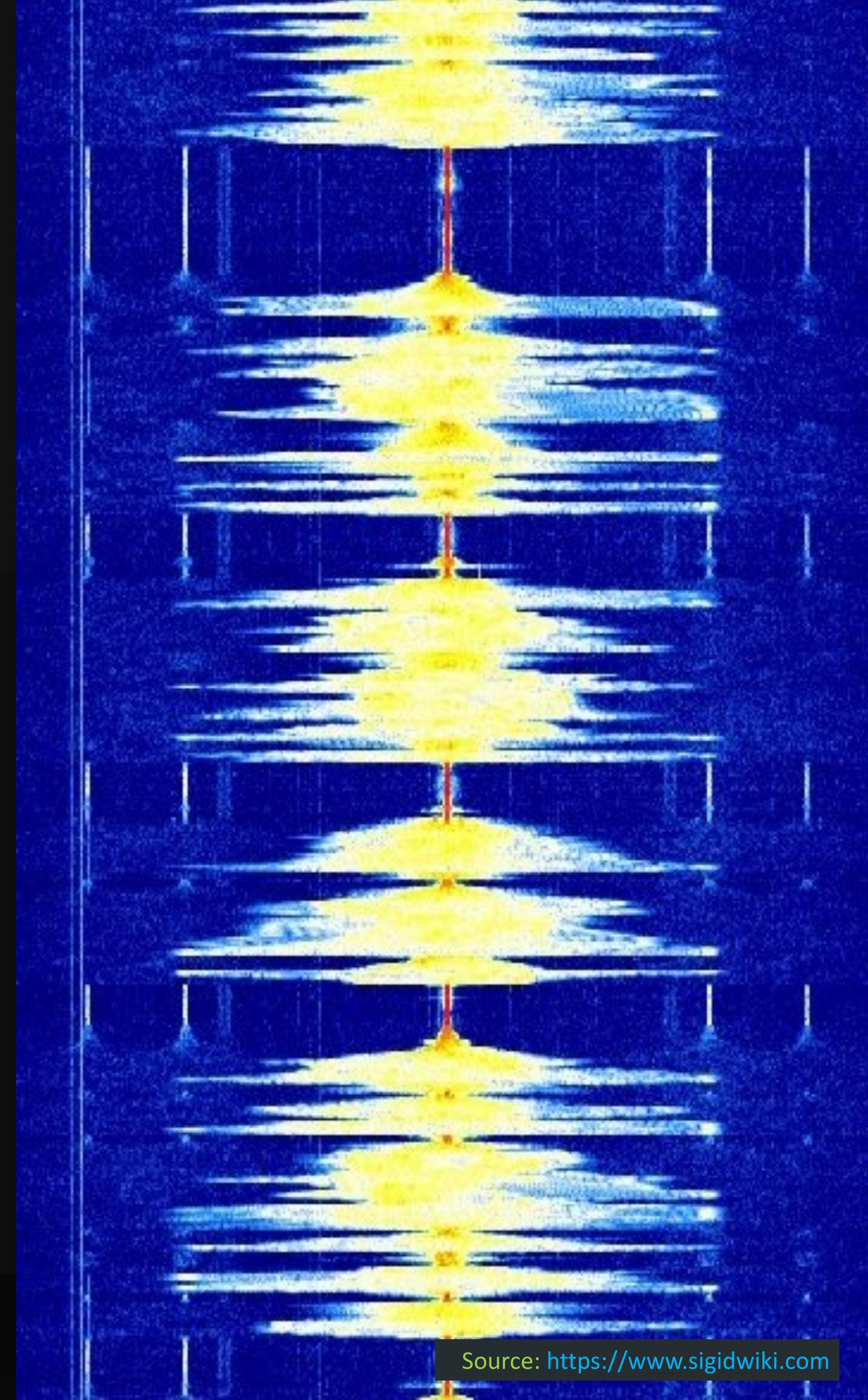
	1209 Hz	1336 Hz	1477 Hz	1633 Hz
697 Hz	1	2	3	A
770 Hz	4	5	6	B
852 Hz	7	8	9	C
941 Hz	*	0	#	D



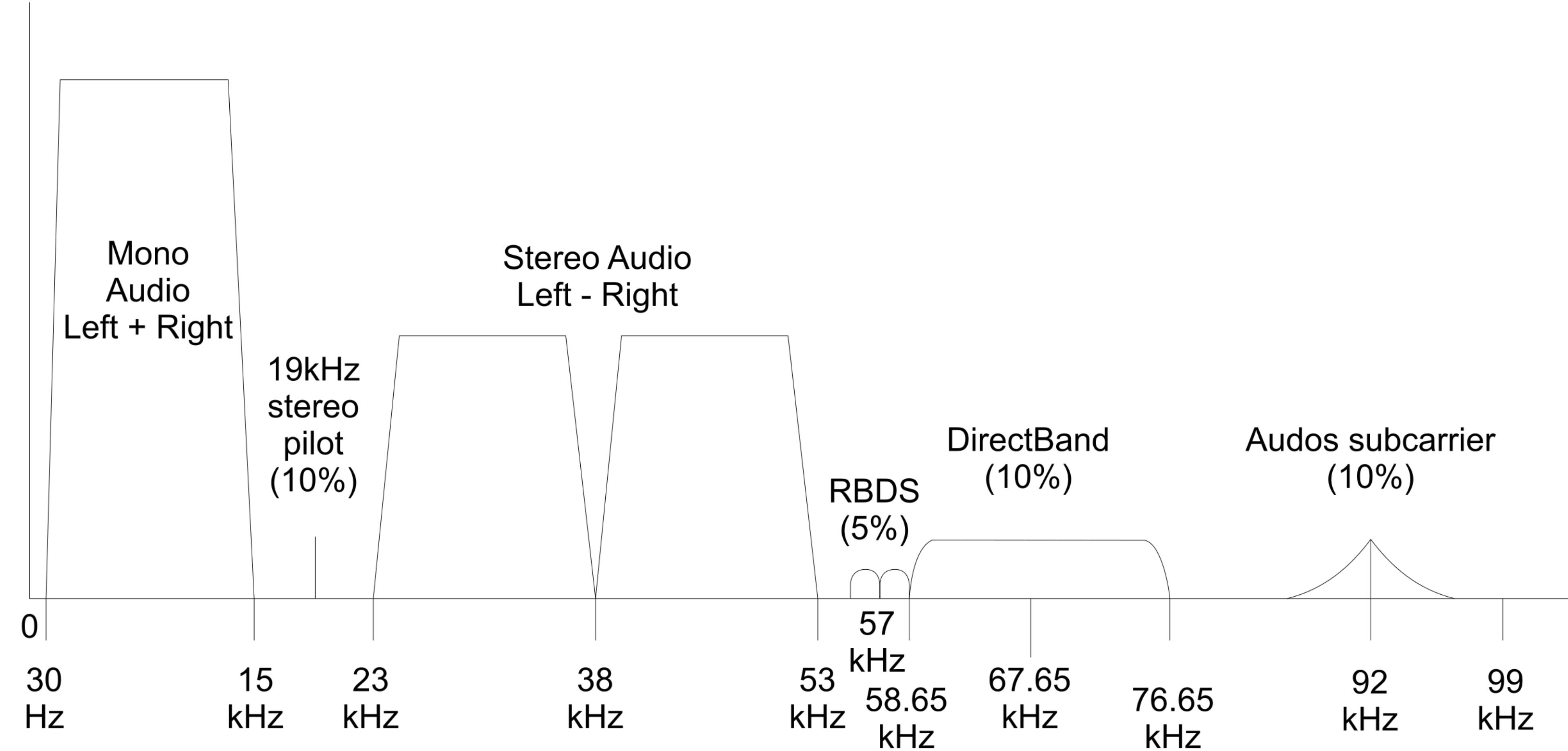
FREQUENCY MODULATION (FM)



Source: <https://commons.wikimedia.org/wiki/File:FM-Final-Wiki-TEK.svg>

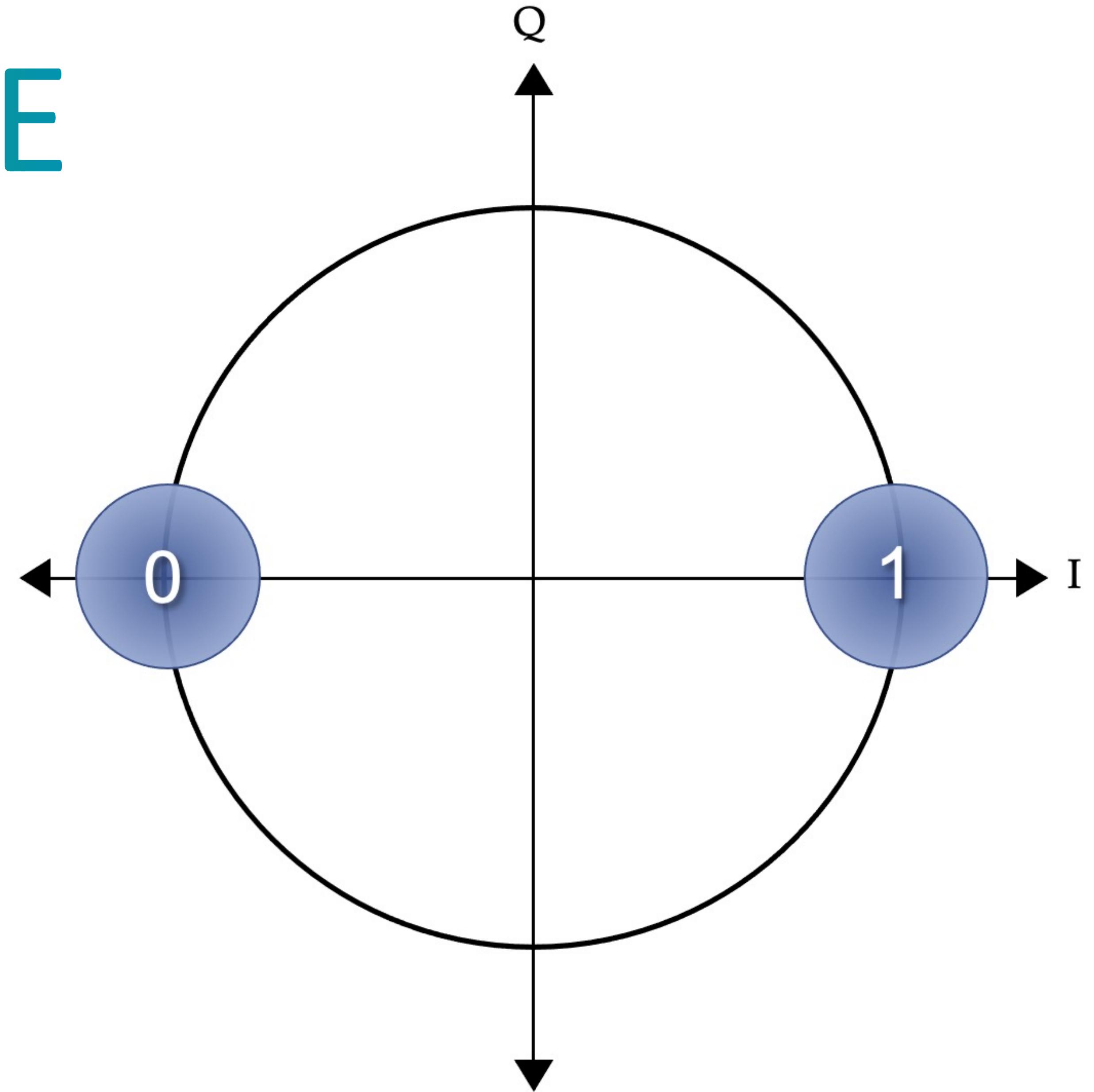


Source: <https://www.sigidiwiki.com>

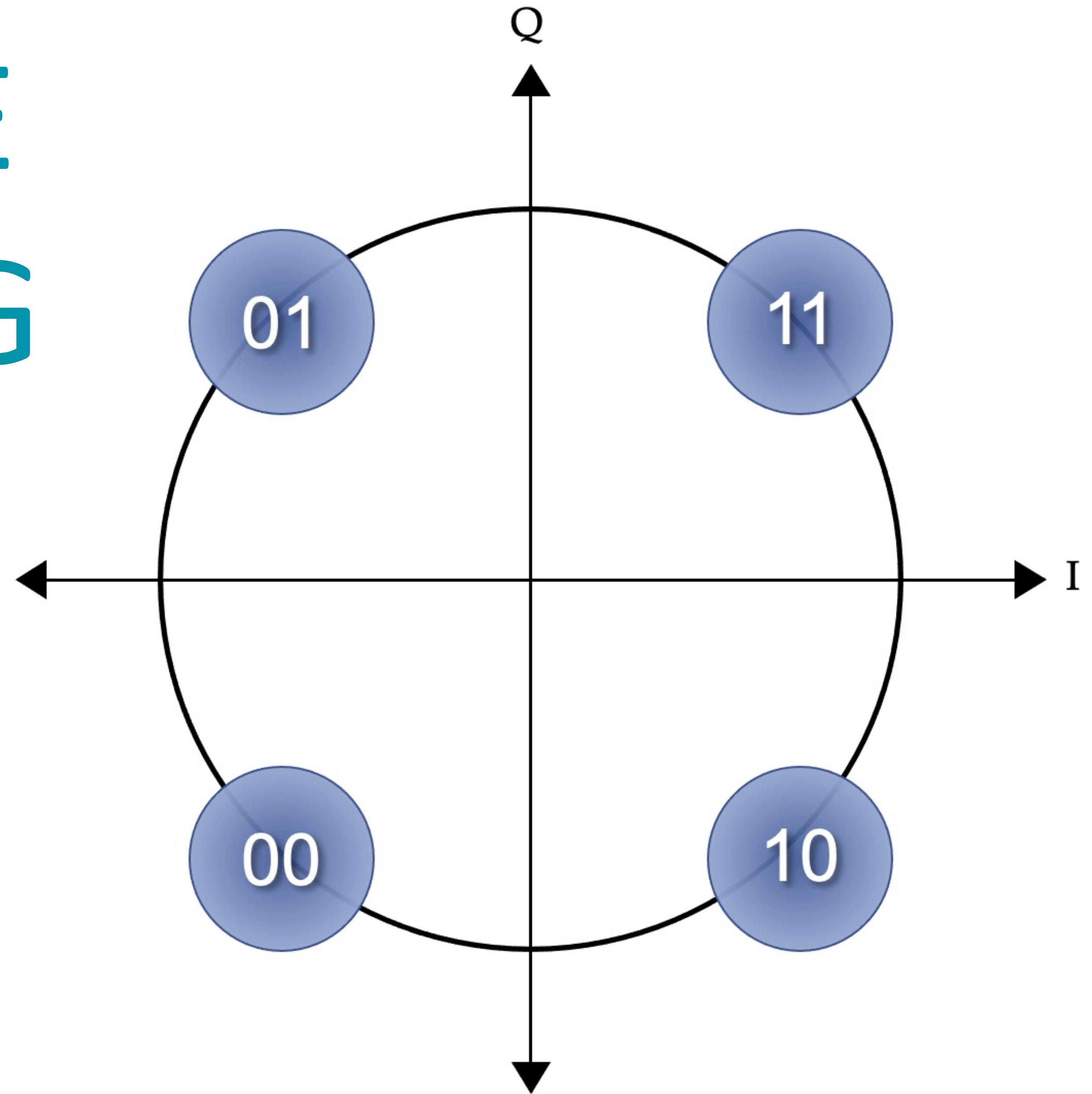


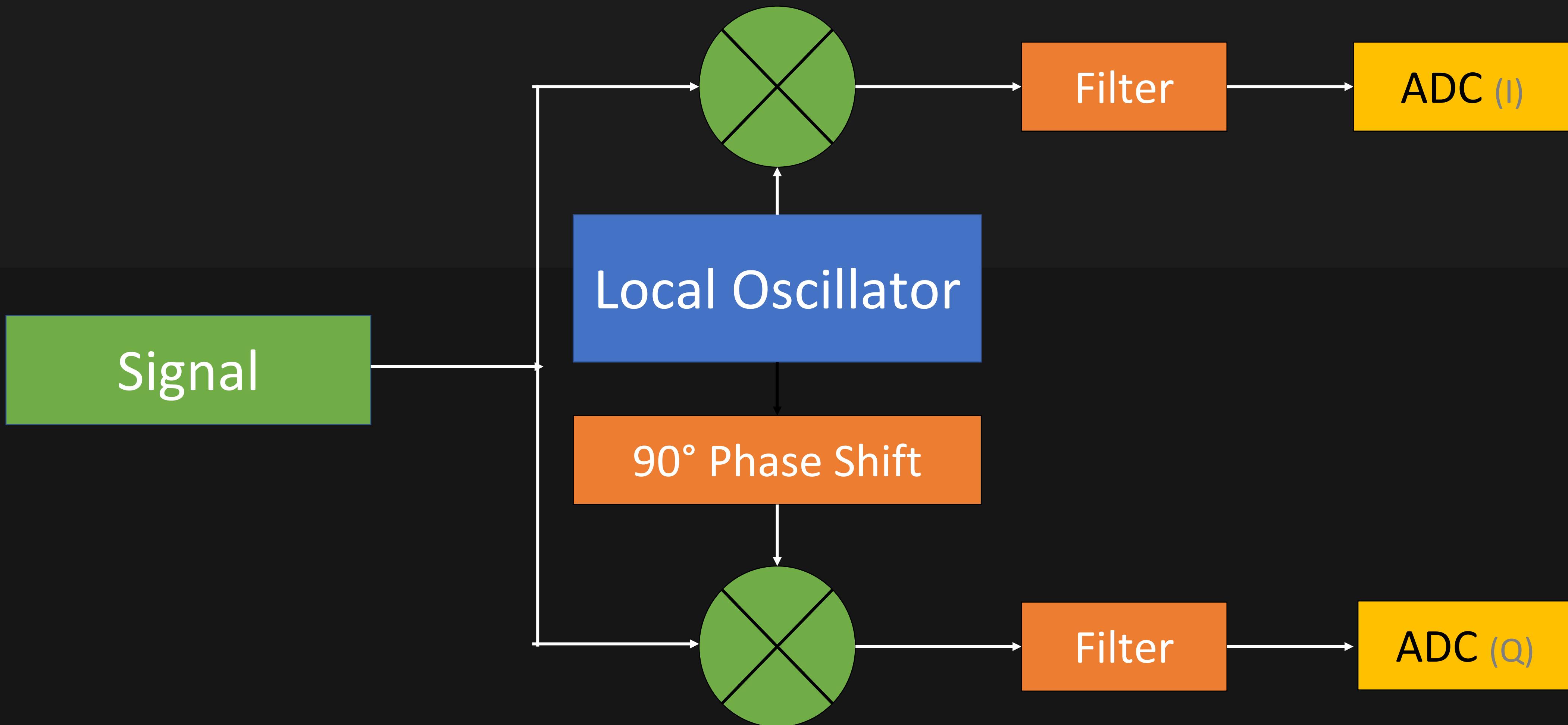
Source: https://en.wikipedia.org/wiki/FM_broadcasting#/media/File:RDS_vs_DirectBand_FM-spectrum2.svg

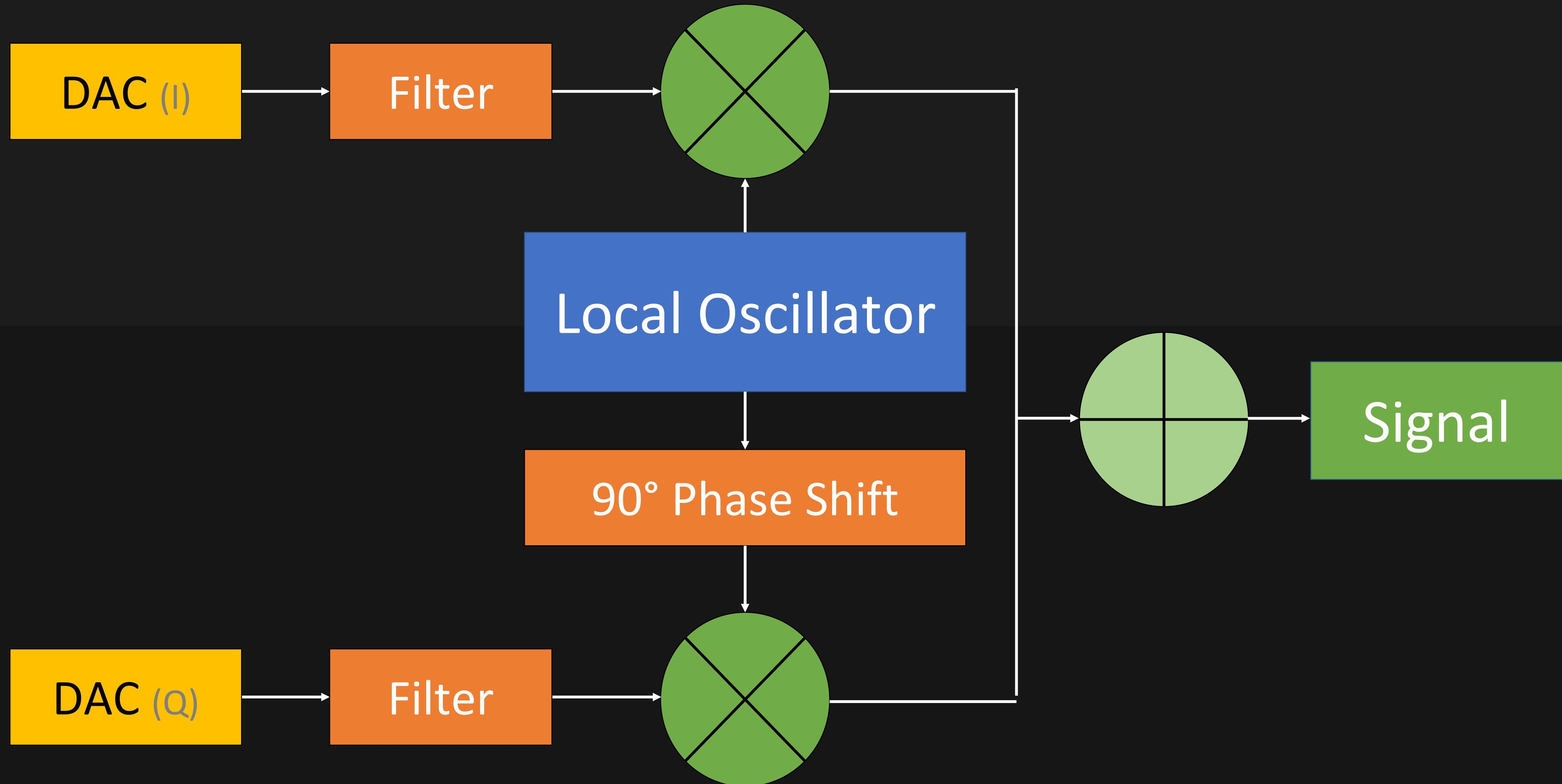
BINARY PHASE SHIFT KEYING (BPSK)



QUAD PHASE SHIFT KEYING (QPSK)

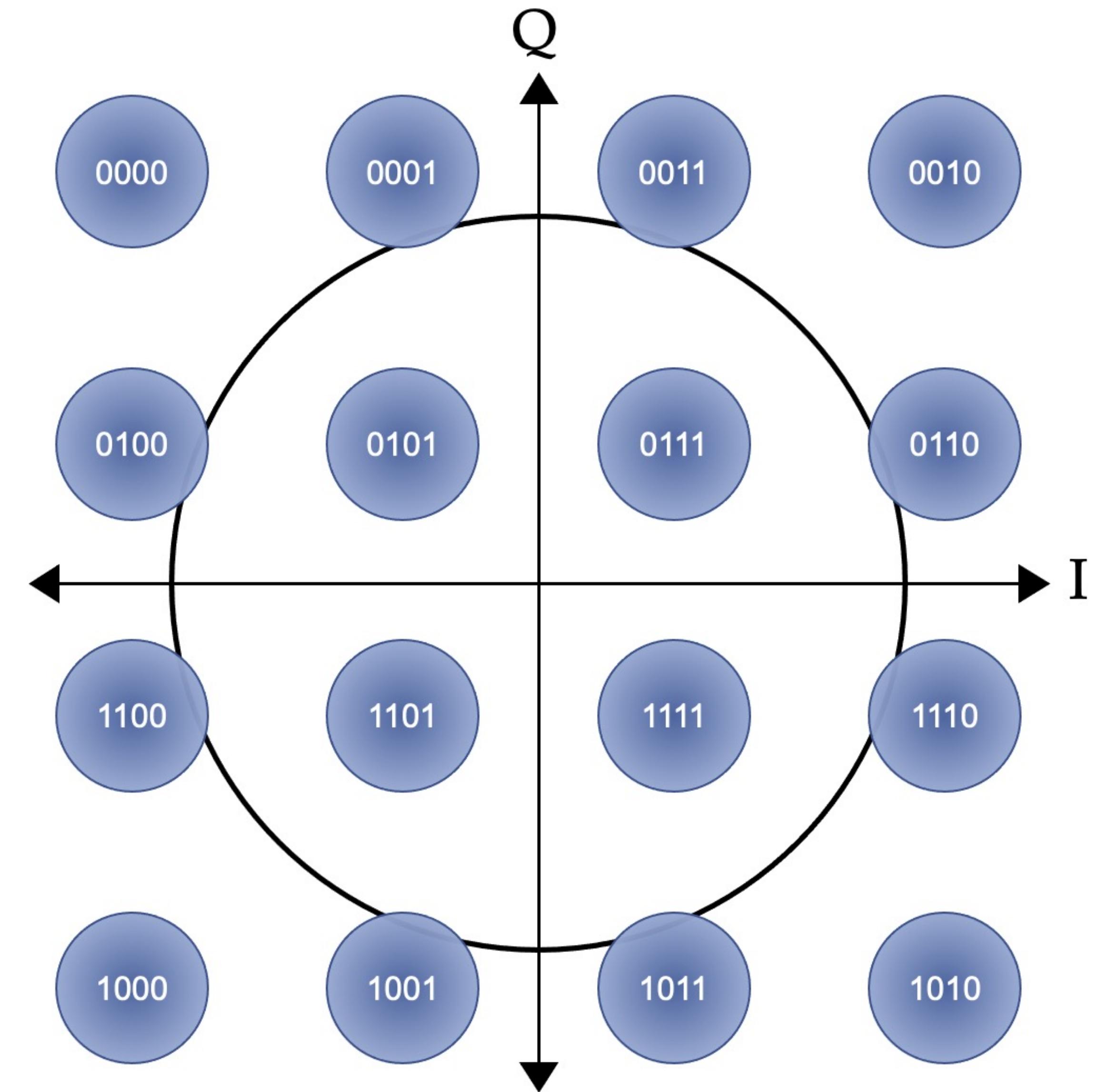






QUADRATURE AMPLITUDE MODULATION (QAM)

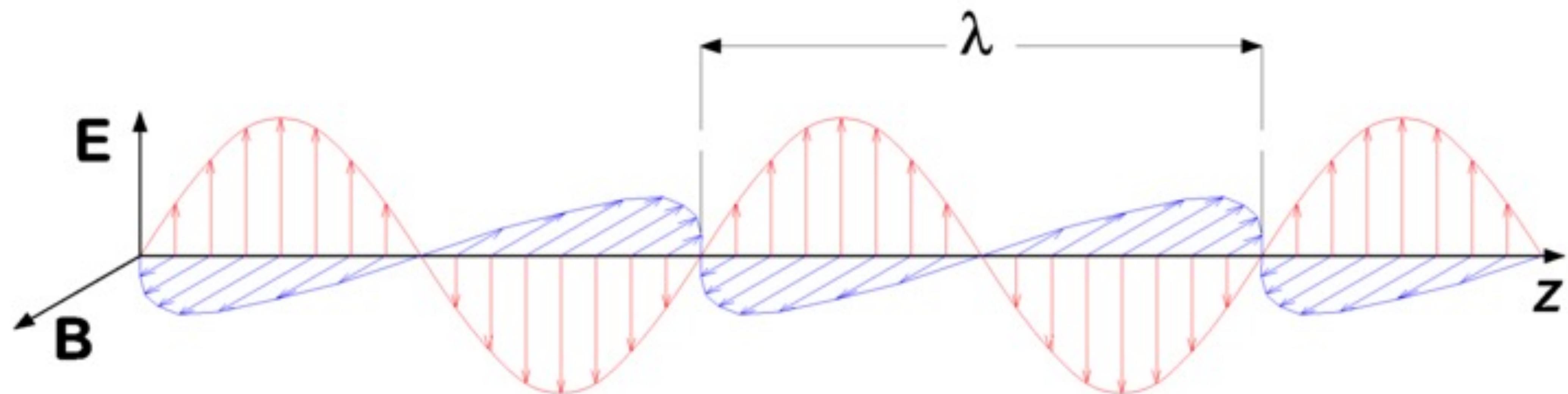
Inspecting Signals

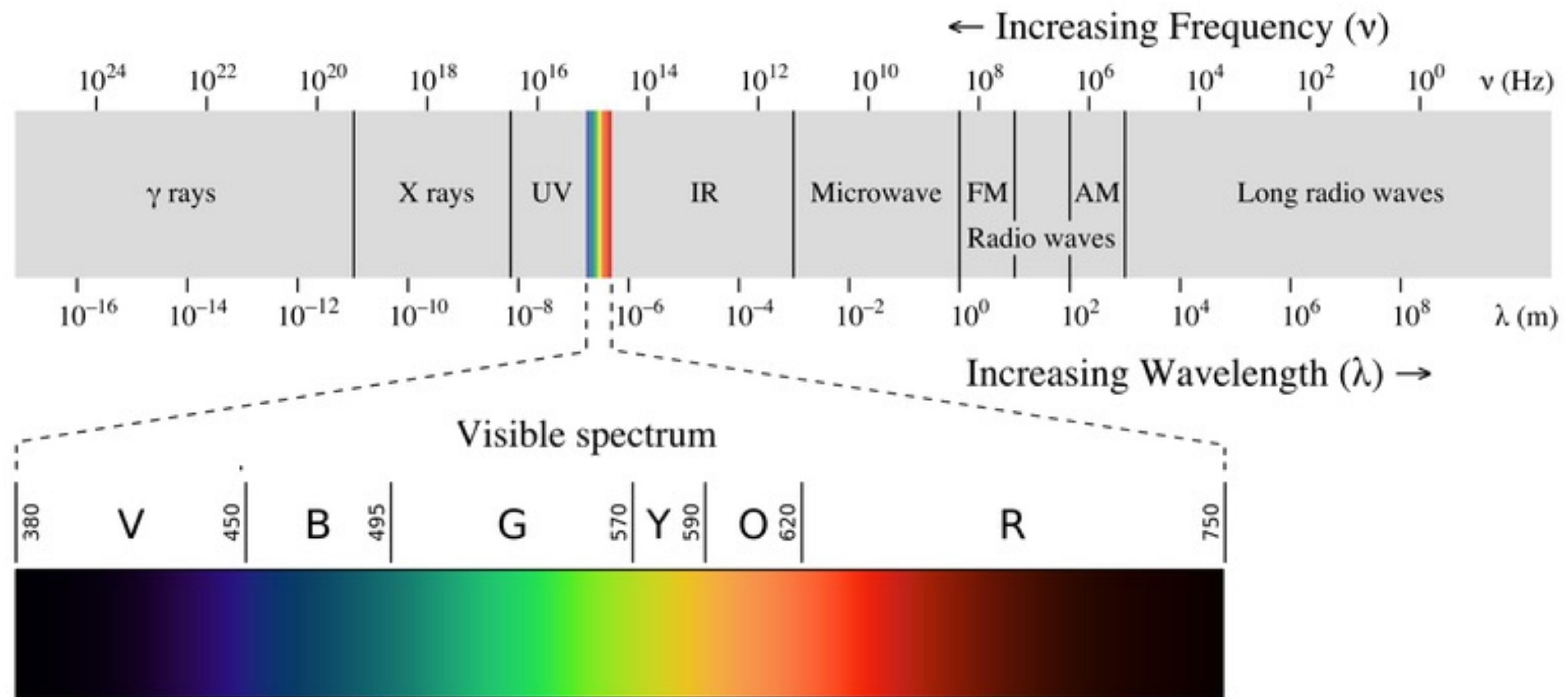


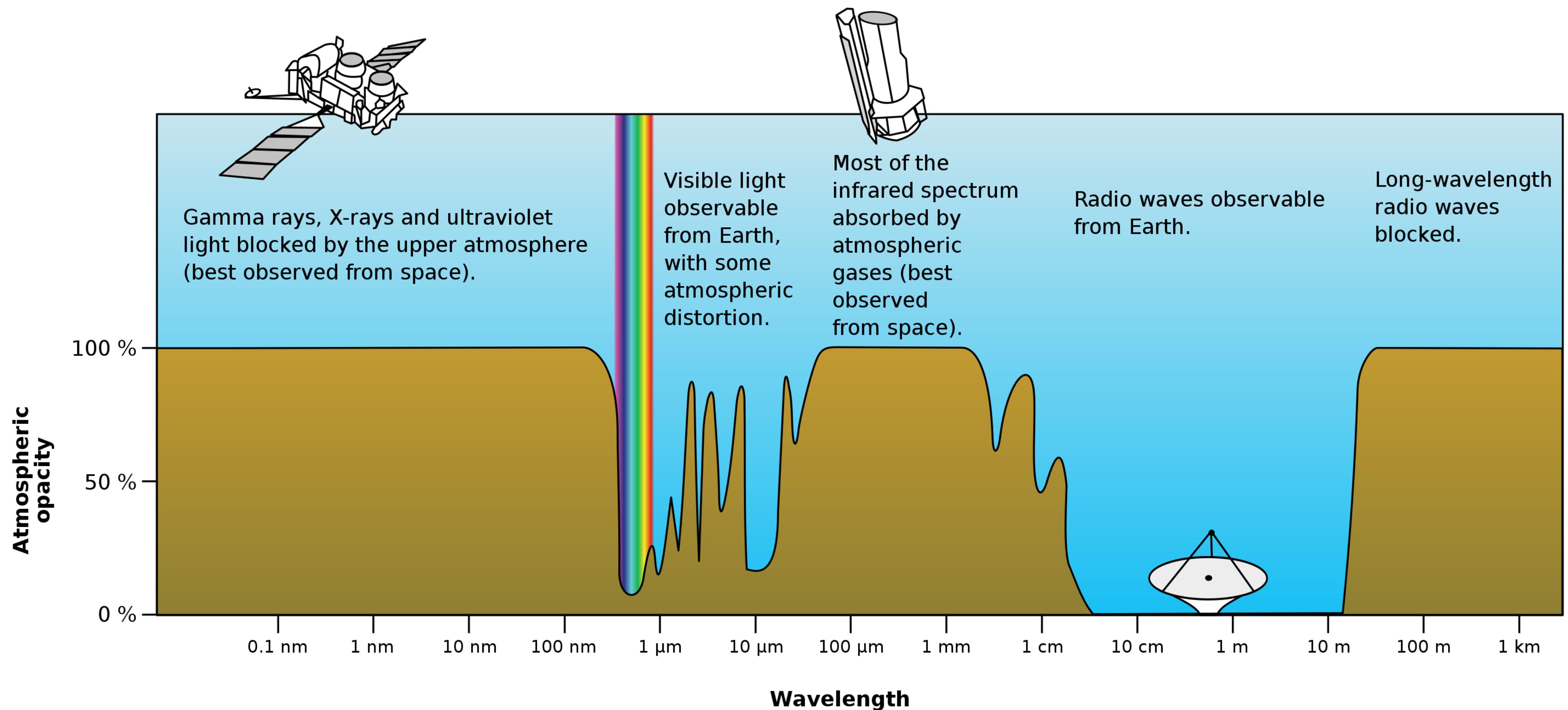
Unit Four

The Electromagnetic

Spectrum







UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM



ACTIVITY CODE

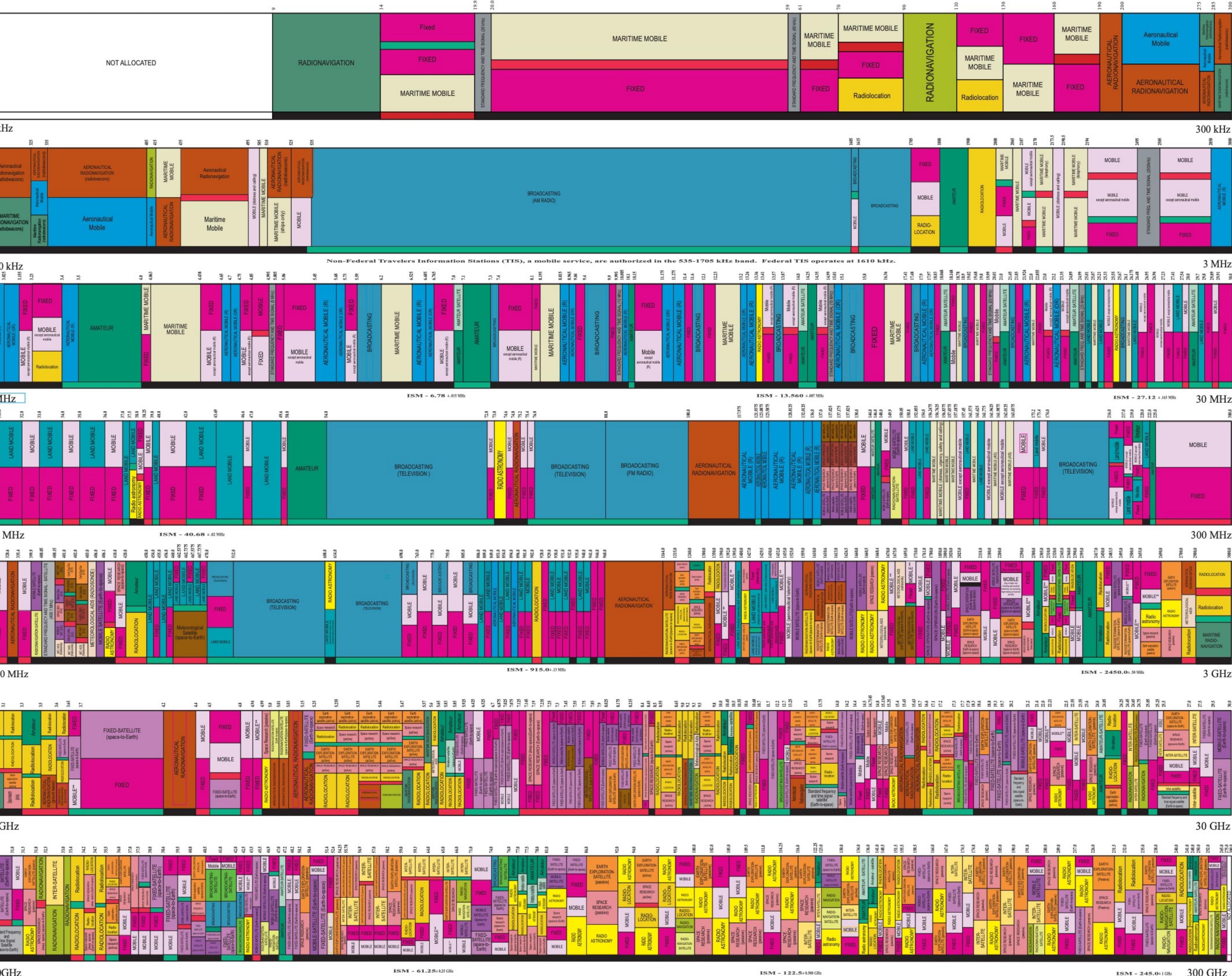
FEDERAL EXCLUSIVE FEDERAL/NON-FEDERAL SHARED

NON-FEDERAL EXCLUSIVE

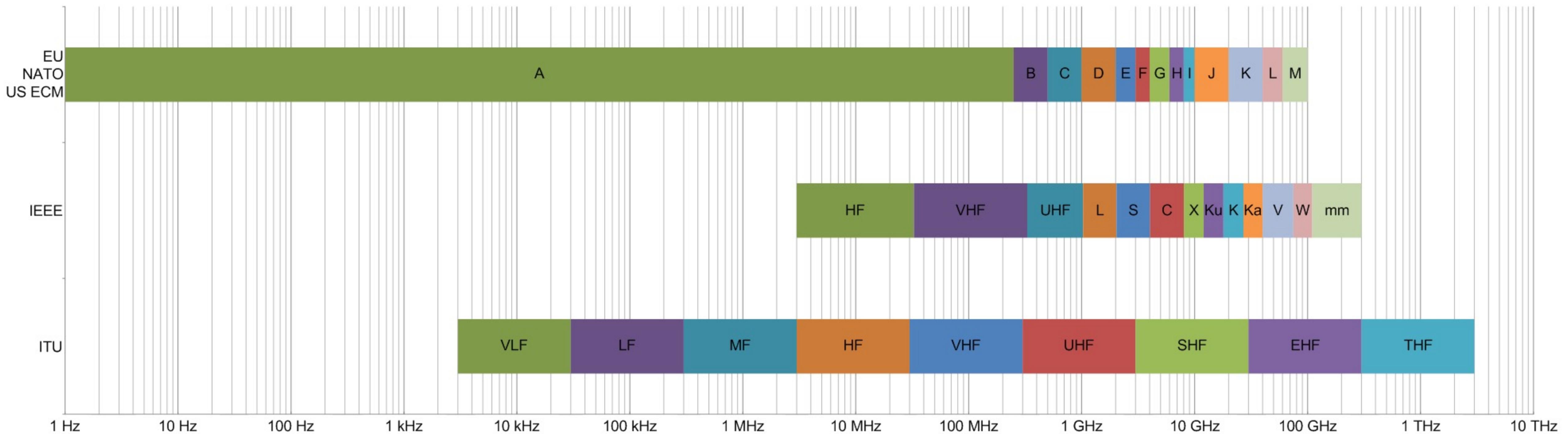
ALLOCATION USAGE DESIGNATION

SERVICE	EXAMPLE	DESCRIPTION
Primary	FIXED	Capital Letters
Secondary	Mobile	1st Capital with lower case letters

This chart is a graphic single-point-in-time portrayal of the Table of Frequency Allocations used by the FCC and NTIA. As such, it may not completely reflect all aspects, i.e. footnotes and recent changes made to the Table of Frequency Allocations. Therefore, for complete information, users should consult the Table to determine the current status of U.S. allocations.



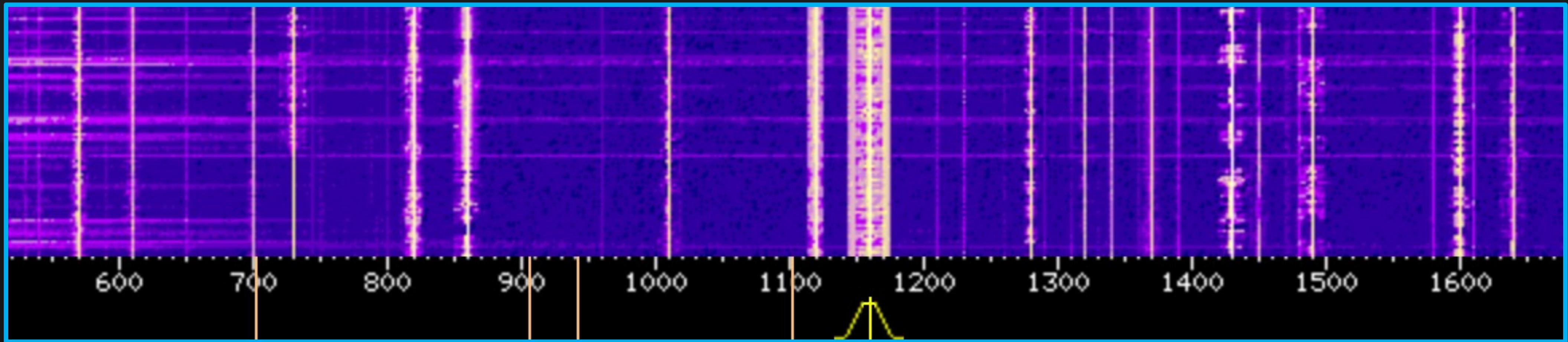
Inspecting Signals



EXERCISE 4.1

Inspecting Signals

Online Signal Hunting



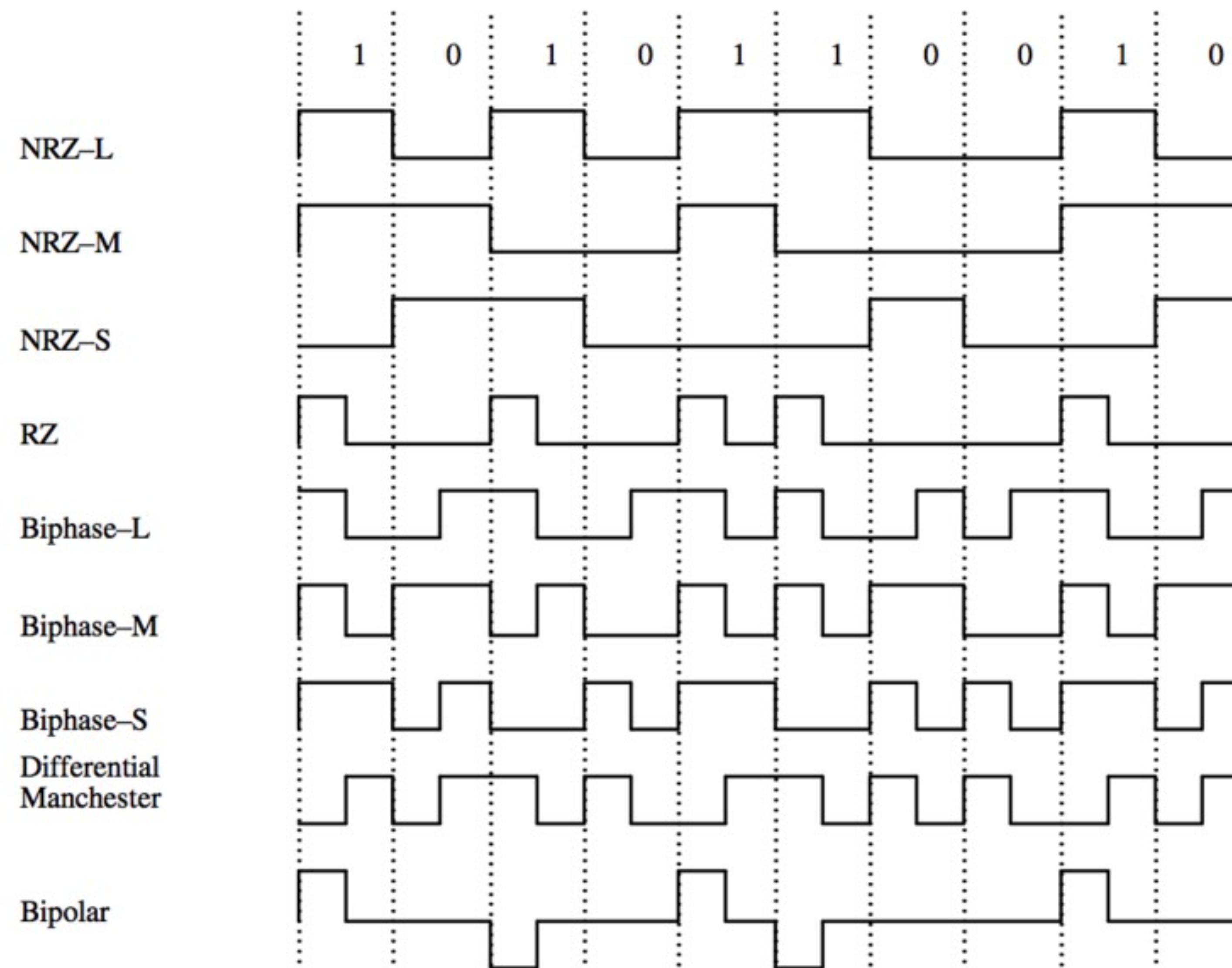
DEMO SLIDE

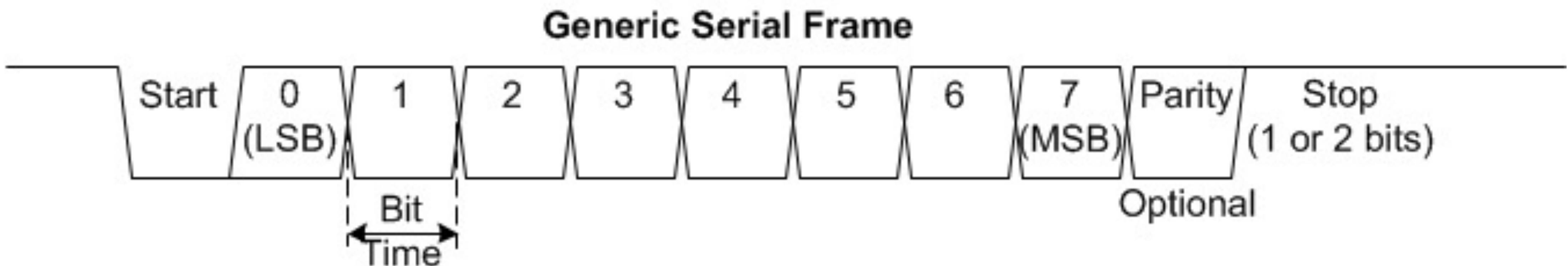
Inspecting Signals

Unit Five

Ones and Zeros

Inspecting Signals





FCC.IO

FCC.io

What?

A simple search and URL shortener for FCC ID queries.

Try it here:

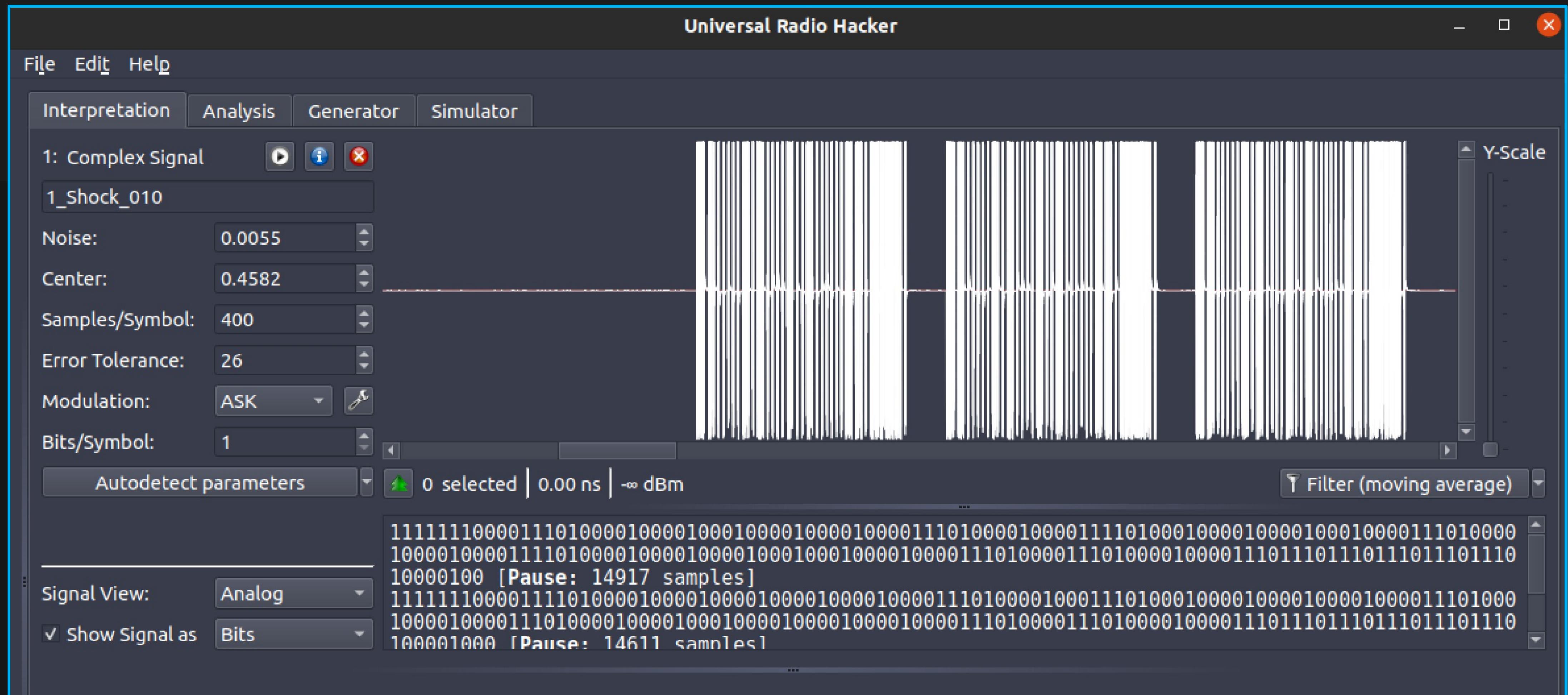
FCC ID:

Search

Unit Six

Satellites and Shock Collars

Universal Radio Hacker



EXERCISE 6.2

NOAA DECODING

Inspecting Signals

