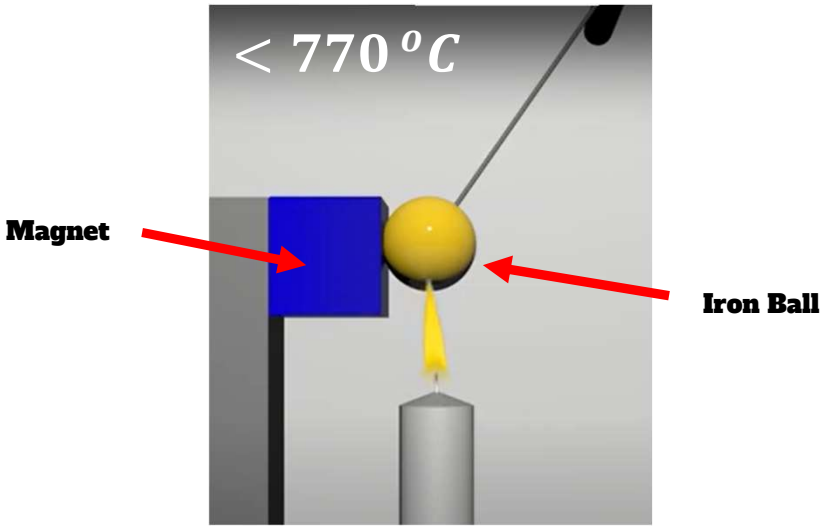
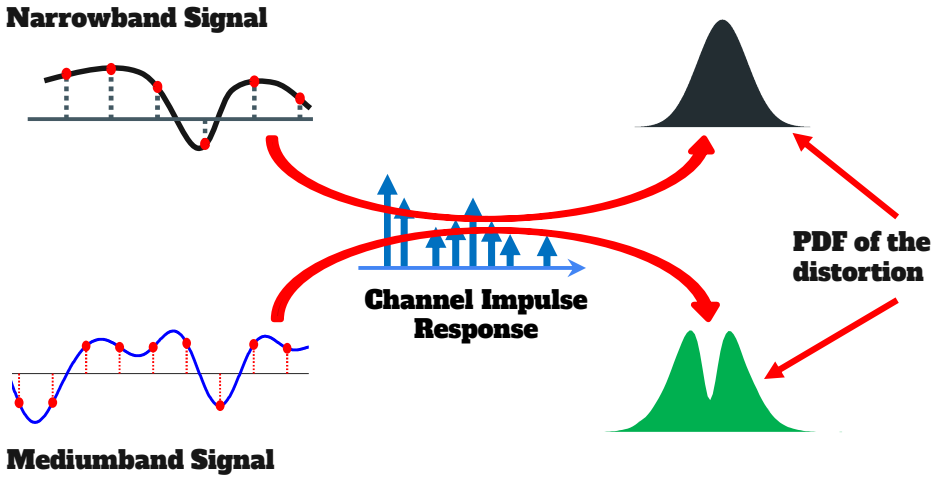
“Metals” and “Wireless Channels” have analogous properties.

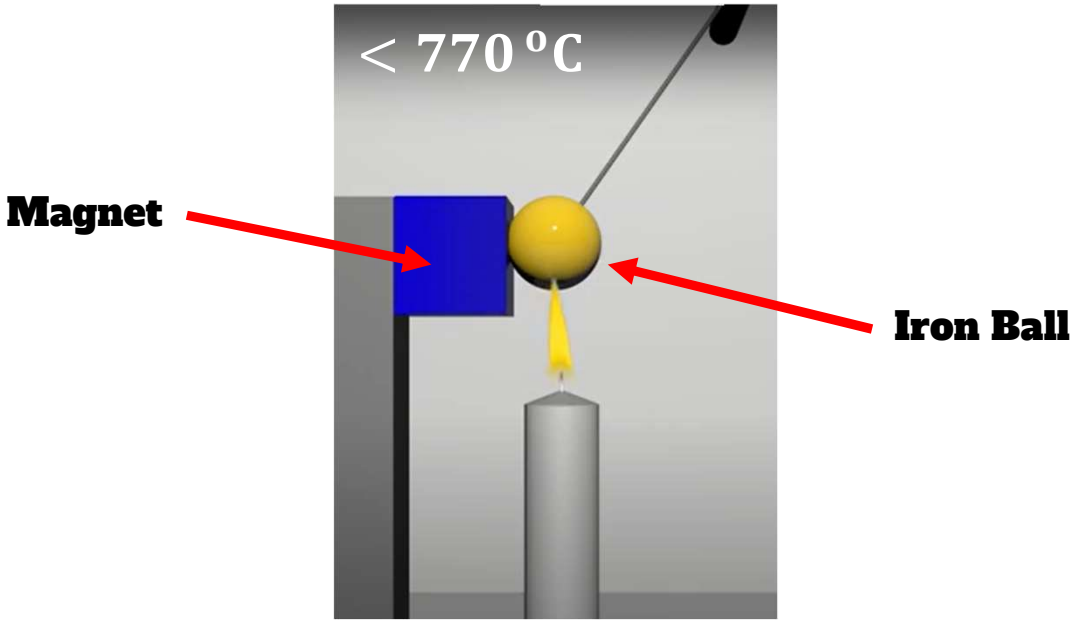


Metals (Iron)

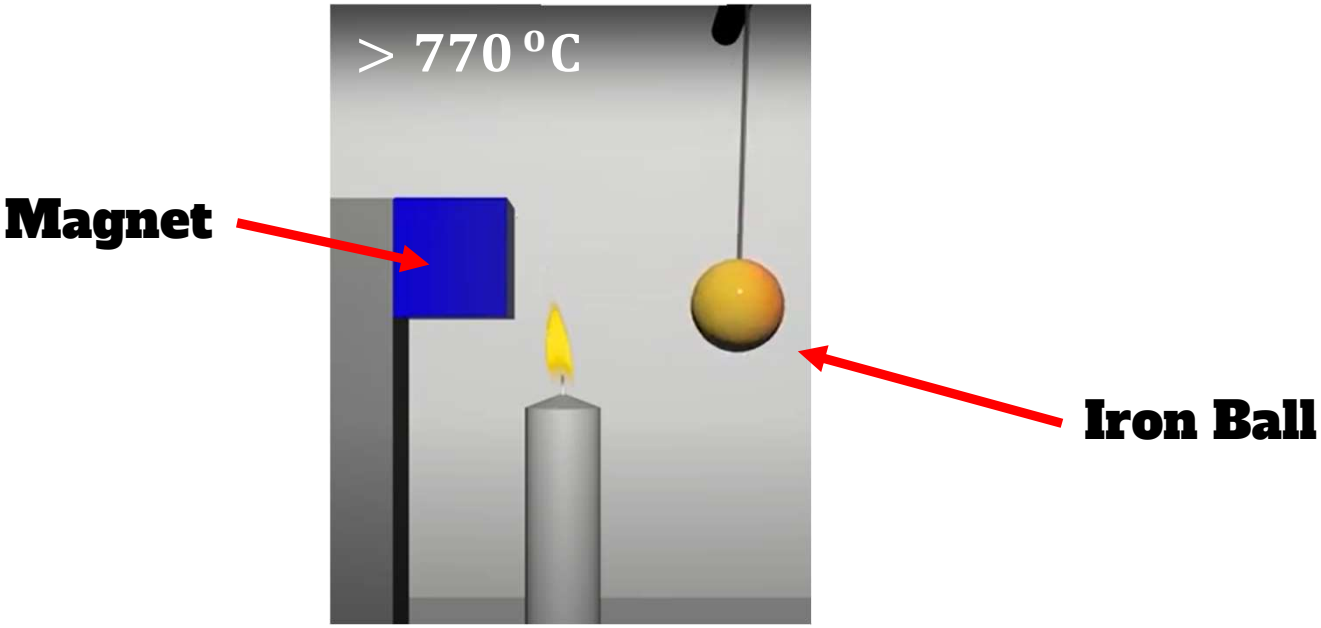


Wireless Channel

Metals exhibit magnetic attraction below its Curie temperature. It is $770\,^{o}C$ for iron.



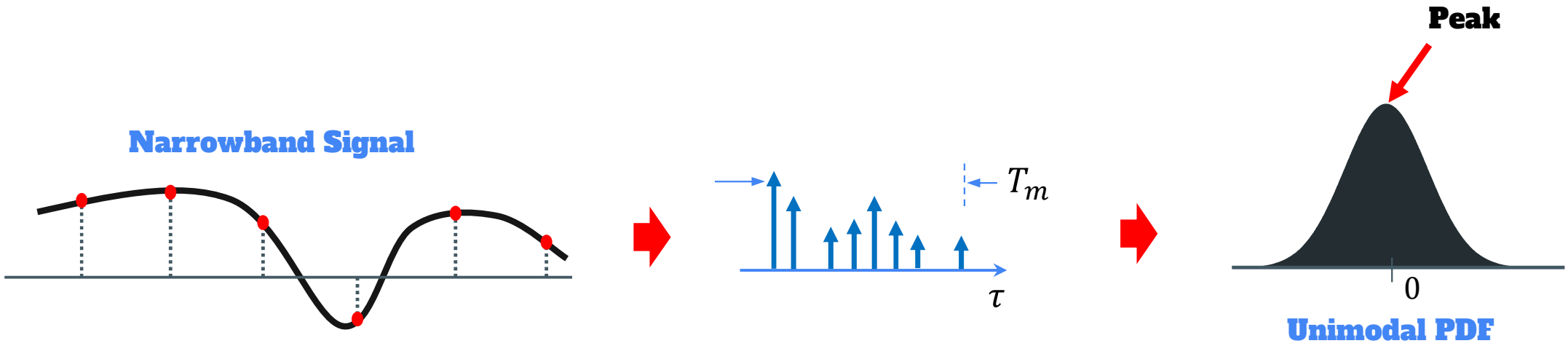
When iron's temperature rises above its Curie point of 770 °C, it abruptly loses its magnetic attraction.



Something similar happens to *"wireless channels"* as well.

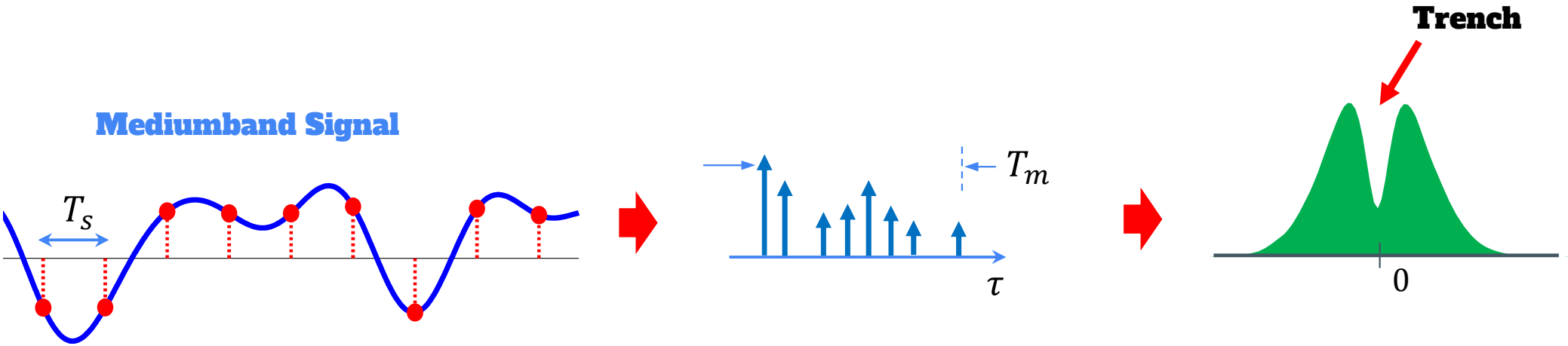
As the signal bandwidth increases above a certain point, the distortion caused by the wireless environment on the data signal abruptly changes.

When the signal bandwidth is low (i.e. narrowband), the random distortion caused by the wireless environment on the data signal is "*unimodally distributed with a peak at zero*".



Note: This unimodality means the distortion caused by the environment is highly likely to be adverse for the overall quality of wireless communication.

When the signal bandwidth increases above a certain point (i.e. to mediumband), the random distortion caused by the wireless environment on the data signal would abruptly be *"bimodally distributed with a trench at zero".*



Note: This bimodality means the distortion caused by the environment is significantly less likely to be adverse for the overall quality of wireless communication.

When the signal bandwidth rises, the probability density function of the random distortion caused by the propagation environment abruptly changes from a *"peak"* to a *"trench"*.

Analogous properties are:

Metals	Wireless Channels
Temperature	Bandwidth of the data signal
Magnetism of Metals • Low temperature: magnetism is large • High temperature: magnetism is very law	Deep fading ▪ Low bandwidth: deep fading is high ▪ High bandwidth: deep fading is very low.
Curie temperature	Boundary between narrowband and mediumband on the $T_m T_s -$ plane

Note: T_m **- Delay spread, and** T_s **- Symbol period**

Read More:

D. A. Basnayaka, “Introduction to mediumband wireless communication” *IEEE Open Journal of the Communication Society*, May. 2023.

D. A. Basnayaka, “Communicating in the mediumband: What it is and why it matters,” *IEEE Communication Magazine*, Nov. 2024.

A. Firag, J. Jia and D. A. Basnayaka, "A link-level performance analysis for mediumband wireless communication,“ *IEEE VCC*, NY, USA, Dec. 2024

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