

# AUTOFOCUSING IN LOSSY MEDIA



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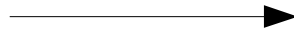
Oviedo School of Mines



Center for Wave Phenomena

# The problem

Autofocusing



Virtual source

Imaging using multiples

# The problem

Autofocusing



Virtual source

Imaging using multiples

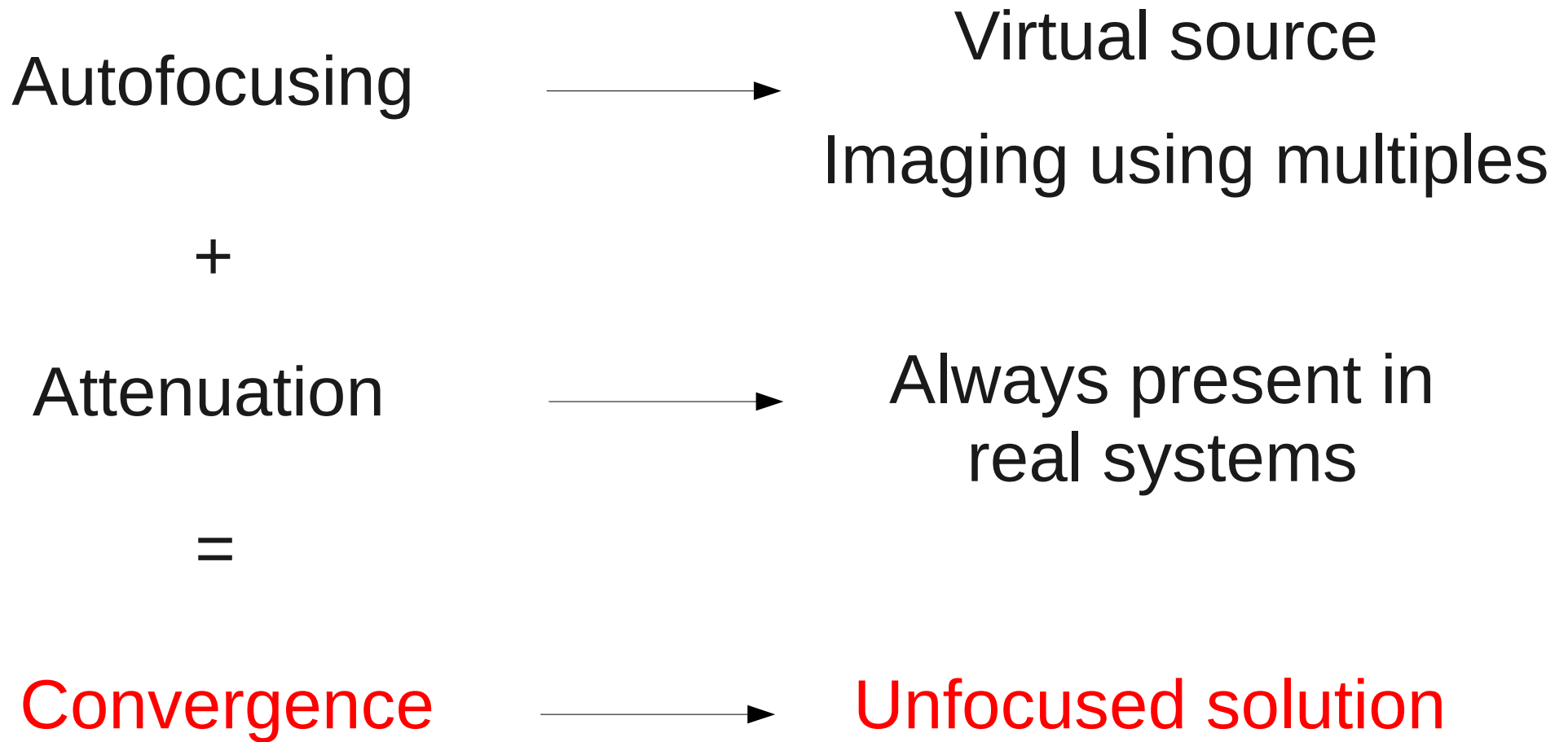
+

Attenuation

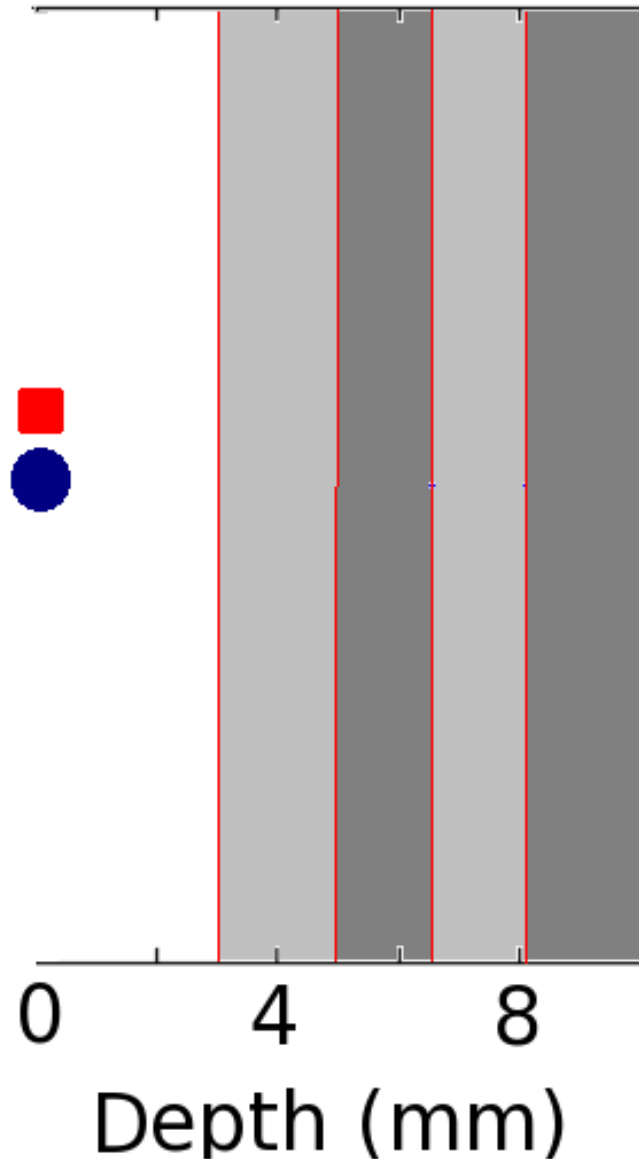


Always present in  
real systems

# The problem



# Convergence of the algorithm

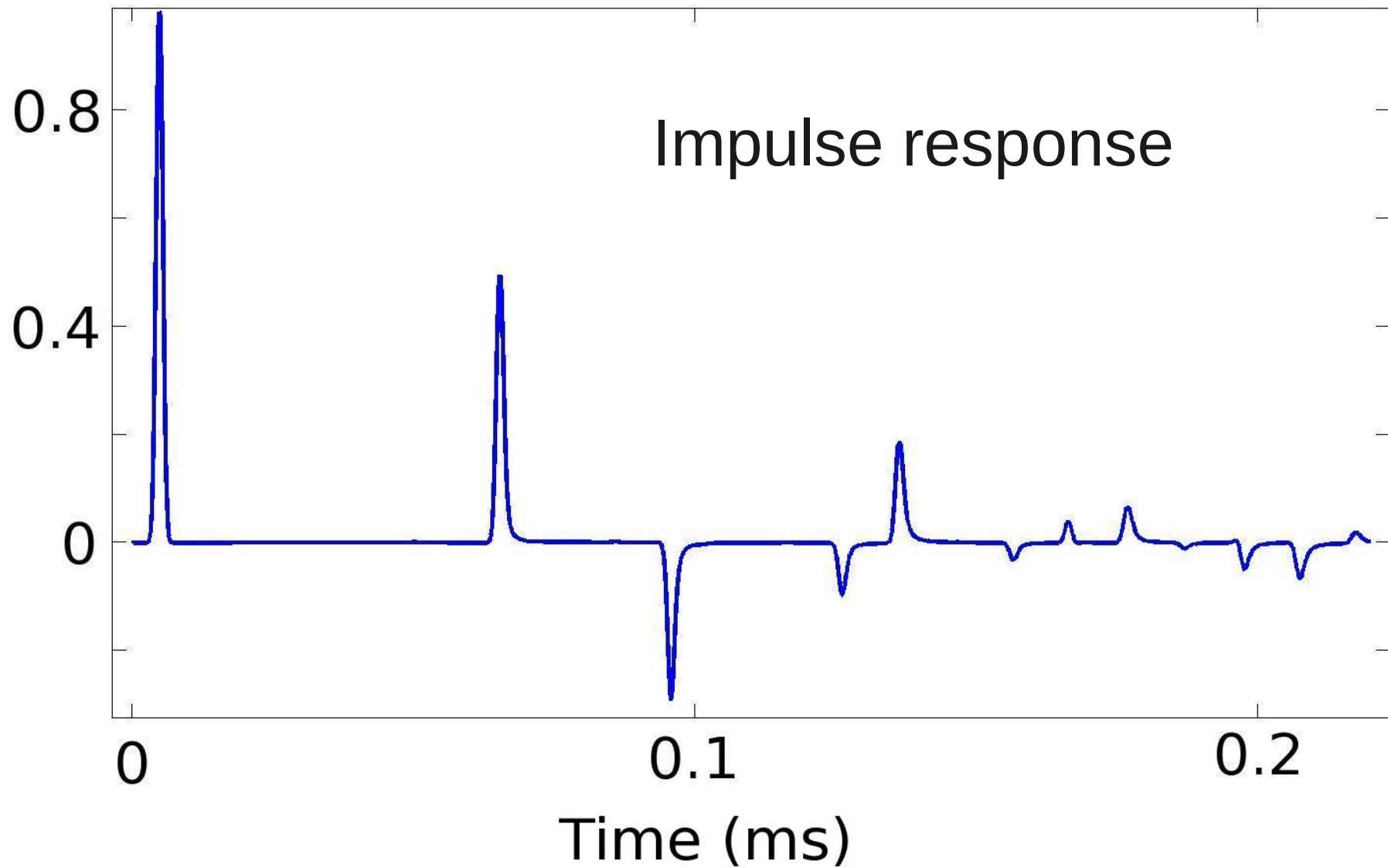


Impulse response  
experiment

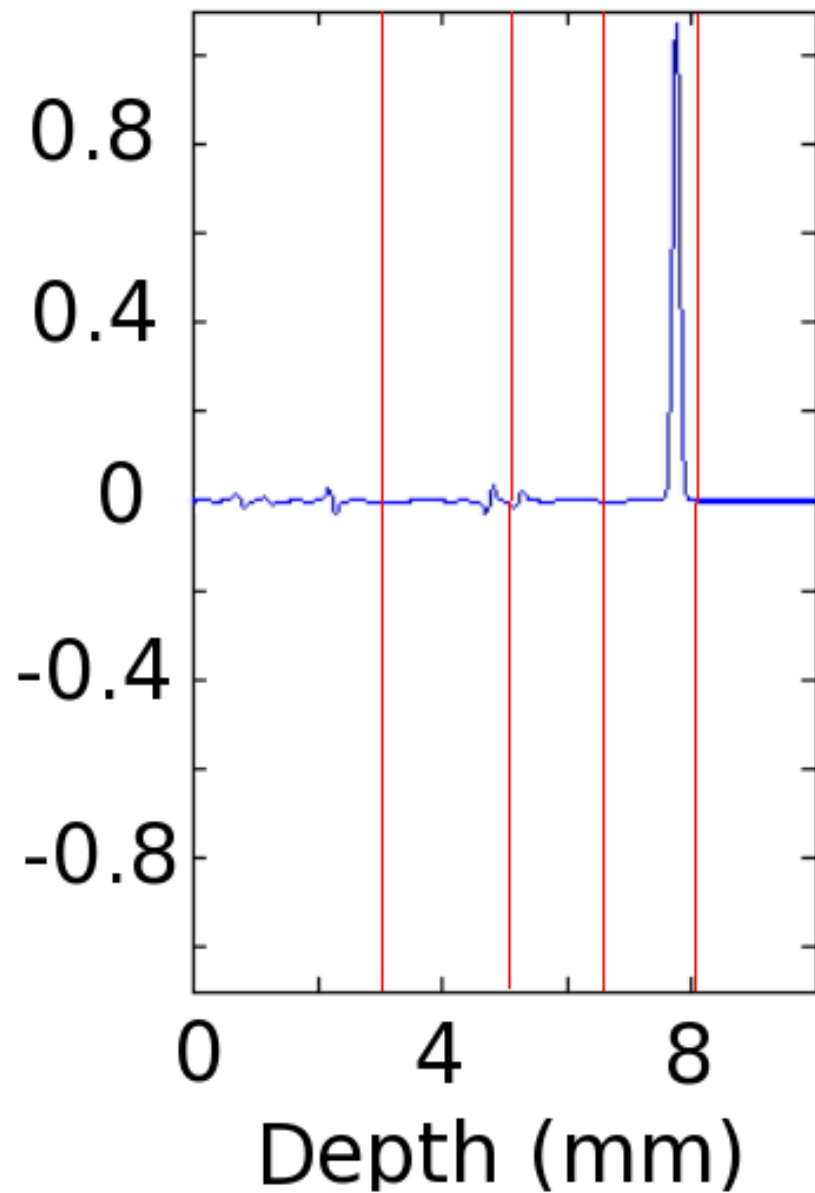
1-D media

1-D wave propagation

# Convergence of the algorithm



# Convergence of the algorithm

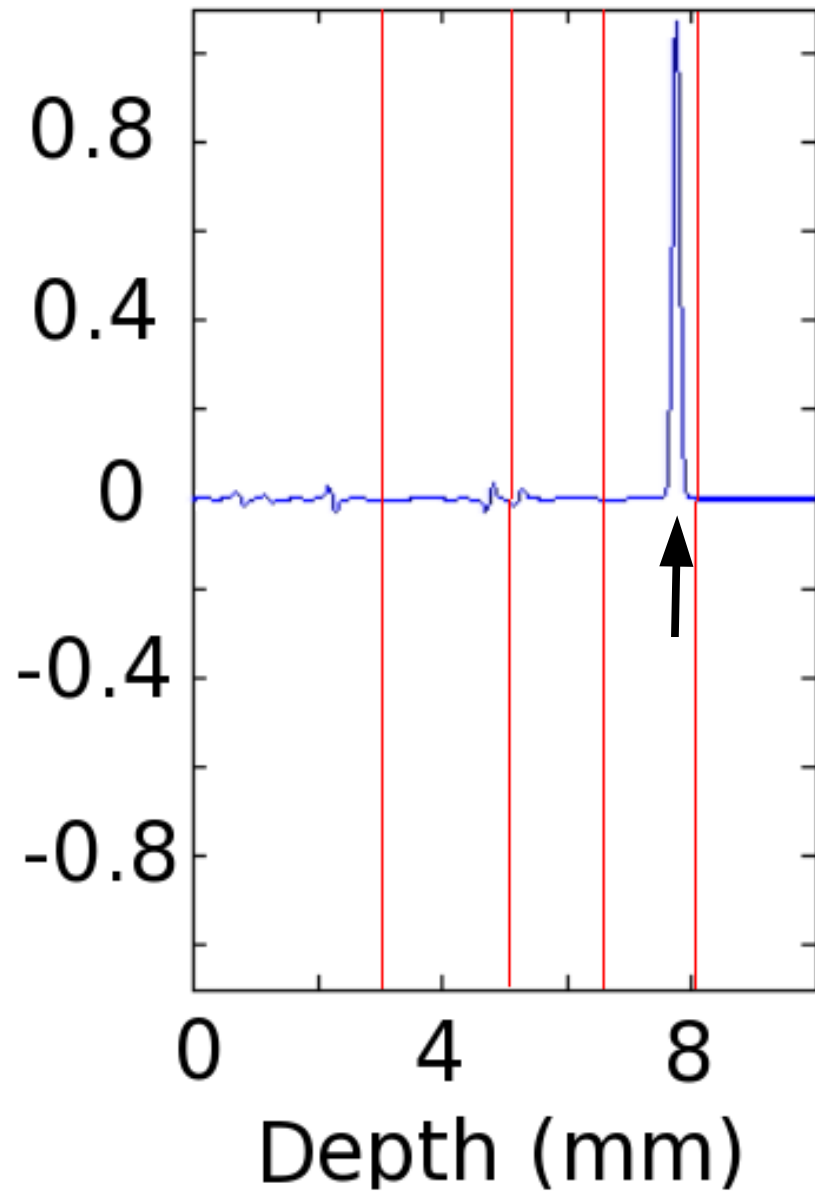


LOSSLESS medium



Focusing

# Convergence of the algorithm



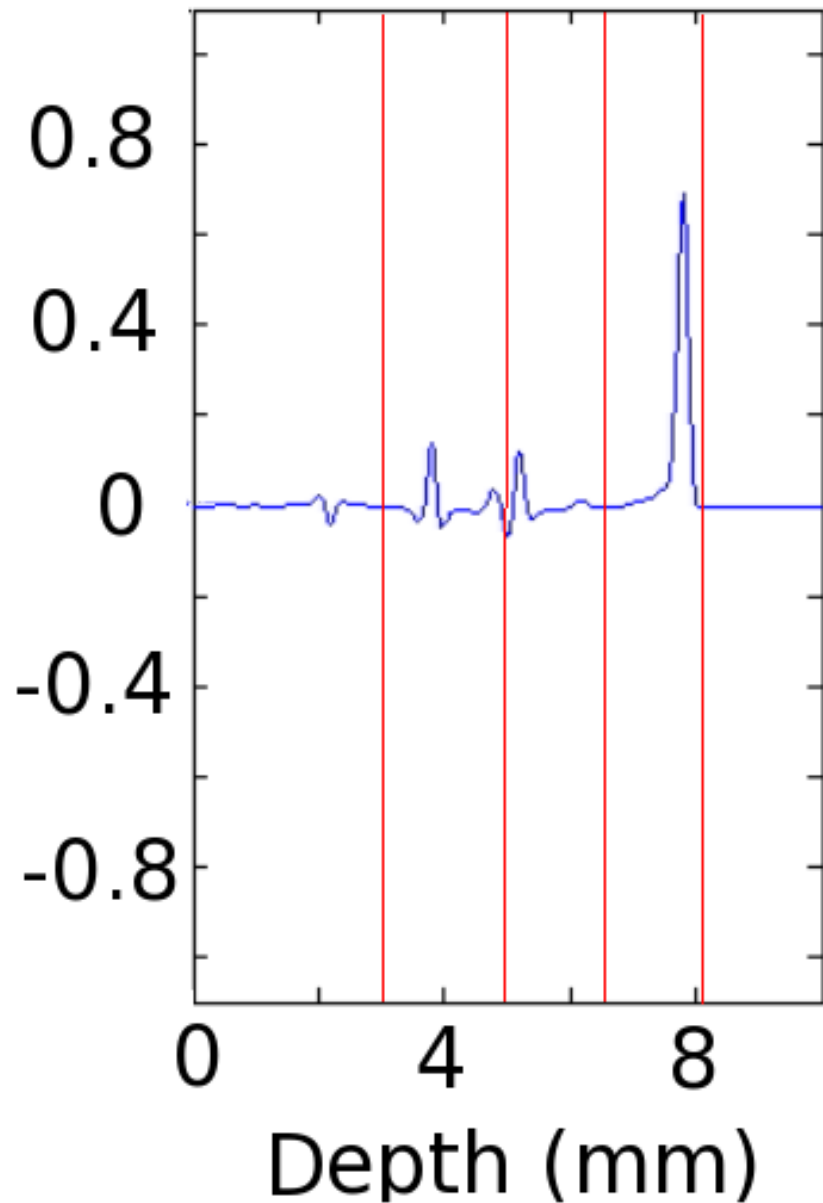
LOSSLESS medium



Focusing



# Convergence of the algorithm

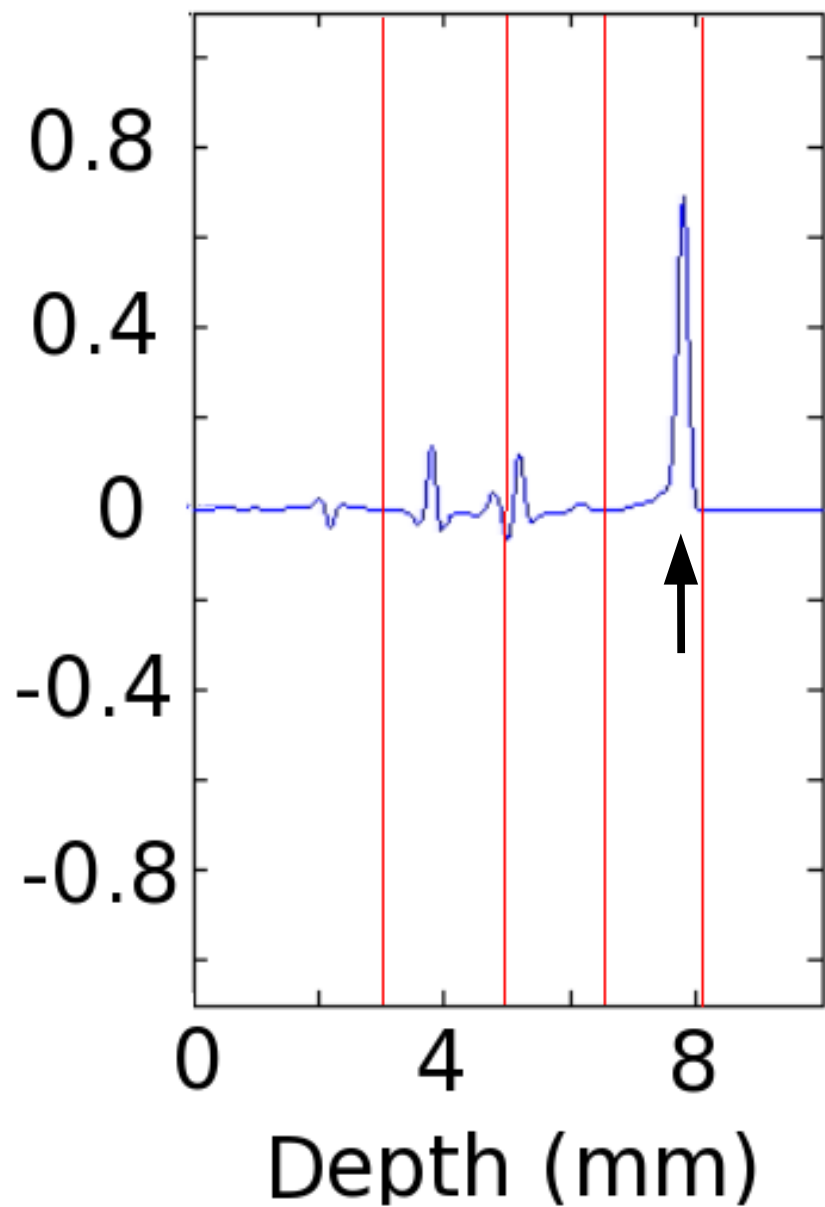


LOSSY medium



Unfocused solution

# Convergence of the algorithm

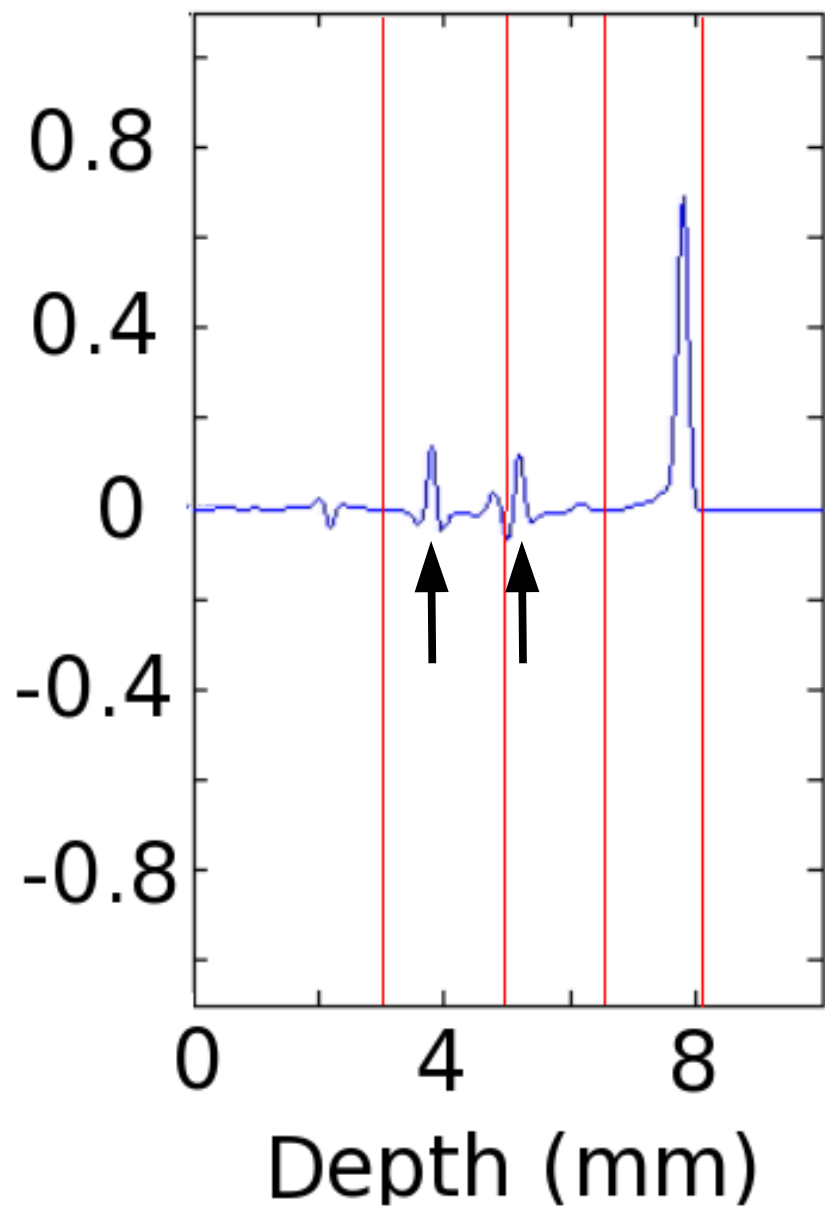


LOSSY medium



Unfocused solution

# Convergence of the algorithm

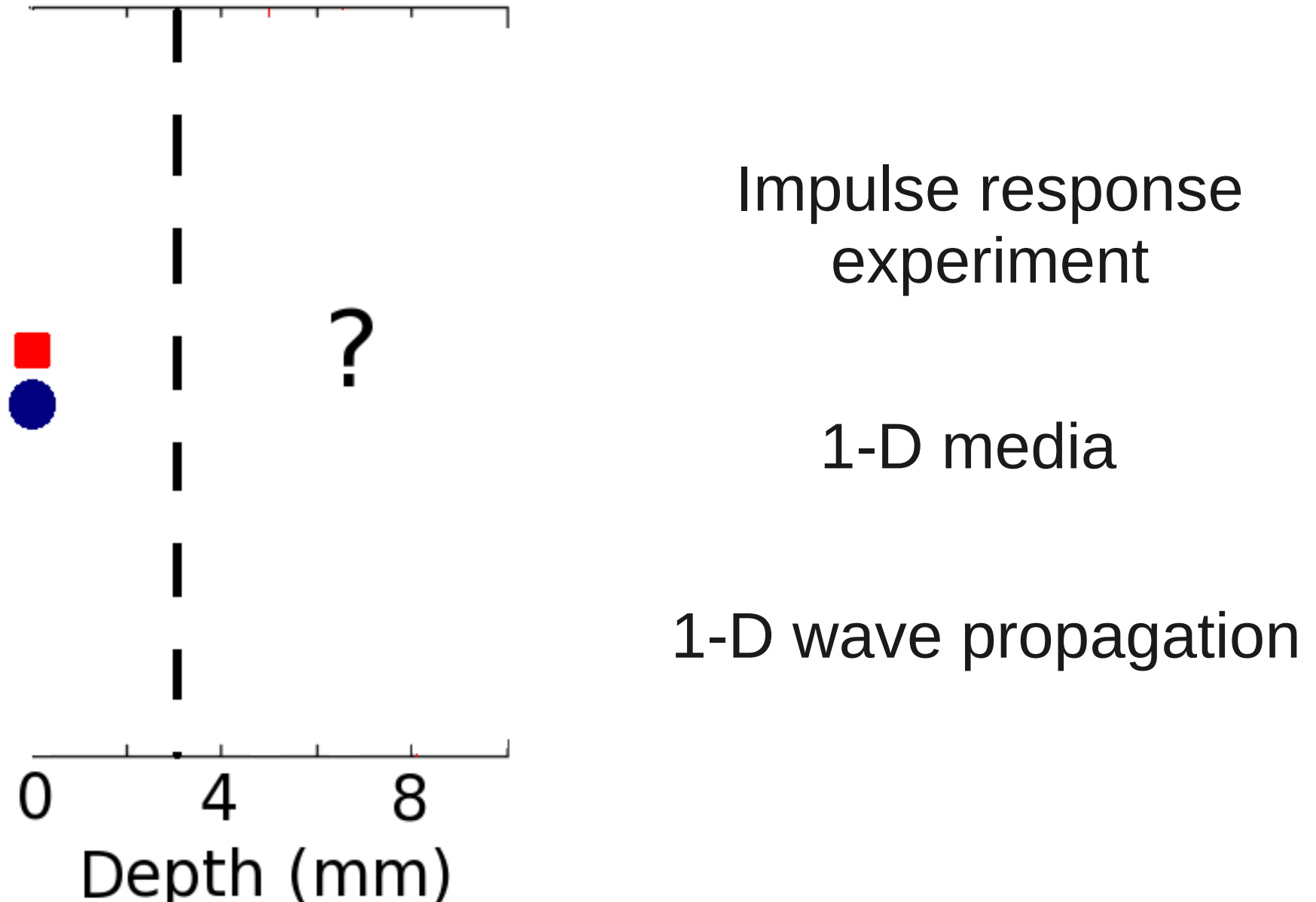


LOSSY medium

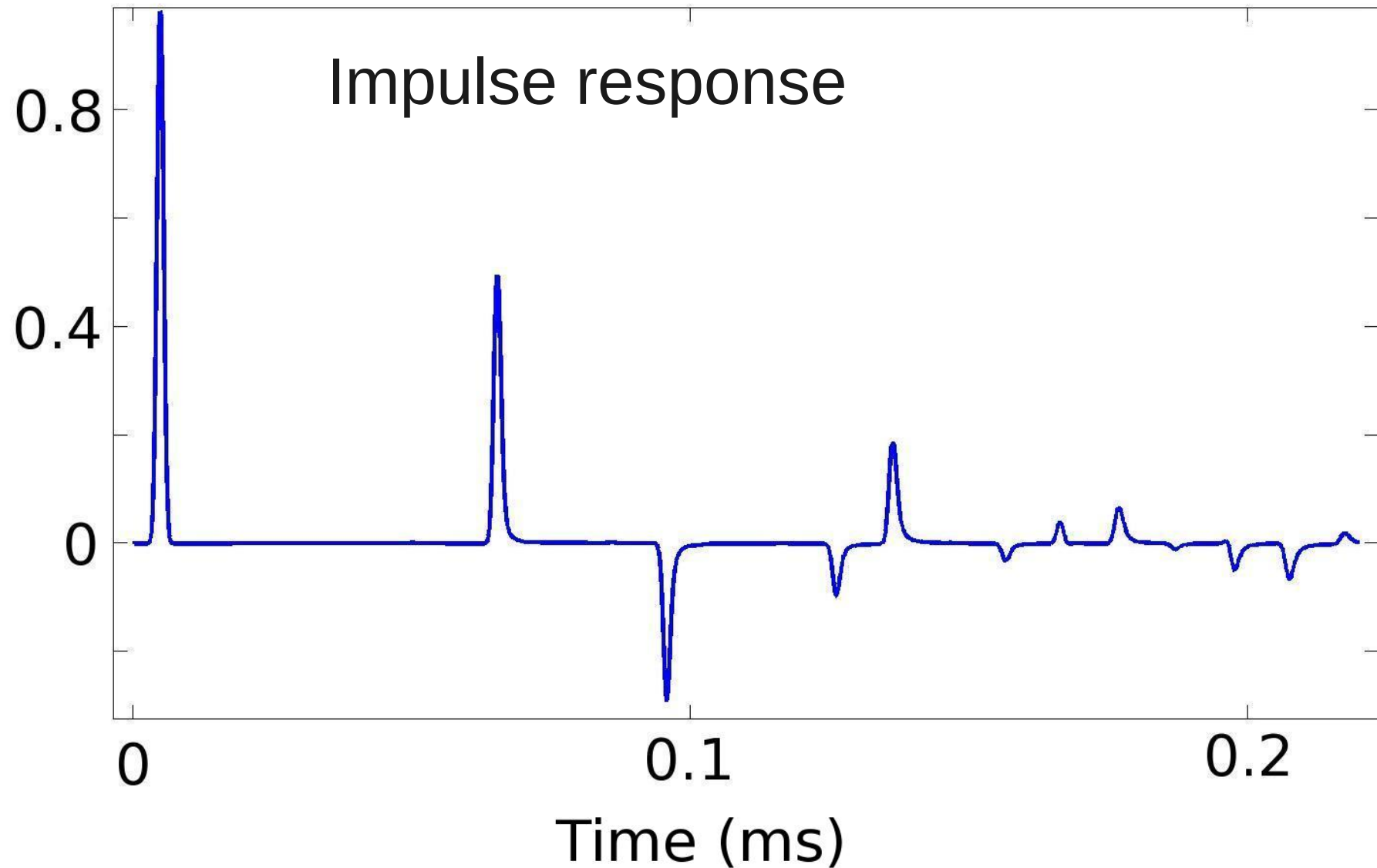


Unfocused solution

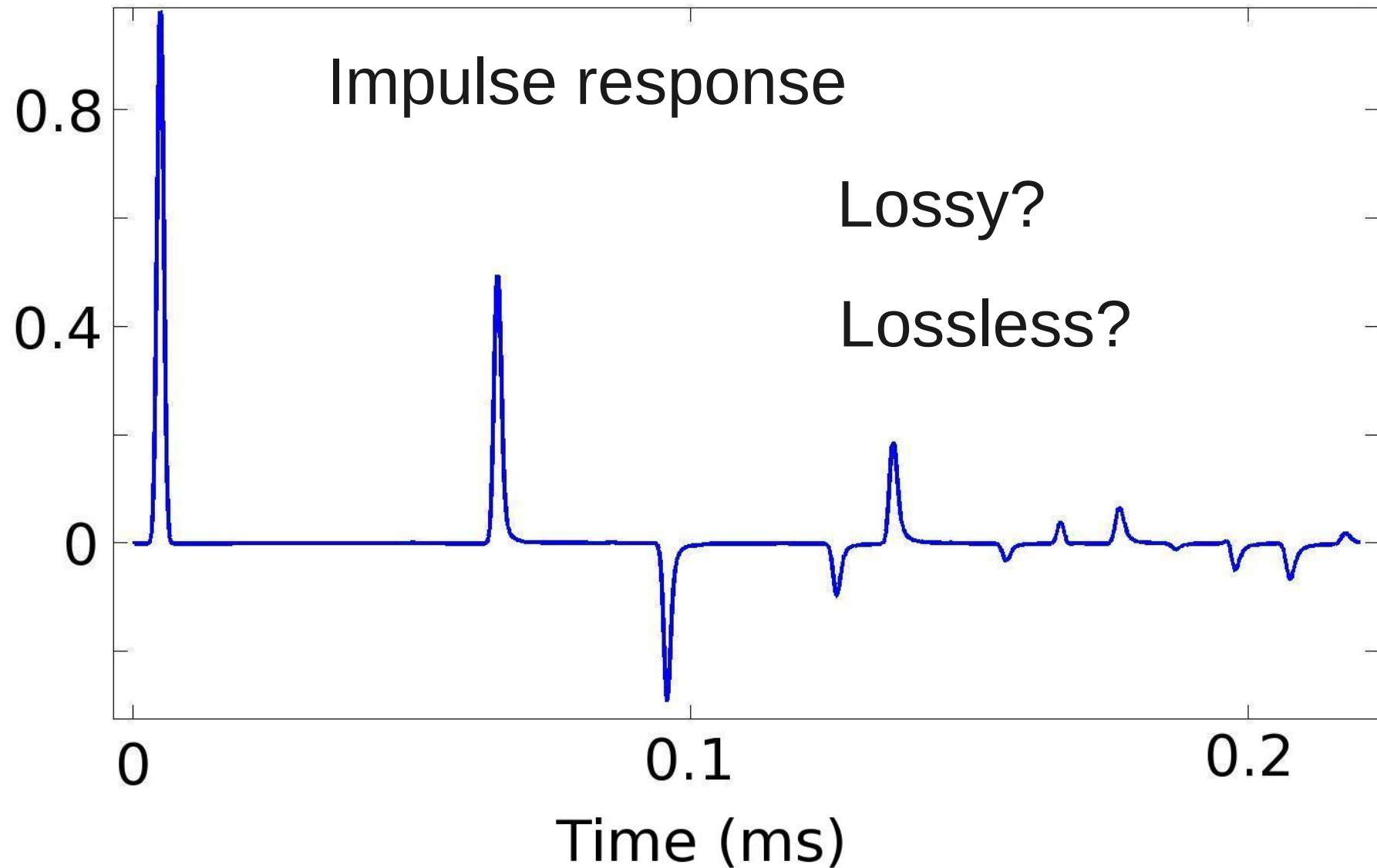
# The indistinguishability problem



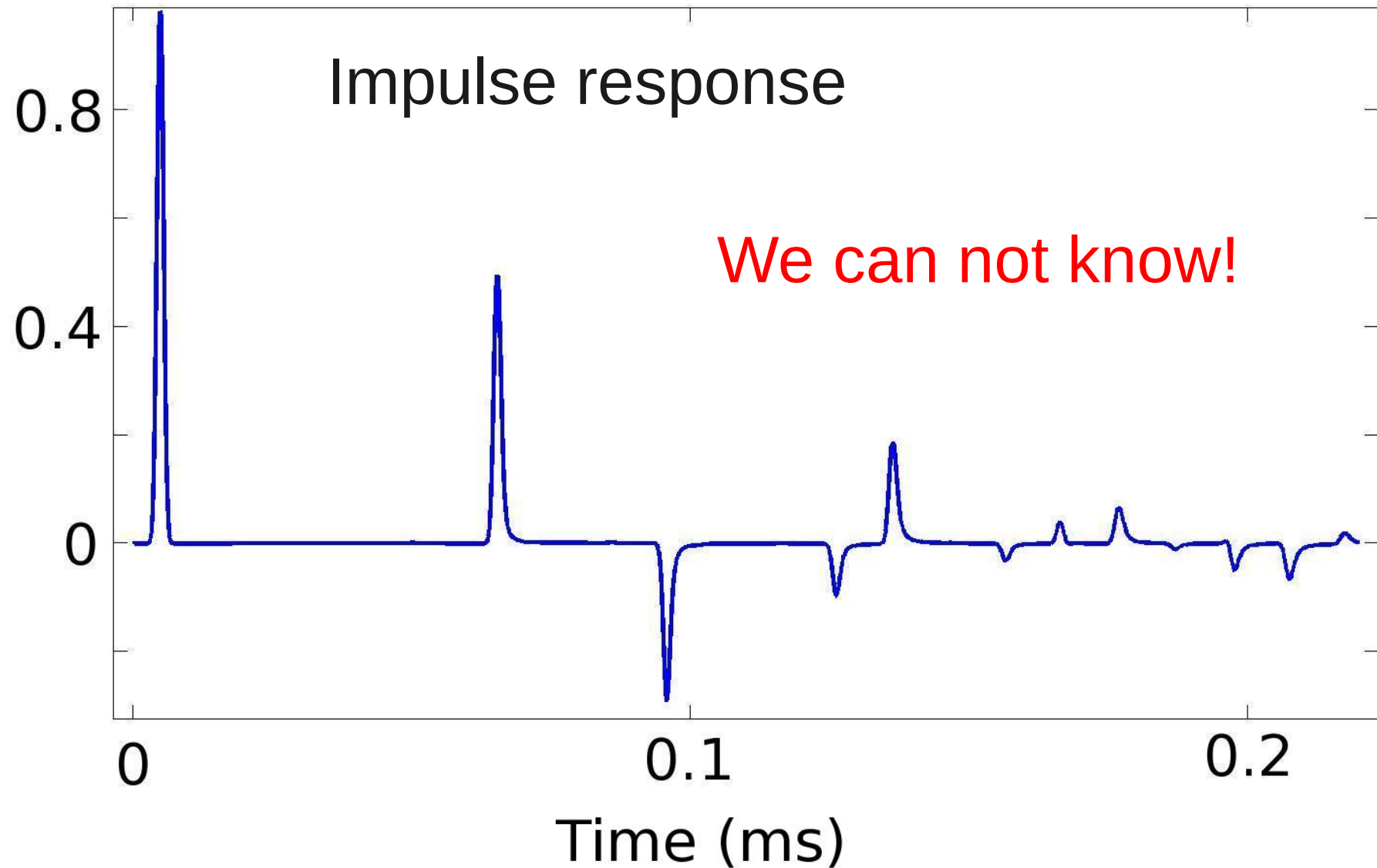
# The indistinguishability problem



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# The indistinguishability problem



# The idea of focusing

Needs time reversal symmetry



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Attenuation: breaks symmetry  
(energy loss)

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Needs time reversal symmetry

Attenuation: breaks symmetry  
(energy loss)

Correction function:  
recover time reversal symmetry  
(energy recovery)

# Focusing correction

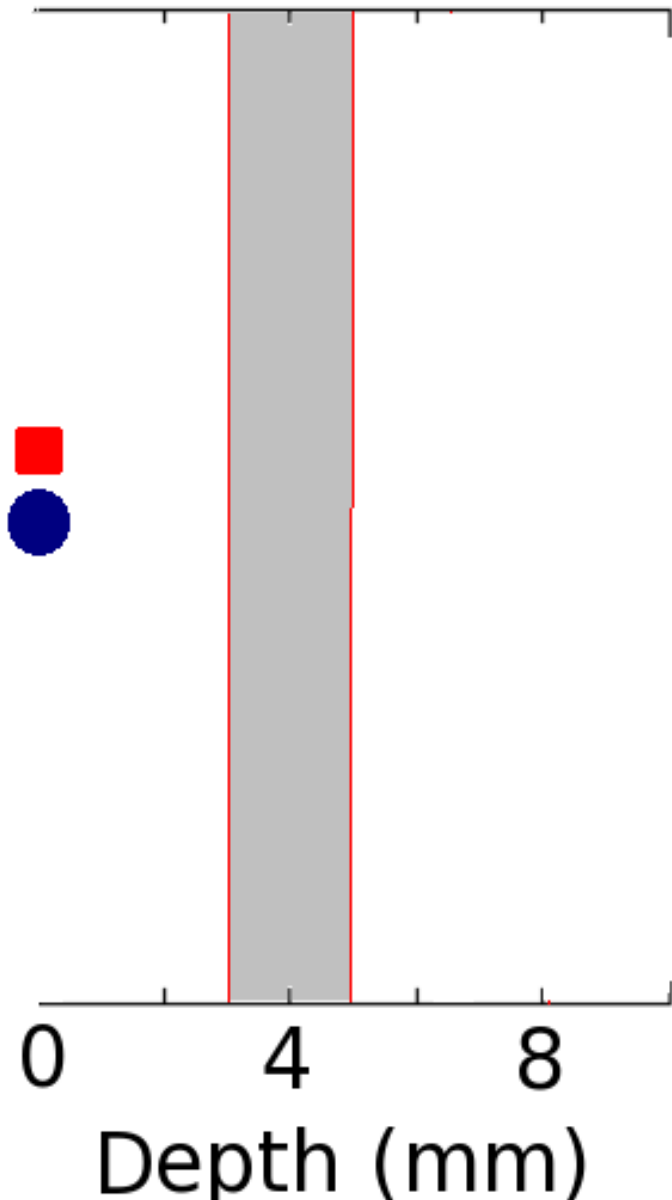
Corrected response

=

Lossy response \* Correcting function

$$P_c(t) = P(t)e^{2\alpha t}$$

# Focusing correction

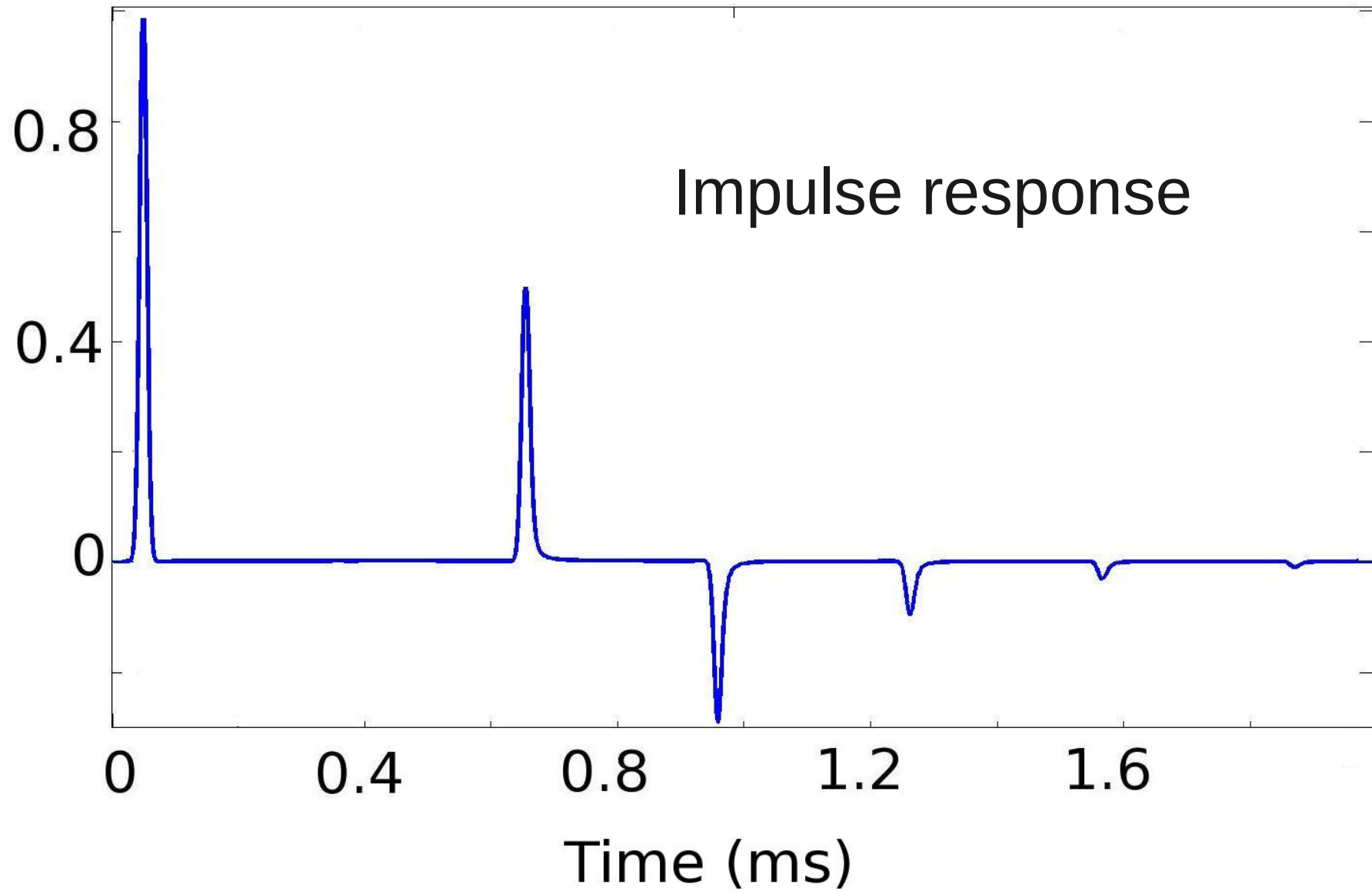


Impulse response  
experiment

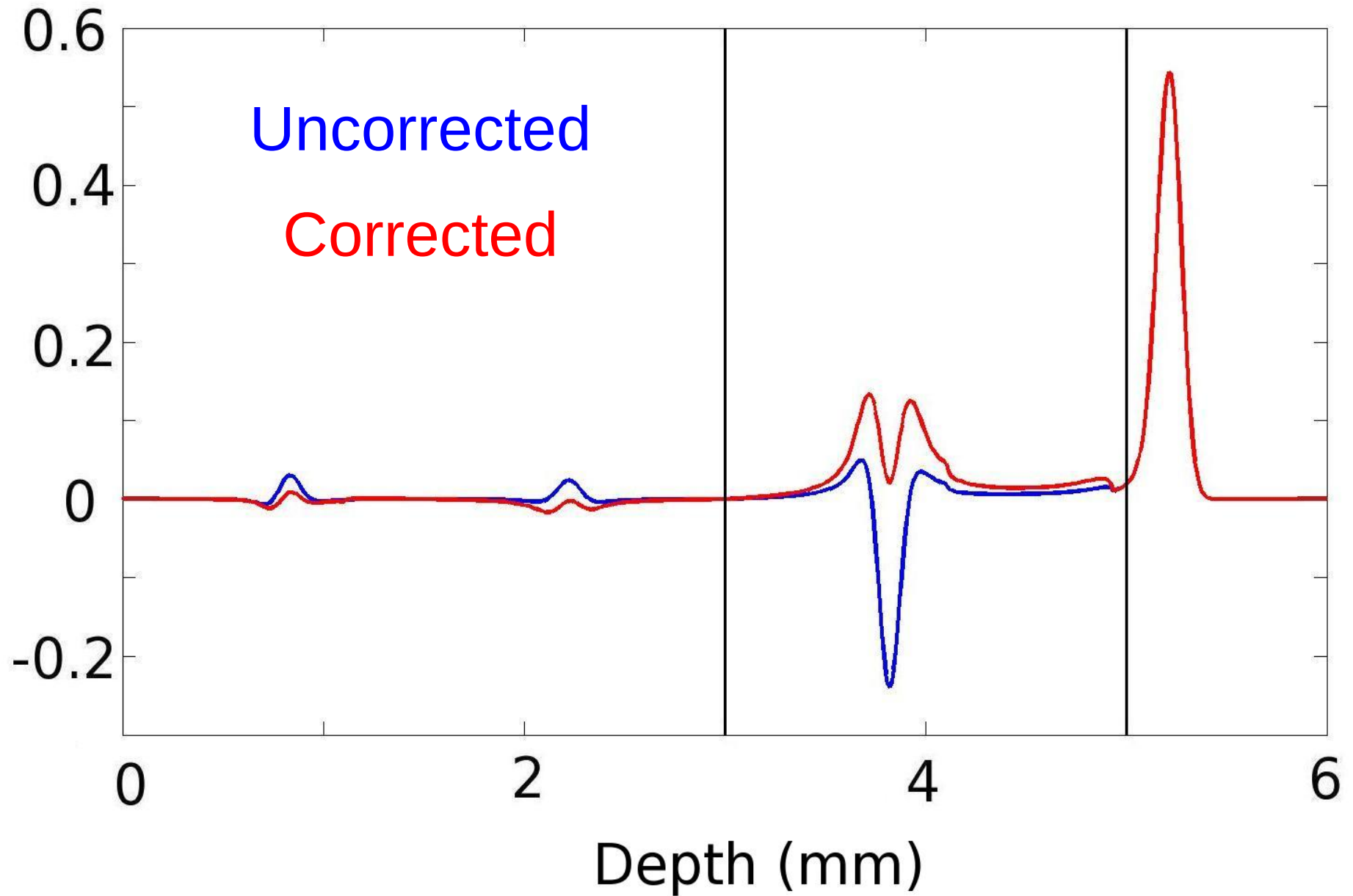
1-D media

1-D wave propagation

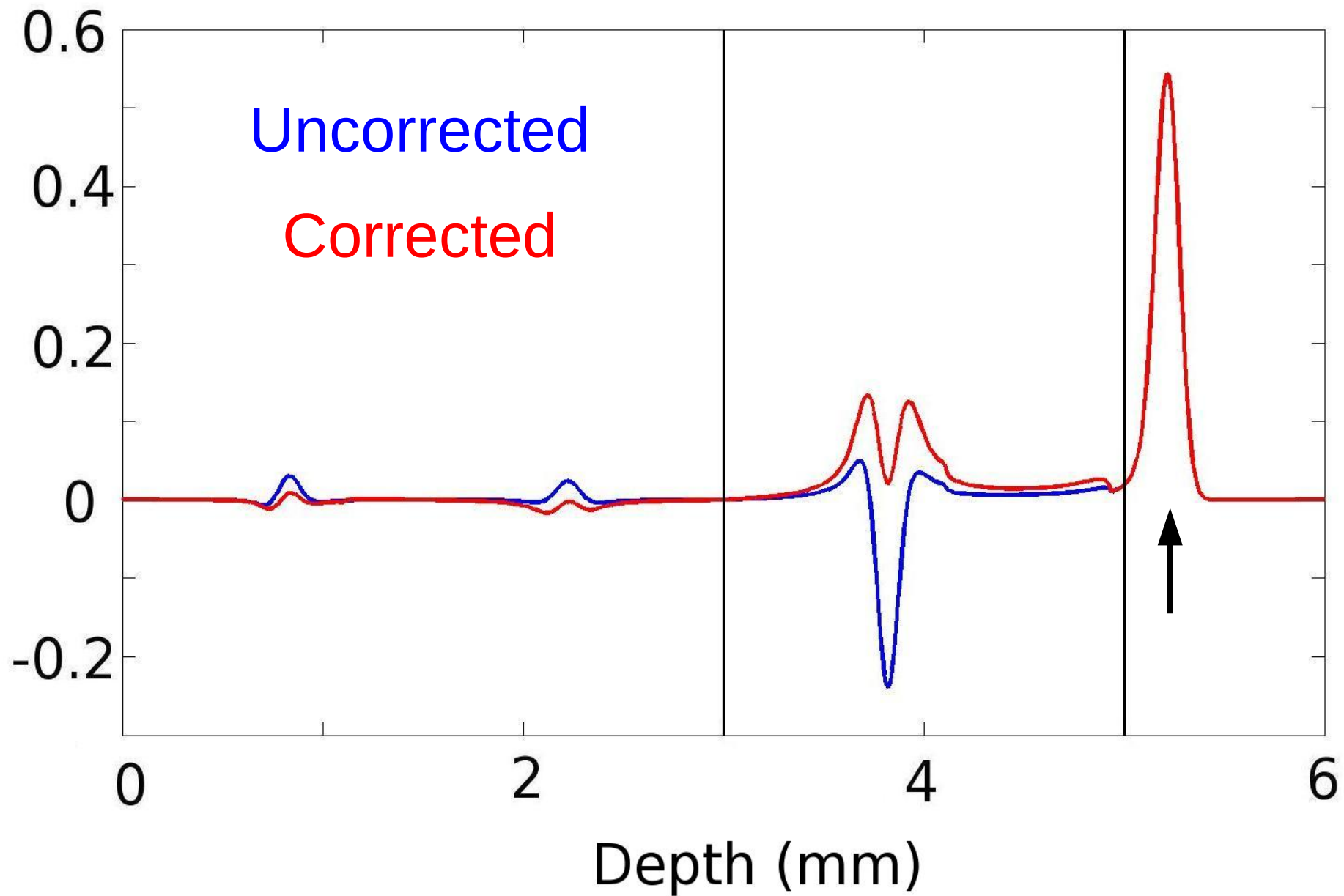
# Focusing correction



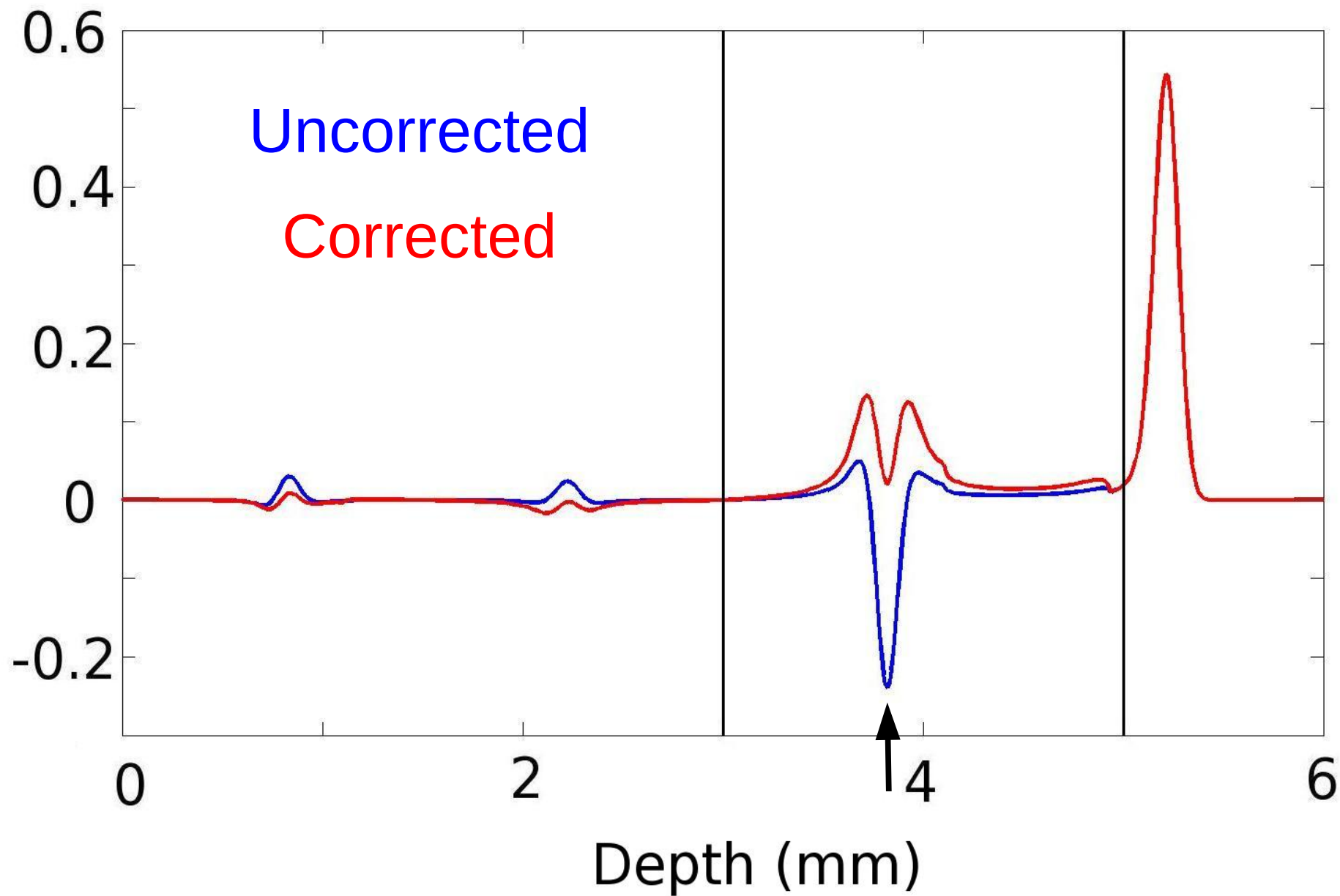
# Focusing correction



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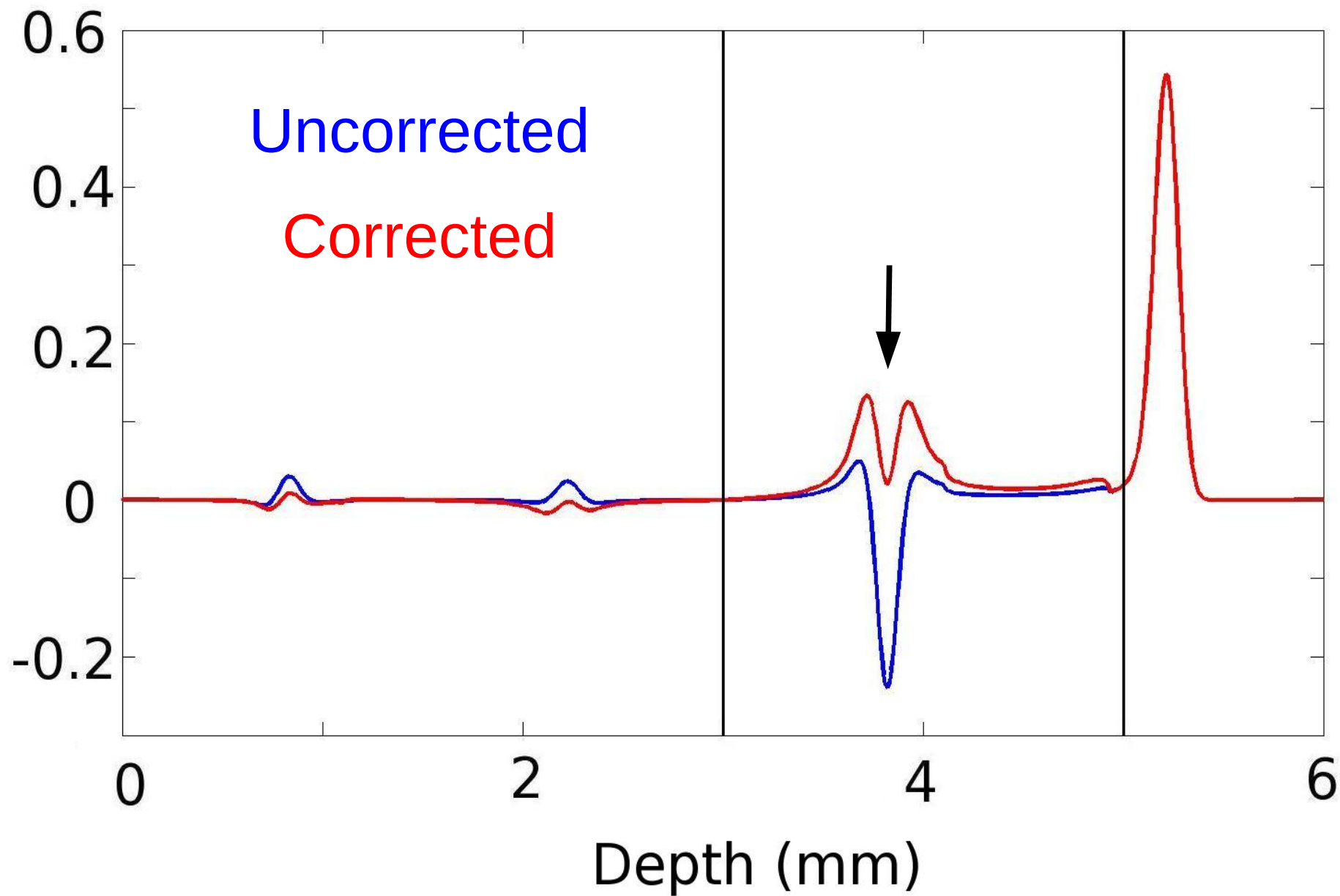


# Focusing correction





# Focusing correction



# Looking forward

Other corrections for attenuation

# Looking forward

Other corrections for attenuation

Higher dimensions

# Looking forward

Other corrections for attenuation

Higher dimensions

Characterize attenuation  
using focusing

**GRACIAS!** (Thank you)