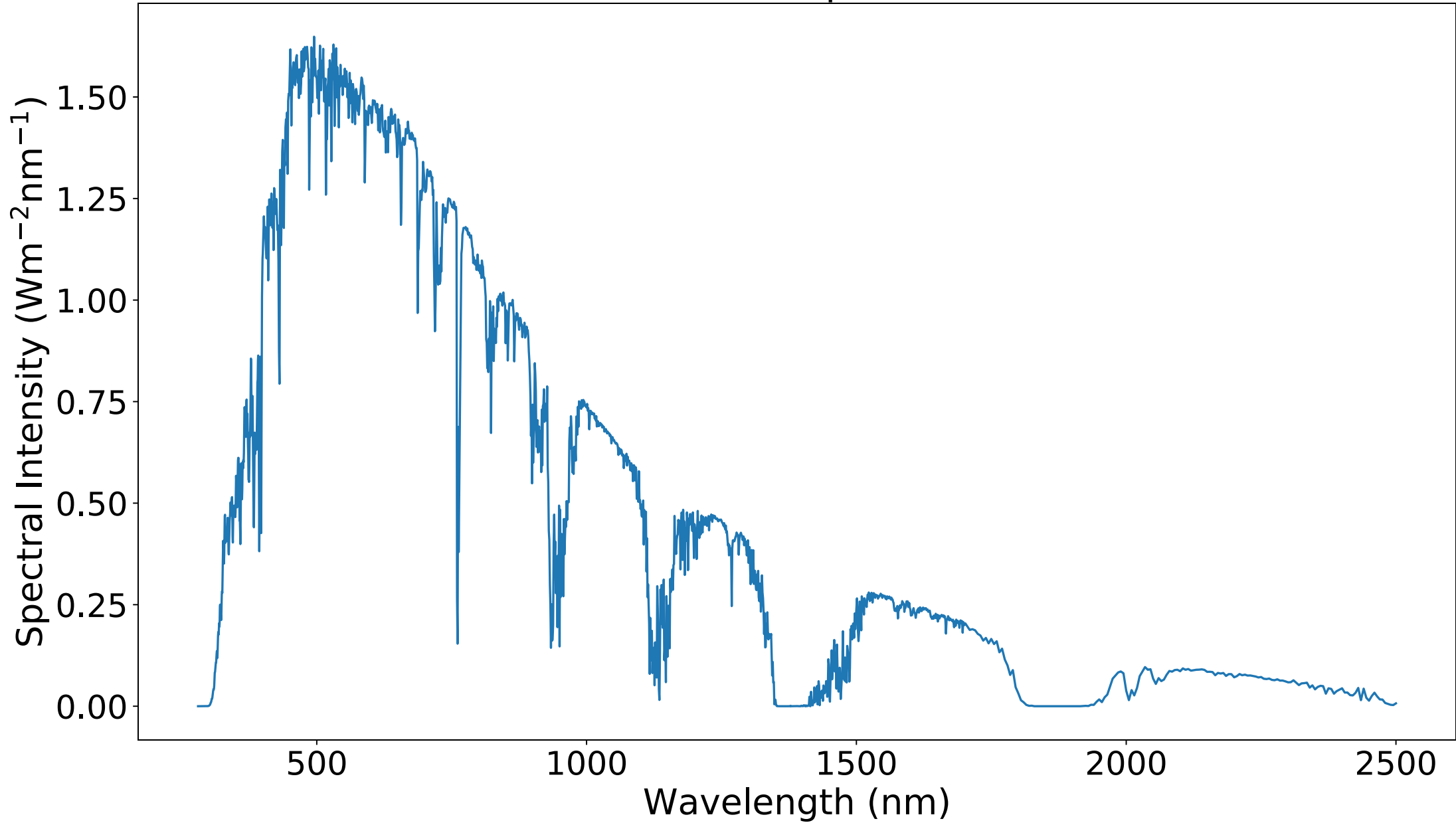


# **Studying Phonon Broadening with Photoluminescence and Photoreflectance**

**Johannes Byle**

**Adviser: Dr. Sellers**

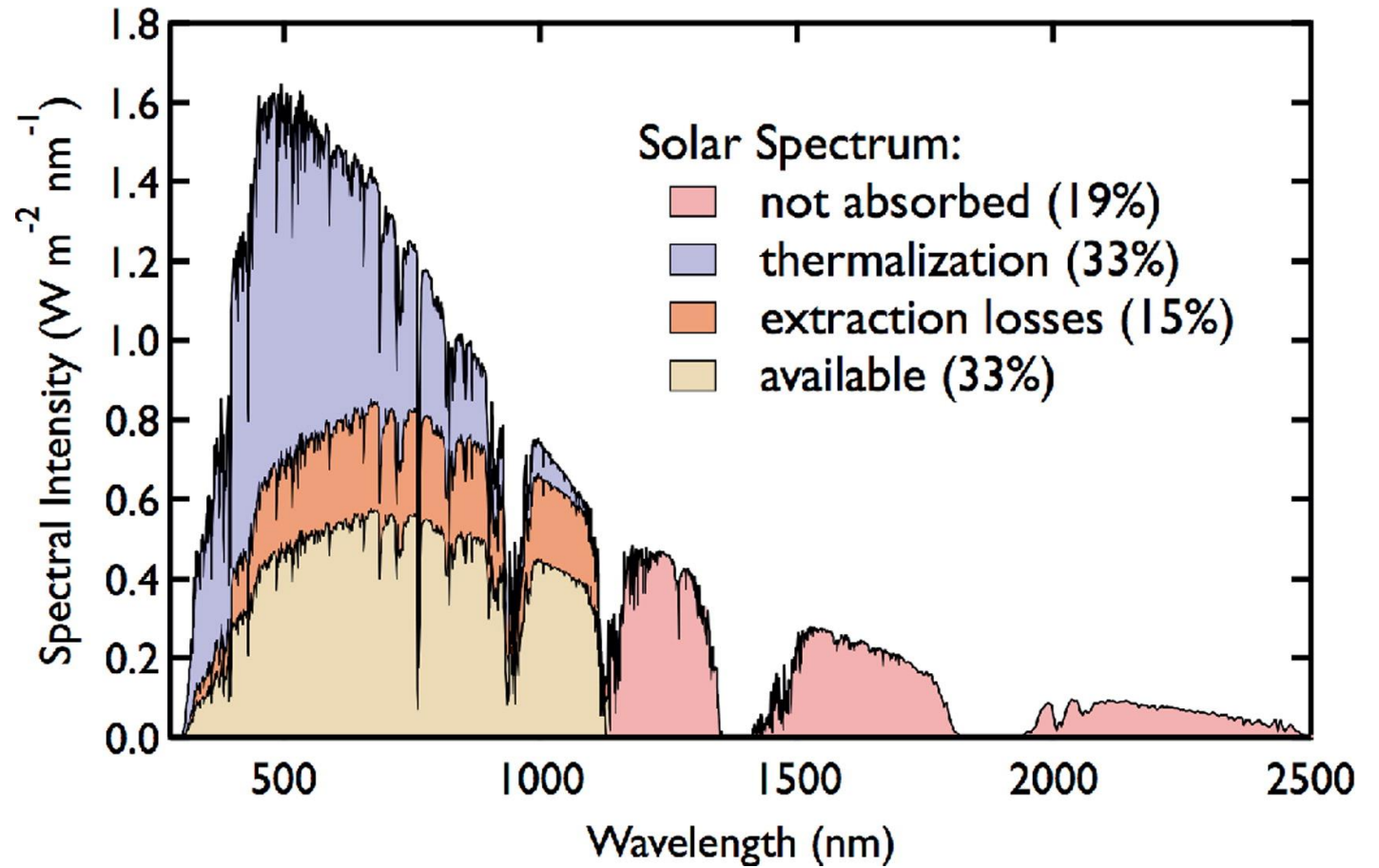
# The Solar Spectrum



# Limits to Solar Cell Efficiency

## Thermalization Losses

Photons with energy greater than the band gap can create hot carriers which can lose their energy by generating phonons rather than by creating current.



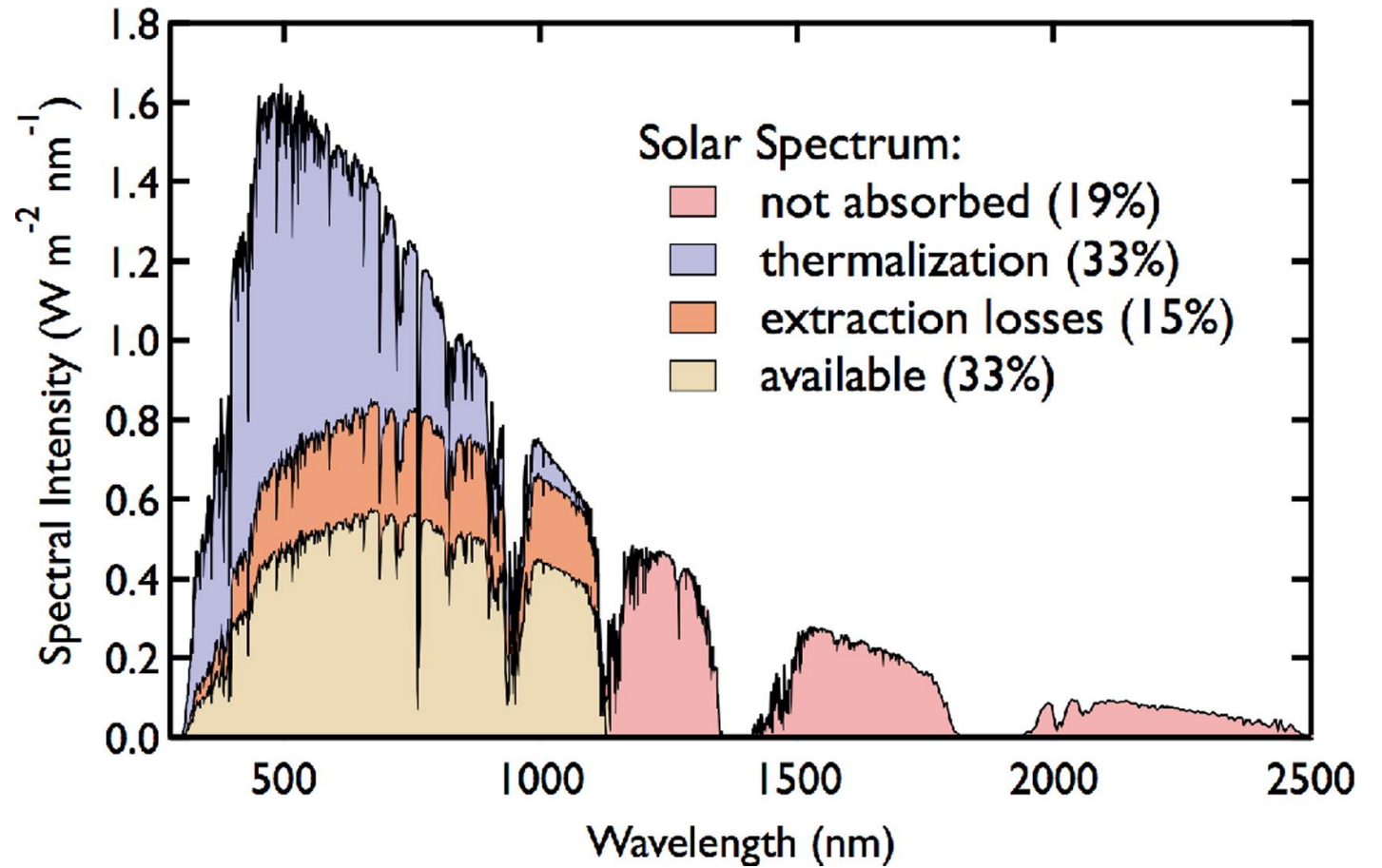
# Limiting Thermalization Losses

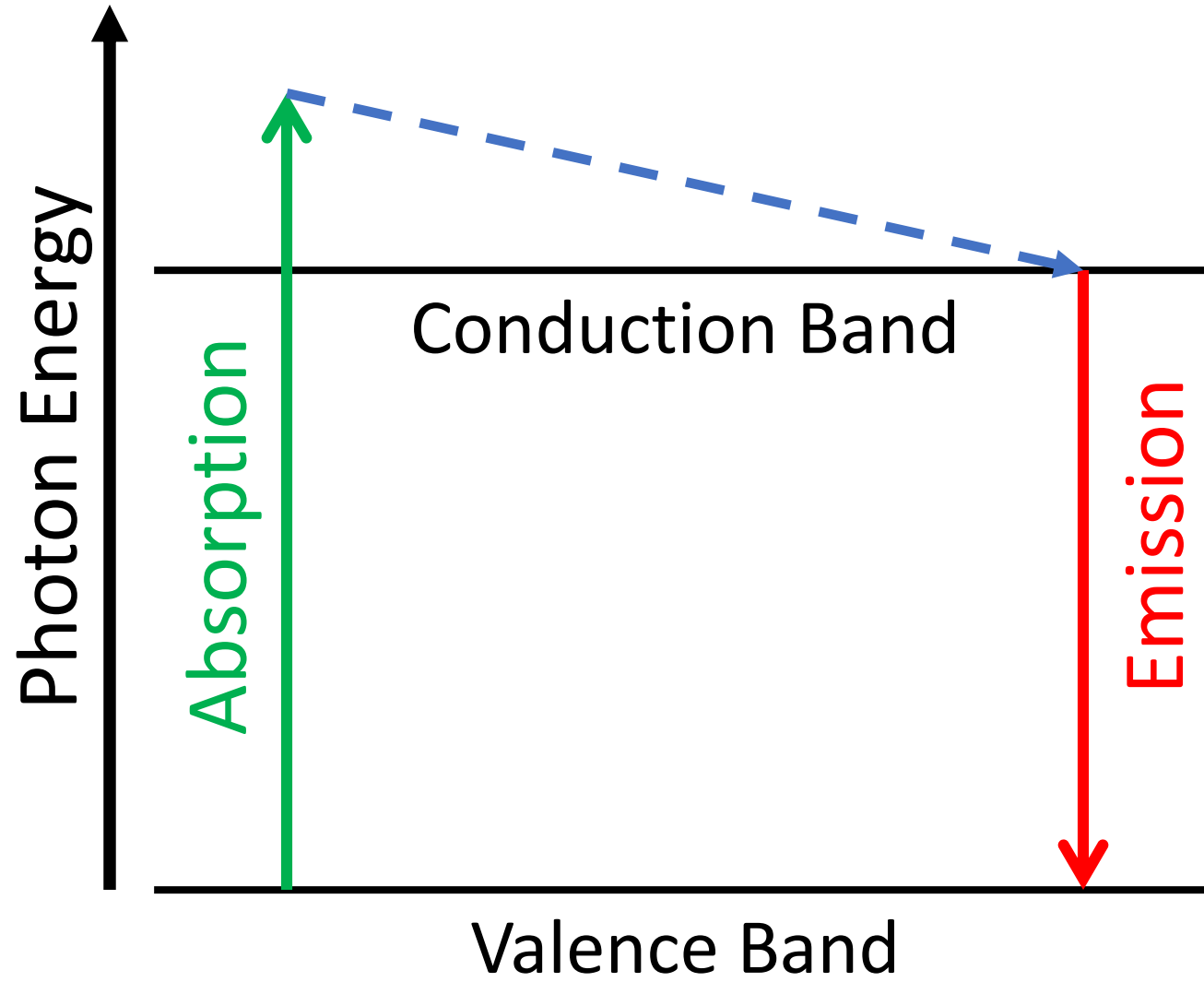
## Energy Selective Contacts

Because hot carriers have greater energy than equilibrium carriers hot carrier extraction requires contacts that absorb at higher voltages.

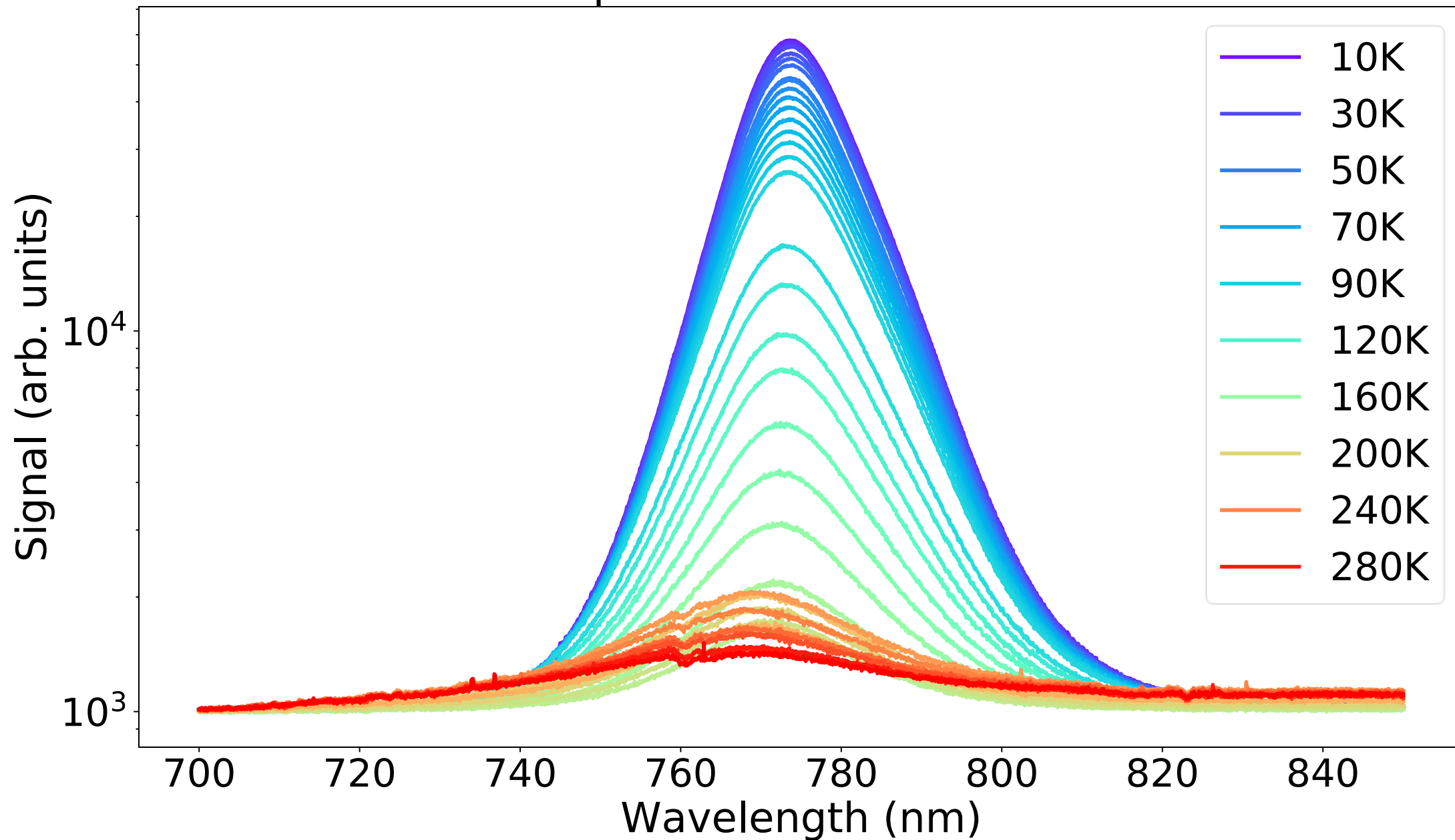
## Hot Carrier Lifetimes

If phonon interactions happen faster than extraction hot carriers will lose energy to phonon interactions.

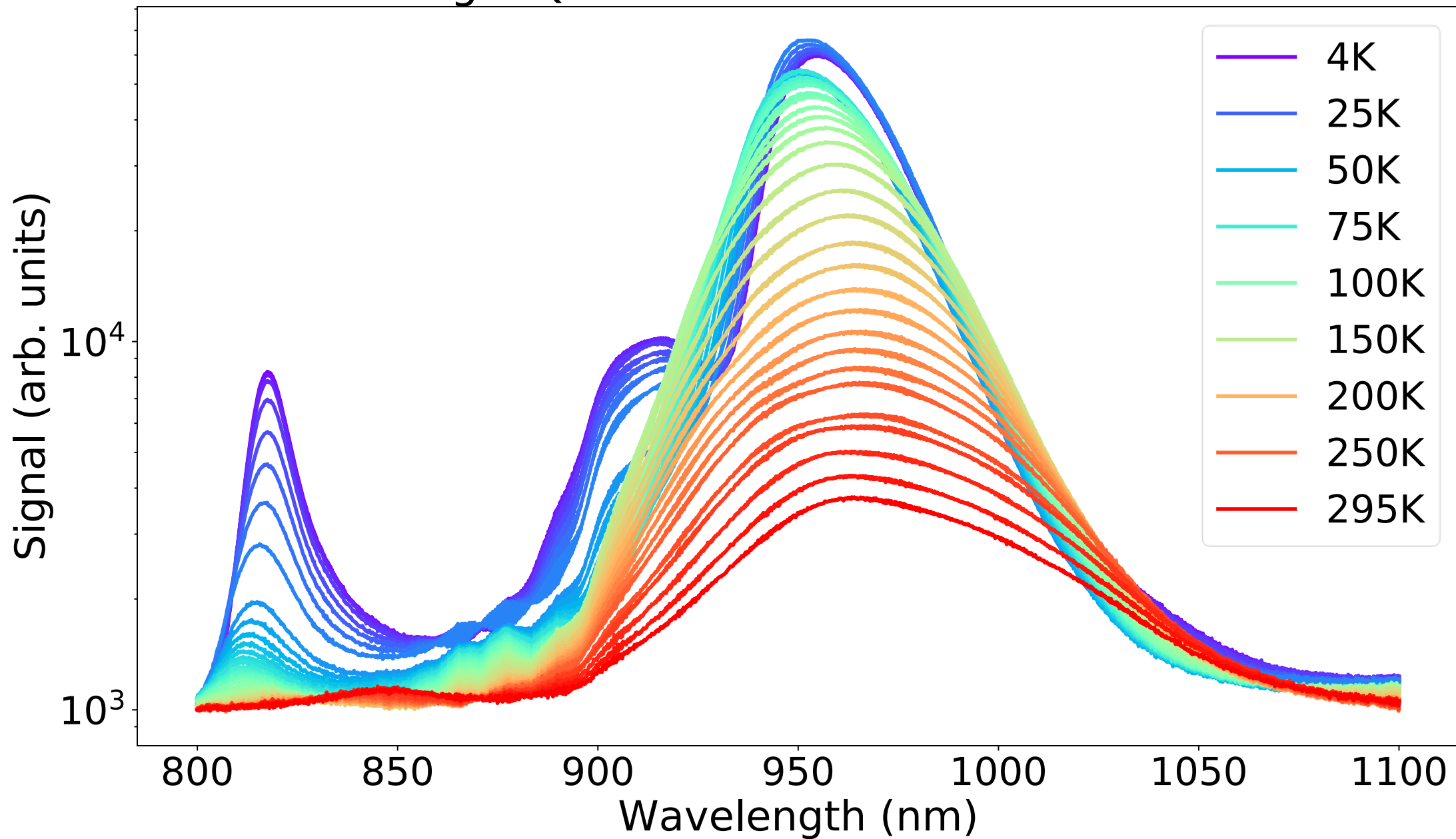




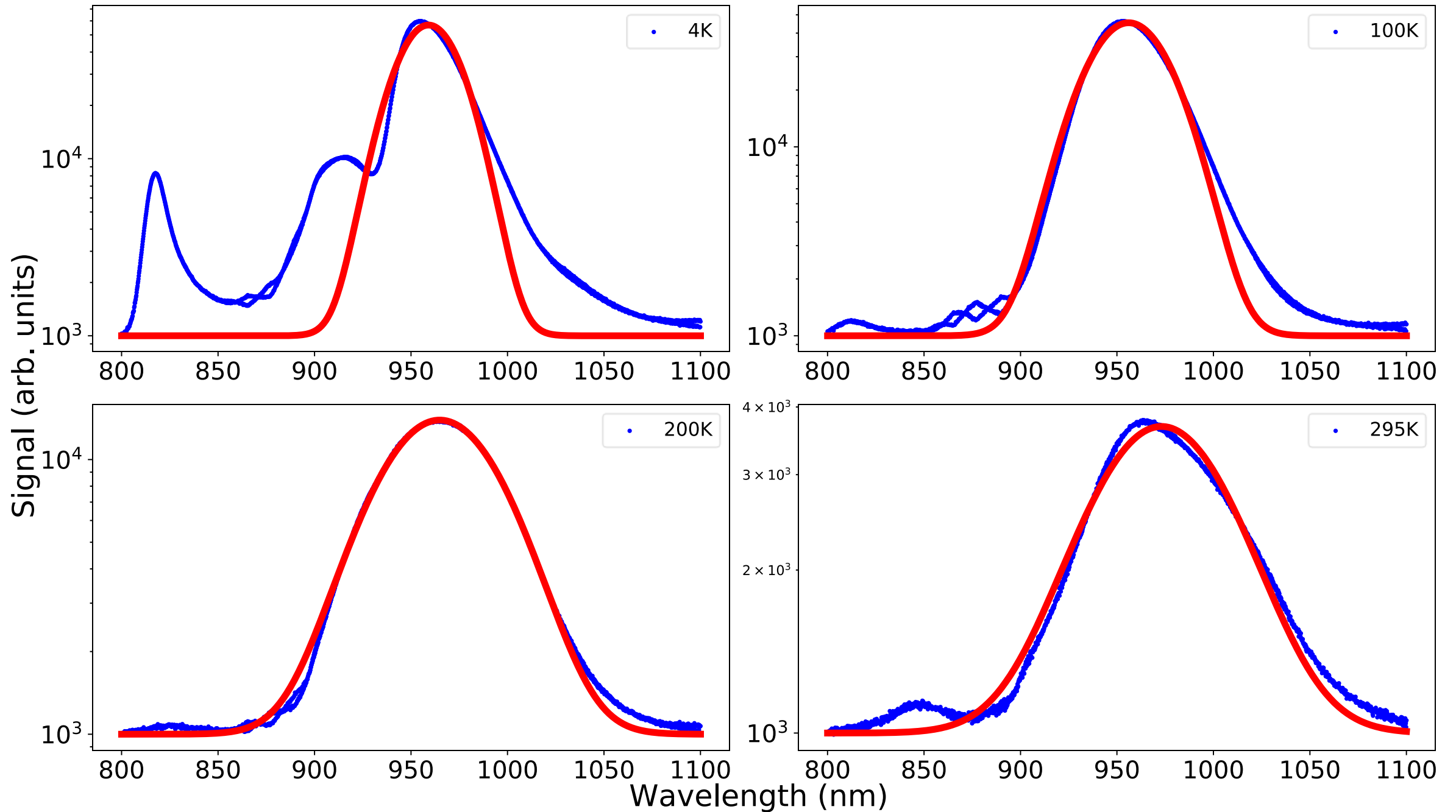
# Sample Photoluminescence



# InP Single Quantum Well Photoluminescence

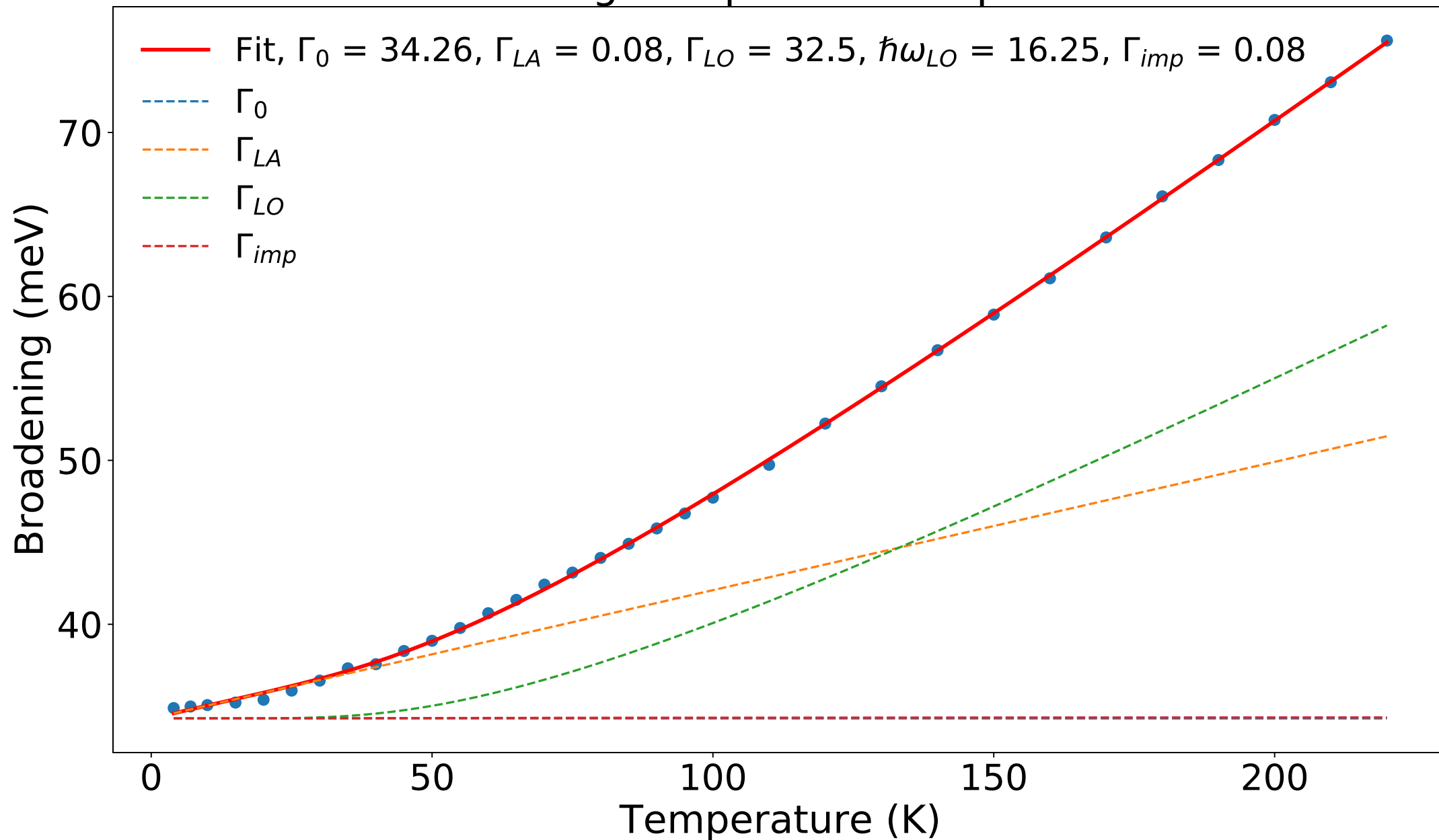


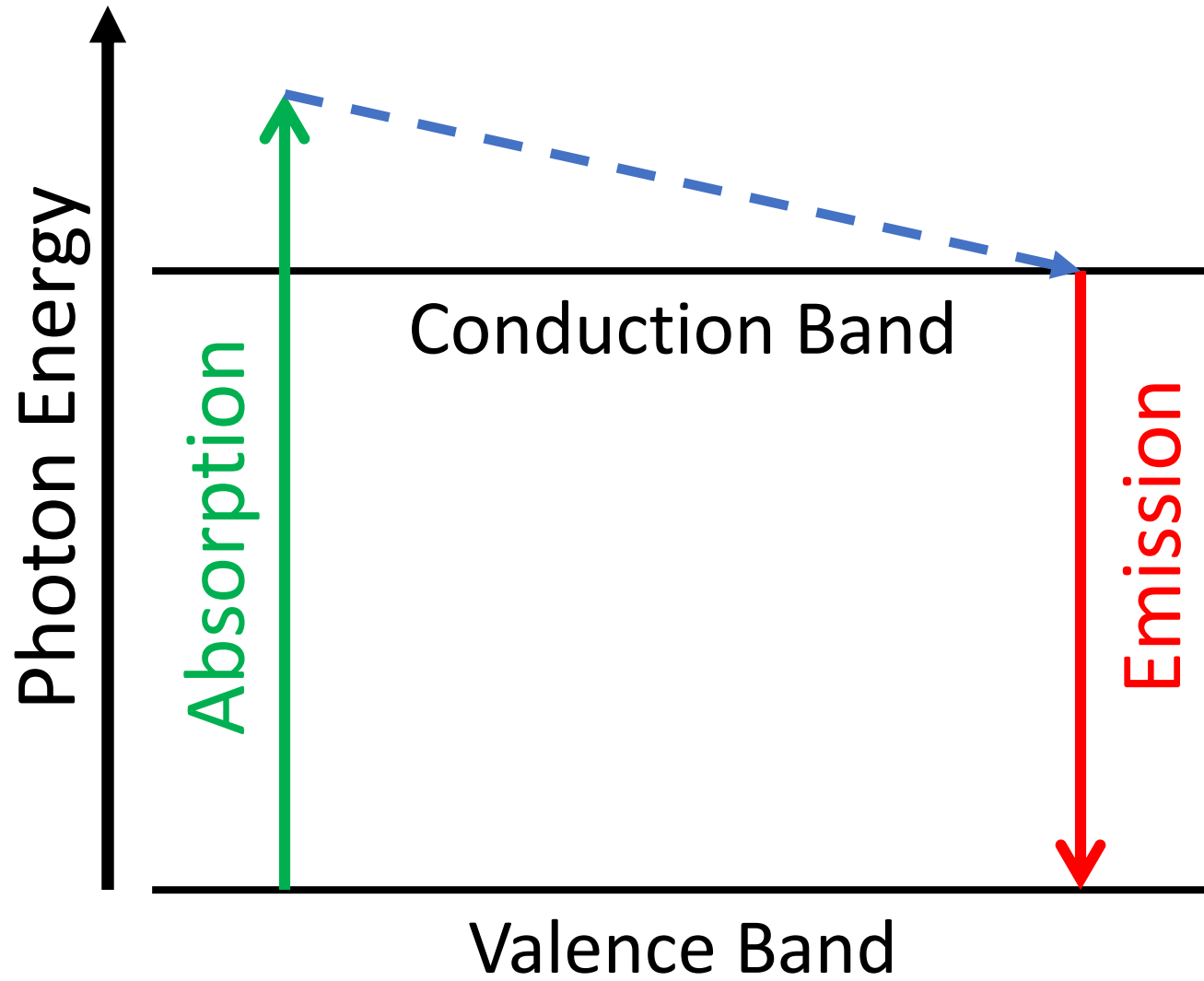
# InP Single Quantum Well Photoluminescence



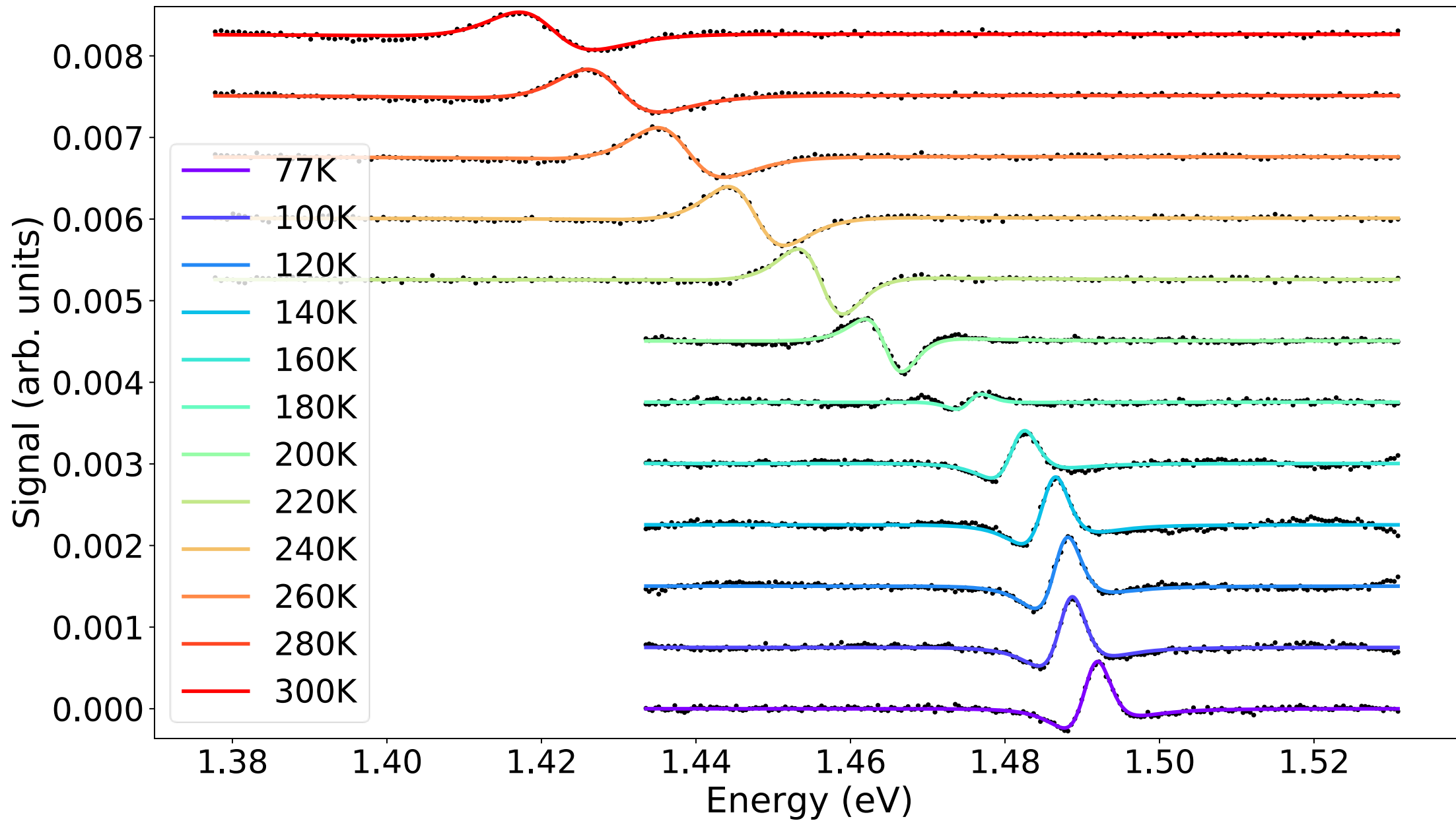


# Broadening Temperature Dependence

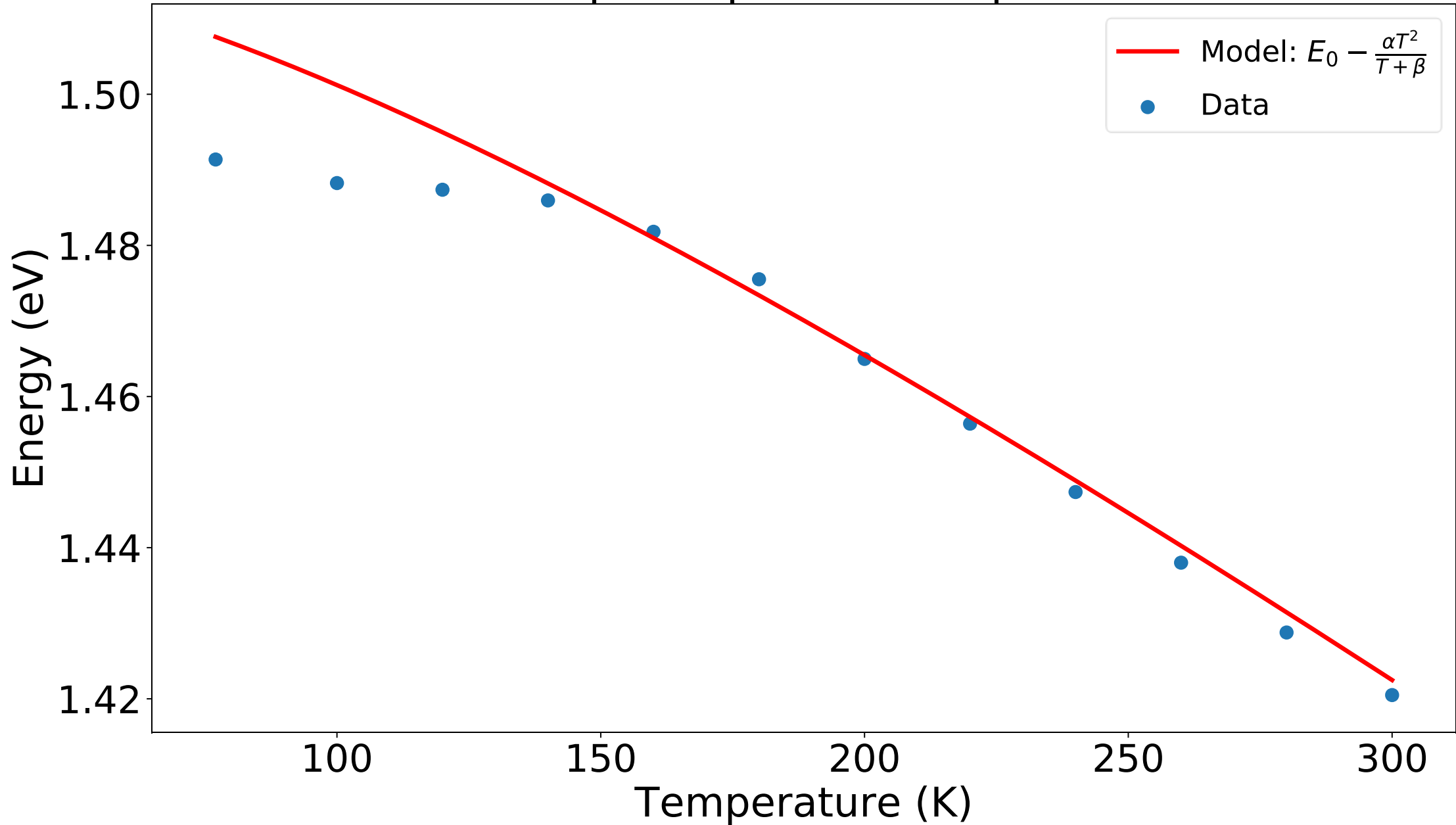




# GaAs Photoreflectance



# Band Gap Temperature Dependence



# Broadening Temperature Dependence

