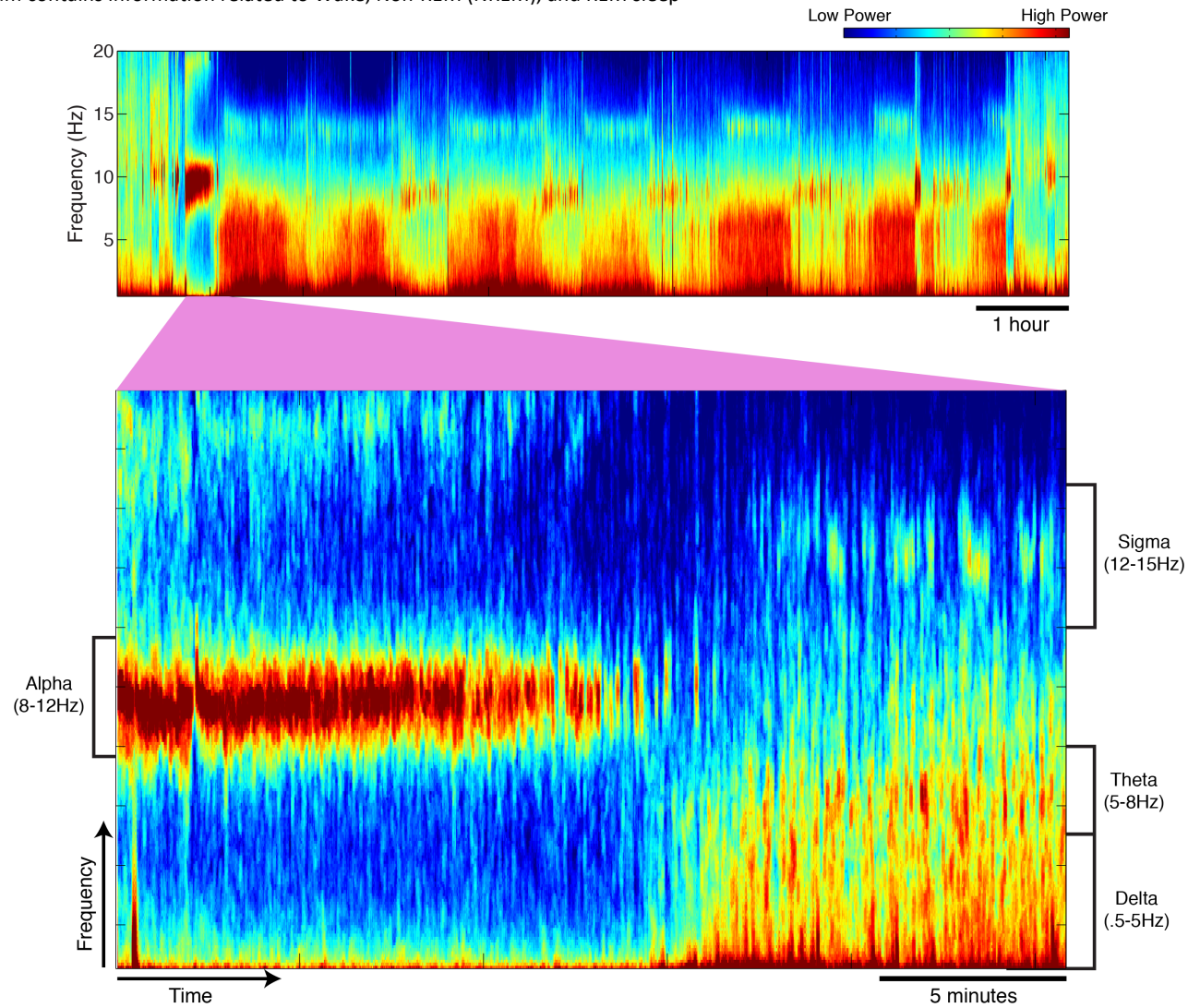
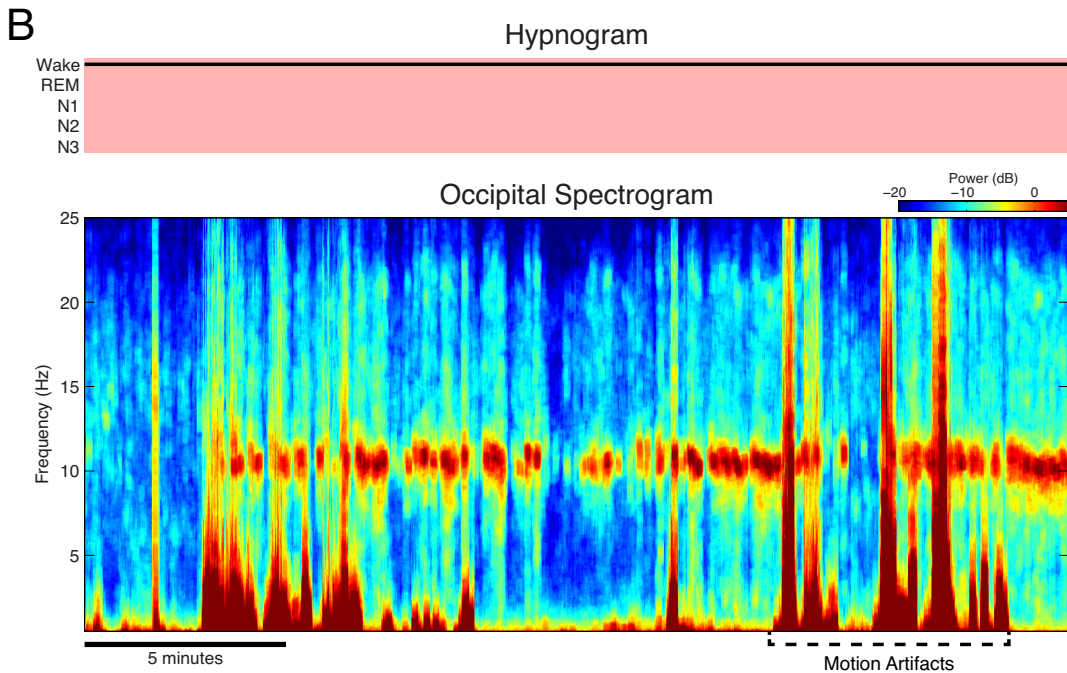
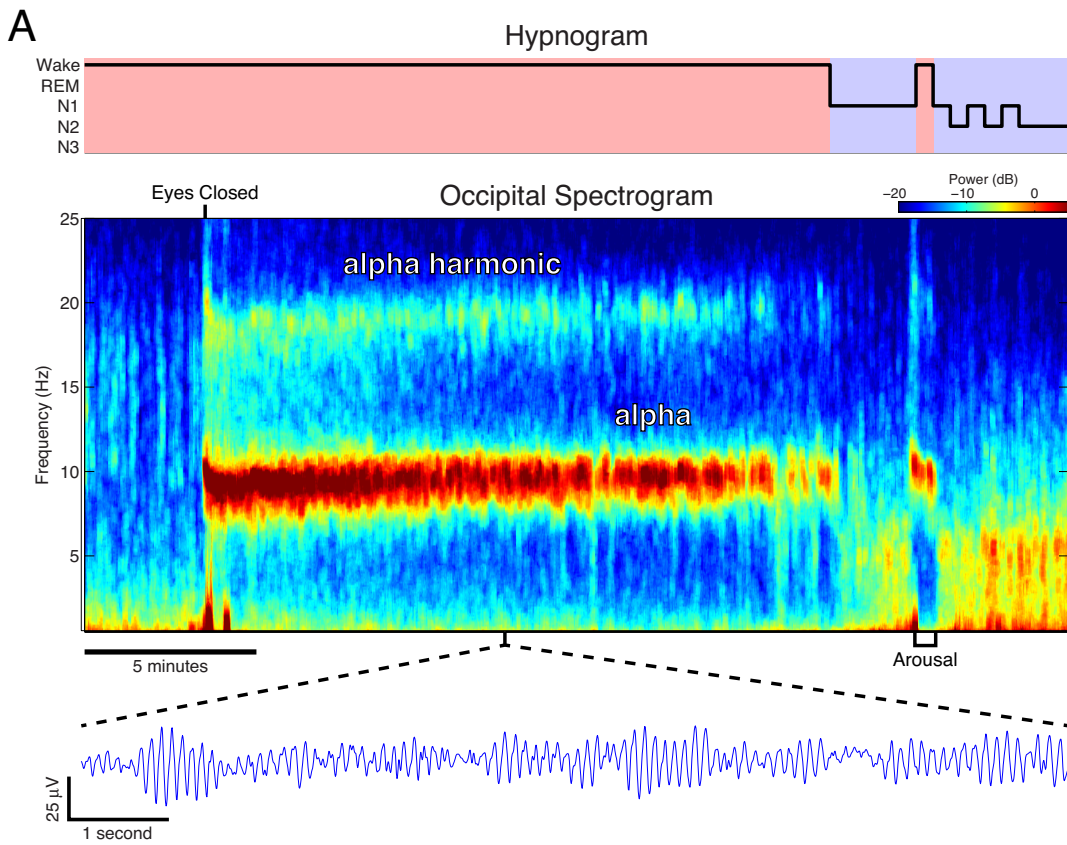


SLEEP SPECTROGRAM (MULTITAPER)

- The spectrogram represents the time-frequency representation of the sleep EEG
 - x-axis: time, y-axis: frequency, colors: power
 - cool colors: low power → hot colors: high power
- The occipital EEG spectrogram contains information related to Wake, Non-REM (NREM), and REM sleep





WAKE

Eyes Open (Quiescent)

Delta	Low power
Theta	Low power
Alpha	Low power
Sigma	Low power
Background	Low power

Eyes Closed

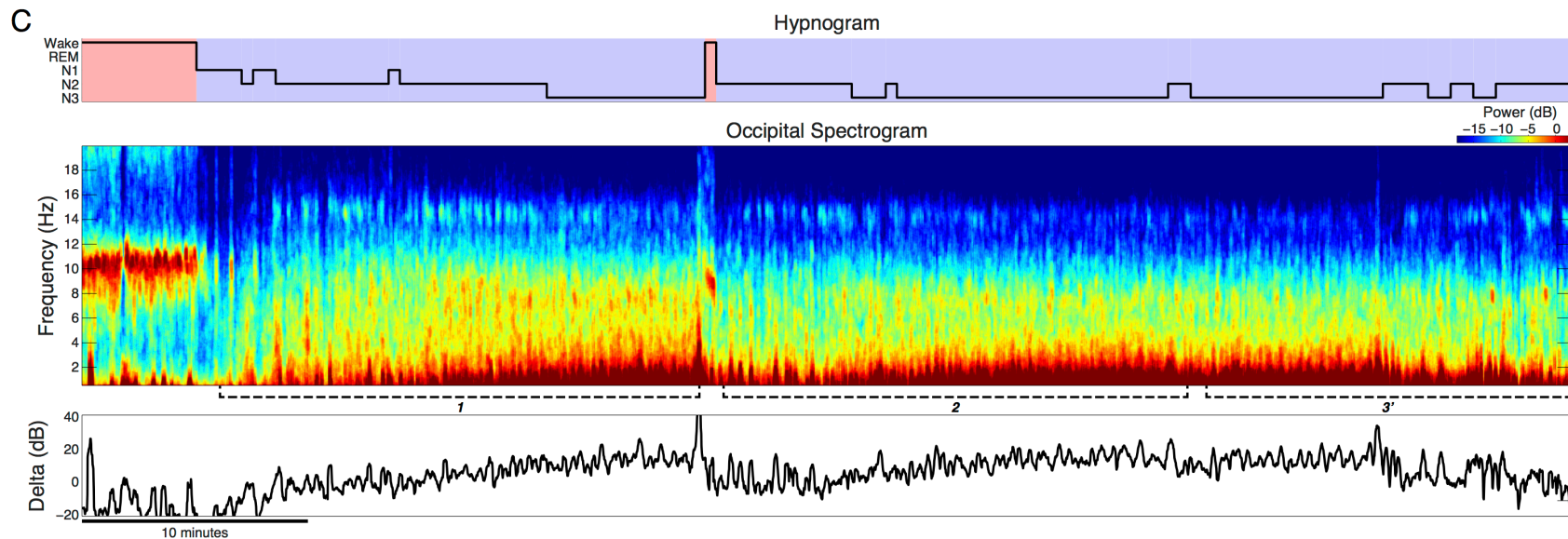
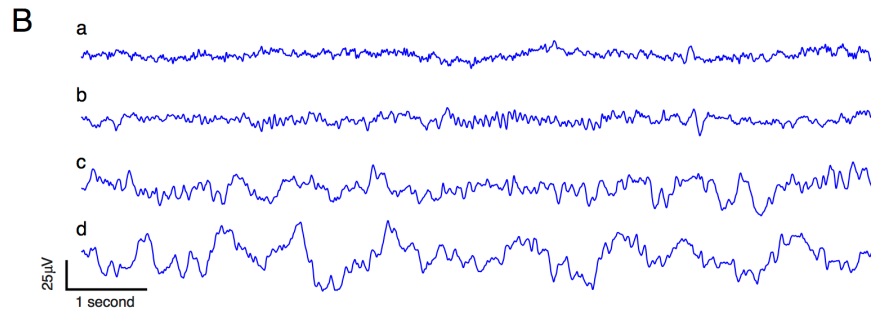
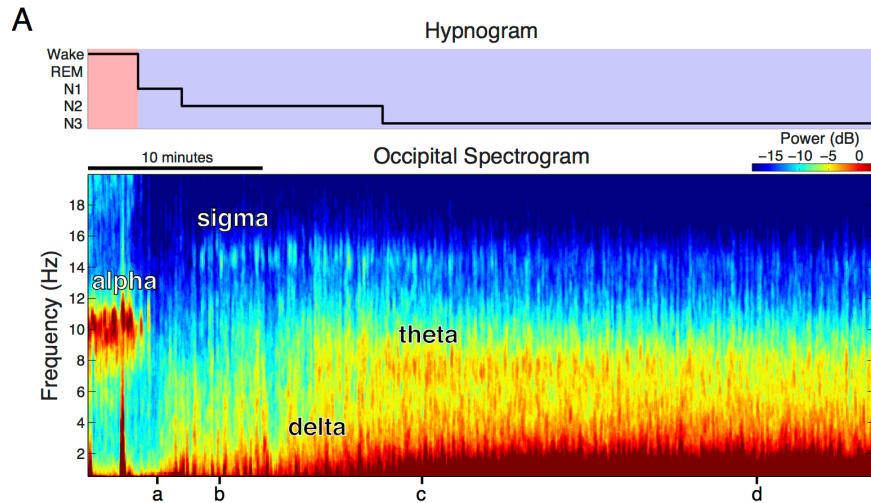
Delta	Low power, below REM levels Low frequency noise possible
Theta	Low power, below REM levels
Alpha	High power, clear oscillation, possible harmonic at double the alpha frequency
Sigma	Low power
Background	Low power

Eyes Open (Active)

Delta	Low power
Theta	Low power
Alpha	Sporadic bursts or absent
Sigma	Low power
Background	Broadband background power, motion artifacts

Dynamics

- Eyes open wake has low power at all frequencies and no clear oscillatory dynamics
- Eyes closed wake shows a strong alpha oscillation which decreases in power and bandwidth during the sleep onset process
- Active wake has a mix of eyes closed, eyes open, and motion artifact
- Motion artifacts are seen as distinct vertical high power bands and may be seen during any stage
- Arousals are seen as a transient burst of power in alpha and may be seen during any stage



NON-REM (NREM)

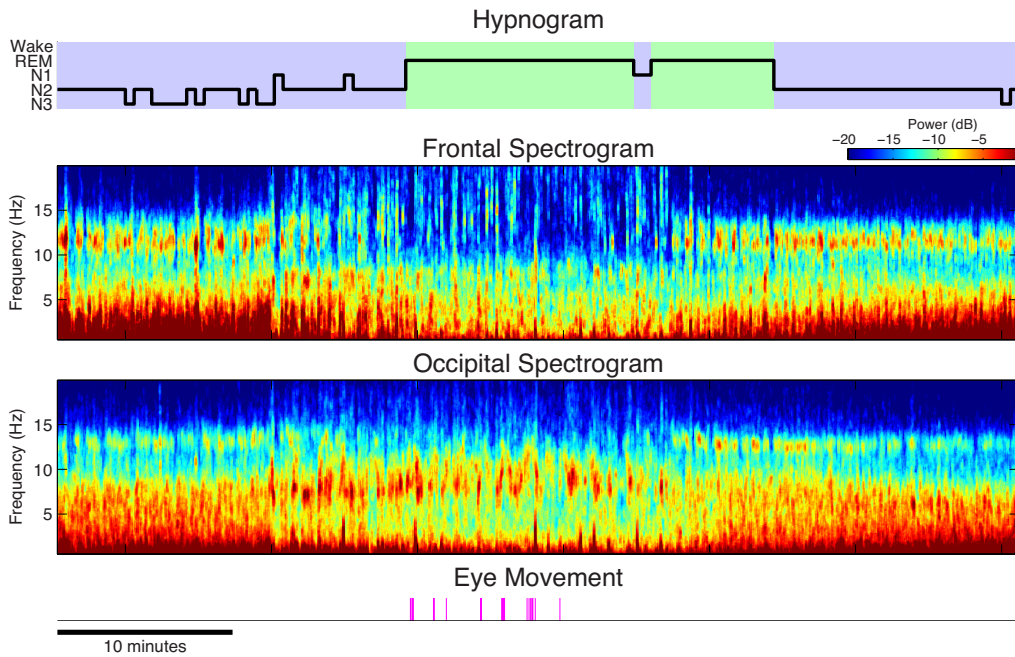
NREM Progression into Slow Wave Sleep

Delta	Gradual increase to high power and large bandwidth
Theta	Gradual increase in power and bandwidth following delta
Alpha	Low Presence of transient alpha corresponds to an arousal
Sigma	Rapid appearance of power following initial increase of delta Power decreases as NREM progresses
Background	Broadband background power

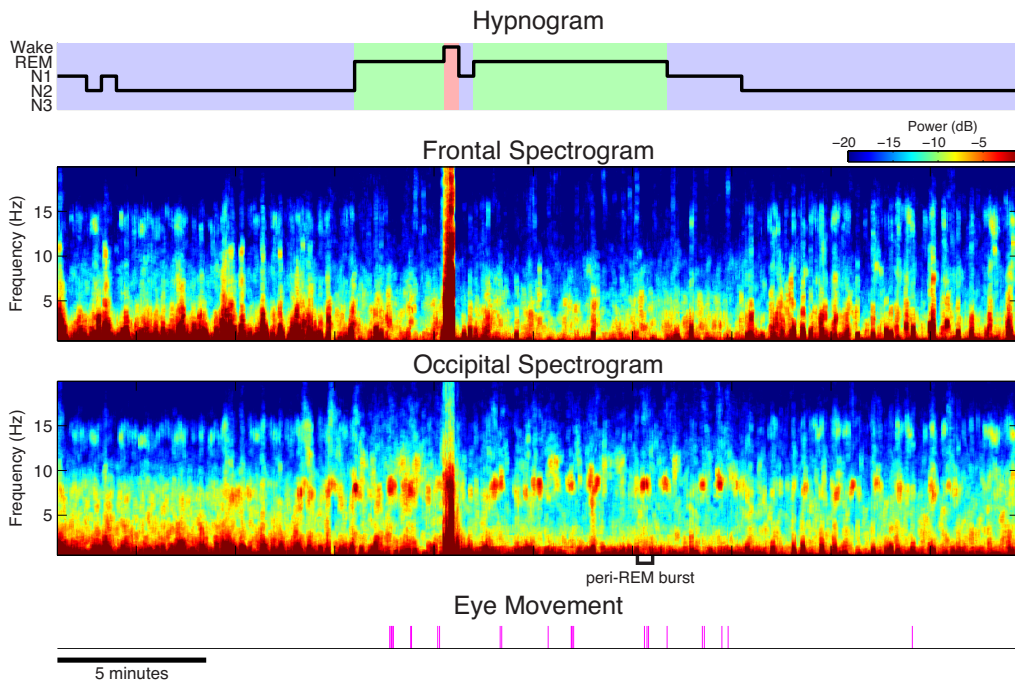
Dynamics

- As NREM progresses into Slow Wave Sleep:
 - The power and bandwidth of the delta and theta oscillations increase
 - Power in sigma appears (may then decrease as delta increases)
- Arousals during NREM are marked by alpha and/or a motion artifact, and a reset of NREM process to lighter levels
- During a slow lightening of NREM, there is a reduction of delta and theta power, and sigma power reappears

A



B



THE REM PERIOD

Delta	Rapid decrease to low power following NREM
Theta	Rapid decrease to low power following NREM
Alpha	Recurring transient occipital power in low-alpha frequencies
Sigma	Low power
Background	Background power level above that observed during <i>Eyes Closed Wake</i>

Dynamics

- From NREM, delta and theta power and bandwidth rapidly decrease
- From NREM, sigma power disappears
- Background power in higher than during *Eyes Closed Wake*

Peri-REM Alpha Bursting

- Some subjects exhibit transient, recurring bursts occipitally in low-alpha frequencies
- The bursts:
 - Have lower power, bandwidth, and peak frequency than the alpha seen during *Eyes Closed Wake*
 - Begin to appear at the end of the preceding NREM period and may continue into the next NREM period
 - Decrease in temporal recurrence as REM progresses
 - Rise and fall in peak frequency across the peri-REM period

C

