

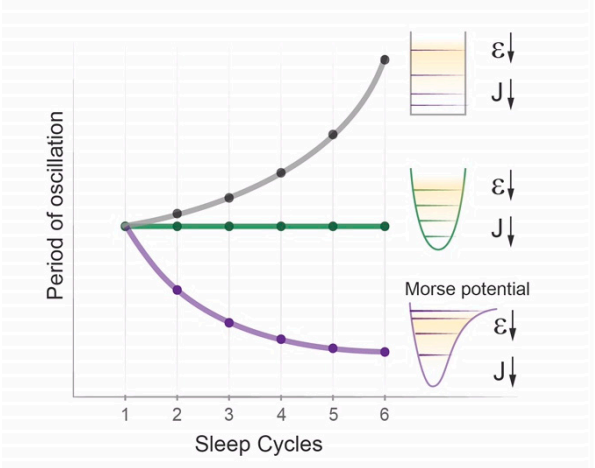
Kharchenko V. and Zhdanova I.V. The wave model of sleep dynamics and an invariant relationship between NonREM and REM sleep

Supplemental materials:

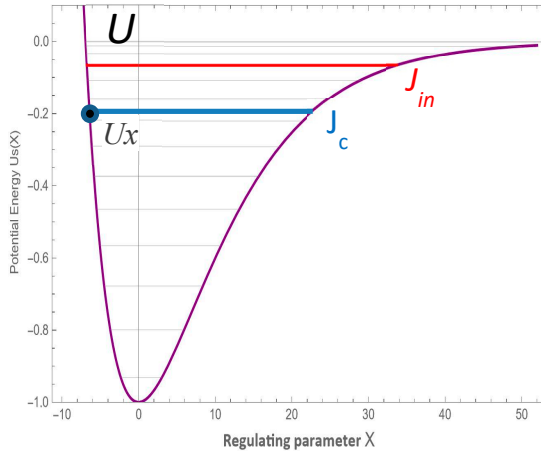
Supplemental Table 1 The Wave Model of Sleep parameters for groups with Regular and Extended sleep.

Group	$U_s$ width $\sigma$	Number of initial level $j_{in}$	Resonance level $j_c$	Resonance width $\Gamma$
Regular sleep	10	10.3	7.1	0.44
Extended sleep	11.3	11.8	7.6	0.52

Regular sleep: 9-h regular nighttime sleep opportunity, described in Method 16.  
Extended sleep: 14-h extended nighttime sleep opportunity, described by Barbato and Wher<sup>30</sup>.  
At sleep onset,  $\varepsilon$  can slightly deviate from exact  $U_s$  level, hence  $j_{in}$  in model approximation appears non-integer. However, at  $x_o$  (Fig. 2) the wavepacket would occupy the closest integer level. Time-scaling constants to convert relative duration values to absolute time (min) and for these groups,  $A_{NREM}$  and  $A_{REM}$  were, respectively, 0.6 and 23 for Regular sleep and 0.5 and 22 for Extended sleep.



**Figure S1 Consecutive periods of energy relaxation in potential wells of different shape.**  
The dynamics of energy  $\varepsilon$  relaxation over consecutive cycles toward the lowest energy level  $j$  depends on the shape of the potential well and energy gaps between levels. The period of oscillation is inverse proportional to the energy gap. For rectangular potential (black), top-to-bottom reduction of energy gaps leads to gradual increase in cycle period during energy decline. For a parabolic well (green), equal energy gaps lead to periods of equal duration (harmonic oscillator). For asymmetric Morse potential (purple), gradual top-to-bottom increase in energy gaps leads to a decline in the period of oscillations during energy relaxation.



**Figure S2 Actual position of the initial and resonance levels within the  $U_s$  potential well.**

For regular sleep (Fig. 3b, Table 1. Regular), typical position of the initial  $U_s$  energy level ( $J_{in}$ , red line) of sleep onset is around level 10. The energy of the resonance level ( $J_c$  blue line) is around  $U_s$  levels 7, near the homeostatic energy threshold,  $U_{xc}$  (black dot). Note that  $J_c$  does not belong to  $U_s$  and can be positioned asymmetrically relative to  $U_s$  levels (thin horizontal lines). Conventionally, energy levels are counted from the bottom of the potential well. There is a positive correlation between the total number of  $U_s$  levels and the width of the potential well. In cases of regular sleep, the potential well typically includes around 14 levels.