

Supplementary Table S1. Benchmark results for the recall of CS prediction in Sec/SPI in four tolerance windows. The PEFT-SP (LoRA) represents PEFT-SP using LoRA with ESM2-3B backbone. The bold value represents the highest recall among the predictors in a particular tolerance window. The n.d. represents the model was not trained on the data. The * denotes the performance reported in SignalP 6.0.

CS recall Method	Archaea				Eukarya				Gram-negative bacteria				Gram-positive bacteria			
	±0	±1	±2	±3	±0	±1	±2	±3	± 0	±1	± 2	±3	± 0	±1	±2	±3
PEFT-SP (LoRA)	0.612	0.679	0.679	0.708	0.827	0.866	0.901	0.920	0.711	0.764	0.878	0.904	0.813	0.832	0.852	0.860
SignalP 6.0 retrained	0.575	0.632	0.632	0.671	0.817	0.858	0.900	0.920	0.782	0.839	0.892	0.914	0.766	0.779	0.794	0.812
SignalP 6.0 *	0.500	0.556	0.556	0.583	0.747	0.774	0.808	0.829	0.639	0.672	0.689	0.721	0.800	0.800	0.800	0.800
SignalP 5.0 *	0.389	0.472	0.472	0.528	0.630	0.651	0.705	0.760	0.508	0.574	0.656	0.672	0.733	0.733	0.733	0.733
DEEPSIG *	n.d.	n.d.	n.d.	n.d.	0.603	0.630	0.658	0.699	0.508	0.574	0.574	0.574	0.733	0.733	0.800	0.800
Lipop *	0.389	0.528	0.556	0.639	0.288	0.329	0.370	0.404	0.656	0.705	0.721	0.721	0.467	0.467	0.533	0.533
PHILIUS *	0.500	0.611	0.611	0.611	0.596	0.658	0.712	0.760	0.623	0.672	0.721	0.754	0.467	0.467	0.467	0.467
PHOBIUS *	0.472	0.583	0.611	0.639	0.637	0.671	0.699	0.753	0.557	0.656	0.721	0.738	0.467	0.467	0.467	0.467
PolyPhobius *	0.528	0.667	0.667	0.667	0.623	0.678	0.733	0.801	0.557	0.672	0.754	0.754	0.667	0.667	0.733	0.733
PRED-LIPO *	0.472	0.556	0.611	0.639	0.068	0.082	0.130	0.158	0.410	0.475	0.508	0.525	0.867	0.867	0.867	0.867
PRED-SIGNAL *	0.861	0.917	0.917	0.917	0.226	0.267	0.301	0.329	0.426	0.492	0.607	0.639	0.800	0.800	0.800	0.800
PRED-TAT *	0.556	0.694	0.750	0.778	0.370	0.445	0.500	0.548	0.656	0.721	0.754	0.770	0.867	0.867	0.867	0.867
Signal-3L 2.0 *	n.d.	n.d.	n.d.∅	n.d.	0.644	0.671	0.719	0.753	0.607	0.639	0.672	0.705	0.733	0.733	0.800	0.800
Signal3Lv2 *	n.d.	n.d.	n.d.	n.d.	0.664	0.685	0.726	0.753	0.541	0.607	0.623	0.639	0.800	0.800	0.800	0.800
SOSUlsignal *	n.d.	n.d.	n.d.	n.d.	0.151	0.308	0.459	0.568	0.246	0.377	0.557	0.623	0.200	0.267	0.267	0.467
SPElip *	n.d.	n.d.	n.d.	n.d.	0.685	0.712	0.747	0.781	0.574	0.656	0.705	0.721	0.600	0.600	0.667	0.667
SPOCTOPUS *	0.333	0.389	0.417	0.472	0.384	0.514	0.678	0.747	0.426	0.656	0.820	0.869	0.600	0.667	0.733	0.867
TOPCONS2 *	0.389	0.528	0.556	0.583	0.329	0.452	0.596	0.692	0.443	0.541	0.656	0.689	0.267	0.333	0.333	0.400