**Supplemental Text for: Adaptable Functionality of Transcriptional Feedback in Bacterial Two-Component Systems** by J. Christian J. Ray and Oleg A. Igoshin

## Text S3: Non-steady state open loop gains and response times

Monte Carlo parameter sampling shows that, in most cases, negative feedback speeds induction times copared to positive feedback (Figure 3). A small subset of negative feedback cases appears to contradict this rule. The measure of feedback sign used is the steady state open loop gain,  $\frac{\partial[\text{RRP}_1]}{\partial[\text{R}_0]}\Big|_{k_{ph}=0.1}$ . However, after an instantaneous change of the parameter  $k_{ph}$  indicating the signal, the system relaxes from a non-steady state point. Assuming that biochemical kinetics are sufficiently fast, feedback-regulated induction dynamics are set by the transcriptional timescale, and intermediate open loop gains can be approximated by quasi-steady state points  $\frac{\partial[\text{RRP}_1]}{\partial[\text{R}_0=\text{RRP}_2(t)]}\Big|_{k_{ph}=0.1}$  for time points *t* preceding the activated steady state. In cases where negative steady state open loop gain apparently slows the system response, the non-steady state gains are positive for much of the induction time, converging to a negative gain at a late timepoint. We thus found some instances of TCS induction kinetics that have negative steady state gain, but with kinetics dominated by positive non-steady state gain (Figure S4). As noted in the main text, these cases do not exhibit overshoot, which contributes significantly to speeding responses.