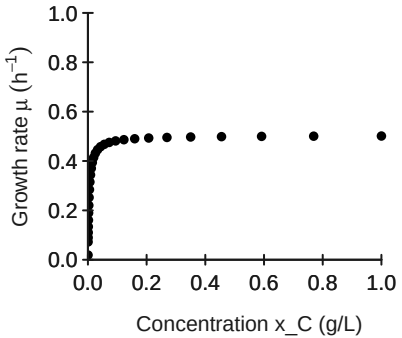
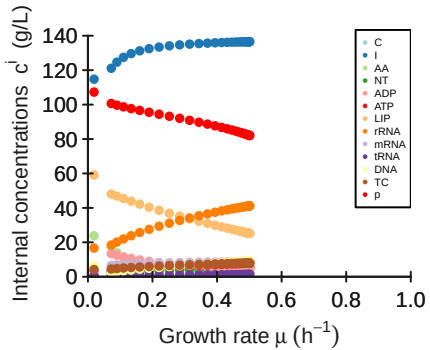
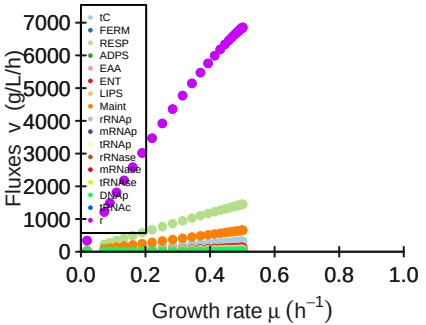
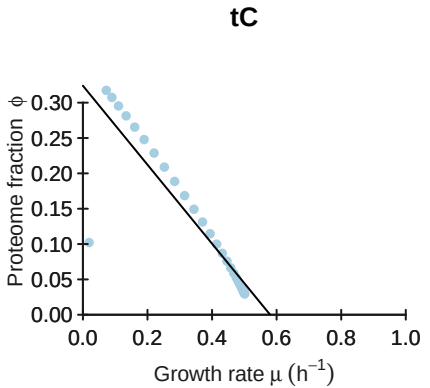
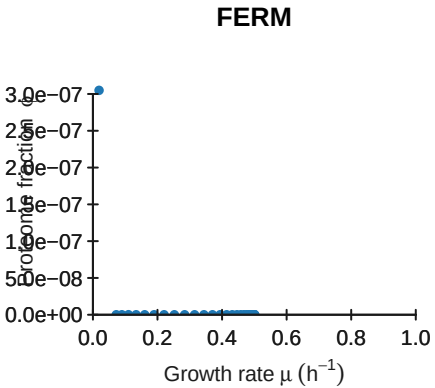
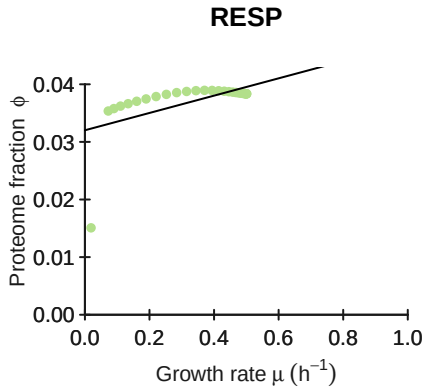

Growth rate μ (h$^{-1}$)
Concentration x_C (g/L)

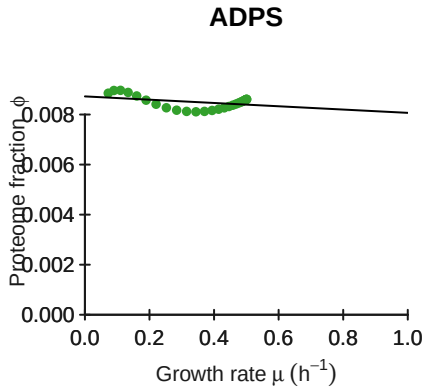

Internal concentrations $c^i$ (g/L)
Growth rate μ (h$^{-1}$)
C
I
AA
NT
ADP
ATP
LIP
rRNA
mRNA
tRNA
DNA
TC
p

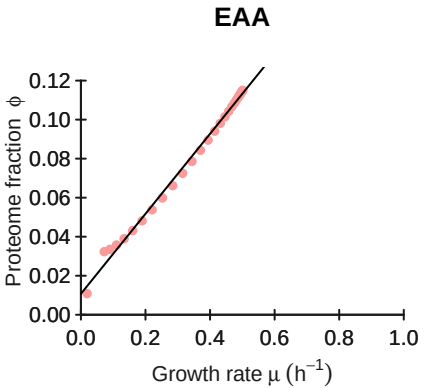

Fluxes v (g/L/h)
Growth rate μ (h$^{-1}$)
tC
FERM
RESP
ADPS
EAA
ENT
LIPS
Maint
rRNAp
mRNAp
tRNAp
rRNase
mRNase
tRNAse
DNAp
tRNAc
r

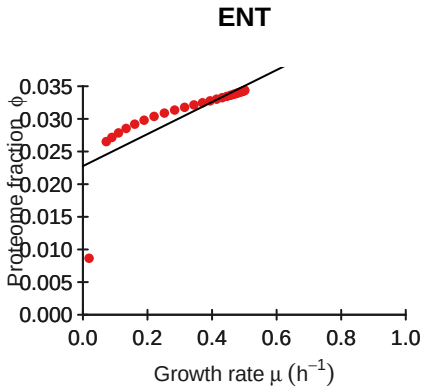

tC
Proteome fraction ϕ
Growth rate μ (h$^{-1}$)

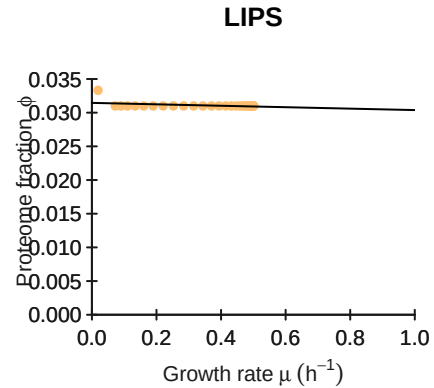

FERM
Proteome fraction ϕ
Growth rate μ (h$^{-1}$)

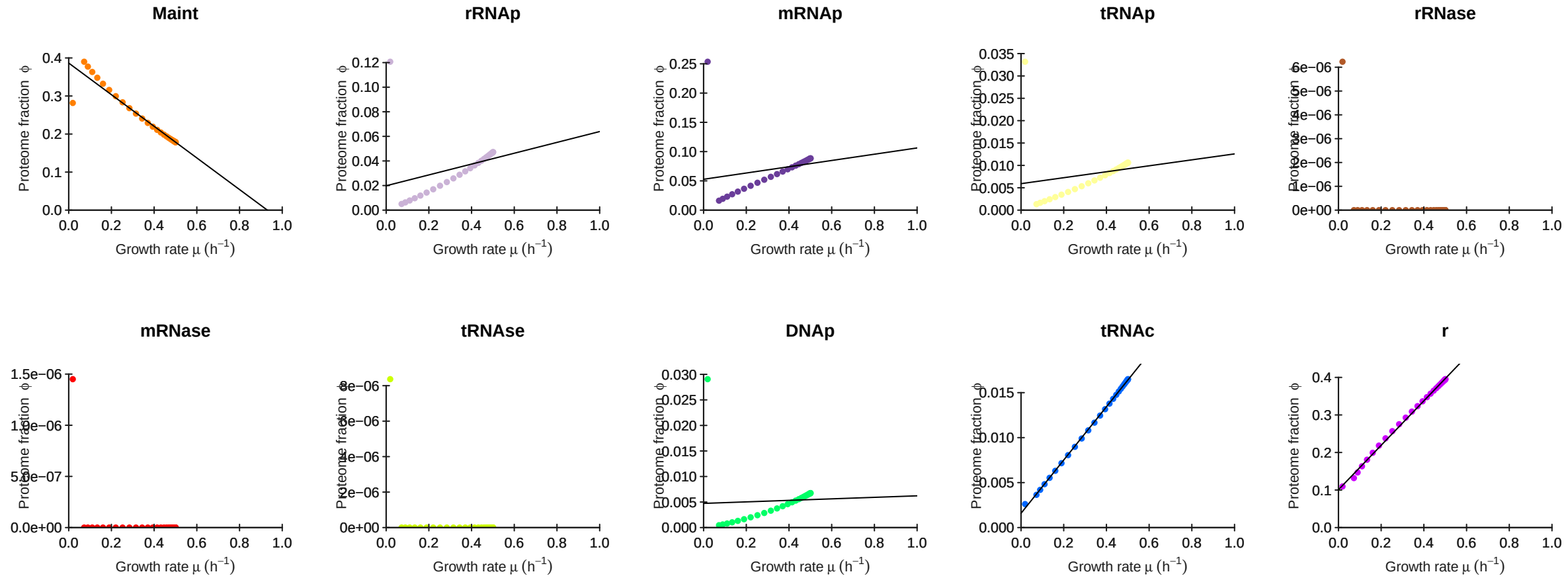

RESP
Proteome fraction ϕ
Growth rate μ (h$^{-1}$)

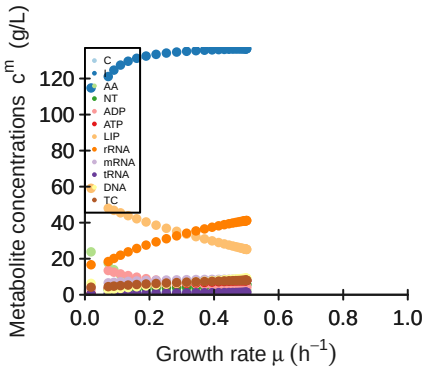

ADPS
Proteome fraction ϕ
Growth rate μ (h$^{-1}$)

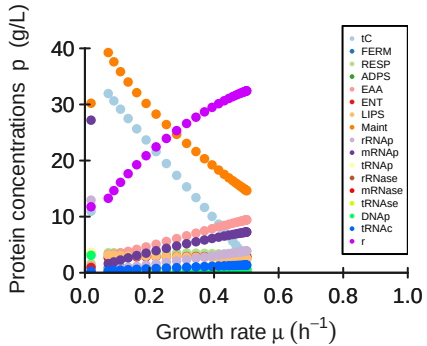

EAA
Proteome fraction ϕ
Growth rate μ (h$^{-1}$)

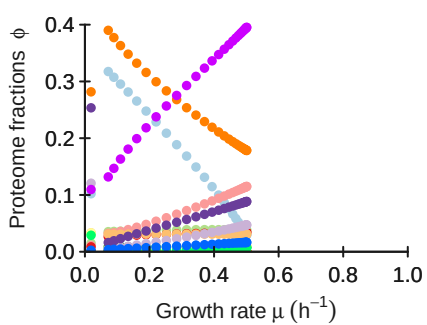

ENT
Proteome fraction ϕ
Growth rate μ (h$^{-1}$)

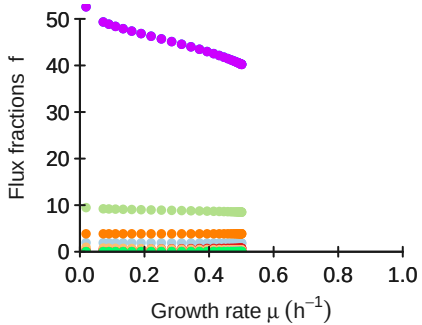

LIPS
Proteome fraction ϕ
Growth rate μ (h$^{-1}$)

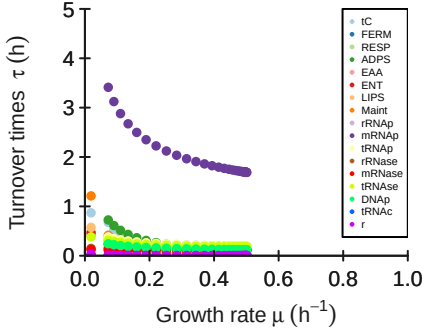

Maint
rRNAp
mRNAp
tRNAp
rRNase
mRNase
tRNAse
DNAp
tRNAc
r
Proteome fraction ϕ
Growth rate μ (h$^{-1}$)

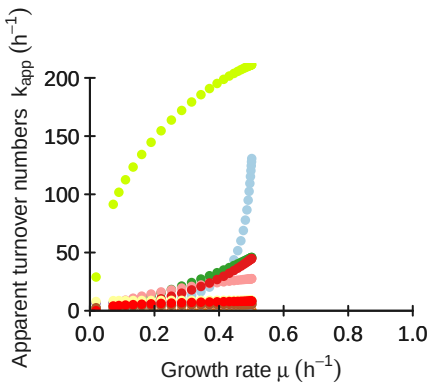

Metabolite concentrations $c^m$ (g/L)
C
AA
NT
ADP
ATP
LIP
rRNA
mRNA
tRNA
DNA
TC
Growth rate μ ($h^{-1}$)

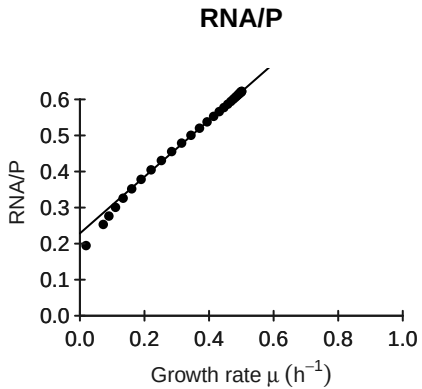

Protein concentrations p (g/L)
tC
FERM
RESP
ADPS
EAA
ENT
LIPS
Maint
rRNAp
mRNAp
tRNAp
rRNase
mRNAse
tRNAse
DNAp
tRNAc
r
Growth rate μ ($h^{-1}$)

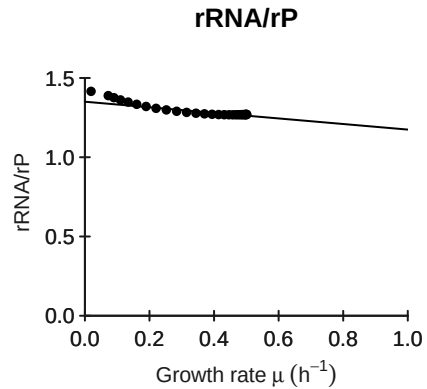

Proteome fractions ϕ
Growth rate μ ($h^{-1}$)

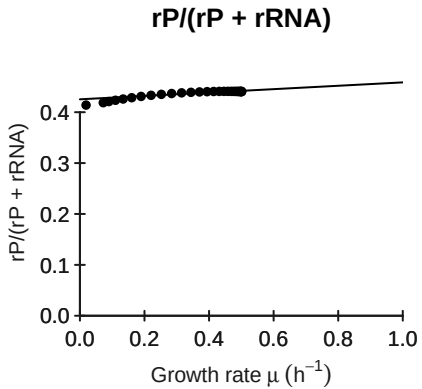

Flux fractions f
Growth rate μ ($h^{-1}$)

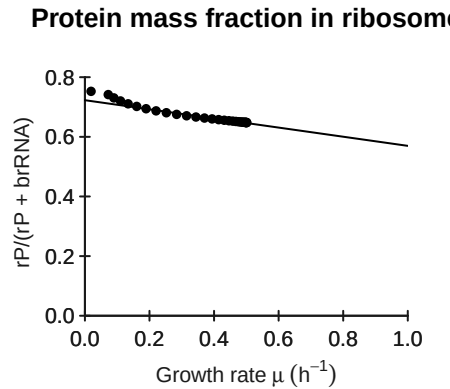

Turnover times τ (h)
tC
FERM
RESP
ADPS
EAA
ENT
LIPS
Maint
rRNAp
mRNAp
tRNAp
rRNase
mRNAse
tRNAse
DNAp
tRNAc
r
Growth rate μ ($h^{-1}$)

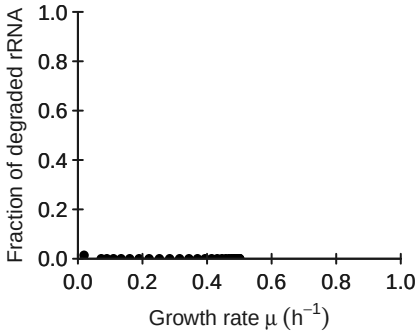

Apparent turnover numbers $k_{app}$ ($h^{-1}$)
Growth rate μ ($h^{-1}$)

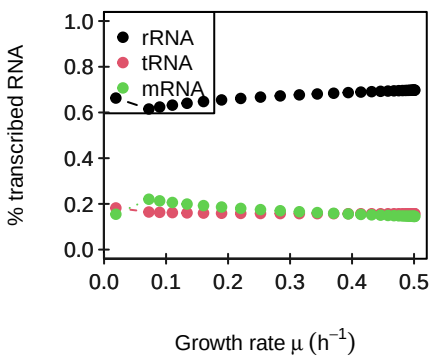

RNA/P
RNA/P
Growth rate μ ($h^{-1}$)

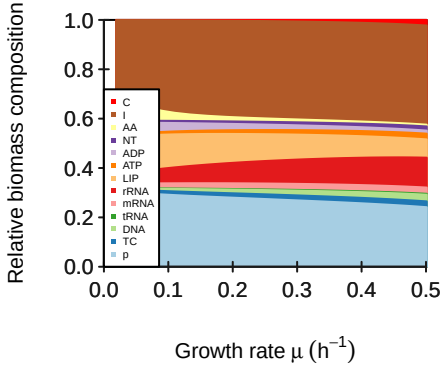

rRNA/rP
rRNA/rP
Growth rate μ ($h^{-1}$)

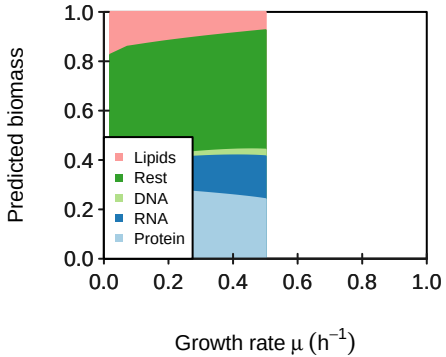

rP/(rP + rRNA)
rP/(rP + rRNA)
Growth rate μ ($h^{-1}$)

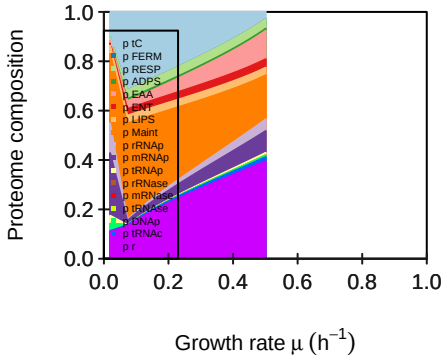

Protein mass fraction in ribosome
rP/(rP + brRNA)
Growth rate μ ($h^{-1}$)

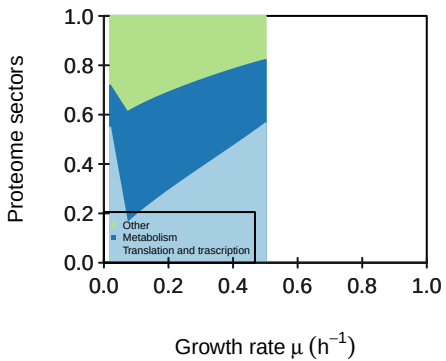

Fraction of degraded rRNA
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Growth rate μ (h−1)


% transcribed RNA
rRNA
tRNA
mRNA
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.1
0.2
0.3
0.4
0.5
Growth rate μ (h−1)


Relative biomass composition
C
I
AA
NT
ADP
ATP
LIP
rRNA
mRNA
tRNA
DNA
TC
p
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.1
0.2
0.3
0.4
0.5
Growth rate μ (h−1)


Predicted biomass
Lipids
Rest
DNA
RNA
Protein
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Growth rate μ (h−1)


Proteome composition
p tC
p FERM
p RESP
p ADPS
p EAA
p ENT
p LIPS
p Maint
p rRNAp
p mRNAp
p tRNAp
p rRNase
p mRNase
p tRNAse
p DNAp
p tRNAc
p r
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Growth rate μ (h−1)


Proteome sectors
Other
Metabolism
Translation and trascription
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Growth rate μ (h−1)

keep_ribosome_kcat FALSE
keep_transport_kcat FALSE
maintenance_fun constant

# M

| | tC | FERM | RESP | ADPS | EAA | ENT | LIPS | Maint | rRNAp | mRNAp | tRNAp | rRNase | mRNase | tRNAse | DNAp | tRNAc | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **C** | 1 | −0.4 | −0.2 | 0 | 0 | −0.167 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **I** | 0 | 0.2 | 0.1 | 0 | −1 | 0 | −0.18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **AA** | 0 | 0 | 0 | 0 | 1 | −0.167 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | −0.006 | 0 |
| **NT** | 0 | 0 | 0 | −1 | 0 | 0.334 | 0 | 0 | −1 | −1 | −1 | 1 | 1 | 1 | −1 | 0 | 0 |
| **ADP** | 0 | −0.6 | −0.8 | 1 | 0 | 0.666 | 0.82 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.026 | 0.026 |
| **ATP** | 0 | 0.6 | 0.8 | 0 | 0 | −0.666 | −0.82 | −1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | −0.026 | −0.026 |
| **LIP** | 0 | 0 | 0 | 0 | 0 | 0 | 0.18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **rRNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | −1 | 0 | 0 | 0 | 0 | 0 |
| **mRNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | −1 | 0 | 0 | 0 | 0 |
| **tRNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | −1 | 0 | −0.968 | 0.968 |
| **DNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **TC** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.974 | −0.974 |
| **p** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.006 |

# K

| | tC | FERM | RESP | ADPS | EAA | ENT | LIPS | Maint | rRNAp | mRNAp | tRNAp | rRNase | mRNase | tRNAse | DNAp | tRNAc | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **x_C** | 0.05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **x_W** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **C** | 15 | 0.8 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **I** | 0 | 29.8 | 149 | 0 | 38 | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **AA** | 0 | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **NT** | 0 | 0 | 0 | 1 | 0 | 4 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| **ADP** | 0 | 0.2 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ATP** | 0 | 0.6 | 3 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| **LIP** | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **rRNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 |
| **mRNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| **tRNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| **DNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TC** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| **p** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# KA

| | tC | FERM | RESP | ADPS | EAA | ENT | LIPS | Maint | rRNAp | mRNAp | tRNAp | rRNase | mRNase | tRNAse | DNAp | tRNAc | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **x_C** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **x_W** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **C** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **I** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **AA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **NT** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ADP** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ATP** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **LIP** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **rRNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 |
| **mRNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| **tRNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DNA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 0 | 0 | 0 | 4 | 0 | 0 |
| **TC** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **p** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# kcat

| | tC | FERM | RESP | ADPS | EAA | ENT | LIPS | Maint | rRNAp | mRNAp | tRNAp | rRNase | mRNase | tRNAse | DNAp | tRNAc | r |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **kcatf** | 141 | 2482 | 1241 | 18 | 10 | 126 | 51 | 51 | 9 | 1 | 9 | 10 | 10 | 10 | 14 | 14156 | 917 |
| **kcatb** | 14 | 248 | 124 | 2 | 1 | 13 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# Keq

| | [,1] | [,2] | [,3] | [,4] | [,5] | [,6] | [,7] | [,8] | [,9] | [,10] | [,11] | [,12] | [,13] | [,14] | [,15] | [,16] | [,17] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [1,] | 3021.42857142857 | 1118.40120967742 | 1118.40120967742 | 9 | 1.05263157894737 | 9.69230769230769 | 5.36842105263158 | Inf | Inf | Inf | Inf | Inf | Inf | Inf | Inf | Inf | Inf |

# phi input

| | [,1] | [,2] | [,3] | [,4] | [,5] | [,6] | [,7] | [,8] | [,9] | [,10] | [,11] | [,12] | [,13] | [,14] | [,15] | [,16] | [,17] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [1,] | 0.043 | 0.023 | 0.023 | 0.002 | 0.165 | 0.021 | 0.031 | 0.3036 | 0.0426 | 0.0213 | 0.0071 | 0.002 | 0.006 | 4e−04 | 0.002 | 0.023 | 0.284 |

**average saturation input**

4

# minimal phi constraint

| | [,1] | [,2] | [,3] | [,4] | [,5] | [,6] | [,7] | [,8] | [,9] | [,10] | [,11] | [,12] | [,13] | [,14] | [,15] | [,16] | [,17] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [1,] | 0 | 0 | 0 | 0 | 0 | 0 | 0.031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# minimal f constraint

| | [,1] | [,2] | [,3] | [,4] | [,5] | [,6] | [,7] | [,8] | [,9] | [,10] | [,11] | [,12] | [,13] | [,14] | [,15] | [,16] | [,17] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [1,] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.85 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |