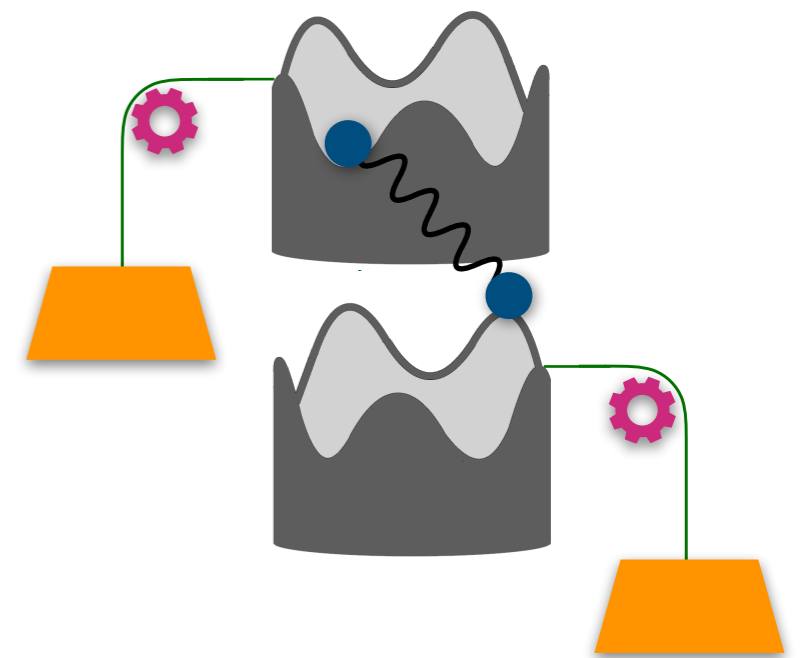


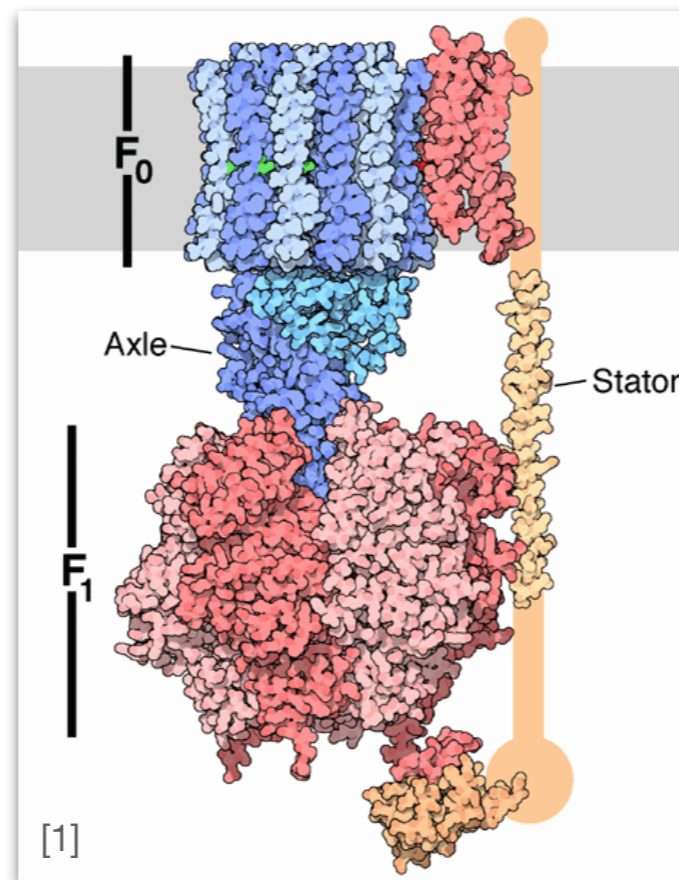
# Non-equilibrium response of a strongly coupled rotary motor

Emma Lathouwers  
Sivak Group  
Department of Physics  
Simon Fraser University

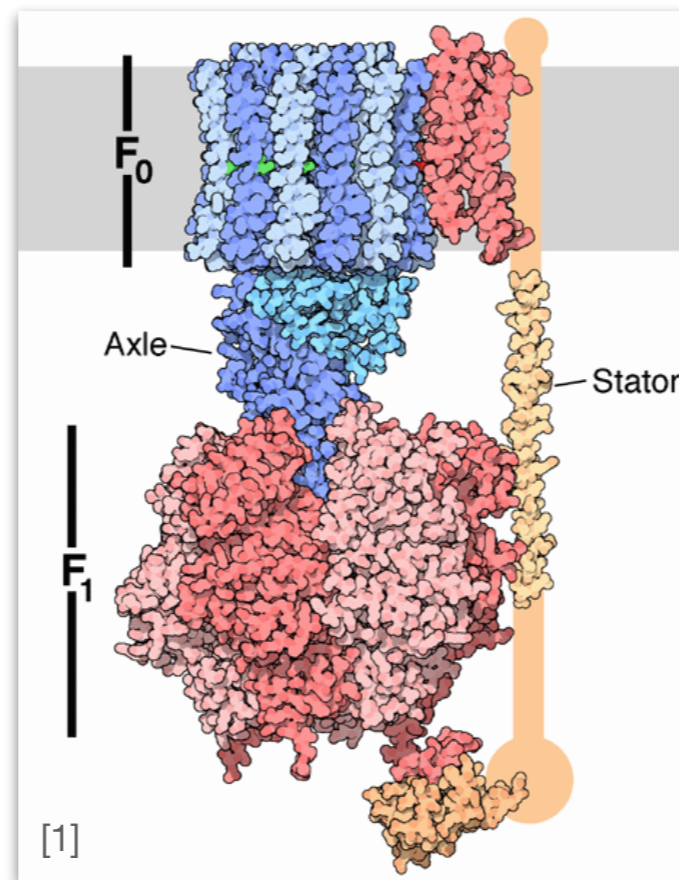
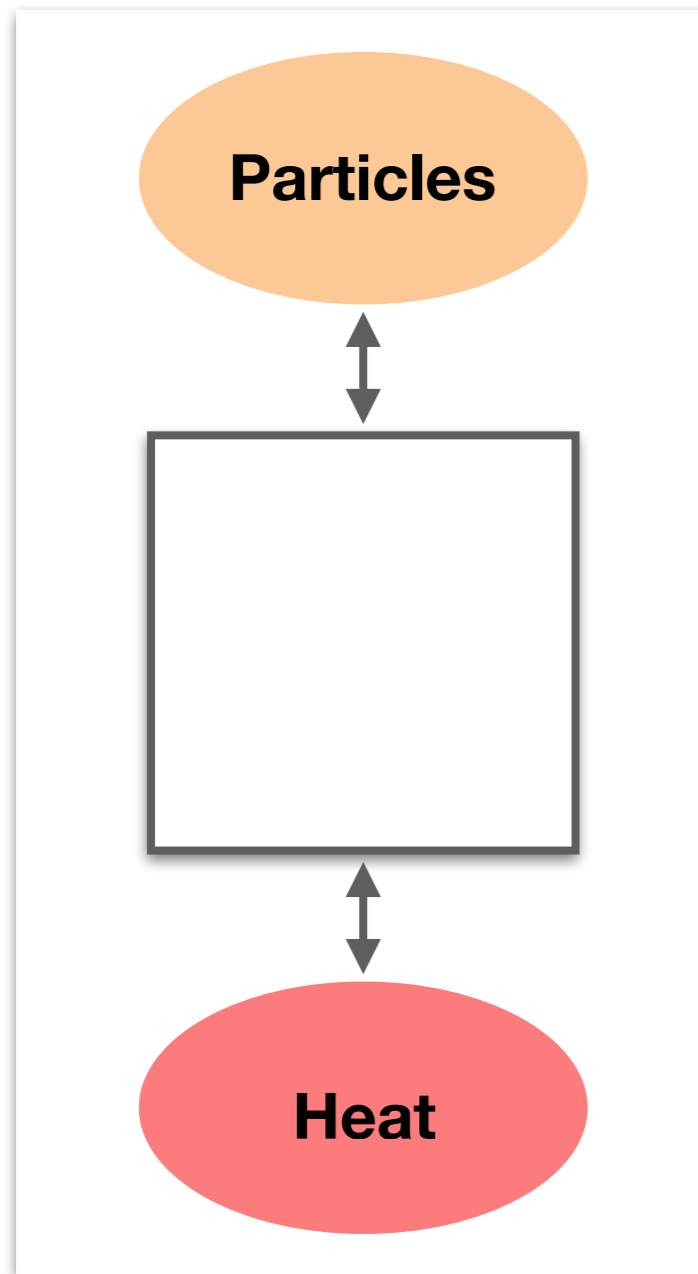


CAP Congress  
June 4, 2019

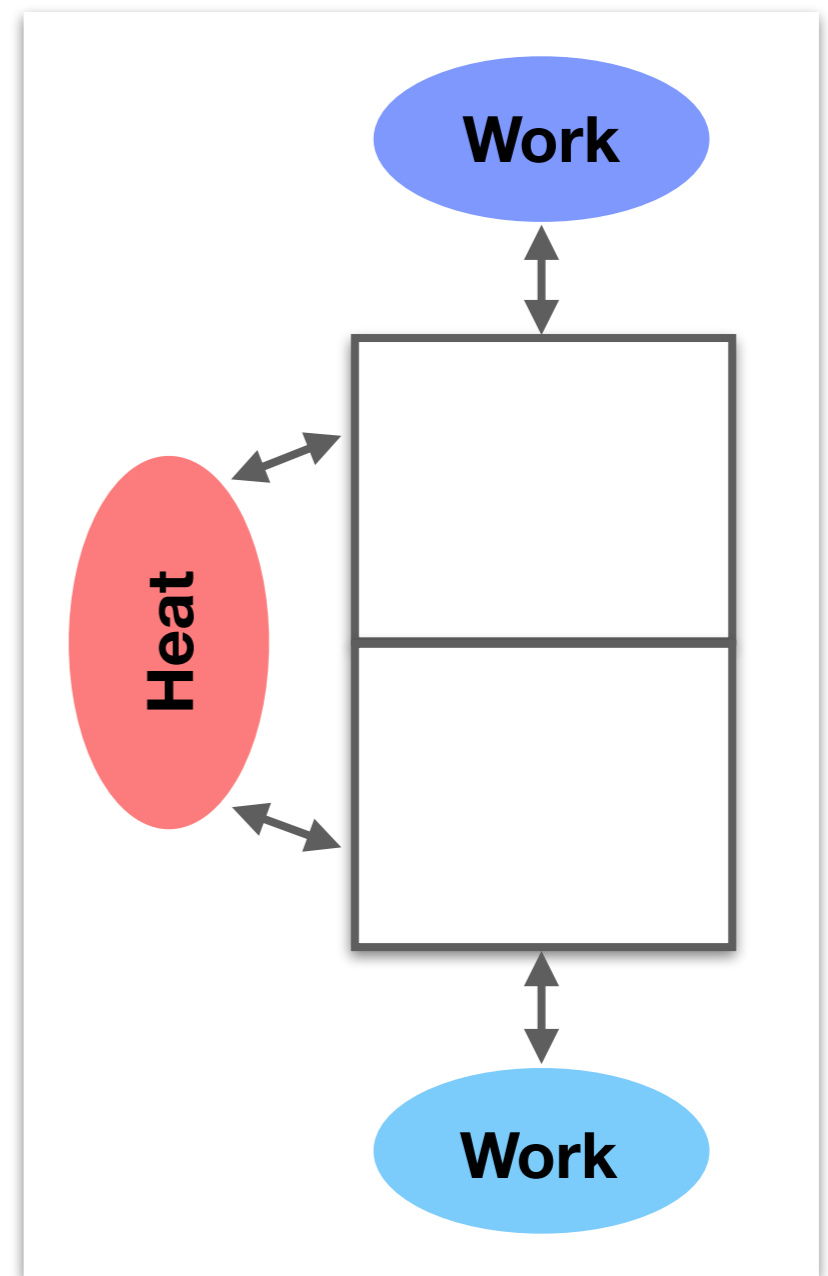
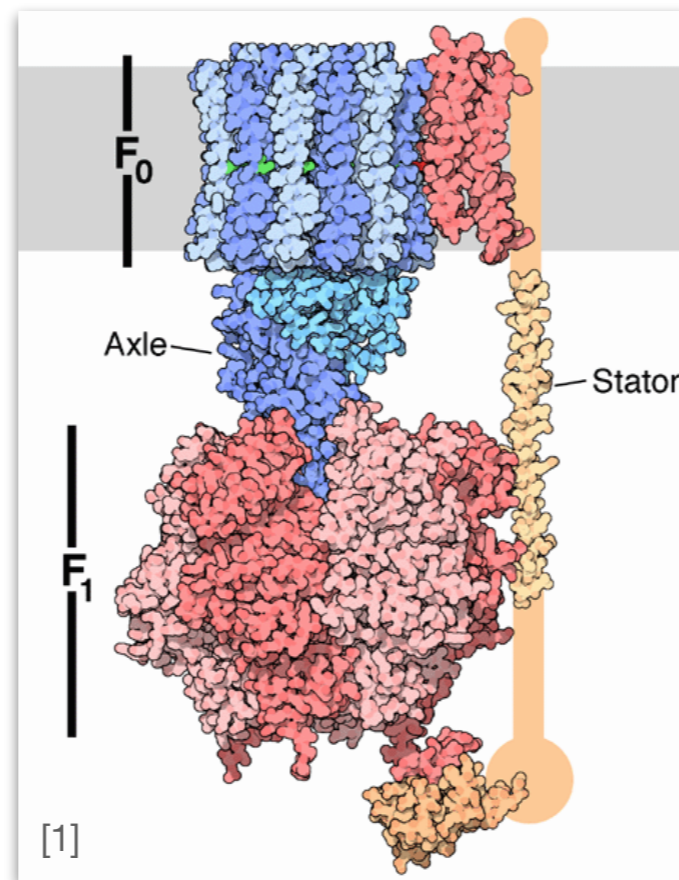
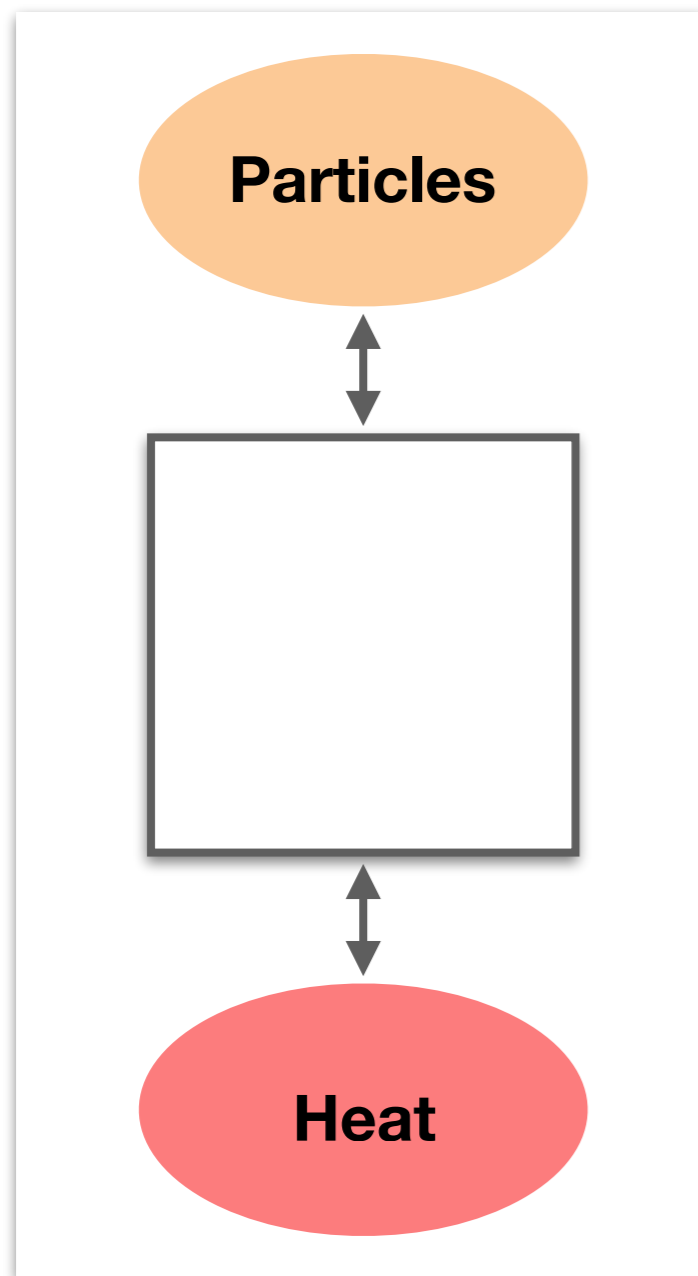
# Modelling a strongly coupled system



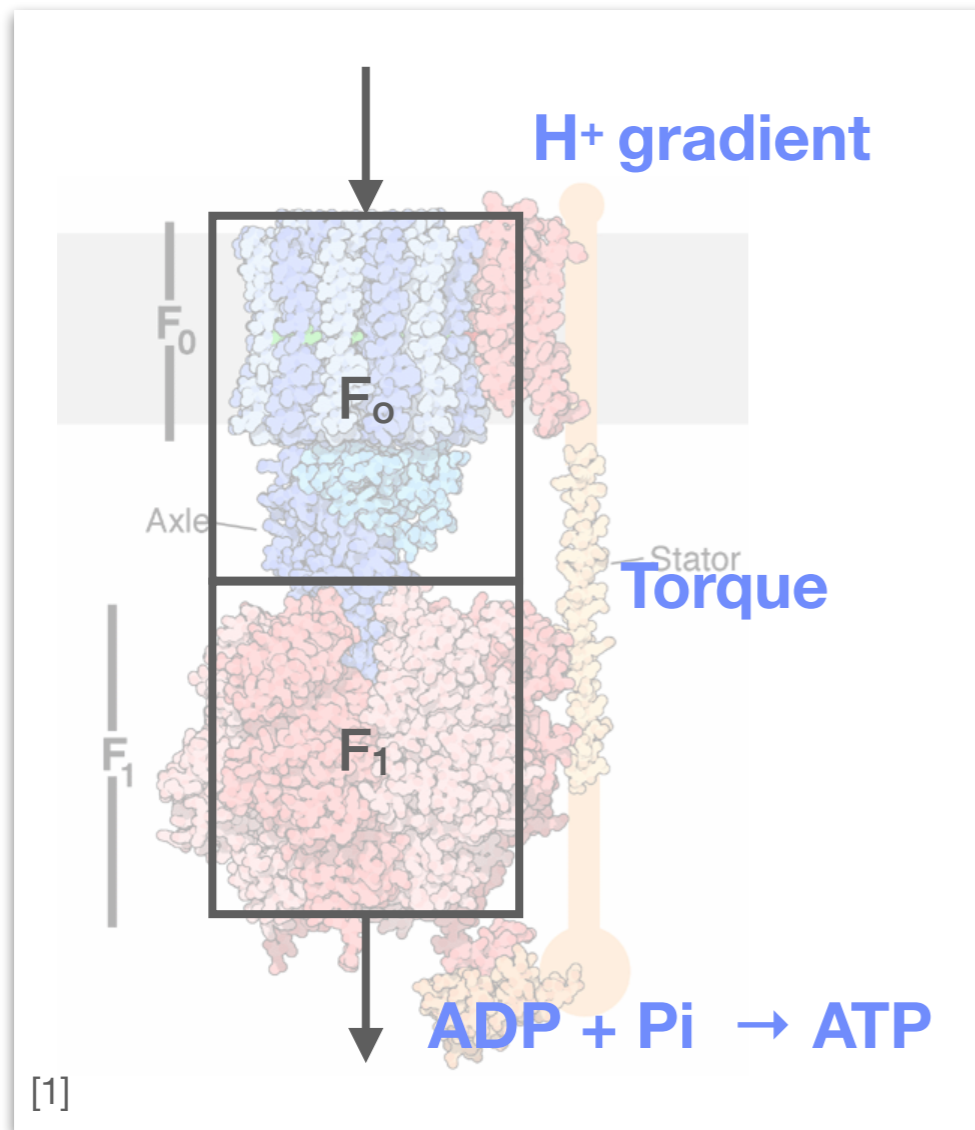
# Modelling a strongly coupled system



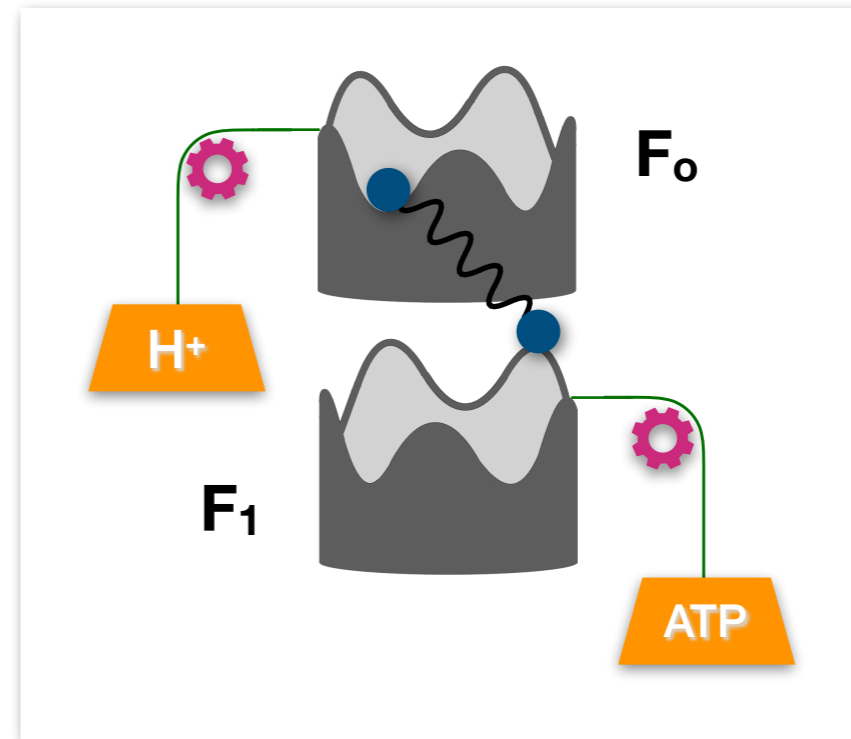
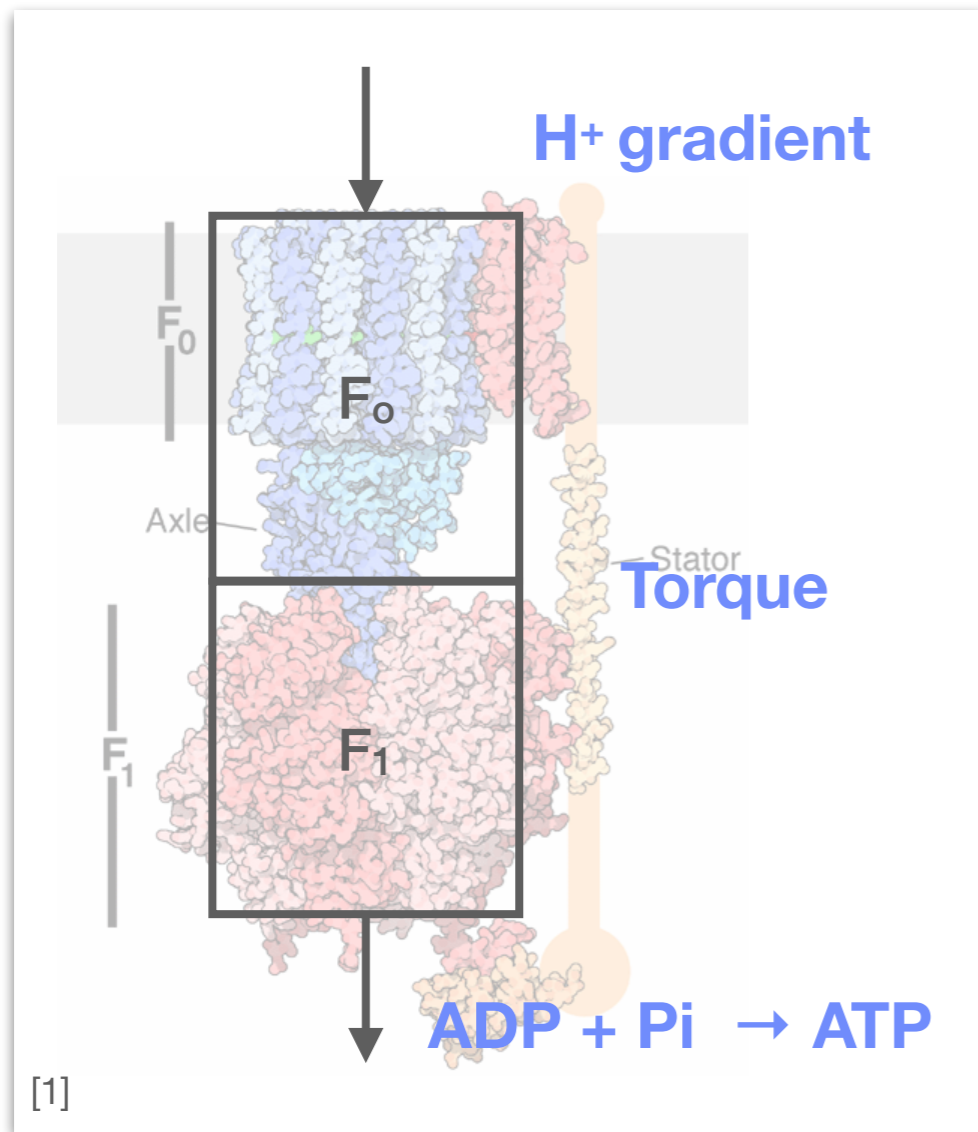
# Modelling a strongly coupled system



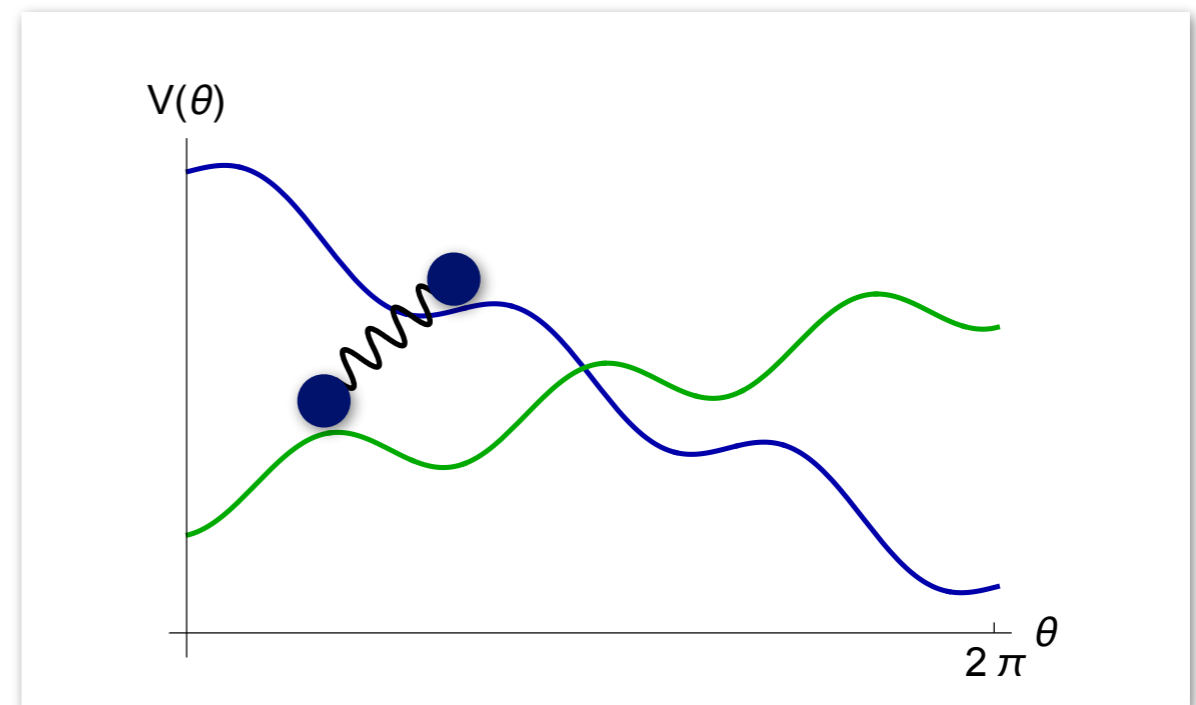
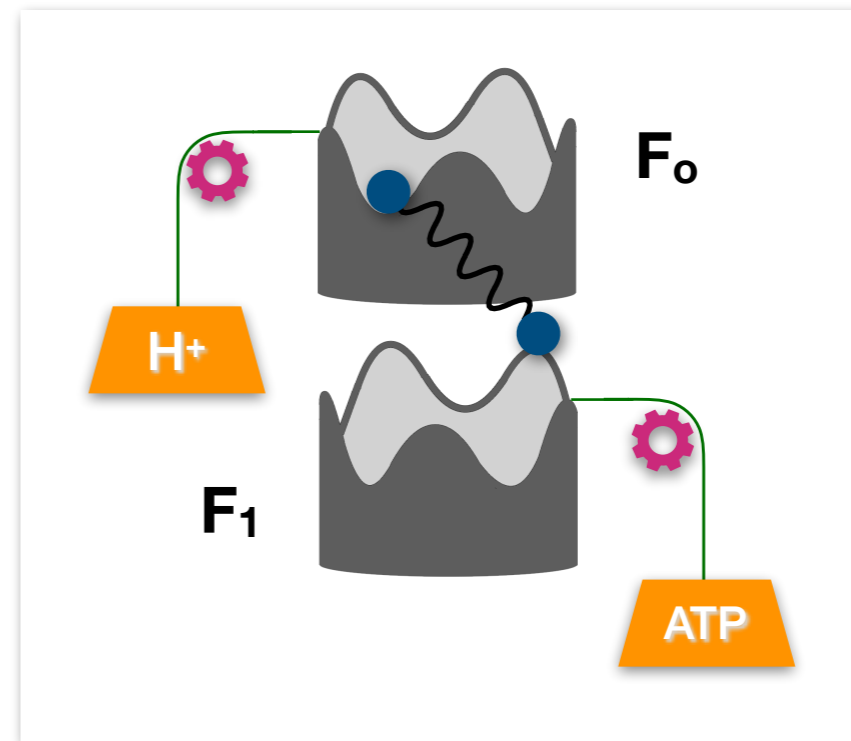
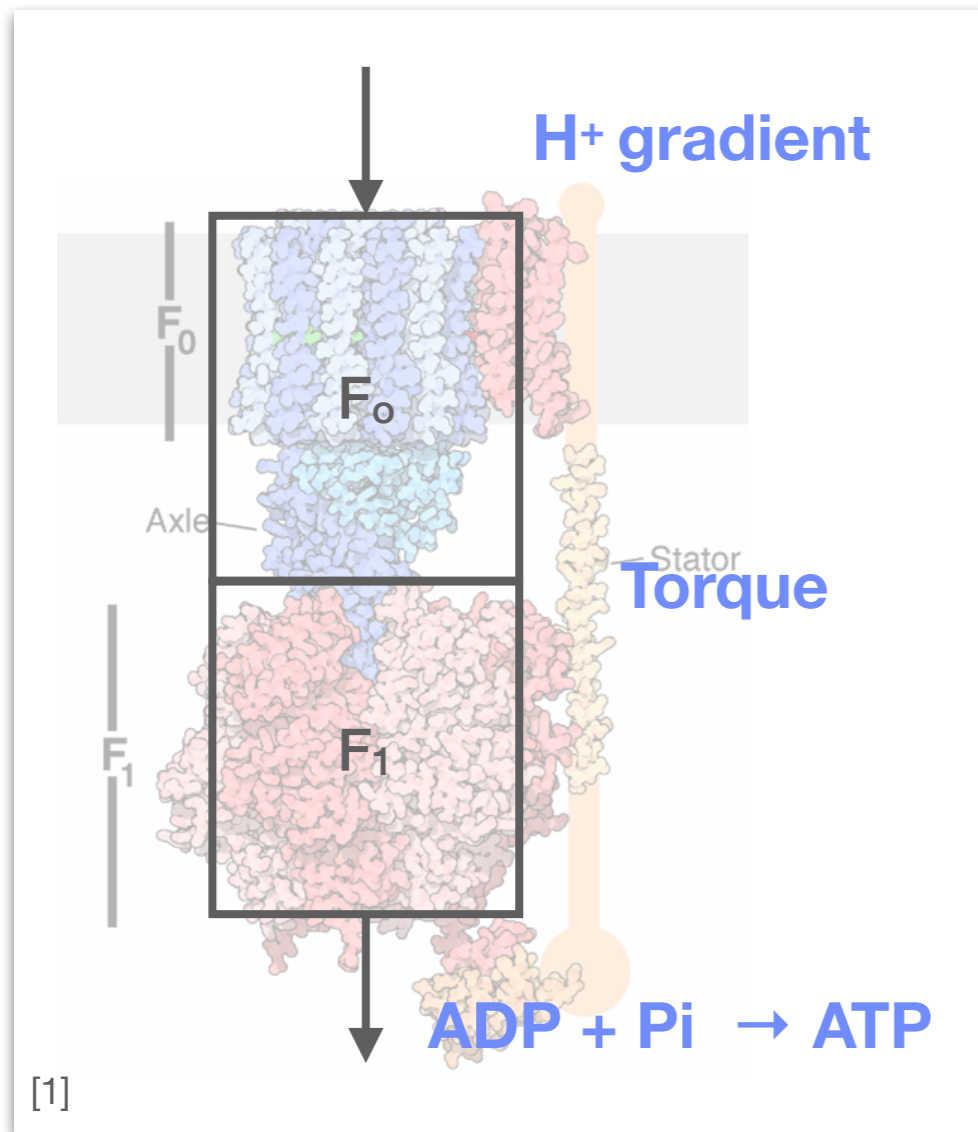
# A strongly coupled rotary motor



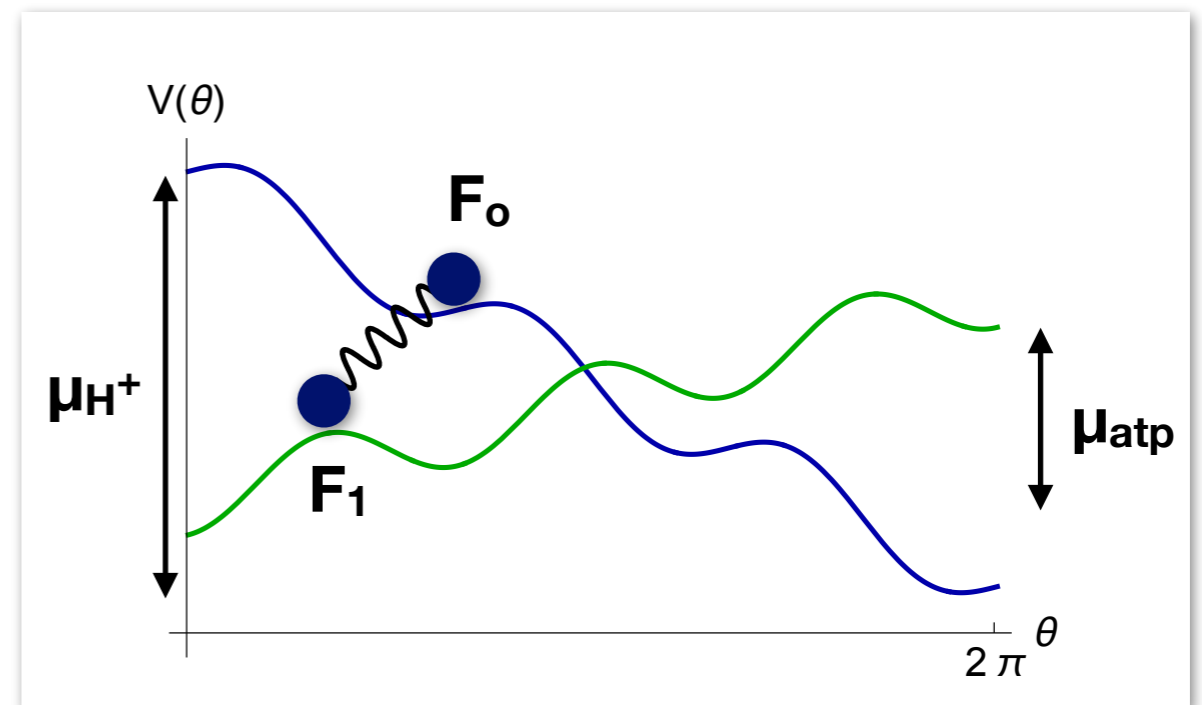
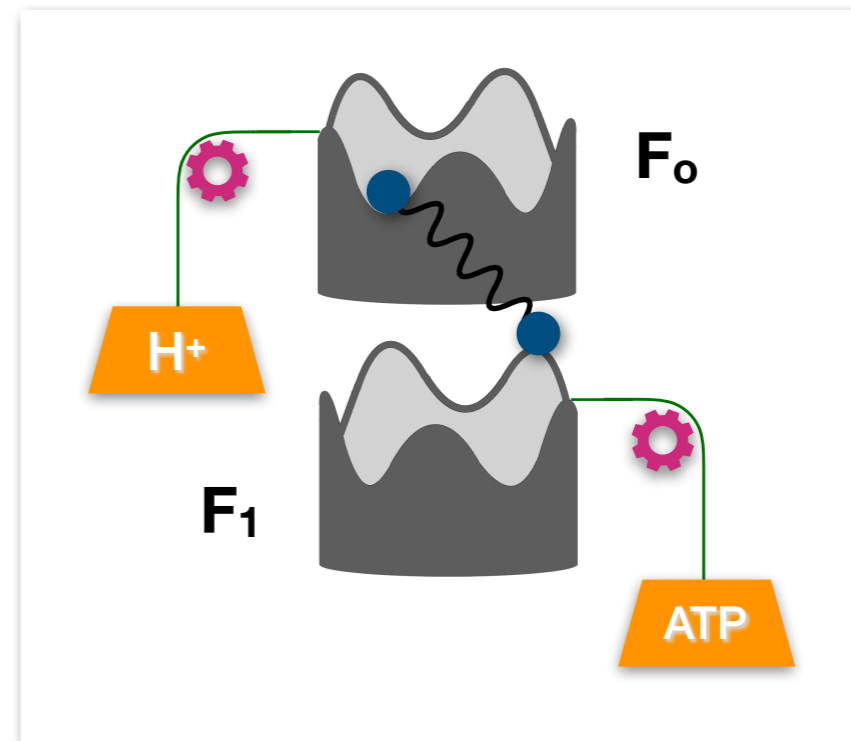
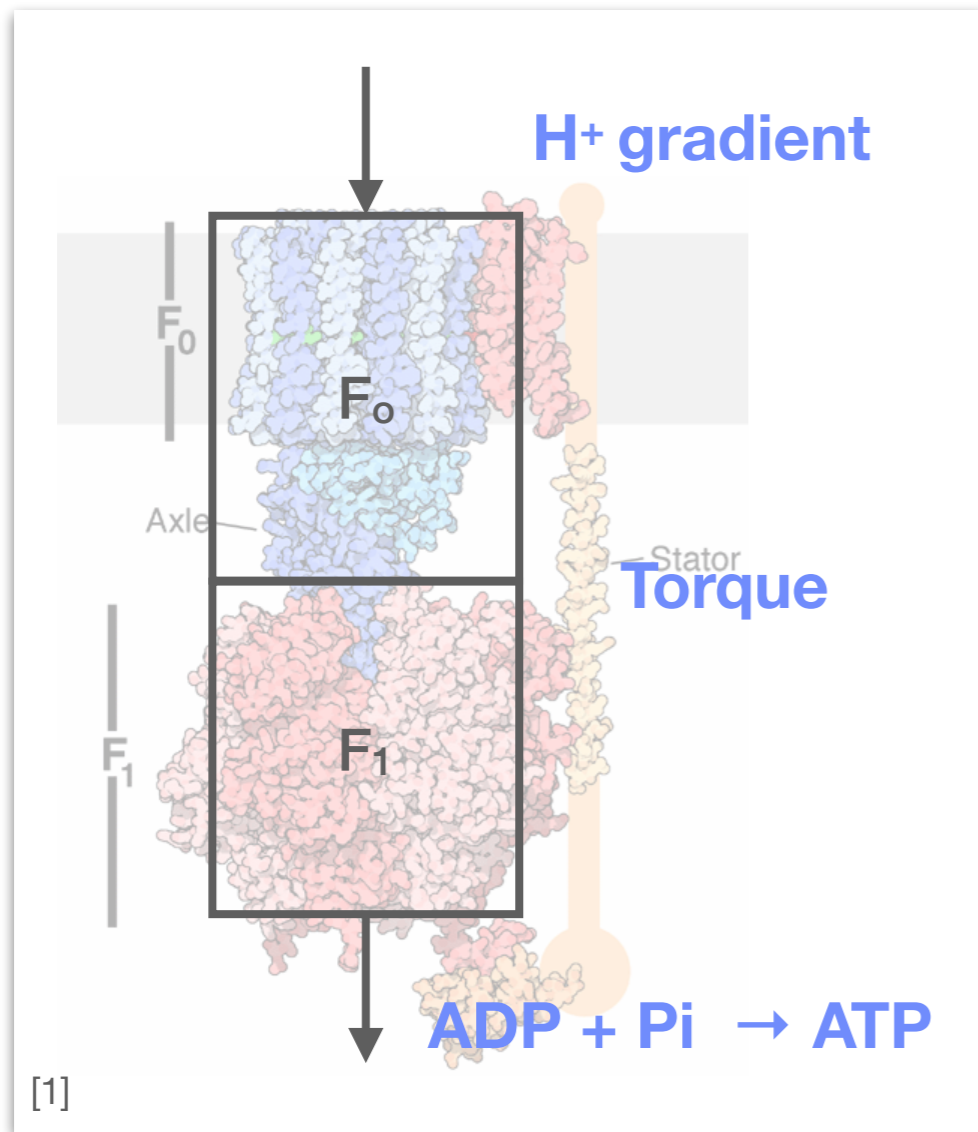
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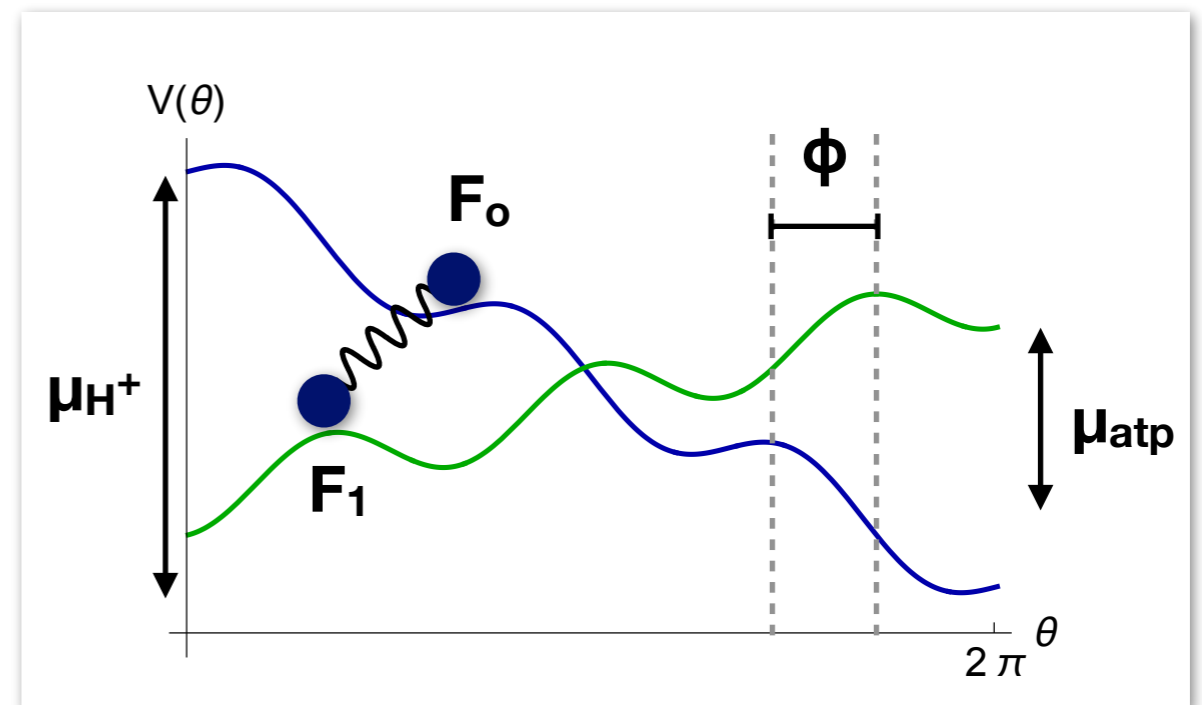
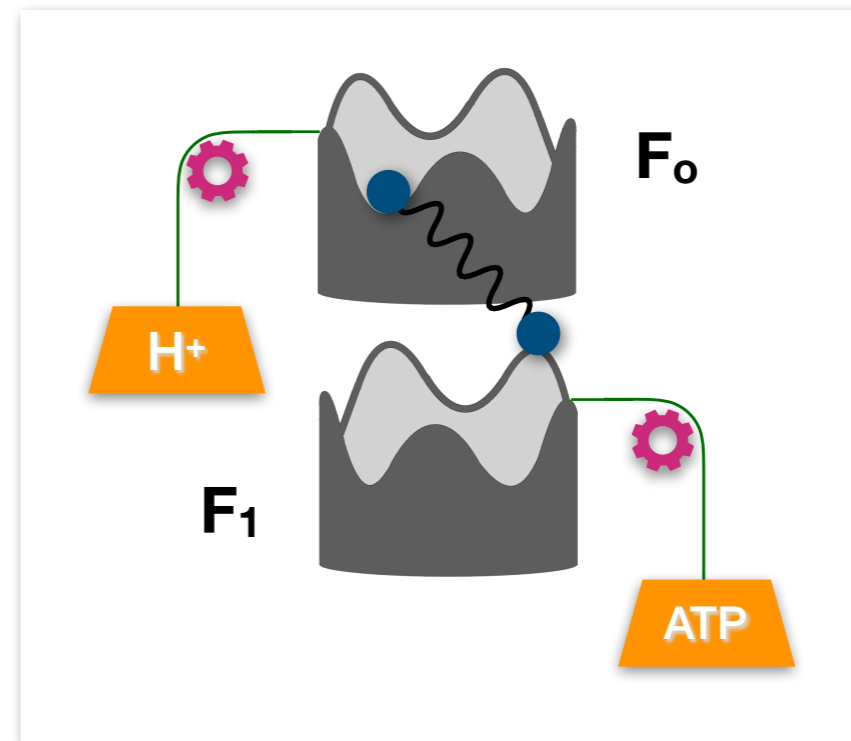
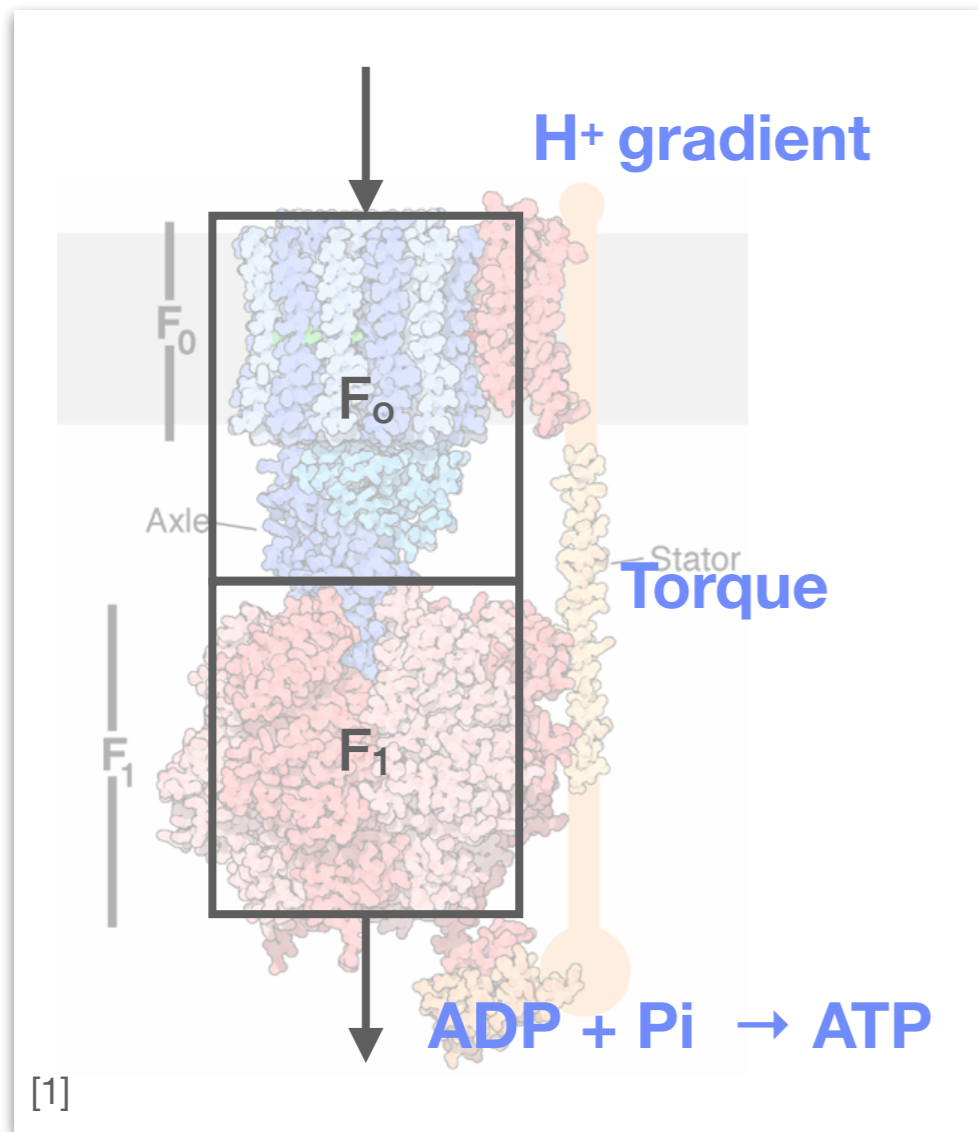


# A strongly coupled rotary motor



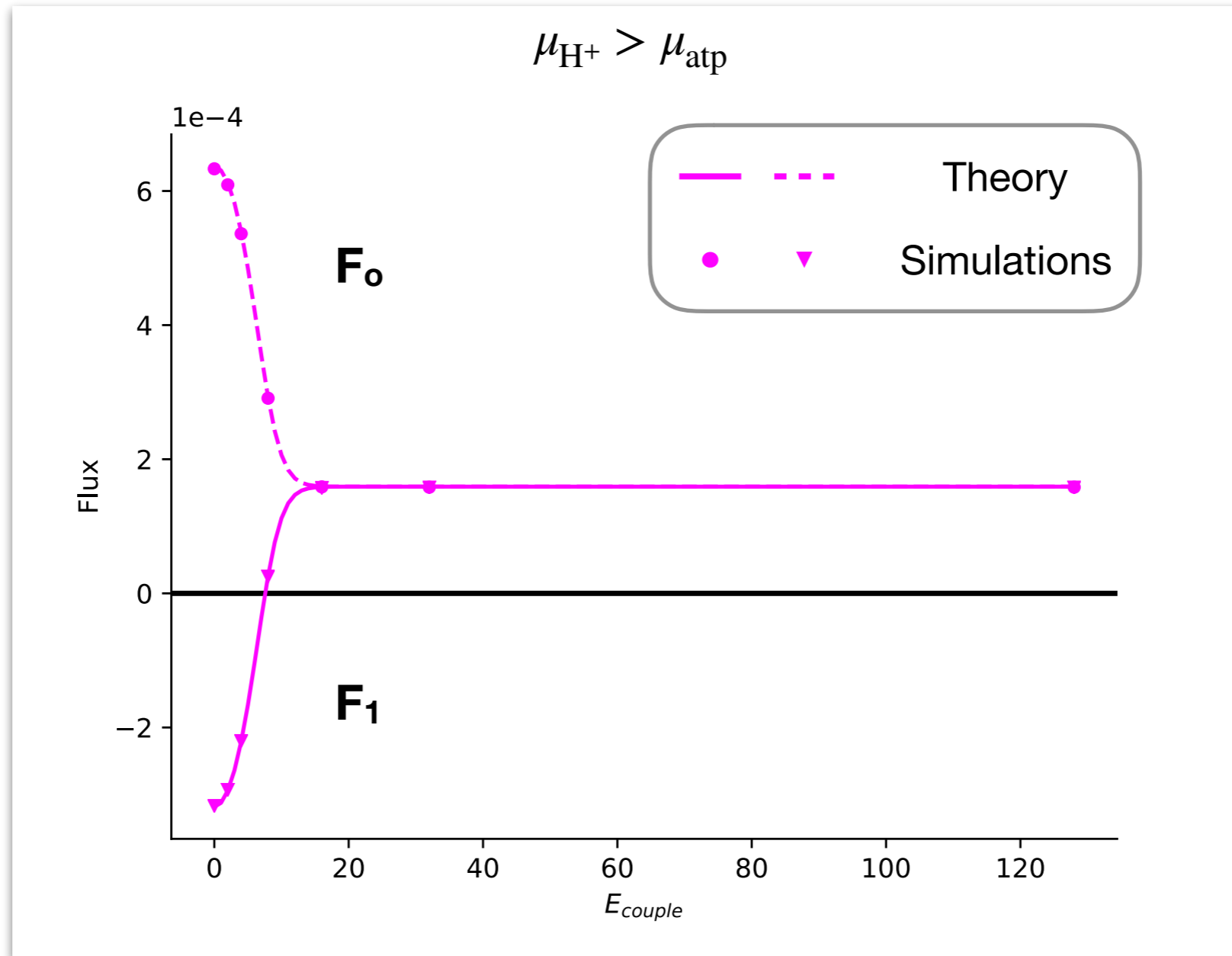


# A strongly coupled rotary motor



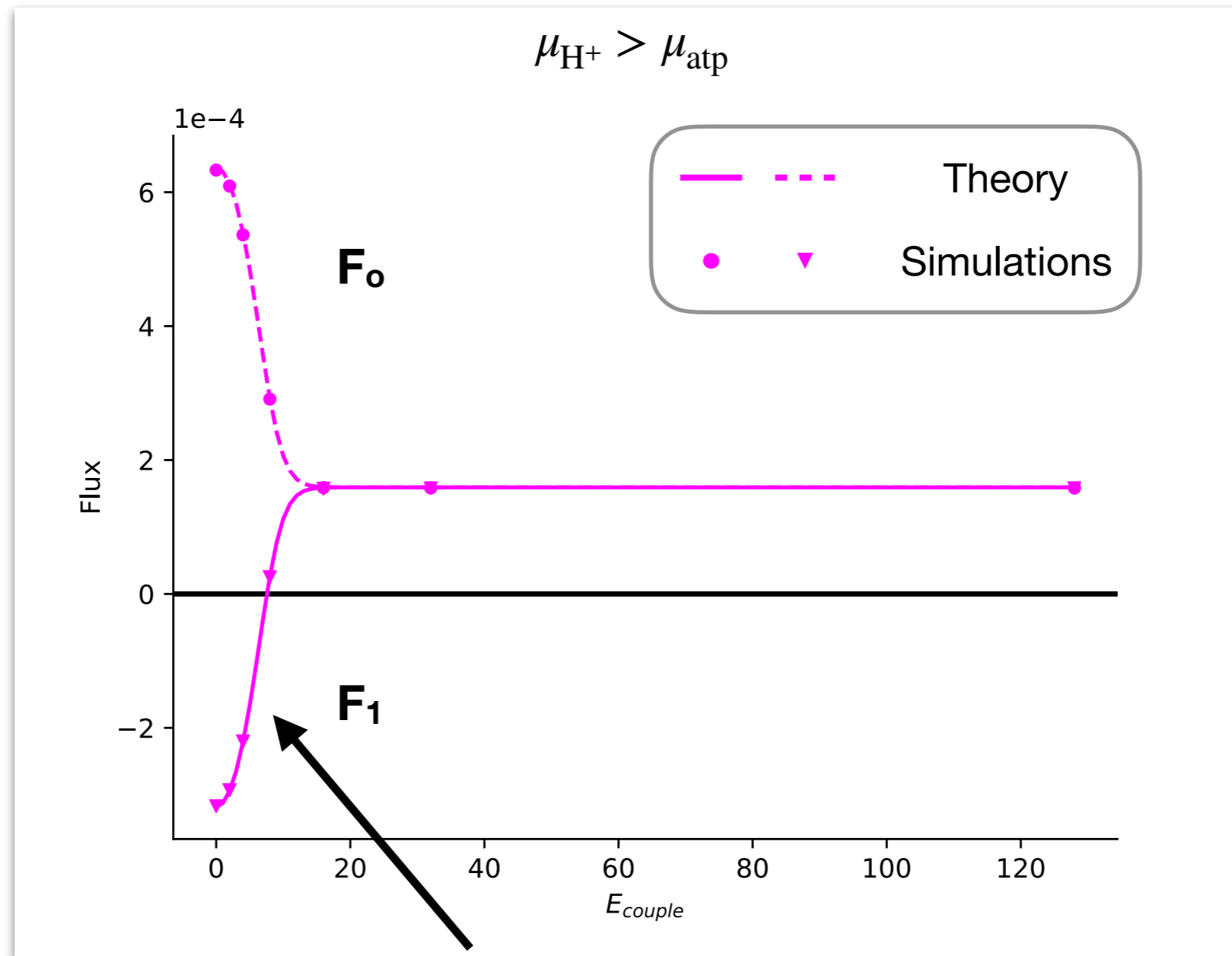
# Minimal coupling needed for energy transduction

No energy barriers



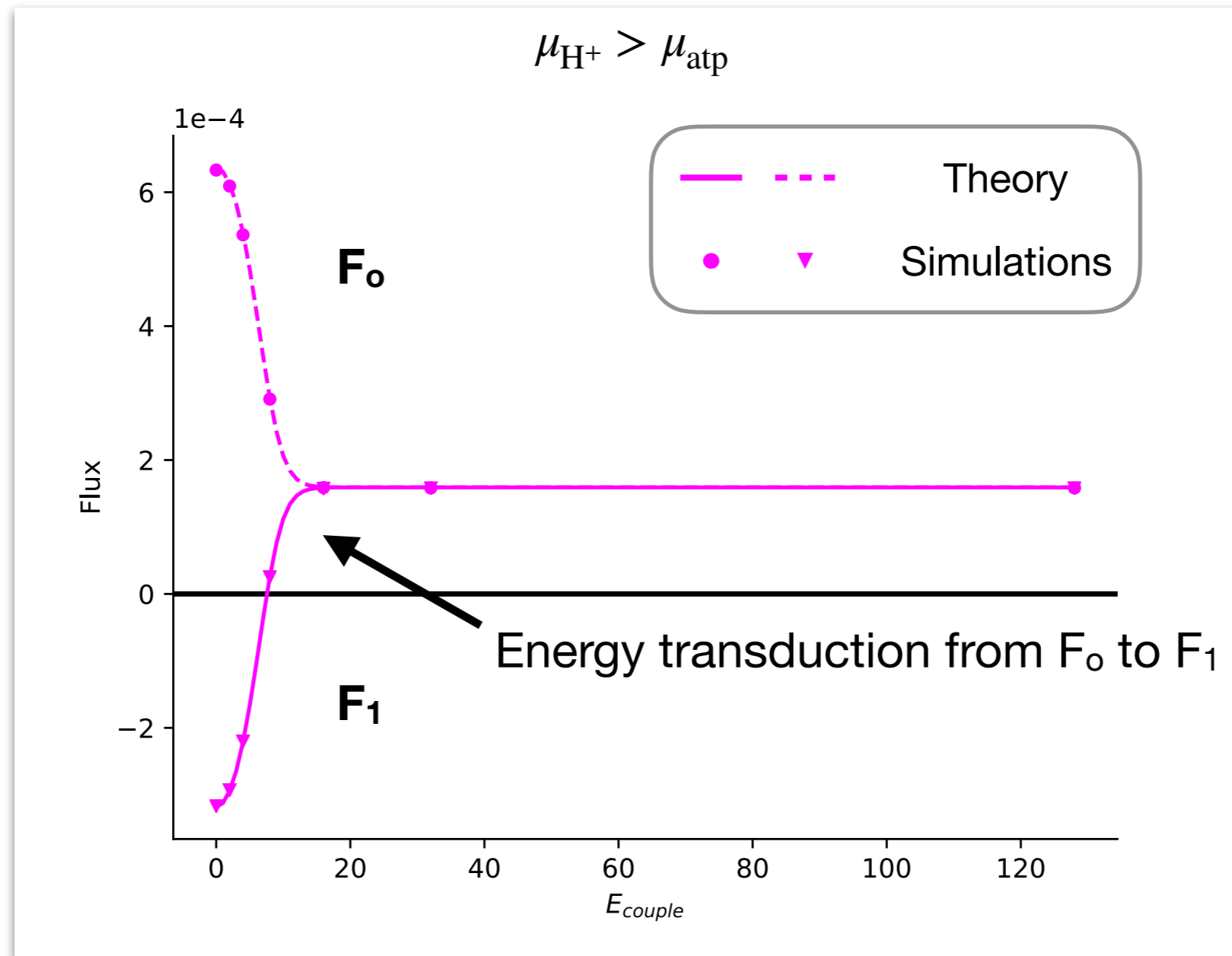
Steady-state operation

# Minimal coupling needed for energy transduction

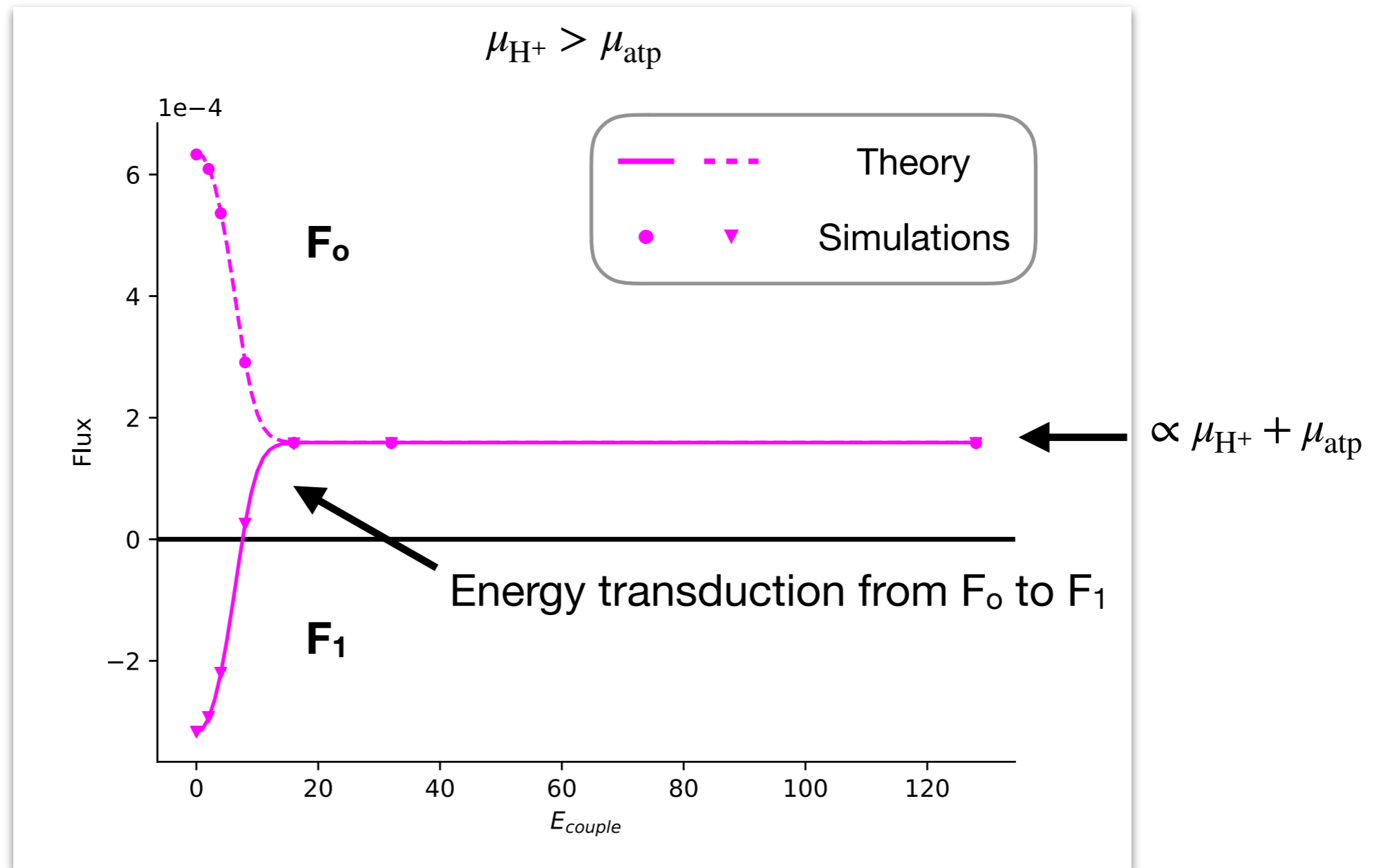


Systems do their own thing on average

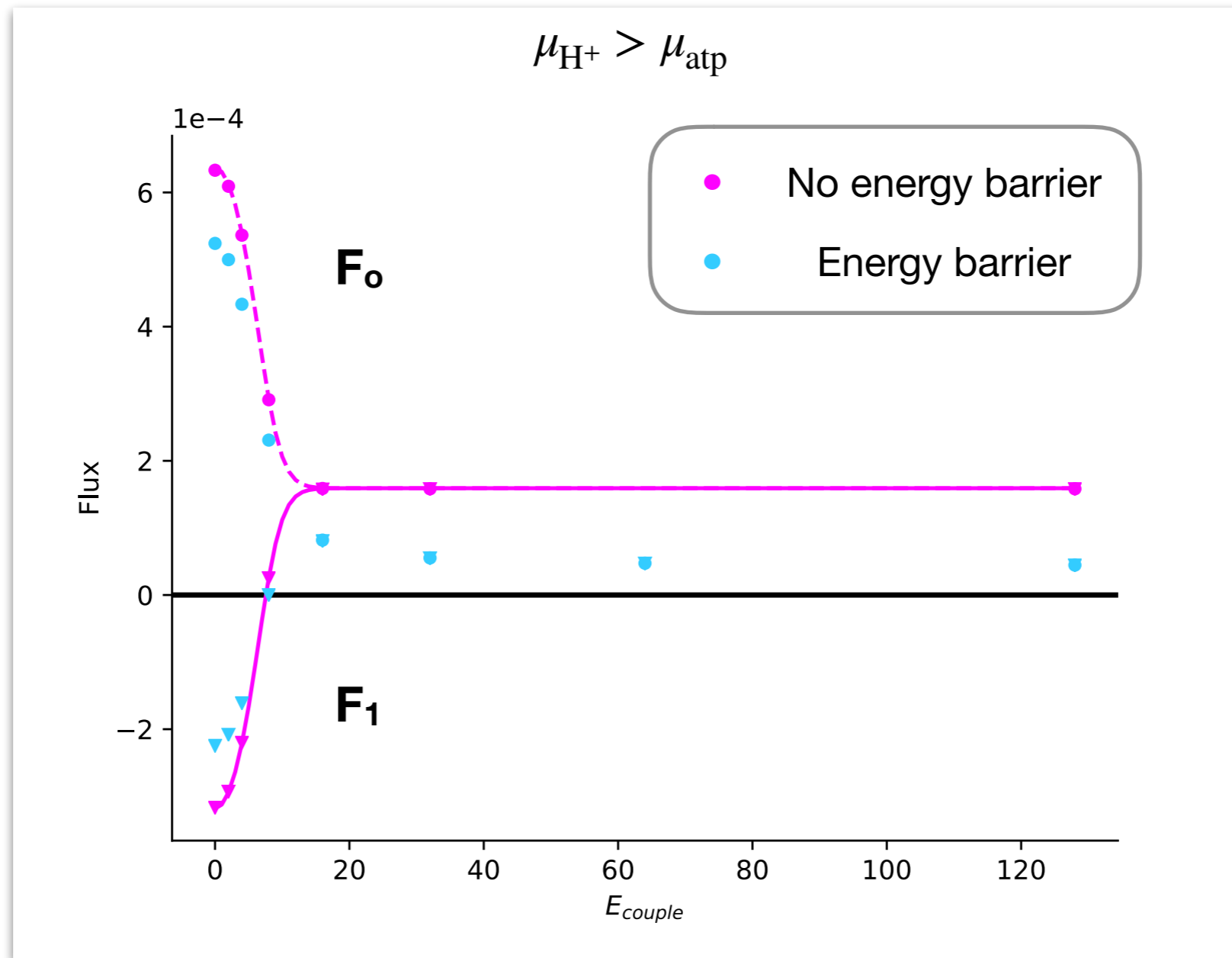
# Minimal coupling needed for energy transduction



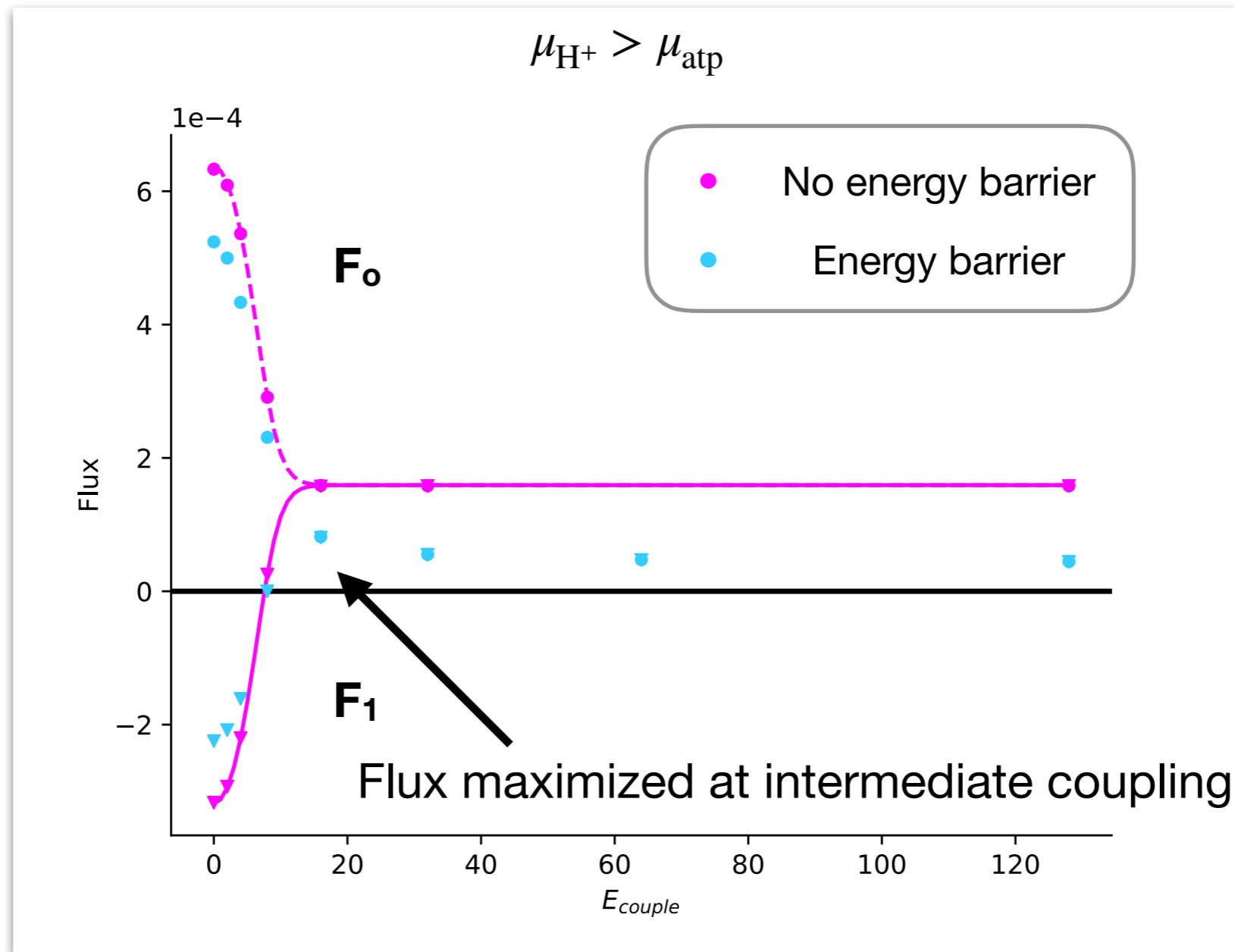
# Minimal coupling needed for energy transduction



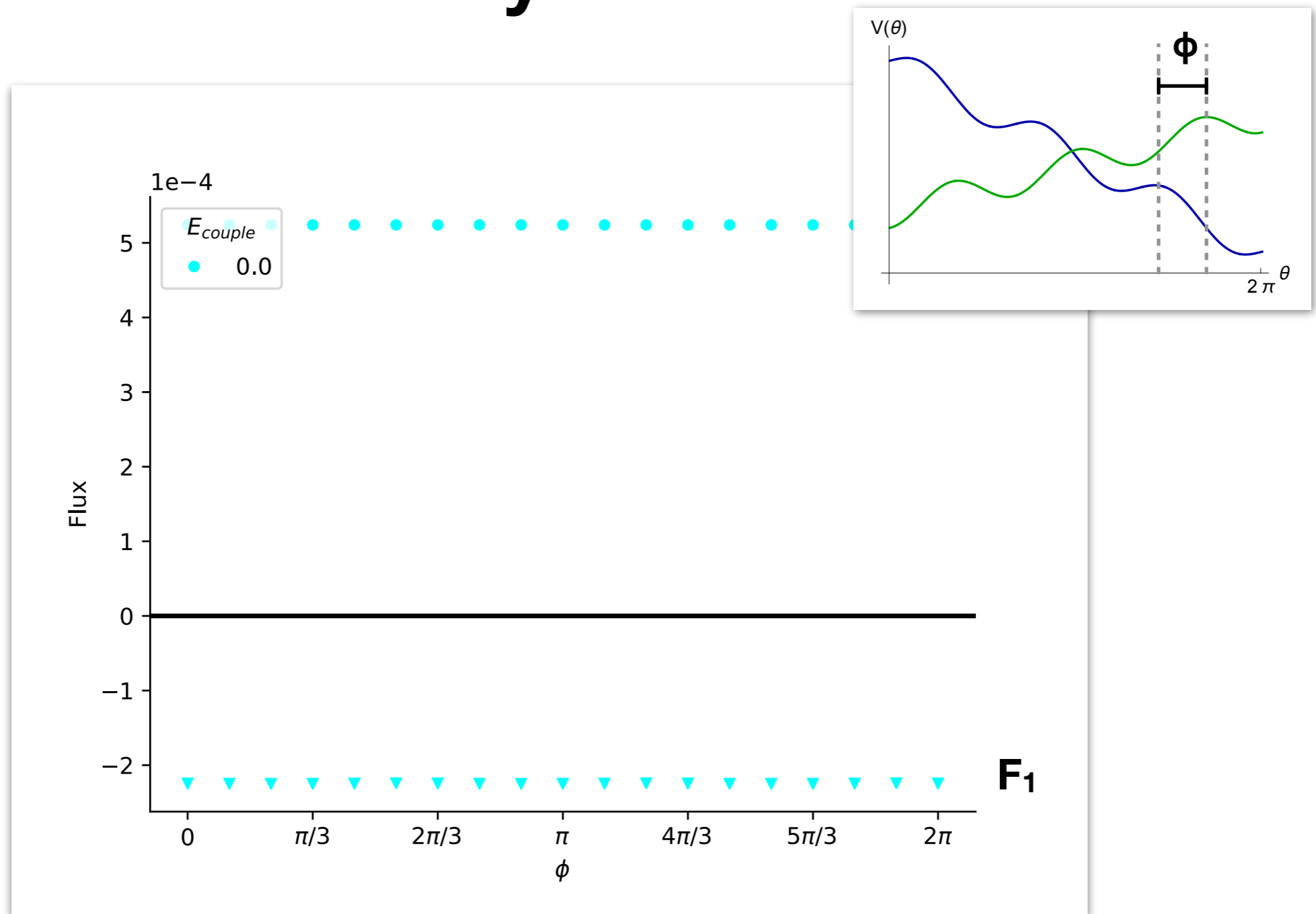
# Intermediate coupling maximizes $F_1$ flux in the presence of energy barriers



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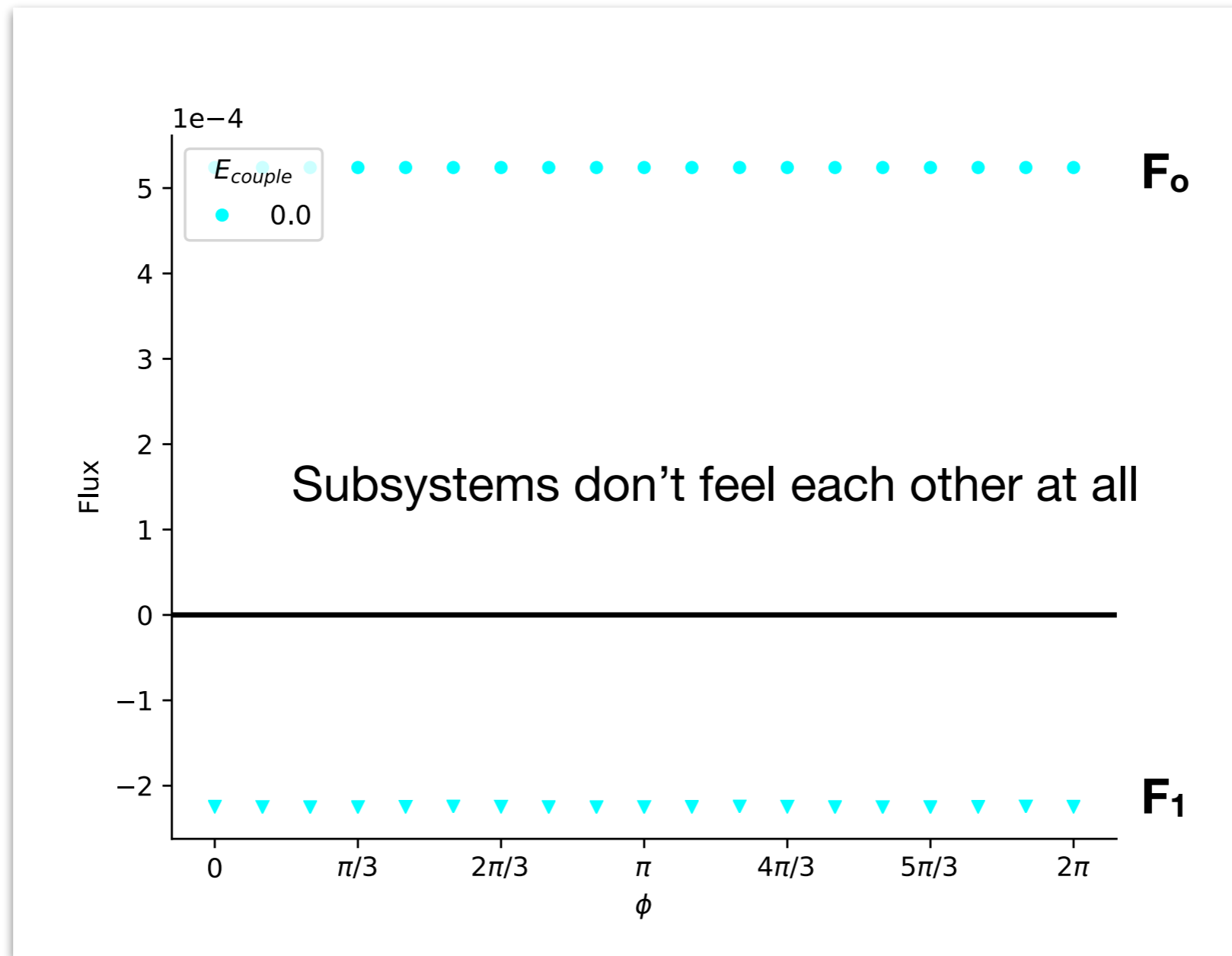


# Having a phase offset between subsystems

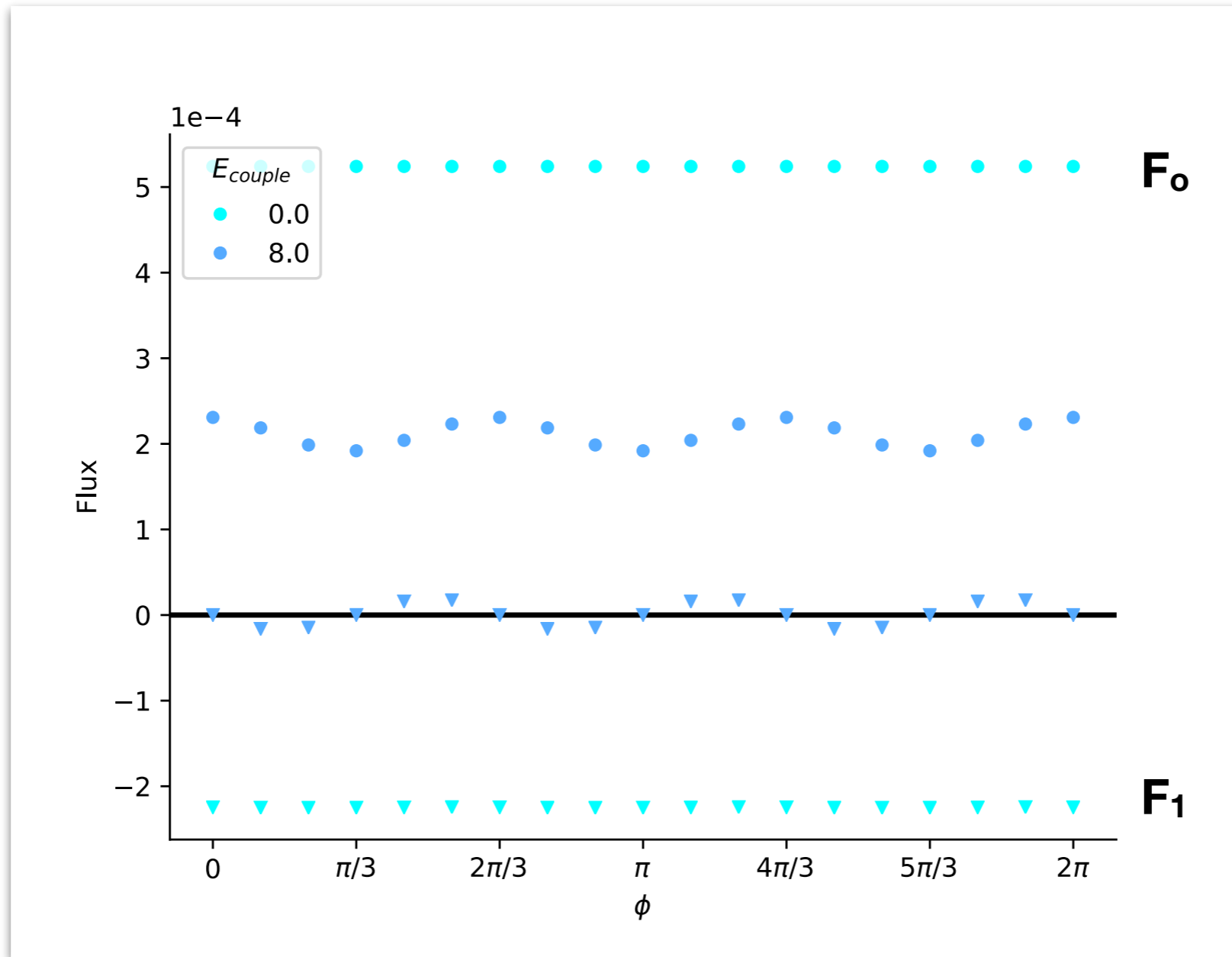




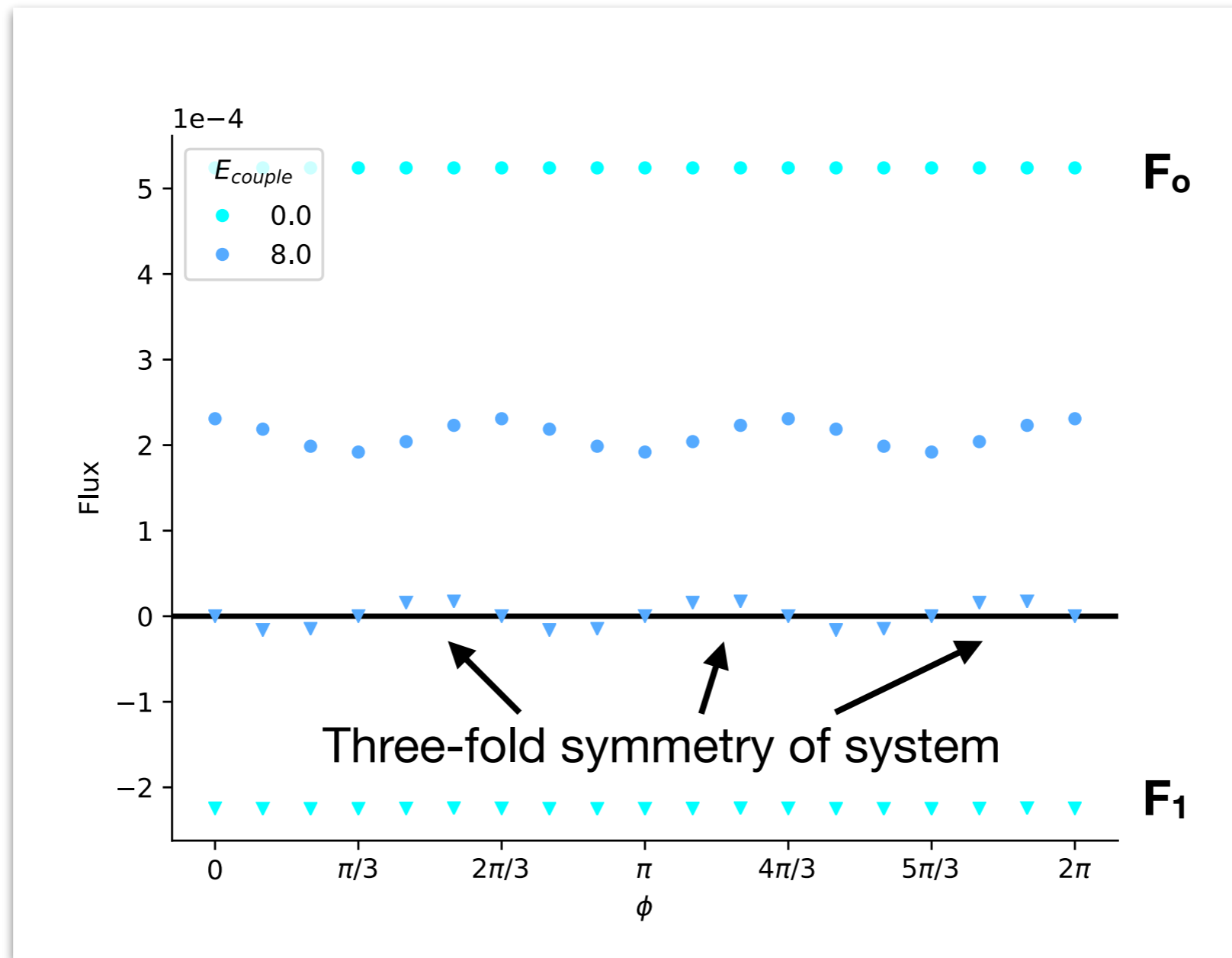
# Having a phase offset between subsystems



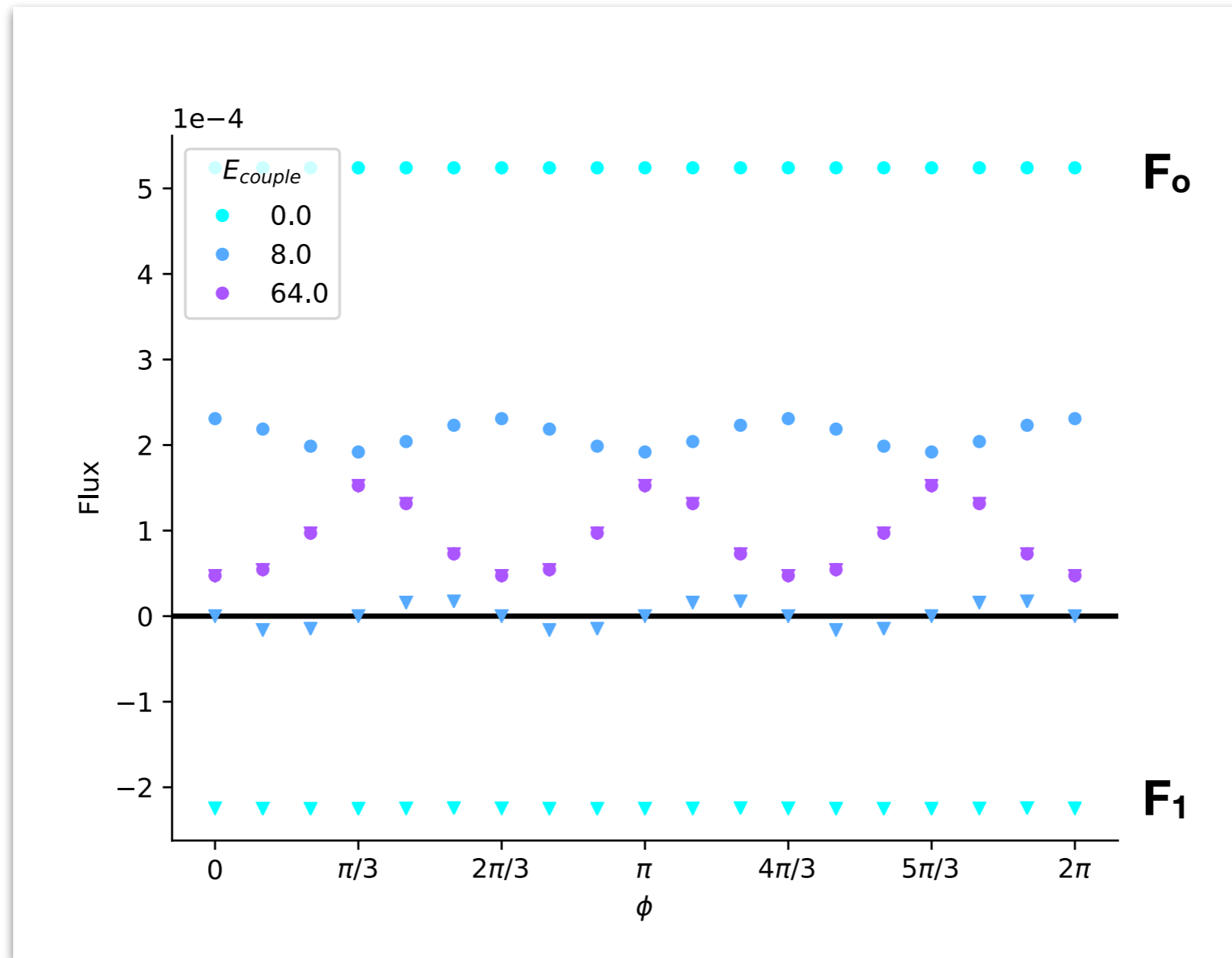
# A phase offset can make a difference



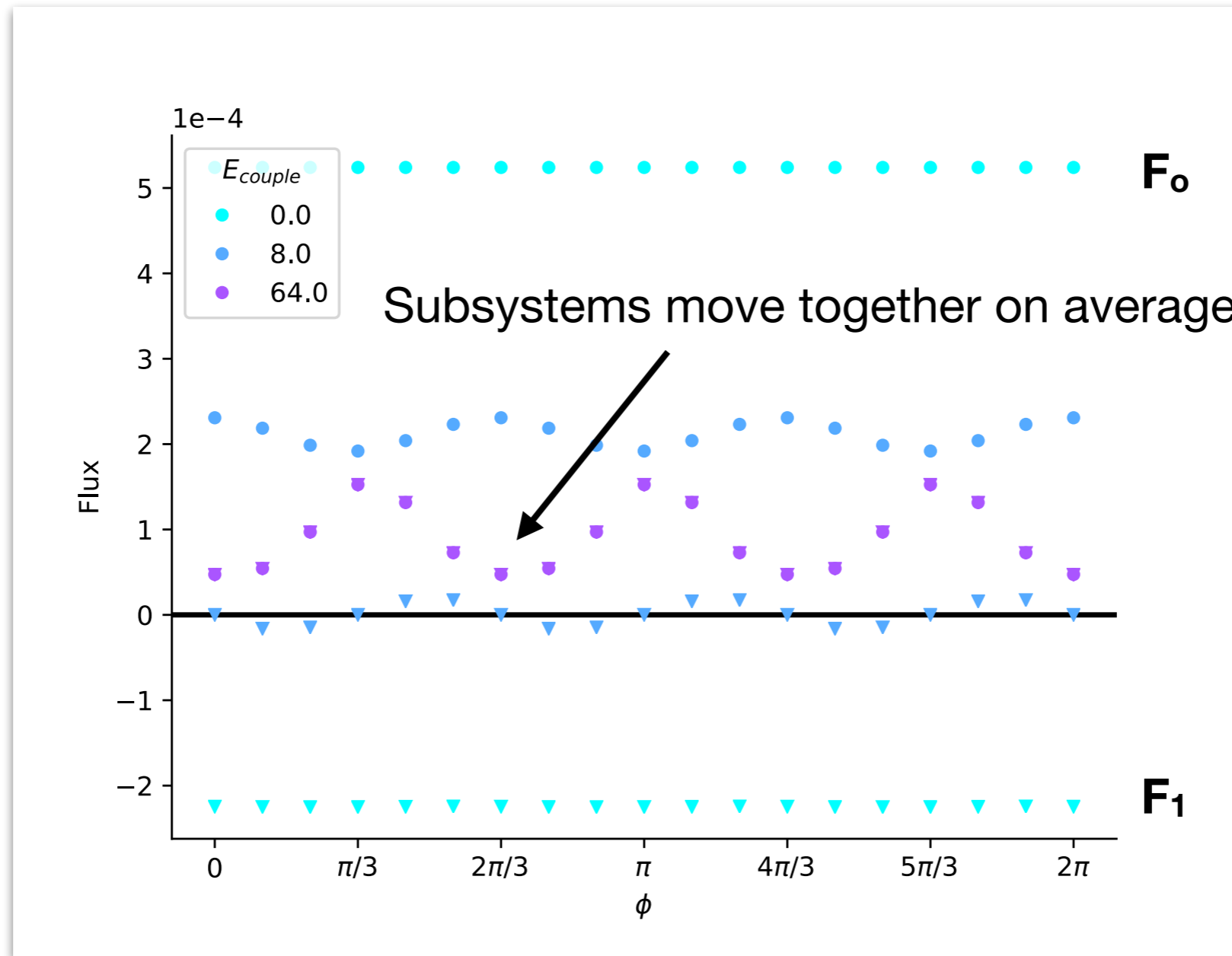
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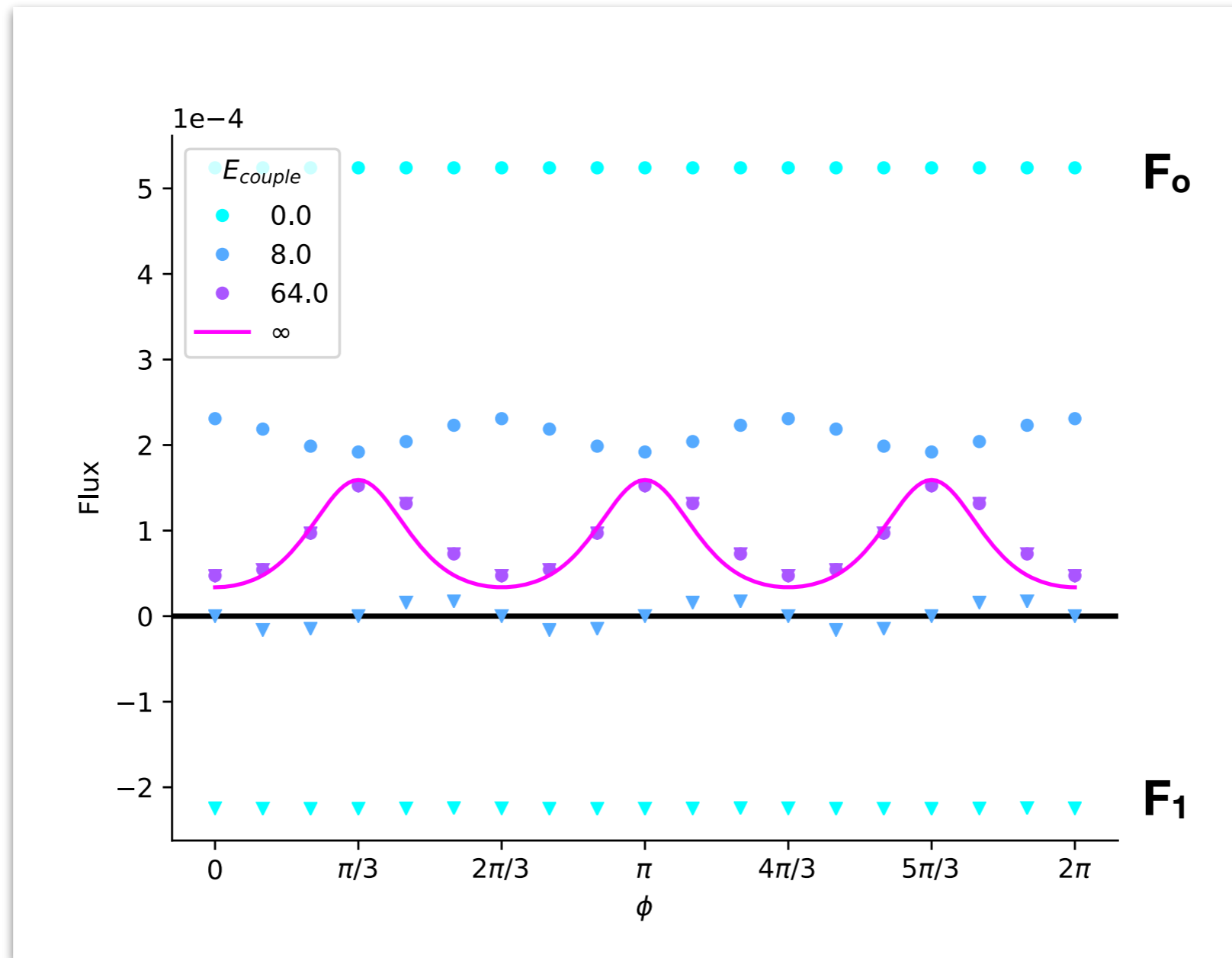
# Having anti-aligned subsystems pays off



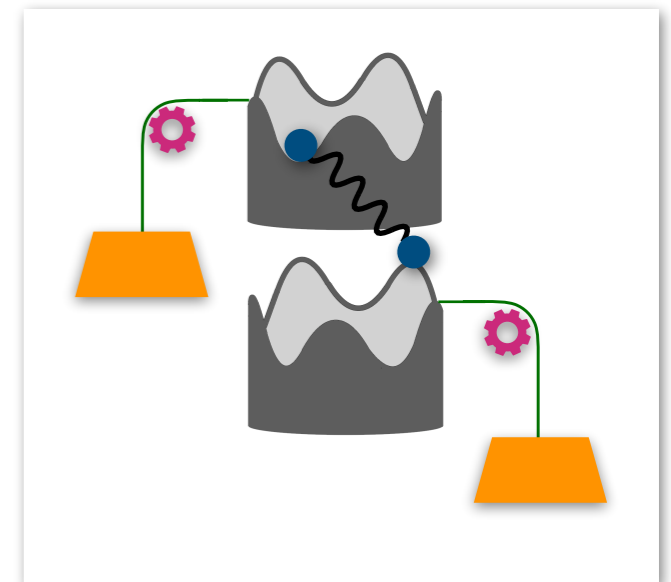
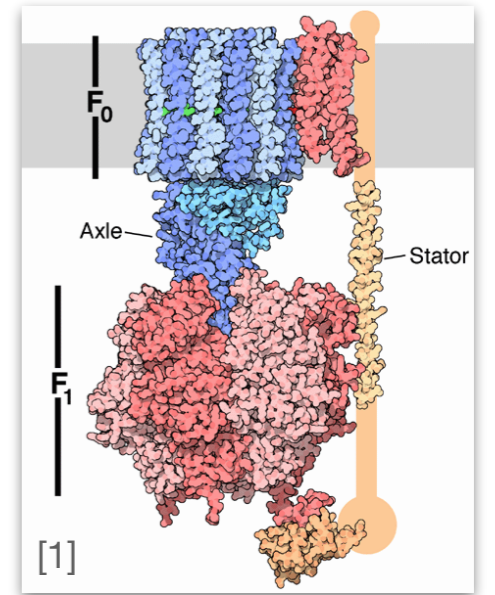
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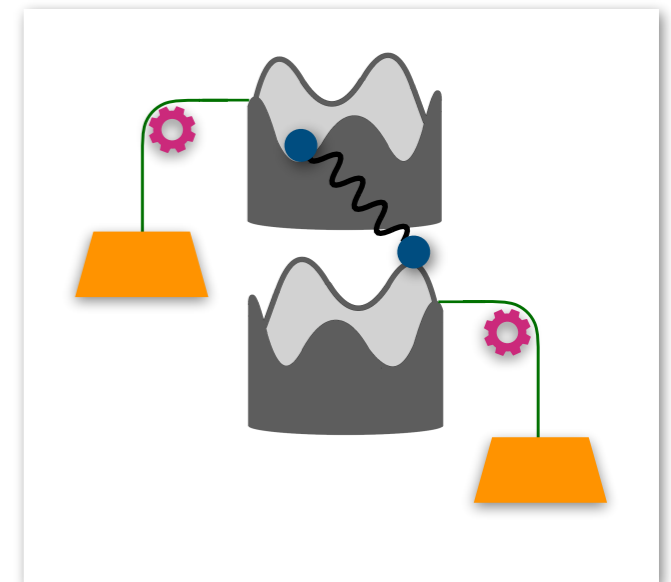
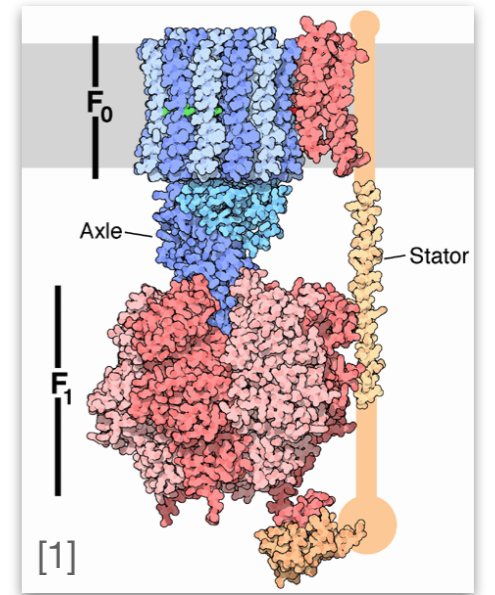


# Conclusion



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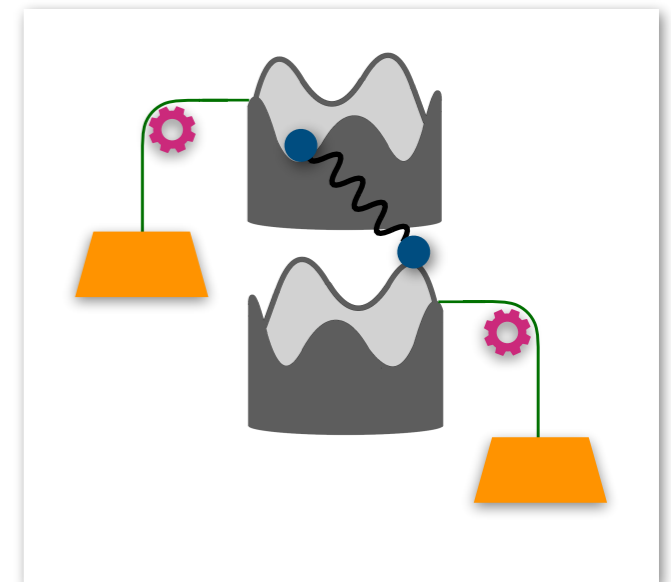
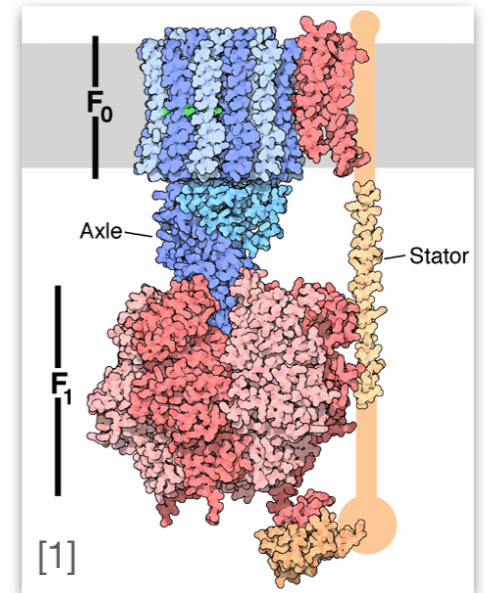
- Explicit modelling of coupling between components of a stochastic machine





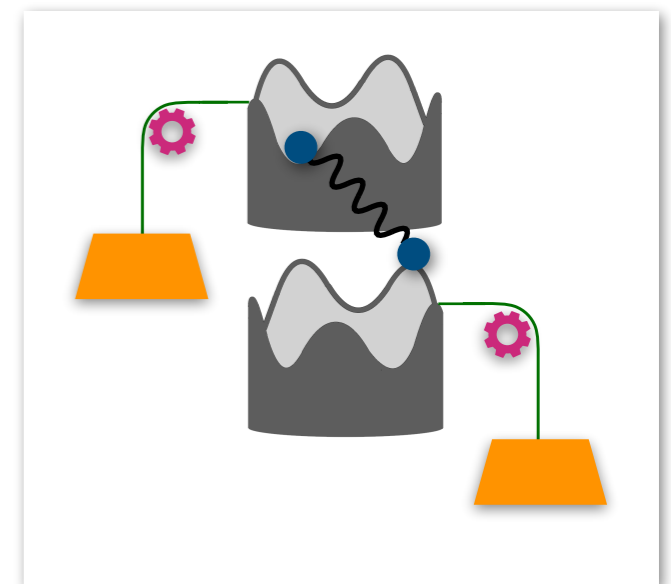
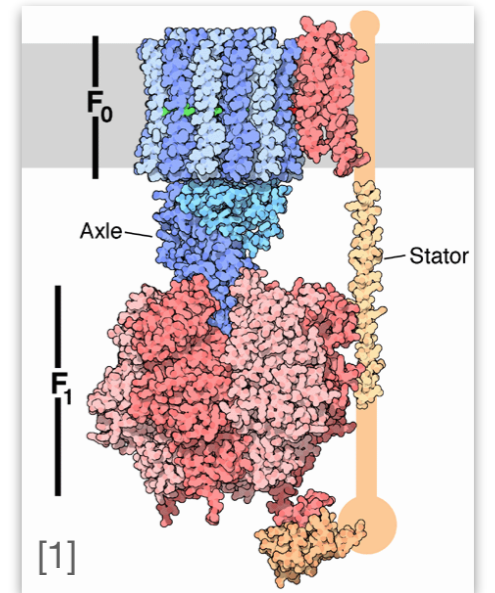
# Conclusion

- Explicit modelling of coupling between components of a stochastic machine
- Simple model inspired by ATP synthase has interesting implications for the design principles of biological systems



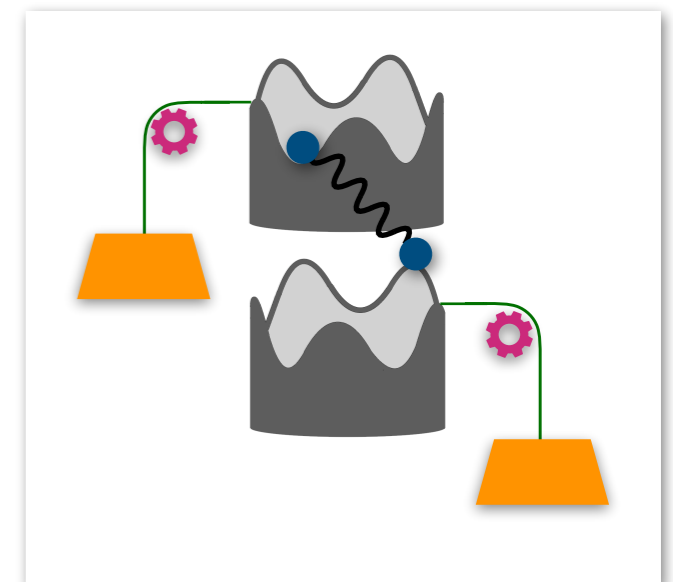
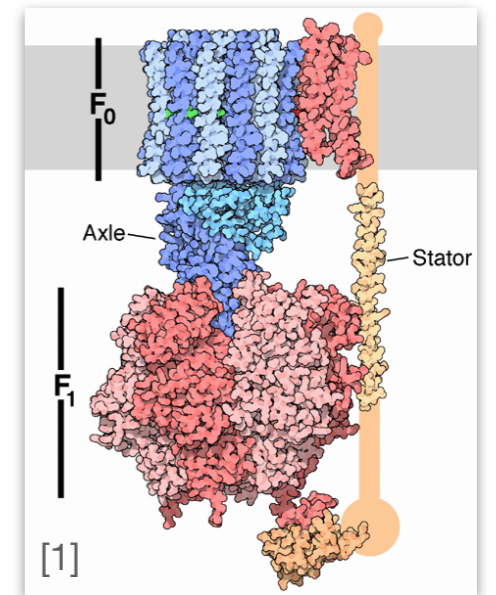
# Conclusion

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# Conclusion

- Explicit modelling of coupling between components of a stochastic machine
- Simple model inspired by ATP synthase has interesting implications for the design principles of biological systems
- Stronger is not always better
- Future work: implications for ATP synthase, look for more general features



# Acknowledgements

**Sivak group**

**Joseph Lucero**



**compute** | **calcul**  
canada | canada