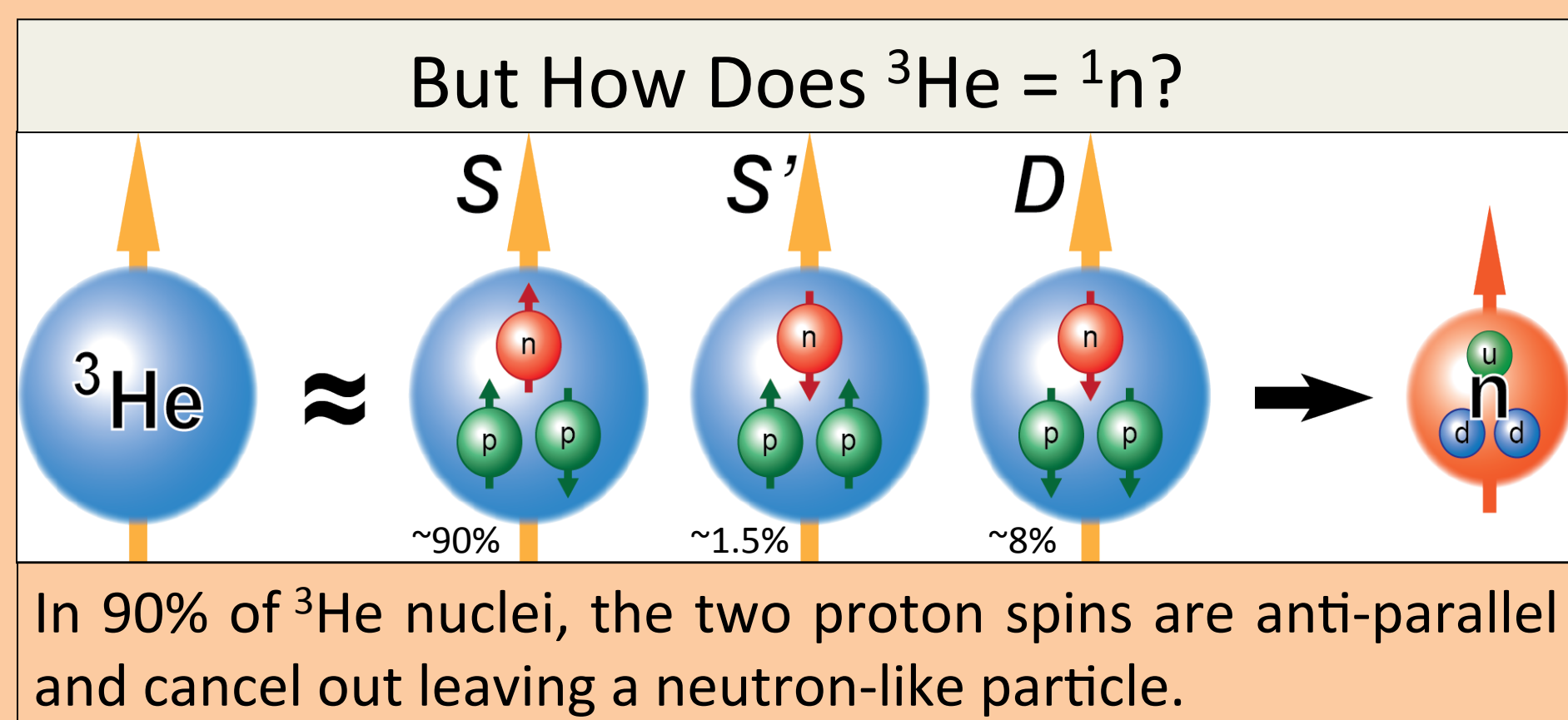


Maximizing Polarization of Helium-3 Gas Cells Using Diode Lasers

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Introduction: Observing the collisions between charged particle beams and helium-3 gas targets allows scientists to probe nuclear reactions and nuclear properties. These He-3 gas cells act as a pseudo-neutron target, since neutrons naturally decay in about 15 minutes when not contained in a nucleus. Also present in the cell, is a small amount of rubidium that can absorb the laser light from the three Comet Diode Lasers and its polarization is eventually transferred to the He-3 nuclei through spin-exchange mechanisms. Those polarized nuclei will align with an applied magnetic field, enabling the use of nuclear magnetic resonance, NMR, to measure the amount of polarization in the gas as a function of time. This study describes attempts to increase polarization by minimizing power loss due to the optical system, maximizing total power output, and adjusting the diodes' emission spectrums via temperature control but was unable to increase the power output enough for the desired experiments at Thomas Jefferson National Accelerator Facility.



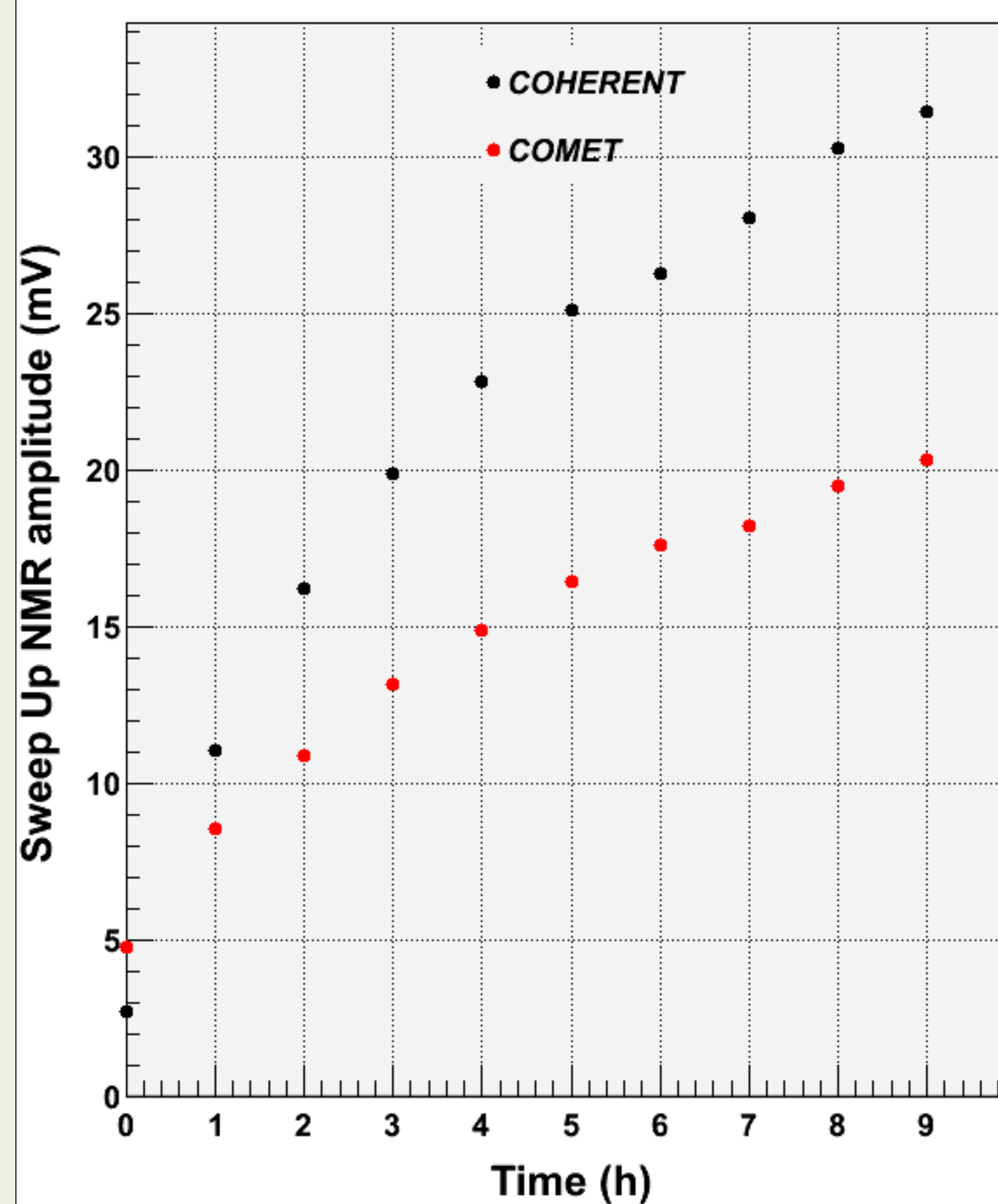
Results and Conclusions

- As seen below, the Coherent lasers polarize the cell better than the Comet Lasers do.
- Since the spectrum is narrow and shifted, the Rb does not absorb enough polarization.
- The Comet diode lasers are emitting light that is coming out initially polarized.
- The fiber orientation determines the ratio of power between the p→p and s→p branch.
- Using the three most powerful diode lasers, the combined total power output is 63.5 W.

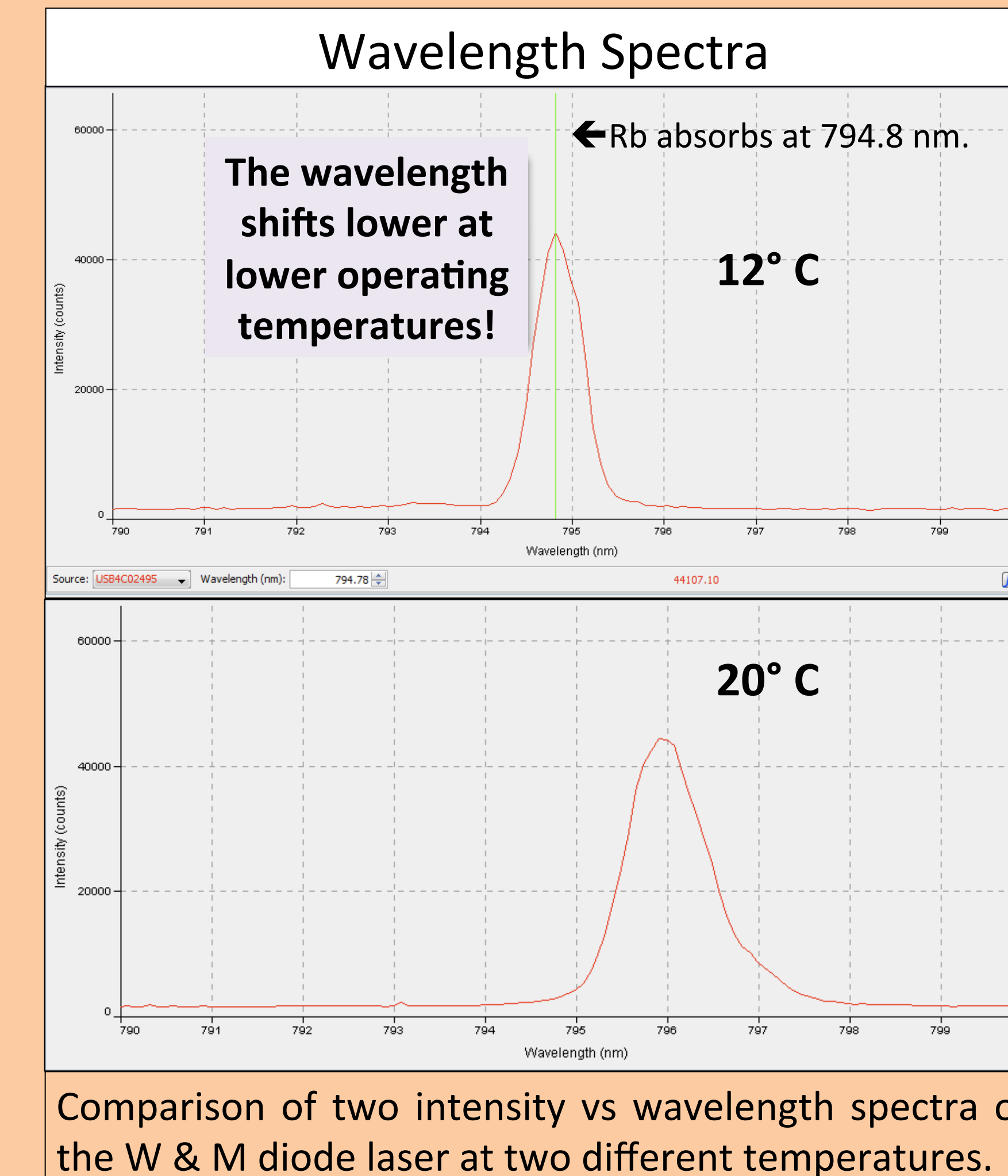
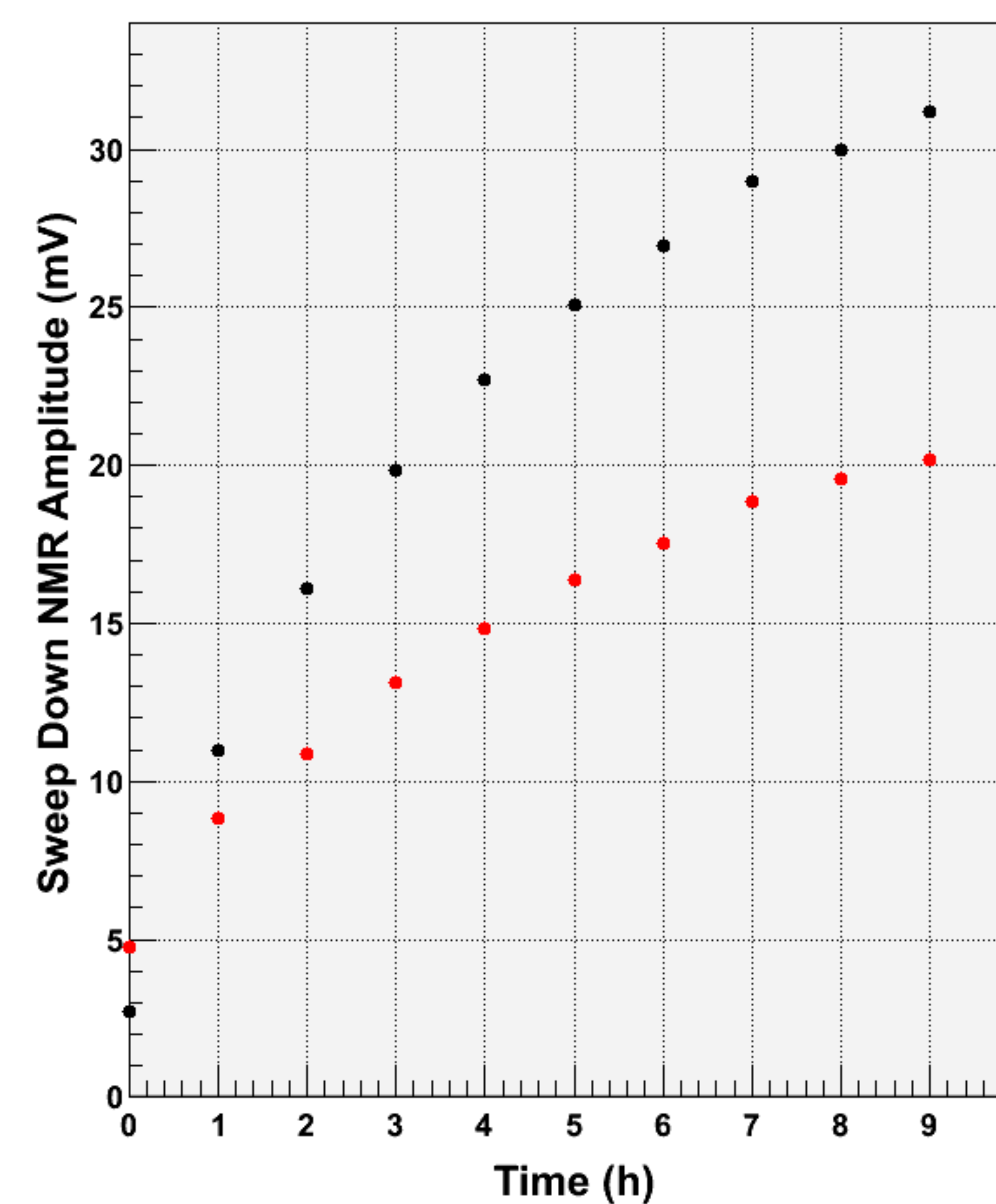
Comet Laser	Max Power (W)
JLab 1	22.6
JLab 2	16.2
Rutgers	19.1
William & Mary	21.8

A comparison of maximum power output of our four diode lasers measured by a power meter.

Dominic Pumping Chamber Spin-Up Curve

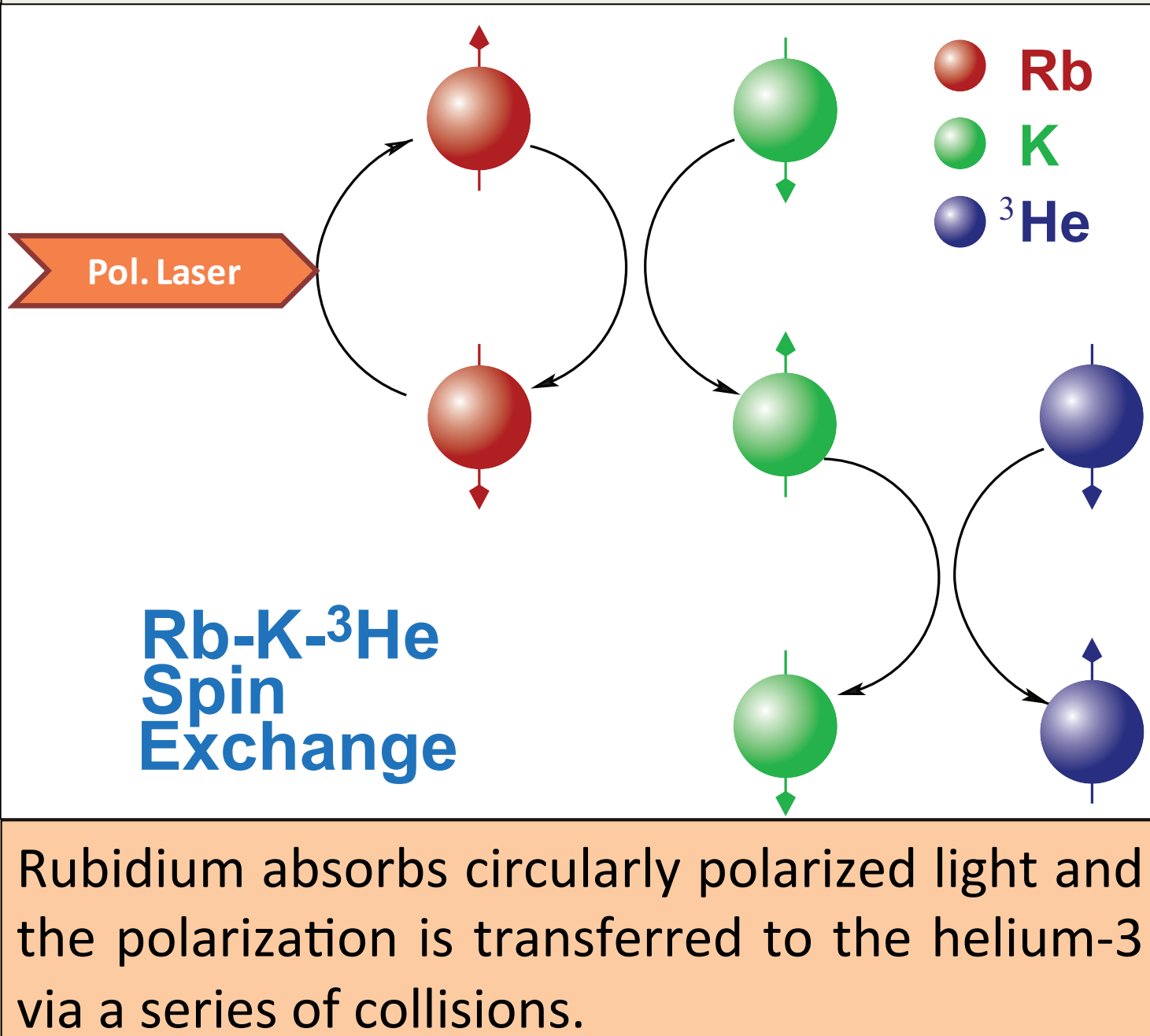


Dominic Pumping Chamber Spin-Up Curve

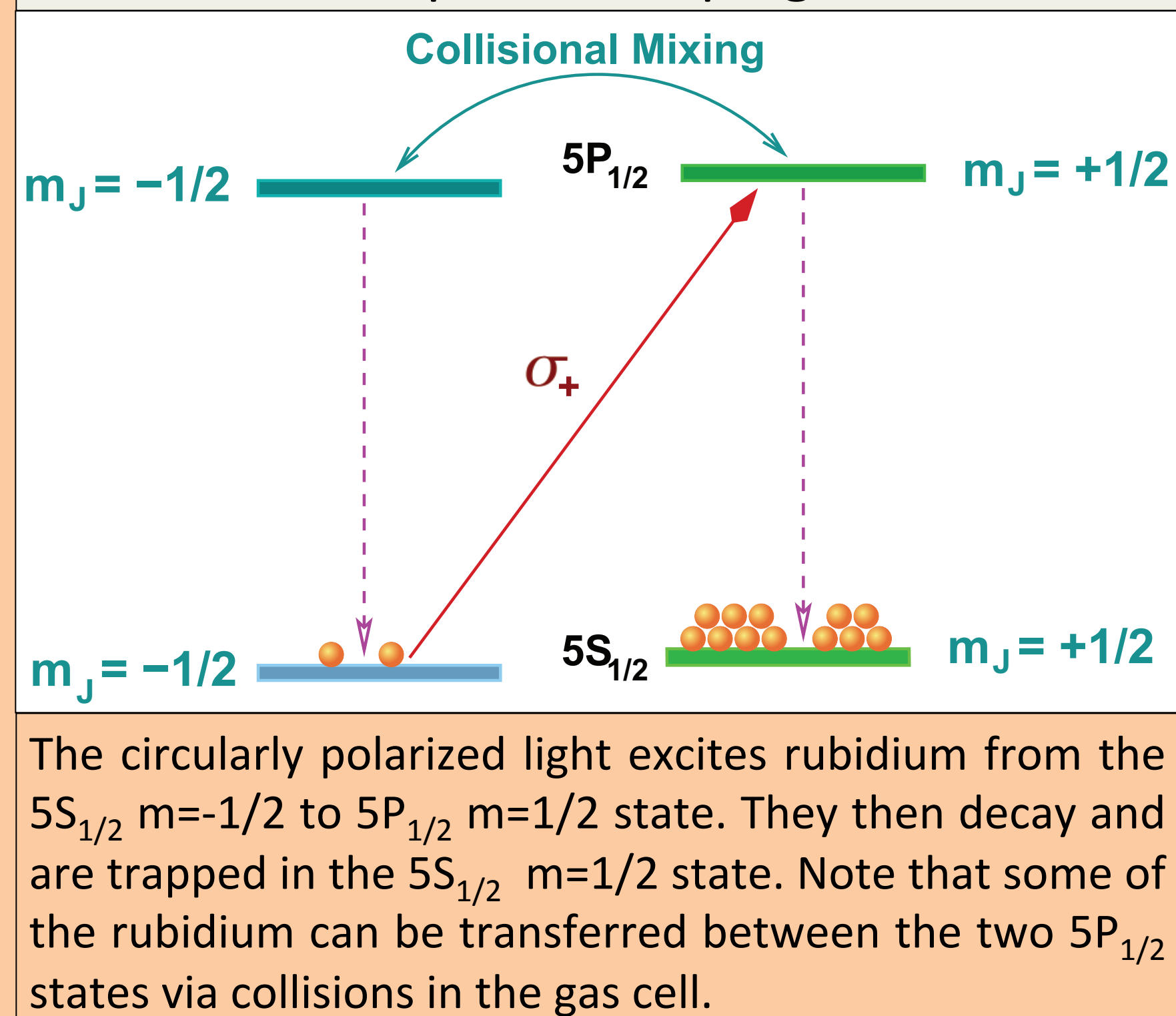


Comparison of two intensity vs wavelength spectra of the W & M diode laser at two different temperatures.

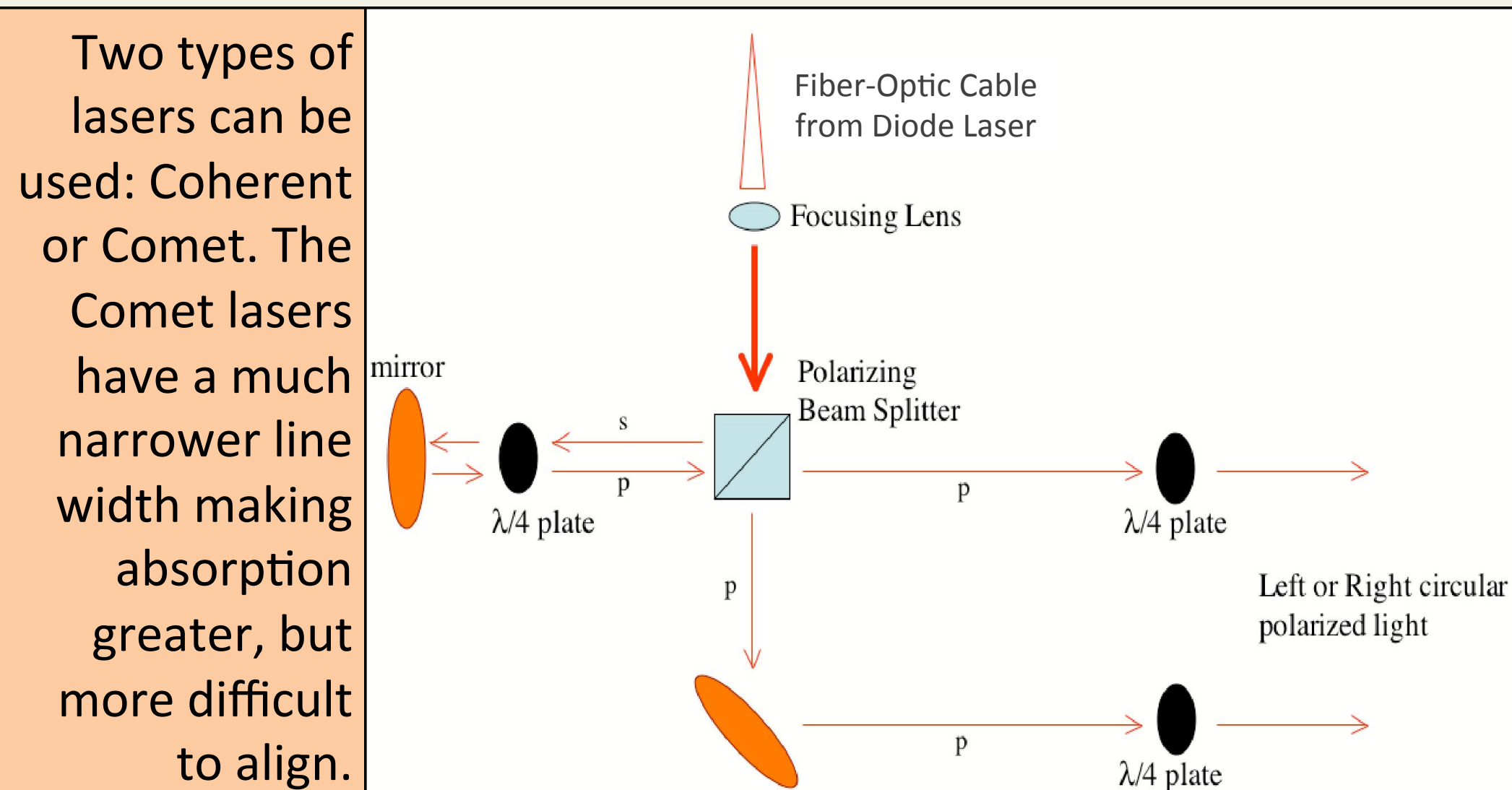
Nuclear Spin-Exchange



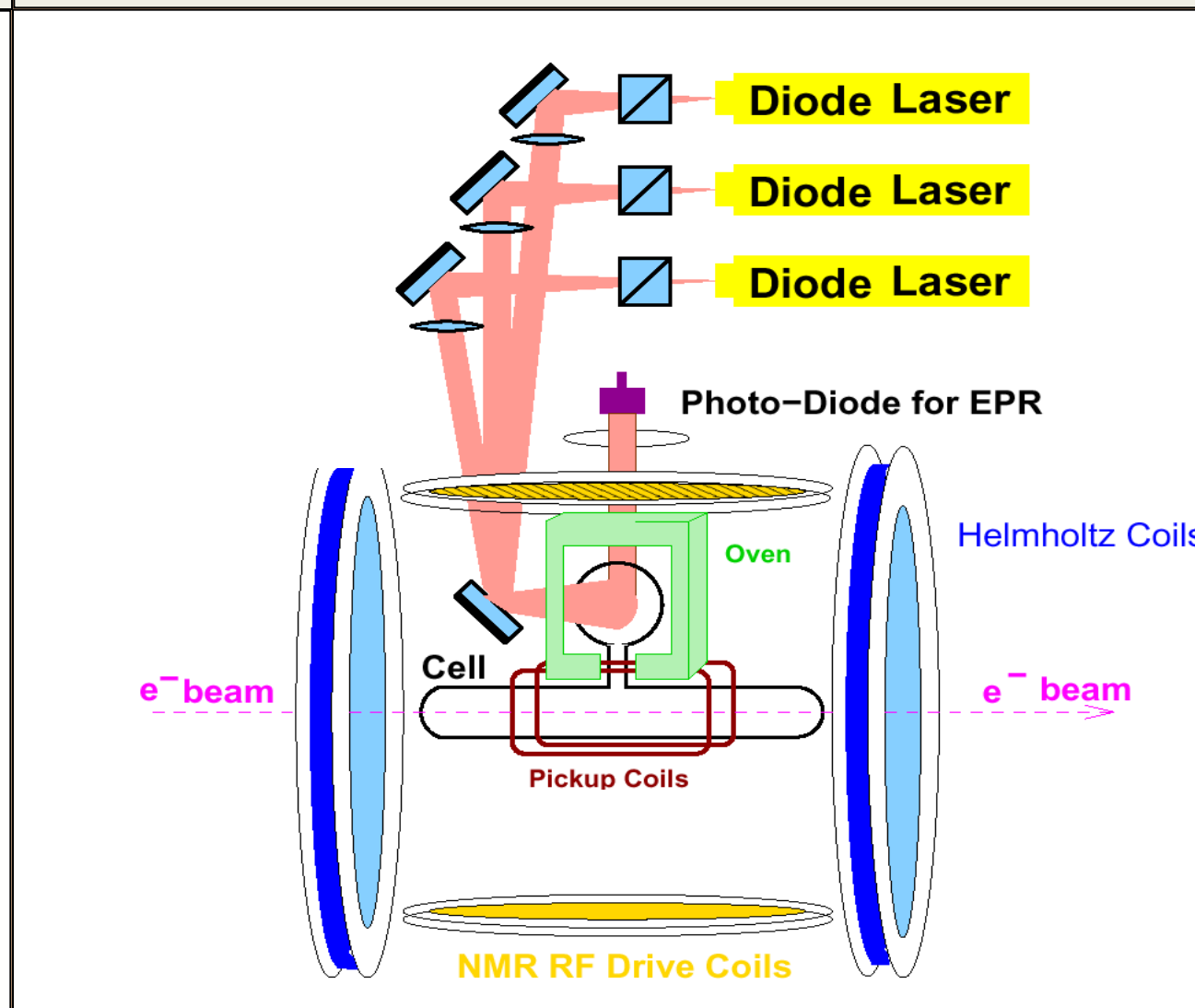
Optical Pumping



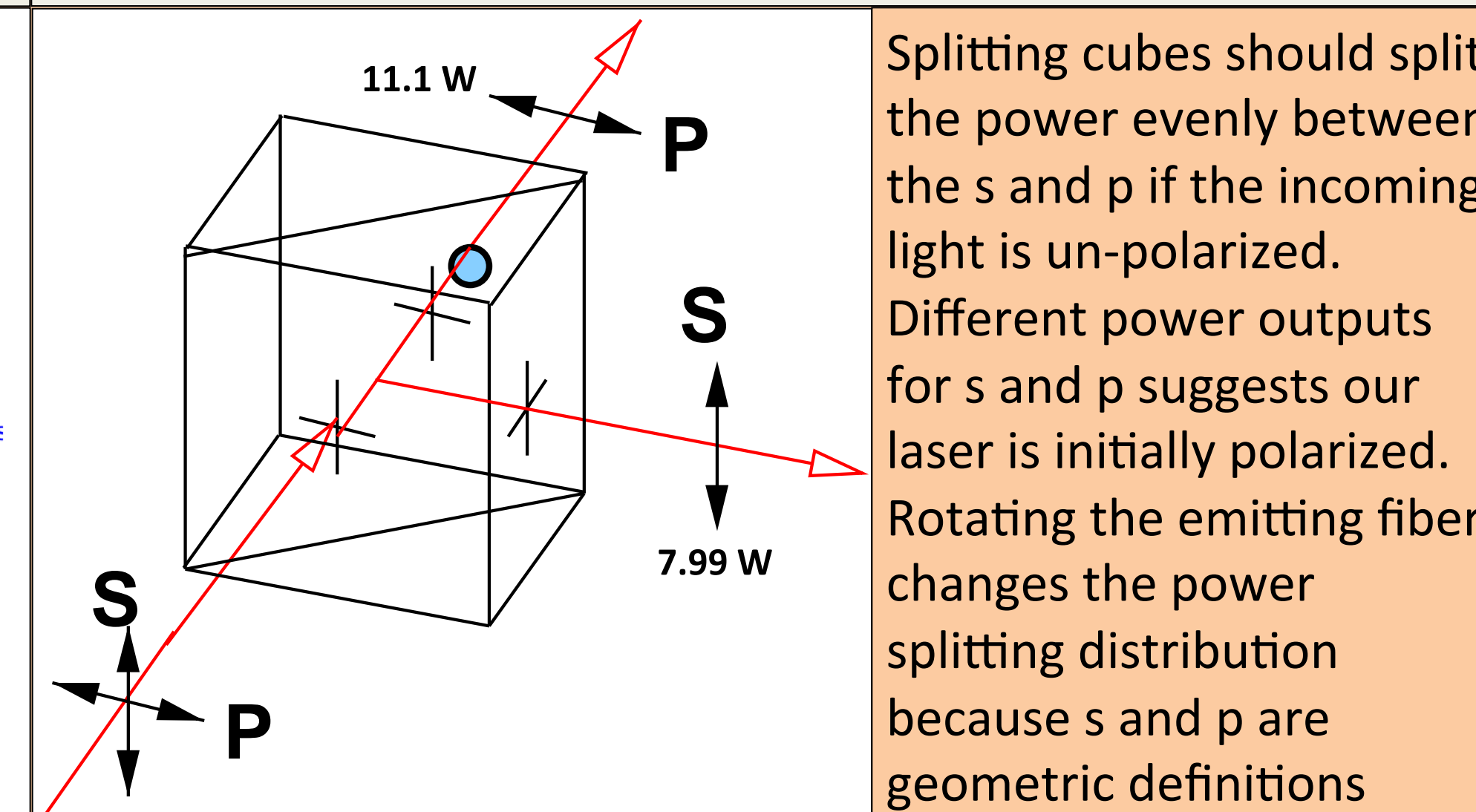
Optics Setup to Create Circularly Polarized Light



Setup for Polarizing the ${}^3\text{He}$



Splitting the Power Distribution



Affiliations

- Denison University
- University of Virginia
- Pennsylvania State University
- Thomas Jefferson National Accelerator Facility
- Rutgers University