Polarized ^{3}He Collaboration Meeting

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Cells

1. Panache (12/19/03)
   1% molar Rb/K Hybrid, 7.95 amg
   3.5" diameter pumping chamber
2. Mamamia (07/02/04)
   1% molar Rb/K Hybrid, 8.25 amg
   2.5" diameter pumping chamber
3. Sosa (08/12/04)
   Pure Rb, 7.80 amg
   3.5" diameter pumping chamber
4. There are no immediate plans for another cell. However, we would eventually like to fill a Rb/Na hybrid cell.

Past Activities

- Only Panache has been tested so far.
- We have successfully performed EPR polarimetry on a hybrid cell.
- 2.5" beam spot, 2 & 3 lasers, $T = 215°\text{C}, 235°\text{C}, 255°\text{C}$
- Best performance (3 lasers @ 235^oC): $P_{sat} = 43\%$, $\gamma_{su}^{-1} = 6$ hrs
- 3.5" beam spot @ $T = 255°\text{C}$
  1. All 3 lasers
  2. 2 lasers at largest angle wrt $\vec{B}_0$
  3. 2 lasers at smallest angle wrt $\vec{B}_0$
  4. 1 laser at smallest angle wrt $\vec{B}_0$
- Best performance (1 laser @ $T = 255°\text{C}$): $P_{sat} = 42\%$, $\gamma_{su}^{-1} = 7$ hrs
- Panache may have degraded due to prolonged exposure to high temp (lifetime 50 hrs $\rightarrow$ 35 hrs)

Current Activities

- Most recent tests varying the power and angle of incident light might be explained by Skew Optical Pumping. (Oven temperature fluctuations might also explain most recent results)
- Faraday Rotation work is on hold for Skew OP tests
- Installing "borrowed" combiner/diffuser into our optics setup has been a challenge
- Measuring horizontal and vertical angles of $\vec{B}_0$ wrt optics table
- Nominal $0°$ has a horizontal offset of $1.55° \pm 0.10°$
- We are now measuring the vertical angle.
- The goal is to pump with 45 W of combined laser light at the smallest possible angle.

Skew Optical Pumping

- Skew optical pumping occurs when the light propagates at an angle wrt the holding field.
- Chann *et al.* (Walker Group) have studied this: Phys. Rev. A 66, 033406 (2002)
- Results from the Chann study
  1. R is the optical pumping rate and Γ is the alkali metal spin relaxation rate
  2. The equilibrium alkali metal polarization is $P_A = \frac{R}{R+\Gamma}\cos(\theta)$
  3. The ratio of laser power needed at an angle θ vs. the power needed at $\theta = 0$ is given by $\Upsilon = 1 + \frac{R}{\Gamma}\sin^2(\theta)$
  4. Light should be well aligned to field
  5. Field gradients should be small
  6. Beam spot should be well focused
- For $R = 4.4\text{x}10^4\text{s}^{-1}$, $\Gamma = 500\text{s}^{-1}$, & $\theta = 6.1$ deg $\rightarrow P_A = 0.983$ & $\Upsilon = 2$

Planned Activities

- Carry out Skew OP tests
- Resume Faraday Rotation project
  1. Test detection electronics
  2. Tune Ti:Sapphire laser
  3. Install optics for probe beam
  4. Install additional power supply
  5. Build analysis package
  6. Perform measurements
- Lifetime & Maximum Polarization measurements of cells in inventory
- Fill and test large pumping chamber Rb/Na hybrid cell
- Move onto saGDH analysis...