

# INPP NUCLEAR LUNCH SERIES

November 15, 2017

Questions are based on

## Observation of the hyperfine spectrum of antihydrogen

(M. Ahmadi *et al.*)

### Theory

1. What are the differences between the Fine Spectrum, the Lamb Shift and the Hyperfine Splitting in terms of a  $H$ -atom? **Utsav**
2. The authors assume that the energy levels of  $\bar{H}$  will be similar to those of  $H$ . The plasma frequency was set according to this. How would the result be affected if this was not true? **Mahesh**
3. What are the angular momentum quantum numbers of the positron in a  $\bar{H}$  atom? **Som**
4. Why is the CPT invariance important for anti-matter? Why is  $\bar{H}$  good candidate to look at when testing CPT invariance? How else can this data be useful other than for a CPT test? **Matt**

### Experiment

1. Are there other experiments that can be carried out by using ALPHA2 detector? **Tyler**
2. Why is the injection ratio of  $\bar{p}$  and  $e^+$  not 1:1? **Cole**
3. Has  $\bar{H}$  lamb shift or fine structure of  $\bar{H}$  been observed? **Ibrahim**
4. What is a microwave induced spin flip? What does  $|c\rangle \rightarrow |b\rangle$  and  $|d\rangle \rightarrow |a\rangle$  spin flip mean? Why are they not considering  $|c\rangle \rightarrow |a\rangle$  or  $|d\rangle \rightarrow |b\rangle$  spin flips? **Sudhanva**
5. What are trappable and untrappable states? Why are the spin up positron states of  $|a\rangle$  and  $|b\rangle$  untrappable? Why is the relative energy of the states seems to depend on positron spin only? **Mamun**
6. Why did they use three layers of annihilation detectors? **Robert**
7. What is the difference between low-field and high-field seeking states? Why do the states seek low or high fields? **Gula**

### General

1. How are antiprotons produced? **Kristyn**
2. What is a Penning trap? How is it different from modified Penning-Malmberg trap? How does the 'modified Penning-Malmberg trap' trap neutral atoms? What is the role of the trap electrodes? **Shiv**
3. Is there any interaction between two antihydrogen atoms? **Nadyah**
4. How is the result useful in NMR? **Doug**