# Update on lifetime measurement: R(0) data

ACME collaboration presentation 1/16/20

## Overview of the Measurement

- Goal: make more precise measurement of H-state lifetime (previous uncertainty: 4.3-7 ms)
- 5 different pump points for preparation laser, 1 probe laser
- Apply E-field to provide quantization axis (38 V/cm)
- Switch between PP 1 (used as normalization) and PPs 2-5 every 7-9

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Pump Pair	Distance (cm)
1-2	25.5
1-3	47
1-4	69
1-5	103.5

## Latest update

- Main improvement: Use R(0) for 943 nm pumping instead of P(1)
  - No need to switch light polarization to fully saturate  $\rightarrow$  reduce effect of individual imperfections in PPs
  - $\circ$   $\,$  However, signal is smaller by ~50%  $\,$
- Compress size of probe beam, implement quadruple pass
- Discovered large source of noise: extra delay in switching between PPs
  Fortunately we monitor the power in each PP. Cut traces taken with insufficient power.
- Implemented other minor datacuts based on monitored parameters
- Error bars now make more sense, with a reduced chi squared of ~1.5-2.0
- Took 13 datasets in total with progressively improved apparatus and performing some systematic checks: probe shifted to different transitions, change timing of PP switching. No statistically significant shift in lifetime detected

#### Example result: Run 38, dataset "4514"



### Results from 13 datasets



## Results from 5 recent "good" datasets (runs 38-39)



## Conclusion

- Significantly improved quality of data with R(0) line
- Can measure lifetime to ~2% statistical uncertainty
- Measurements are repeatable and agree with each other within statistical uncertainty
  - However, still some minor imperfections of individual PPs detectable in fit
- Checked some basic systematics
- Future plans: check detuning and power systematics