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Final Report: Molecular State Readout via Strong Optical Fields

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6. AUTHORS

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5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES AND ADDRESSES

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Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

The views, opinions and/or findings contained in this report are those of the author(s) and should not contrued as an official Department of the Army position, policy or decision, unless so designated by other documentation.

14. ABSTRACT

15. SUBJECT TERMS

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a. REPORT	b. ABSTRACT	c. THIS PAGE			David Patterson
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					805-893-2020

RPPR Final Report
as of 04-Jan-2023

Agency Code: 21XD

Proposal Number: 75340PEII **Agreement Number: W911NF-19-1-0338**
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DUNS Number: 094878394 EIN: 956006145W
Report Date: 15-May-2020 Date Received: 03-Jan-2023
Final Report for Period Beginning 16-May-2019 and Ending 15-Feb-2020
Title: Molecular State Readout via Strong Optical Fields
Begin Performance Period: 16-May-2019 **End Performance Period:** 15-Feb-2020
Report Term: 0-Other
Submitted By: David Patterson Email: davepatterson@ucsb.edu
Phone: (805) 893-2020
Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees: **STEM Participants:**

Major Goals: The goal of this project was to read demonstrate the feasability of reading out individual molecular states with a combination of strong optical fields and ion rapping techniques. To date, there is no general method for reading out the quantum state of "realistic" polyatomic molecules, and a polarized optical tweezer, in combination with a deep ion trap, should be able to realize such a system. This would unlock the vast potential of polyatomic molecules as a coherently controllable quantum system.

Accomplishments: We did not succeed in realizing the individual state readout, However, we succeeded in a highly significant adjacent goal, in realizing the first single molecule spectrometer. This spectrometer can repeatedly measure the state of a molecule, but falls short of the stated goal because the measurement scrambles the state of the molecule via collisions as it is done, rendering it unfit for projective measurement. The instrument, however, is the first instrument of any kind which can definitively determine the identity of an arbitrary polyatomic gas phase molecular ion.

Training Opportunities: Scott Eierman, a graduate student who is now near to receiving his PhD, was funded via this grant. Two undergraduates who were just beginning their scientific careers were also funded.

Results Dissemination: The work has been submitted for publication (Nature, submitted December 2022), but has not yet been accepted

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: PD/PI
Participant: David Patterson
Person Months Worked: 2.00 **Funding Support:**
Project Contribution:
National Academy Member: N

RPPR Final Report
as of 04-Jan-2023

Participant Type: Graduate Student (research assistant)
Participant: Scott Eierman
Person Months Worked: 6.00 **Funding Support:**
Project Contribution:
National Academy Member: N

Partners

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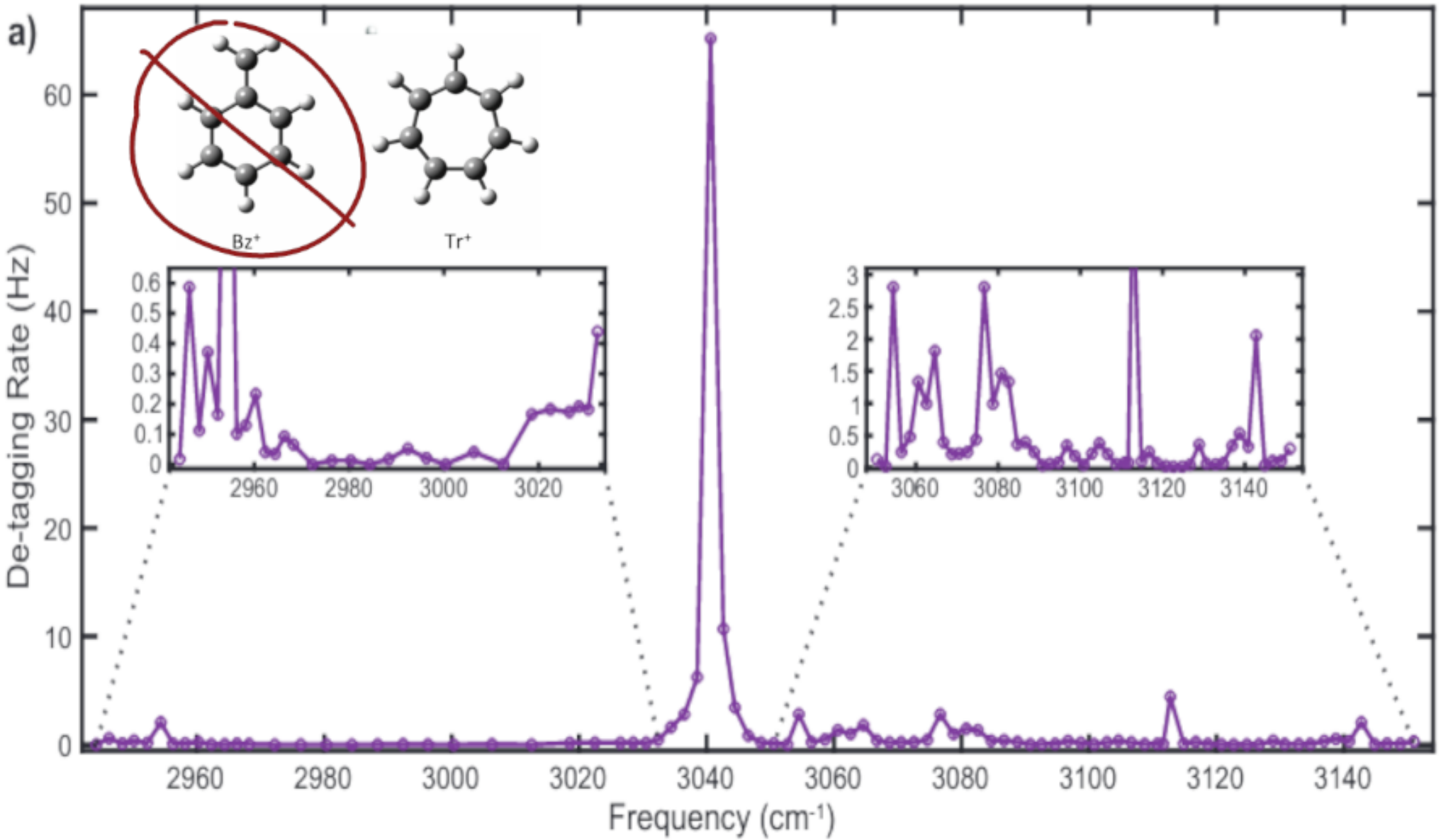
I certify that the information in the report is complete and accurate:
Signature: David Patterson
Signature Date: 1/3/23 4:23PM


a)
Bz+
Tr+
De-tagging Rate (Hz)
Frequency (cm-1)
0
10
20
30
40
50
60
2960
2980
3000
3020
3040
3060
3080
3100
3120
3140
0.6
0.5
0.4
0.3
0.2
0.1
3
2.5
2
1.5
1
0.5