

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

## REPORT DOCUMENTATION PAGE

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |                                                                                                                                                                                                                  |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------------|-------------|----------|---------------|-------|------|----|--|--|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 1a. REPORT SECURITY CLASSIFICATION<br>Unclassified                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             | 1b. RESTRICTIVE MARKINGS<br>None                                                                                                                                                                                 |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 2a. <b>AD-A270 729</b><br>                                                                                                                                                                                                                                                                                                                                                                            |                                             | 3. DISTRIBUTION/AVAILABILITY OF REPORT<br>Unlimited                                                                                                                                                              |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             | 5. MONITORING ORGANIZATION REPORT NUMBER<br>AFOSR-174                                                                                                                                                            |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 6a. NAME OF PERFORMING ORGANIZATION<br>University of Wisconsin<br>Department of Physics                                                                                                                                                                                                                                                                                                                                                                                                | 6b. OFFICE SYMBOL<br>(If applicable)        | 7a. NAME OF MONITORING ORGANIZATION<br>AFOSR                                                                                                                                                                     |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 6c. ADDRESS (City, State and ZIP Code)<br>1150 University Avenue<br>Madison, Wisconsin 53706                                                                                                                                                                                                                                                                                                                                                                                           |                                             | 7b. ADDRESS (City, State and ZIP Code)<br>AFOSR - NE<br>110 Duncan Suite B115<br>Bolling AFB DC 20332-0001                                                                                                       |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 8a. NAME OF FUNDING/SPONSORING ORGANIZATION<br>AFOSR - NE                                                                                                                                                                                                                                                                                                                                                                                                                              | 8b. OFFICE SYMBOL<br>(If applicable)        | 9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER<br>F49620-92-J-0376                                                                                                                                              |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 8c. ADDRESS (City, State and ZIP Code)<br>110 Duncan Suite B115<br>Bolling AFB DC 20332-0001                                                                                                                                                                                                                                                                                                                                                                                           |                                             | 10. SOURCE OF FUNDING NOS.<br><table border="1"><tr><td>PROGRAM ELEMENT NO.</td><td>PROJECT NO.</td><td>TASK NO.</td><td>WORK UNIT NO.</td></tr><tr><td>61102</td><td>2301</td><td>DS</td><td></td></tr></table> |                          | PROGRAM ELEMENT NO. | PROJECT NO. | TASK NO. | WORK UNIT NO. | 61102 | 2301 | DS |  |  |  |                                                                                                                                                                                                  |  |
| PROGRAM ELEMENT NO.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | PROJECT NO.                                 | TASK NO.                                                                                                                                                                                                         | WORK UNIT NO.            |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 61102                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2301                                        | DS                                                                                                                                                                                                               |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 11. TITLE (Include Security Classification) Collisional Processes Involving Atmospheric Gases                                                                                                                                                                                                                                                                                                                                                                                          |                                             |                                                                                                                                                                                                                  |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 12. PERSONAL AUTHOR(S)<br>Chun C. Lin                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                             |                                                                                                                                                                                                                  |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 13a. TYPE OF REPORT<br>Final                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 13b. TIME COVERED<br>FROM 8-1-92 TO 7-31-93 | 14. DATE OF REPORT (Yr., Mo., Day)<br>9-21-93                                                                                                                                                                    | 15. PAGE COUNT<br>one    |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 16. SUPPLEMENTARY NOTATION<br>Final Technical Report for AFOSR Grant F49620-92-J-0376                                                                                                                                                                                                                                                                                                                                                                                                  |                                             |                                                                                                                                                                                                                  |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 17. COSATI CODES<br><table border="1"><tr><td>FIELD</td><td>GROUP</td><td>SUB. GR.</td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></table>                                                                                                                                                                                                                                                                       |                                             | FIELD                                                                                                                                                                                                            | GROUP                    | SUB. GR.            |             |          |               |       |      |    |  |  |  | 18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)<br>electron excitation, optical emission, nitrogen molecule, nitrogen molecule ions, excited electronic states |  |
| FIELD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | GROUP                                       | SUB. GR.                                                                                                                                                                                                         |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |                                                                                                                                                                                                                  |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |                                                                                                                                                                                                                  |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |                                                                                                                                                                                                                  |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 19. ABSTRACT (Continue on reverse if necessary and identify by block number)<br>Optical emission cross section and excitation function for the $D^2\pi_g \rightarrow A^2\pi_u$ bands of $N_2^+$ produced by electron impact on $N_2$ molecules have been measured. Analysis of the results indicates the difference in the production mechanisms for the $N_2^+(D^2\pi_g)$ state as compared to the production mechanisms for the $N_2^+(A^2\pi_u)$ and $N_2^+(B^2\Sigma_u^+)$ states. |                                             |                                                                                                                                                                                                                  |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 93-24338<br>                                                                                                                                                                                                                                                                                                                                                                                       |                                             |                                                                                                                                                                                                                  |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 20. DISTRIBUTION/AVAILABILITY OF ABSTRACT<br>UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS <input type="checkbox"/>                                                                                                                                                                                                                                                                                                      |                                             | 21. ABSTRACT SECURITY CLASSIFICATION<br>Unclassified                                                                                                                                                             |                          |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |
| 22a. NAME OF RESPONSIBLE INDIVIDUAL<br>Kelley                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                             | 22b. TELEPHONE NUMBER<br>(Include Area Code)<br>202-767-4908                                                                                                                                                     | 22c. OFFICE SYMBOL<br>NE |                     |             |          |               |       |      |    |  |  |  |                                                                                                                                                                                                  |  |

## Final Report

### Collisional Processes Involving Atmospheric Gases

AFOSR Grant F49620-92-J-0376

We have studied the production of the  $D^2\pi_g \rightarrow A^2\pi_u$  emission bands of  $N_2^+$  by electron impact on the  $N_2$  molecule. The  $D^2\pi_g \rightarrow A^2\pi_u$  bands are very weak and we are not able to obtain satisfactory data by the conventional analog detection technique. A photon counting system for measuring the molecular emission band has been constructed and used to measure the optical emission cross sections of the (7,8), (9,8), and (4,5) bands of the  $N_2^+(D^2\pi_g \rightarrow A^2\pi_u)$  emission and their excitation function. Our measured excitation functions are found to peak at 200 eV in contrast to the known excitation functions for the  $N_2^+(A^2\pi_u \rightarrow X^2\Sigma_g^+)$  and  $N_2^+(B^2\Sigma_u^+ \rightarrow X^2\Sigma_g^+)$  bands which peak at 100 eV. This result underscores the difference in the production mechanisms for the  $N_2^+(D^2\pi_g)$  states as compared to the production mechanisms for the  $N_2^+(A^2\pi_u)$  and  $N_2^+(B^2\Sigma_u^+)$  states.

|                    |                                            |
|--------------------|--------------------------------------------|
| Accession For      |                                            |
| NTIS CRA&I         | <input checked="checked" type="checkbox"/> |
| DTIC TAB           | <input type="checkbox"/>                   |
| Unannounced        | <input type="checkbox"/>                   |
| Justification      |                                            |
| By                 |                                            |
| Distribution /     |                                            |
| Availability Codes |                                            |
| Dist               | Avail and/or<br>Special                    |
| A-1                |                                            |

DTIC QUALITY INSPECTED 2