

# NASA TECH BRIEF



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## Molecular Radiation: Its Application in Physical Measurements and Analyses

A Specialists Conference was held at the Marshall Space Flight Center on October 5-6, 1967 to review ongoing work in molecular radiation, to evaluate the different possibilities of new research in this field, and to achieve an interdisciplinary exchange of ideas among the participants. The twenty-eight papers presented review present knowledge of molecular radiation and its utilization in three areas, namely, (1) spectral-line studies in the laboratory; (2) application to practical heat transfer calculations of radiative transfer models, as derived with the aid of these studies; and (3) use of measured radiation properties of gases, not only for comparison with the predictions, but also to gain diagnostic knowledge, at remote locations, of certain other properties of flowing or stagnant gas masses. Also included are some applications and developments of recent interest and critical discussions regarding the value and limitations of present approaches. In the welcoming address at the conference, Ernst D. Geissler, Director Aero-Astrodynamic Laboratory of Marshall Space Flight Center, stated: "We think that the work of the last few years has gone a long way toward establishing useful tools for predicting radiation from nonhomogeneous flame regions with reasonable accuracy, usable both in jet plumes and in such mundane applications as industrial furnaces."

The titles of the papers, presented in four sessions at the conference, are as follows:

### Session I

#### LABORATORY STUDIES

Band Model Representations for High Temperature Water Vapor and Carbon Dioxide

Methods of Calculating Atmospheric Transmission Functions  
Infrared Opacity of Hot Water Vapor  
The Surface Pressure of Venus  
Inference of Band Structures from Laboratory Gases  
Application of Band Models to Inhomogeneous Gases

### Session II

#### APPLICATIONS OF RADIATIVE HEAT TRANSFER CALCULATIONS

Radiation Model for Nonscattering Rocket Exhaust Gases  
Review of Experimental Verification of the Curtis-Godson Approximation for Infrared Spectral Radiation from High Temperature Gases  
Radiative Heat Transfer Calculations for Saturn Exhaust Plumes  
Emittance and Radiance Calculations for Solid Propellant Rocket Exhausts  
The Status of Optical Diagnostics on Wakes Behind Hypersonic Vehicles

### Session III

#### INVERSION TECHNIQUES AND REMOTE SENSING

Remote Sensing and Inversion Techniques: State of the Art  
Statistical Inversion Method for the Solution of Integral Equations of the First Kind  
Remote Sensing of Atmospheric Water Vapor and Ozone Using Interferometry  
Remote Detection of Local Temperatures and Local Partial Pressures with Crossed-Beam Spectroscopy

(continued overleaf)

Application of Laser Doppler Techniques to Turbulent Velocity Measurement  
Temperature and Concentration Measurements in Model Exhaust Plumes Using Inversion Techniques  
The Inversion Problem in Stellar Atmospheres

Session IV  
Short Communications

Some Theoretical Frequency Averages for the Emission of a Homogeneous Gas-Particle Cloud  
Determination of Atmospheric Temperature Profiles from Satellite Radiance Measurements at the Limb of the Earth  
Estimating Diurnal Temperature Variation at the Stratopause from Horizon Radiance Measurements  
Molecular Temperature Determinations in Flow Fields of Re-Entering Bodies  
The Relevance of Frequency-Averaged Properties  
Gas Emissivity Model for Radiative Transfer Calculations  
The Doppler Analog of an Elsasser Band Model  
Temperature Sounding With the 4.3 Micron CO<sub>2</sub> band  
Numerical Study of Nonlinear Inversion

**Note:**

The following documentation may be obtained from:

The Clearinghouse for Federal Scientific and Technical Information  
Springfield, Virginia 22151  
Single document price \$3.00  
(or microfiche \$0.65)

Reference: NASA TMX-53711 (N68-18082 through N68-18114), Molecular Radiation and Its Application to Diagnostic Techniques

**Patent status:**

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546

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