Dear Dr. Norris:

This is the final report on CGRO Guest Investigator Program grant NAG5-2026 (PI: Mitchell C. Begelman, The Regents of the University of Colorado, Campus Box 19, Boulder, CO 80309-0019), covering the period 7/15/92-9/30/97. Attached please find a bibliography of the publications to date resulting from this grant. The following are highlights from the research supported by this grant.

- **Theory of gamma-ray blazars**: We studied the theory of gamma-ray blazars, being among the first investigators to propose that the GeV emission arises from Comptonization of diffuse radiation surrounding the jet, rather than from the synchrotron-self-Compton mechanism. In related work, we uncovered possible connections between the mechanisms of gamma-ray blazars and those of intraday radio variability, and have conducted a general study of the role of Compton radiation drag on the dynamics of relativistic jets.

- **A Nonlinear Monte Carlo code for γ-ray spectrum formation**: We developed, tested, and applied the first Nonlinear Monte Carlo (NLMC) code for simulating gamma-ray production and transfer under much more general (and realistic) conditions than are accessible with other techniques. The present version of the code is designed to simulate conditions thought to be present in active galactic nuclei and certain types of X-ray binaries, and includes the physics needed to model thermal and nonthermal electron-positron pair cascades. Unlike traditional Monte-Carlo techniques, our method can accurately handle highly non-linear systems in which the radiation and particle backgrounds must be determined self-consistently and in which the particle energies span many orders of magnitude. Unlike models based on kinetic equations,
our code can handle arbitrary source geometries and relativistic kinematic effects. In its first important application following testing, we showed that popular semi-analytic accretion disk corona models for Seyfert spectra are seriously in error, and demonstrated how the spectra can be simulated if the disk is sparsely covered by localized "flares".

The funds were used primarily to support the visits of three senior scientists to JILA: Dr. Boris Stern (Institute for Nuclear Research, Moscow, Russia), the inventor of the Nonlinear Monte-Carlo method; Dr. Marek Sikora (Copernicus Astronomical Center, Warsaw, Poland), an expert on pair cascades, AGNs, and high-energy radiation processes; and Dr. Greg Madejski (NASA/Goddard Space Flight Center). It also supplied partial support for a postdoctoral research associate, Dr. Yueming Xu, and for two graduate students, Mr. James Dove and Mr. Joern Wilms.

Sincerely yours,

Mitchell C. Begelman
Principal Investigator
1. Papers in Refereed Journals (published, in press, and submitted)


2. Invited Review Articles


2. Contributed Papers


3. **Internal Reports**


4. **Ph.D. Thesis**