(NASA-CR-145391) A STUDY OF CORONAL STRUCTURES IN A NON-MAGNETIC STAR Final Report (Grambling Coll., La.) 4 p HC $3.25 CSCL 03B

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GRAMBLING COLLEGE OF LOUISIANA

DEPARTMENT OF

PHYSICS

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Grambling, Louisiana

FINAL TECHNICAL REPORT

NASA GRANT NGR 19-011-014

A Study of Coronal Structures in a Non-Magnetic Star

The purpose of this project was to study a convective instability in the solar corona. The linear growth of the instability was very successfully studied. This result has been published in the journal <u>Solar Physics</u> and is attached to this report.

Considerable time was also spent investigating the nonlinear development of the instability on a computer. It was hoped that a growing perturbation could be followed from a small local enhancement in the density of the solar wind to a large increase in the density which would look like one of the rays seen in the sun's corona.

The instability should stop growing when its nonlinear amplitude is so large that the viscosity term in the energy equation becomes important. Then viscous losses prevent further growth. However, it could not be followed this far on a computer for the reasons stated below.

As shown by equation (23) in the attached reprint, the linear instability grows exponentially in space at the rate $\alpha = \sqrt{2}/\tau$, where τ is the angular width of the coronal ray that is growing as it moves outward from the sun. Narrow rays grow faster.

A function of position which changes rapidly is hard to represent on a computer because the value of the function must be known at many closely spaced points, requiring a lot of computer storage. The fastest growing part of our instability (narrow coronal structures) is the hardest to store on a computer.

We found that the computers available locally (200K storage or less) were insufficient to follow the instability for more than a few e-folding distances from the starting position, at which point a small scale structure developed. A larger computer could follow the instability a little farther but would still meet the same problem. The small scale structure could not be represented by the number of data points available in the computer.

The problem can also be studied by the usual technique of representing the functions of space by Fourier or Legendre transforms. We tried this and found that we would still need to store in the computer too many Fourier or Legendre coefficients. At this point we ran out of ideas and time and had to return to teaching classes.

REFERENCE:

STRUCTURES IN A NON-MAGNETIC SOLAR CORONA
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