



STELLAR EVOLUTION, ELECTRON DEGENERACY AND THEORETICAL DISCOVERY OF BROWN DWARFS

SHIV S. KUMAR
The Galileo Institute
ssk @ galileoinstitute.org

(RINGBERG 2012 CONFERENCE INVITED TALK)
OCTOBER 22, 2012

FROM ANN ARBOR, MICHIGAN TO NEW YORK CITY VIA CAMBRIDGE, MASSACHUSETTS (1958-1962)

- The Beginning: Fall 1958 (University of Michigan)
- Preliminary Calculations: 1958-1960 (University of Michigan)
- More Calculations and Attempted Publication: 1960-1961 (Smithsonian Astrophysical Obs.)
- Calculations Completed: Summer 1962 (NASA Institute for Space Studies)

Paper presented at the 111th American Astronomical Society meeting: August 29, 1962 (Yale University)

Study of Degeneracy in Very Light Stars.

SHIV S. KUMAR (National Academy of Sciences-National Research Council, Postdoctoral Research Associate with NASA), *Institute for Space Studies.*

(Astronomical Journal, 67, 579, 1962)

Two papers dealing with my predictions concerning the structure and evolution of stars with mass below the H-burning limit were received by the *Astrophysical Journal*: October 20, 1962.

THE STRUCTURE OF STARS OF VERY LOW MASS,

SHIV S. KUMAR

NASA Goddard Space Flight Center, Institute for Space Studies, New York 27, N.Y.

Received October 20, 1962; revised November 27, 1962

ABSTRACT

Completely convective models have been constructed for stars of masses 0.09, 0.08, 0.07, 0.06, 0.05, and 0.04 (solar units), taking into account the non-relativistic degeneracy of the stellar material. It is shown that there is a lower limit to the mass of a main-sequence star. The stars with mass less than this limit become completely degenerate stars of “black” dwarfs as a consequence of gravitational contraction, and, therefore, they never go through the normal stellar evolution.

2nd of the two papers dealing with my predictions.....

THE HELMHOLTZ-KELVIN TIME SCALE
FOR STARS OF VERY LOW MASS

SHIV S. KUMAR

NASA Goddard Space Flight Center, Institute for Space Studies, New York 27, N.Y.

Received October 20, 1962; revised November 21, 1962

ABSTRACT

Assuming that the contracting stars in convective equilibrium evolve vertically downward in the H-R diagram, a simple expression for the Helmholtz-Kelvin time scale t_{HK} is derived. Application of this expression to stars of mass $M < 0.1 M_{\text{sun}}$ shows that these stars contract to a radius of about $0.1 R_{\text{sun}}$ in a time scale of approximately 1 billion years, while the earlier estimates, based on horizontal evolution, gave a time scale t_{HK} greater than a hundred billion years.

The background of the slide is a vibrant, multi-colored nebula, likely the Helix or Ring Nebula, showing shades of blue, purple, red, and yellow. A vertical grey line runs down the center of the image, dividing it into two halves. The text is overlaid on this background.

What is happening in 2012?

Looking toward the future

MODELS FOR STARS OF VERY LOW MASS

SHIV S. KUMAR

INSTITUTE FOR SPACE STUDIES

Report No. X - 644 - 62 - 78 (1962)