Enanas Blancas:

Un posible final para el Sol

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"La ciencia es sólo un ideal, la de hoy corrige la de ayer y la de mañana la de hoy".

- José Ortega y Gasset-

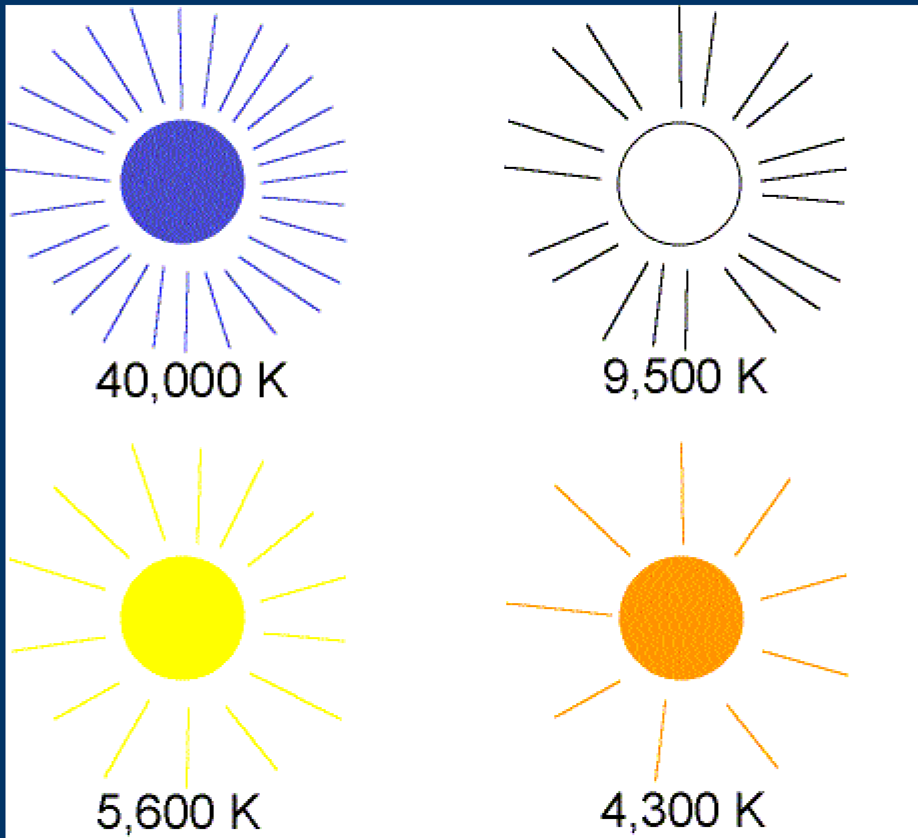
Guía maya de los cielos

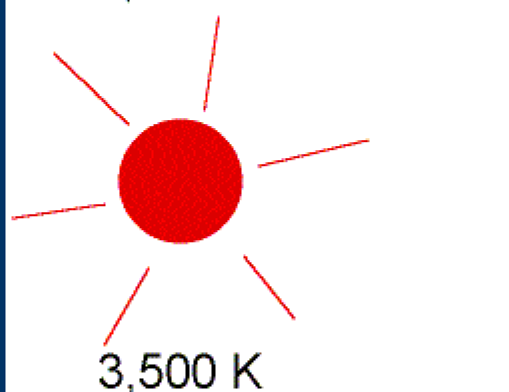
Antiguo mapa estelar chino

Interpretaciones básicas de las estrellas

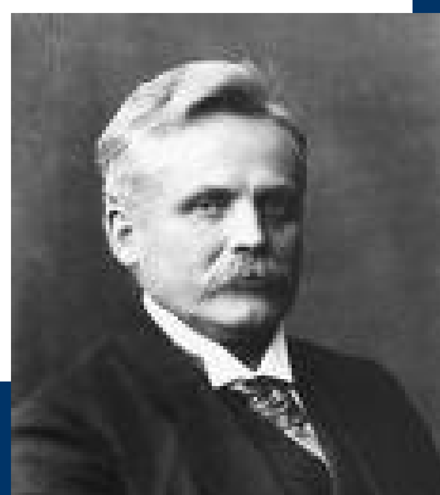
Ley de Wien

(1893)



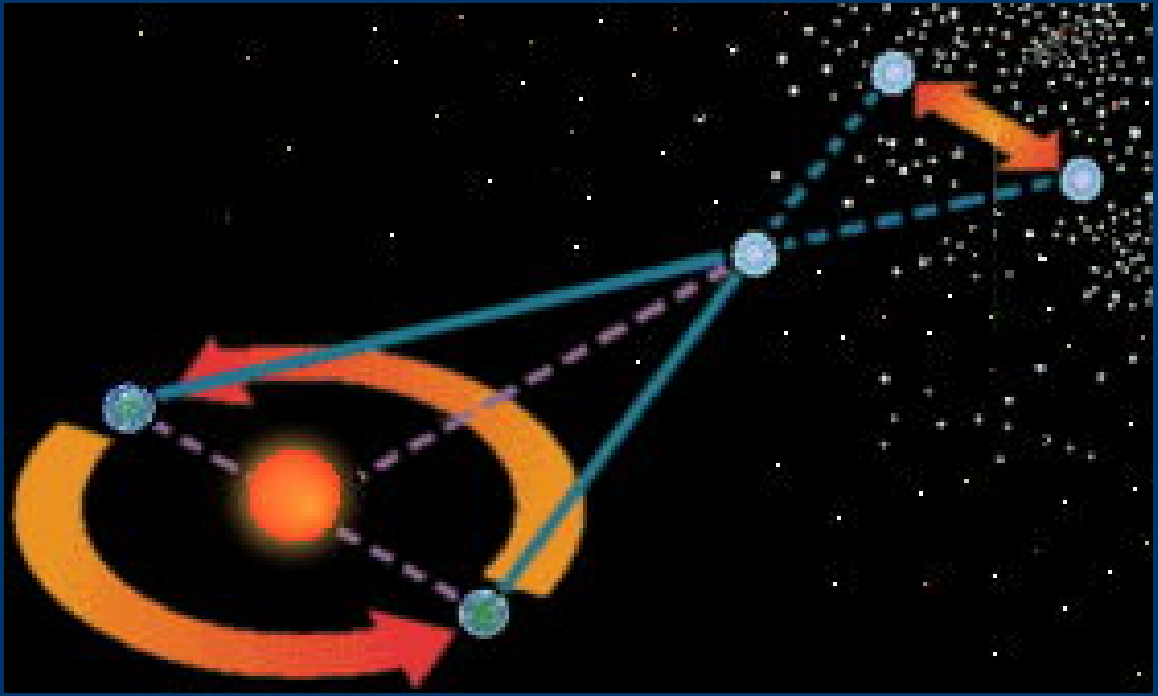


Deducimos la temperatura superficial de una estrella por el aspecto de su luz



Wilhelm Wien, físico alemán (1864-1929)

Paralaje estelar



Evaluamos la distancia de una estrella con el cambio de su posición aparente

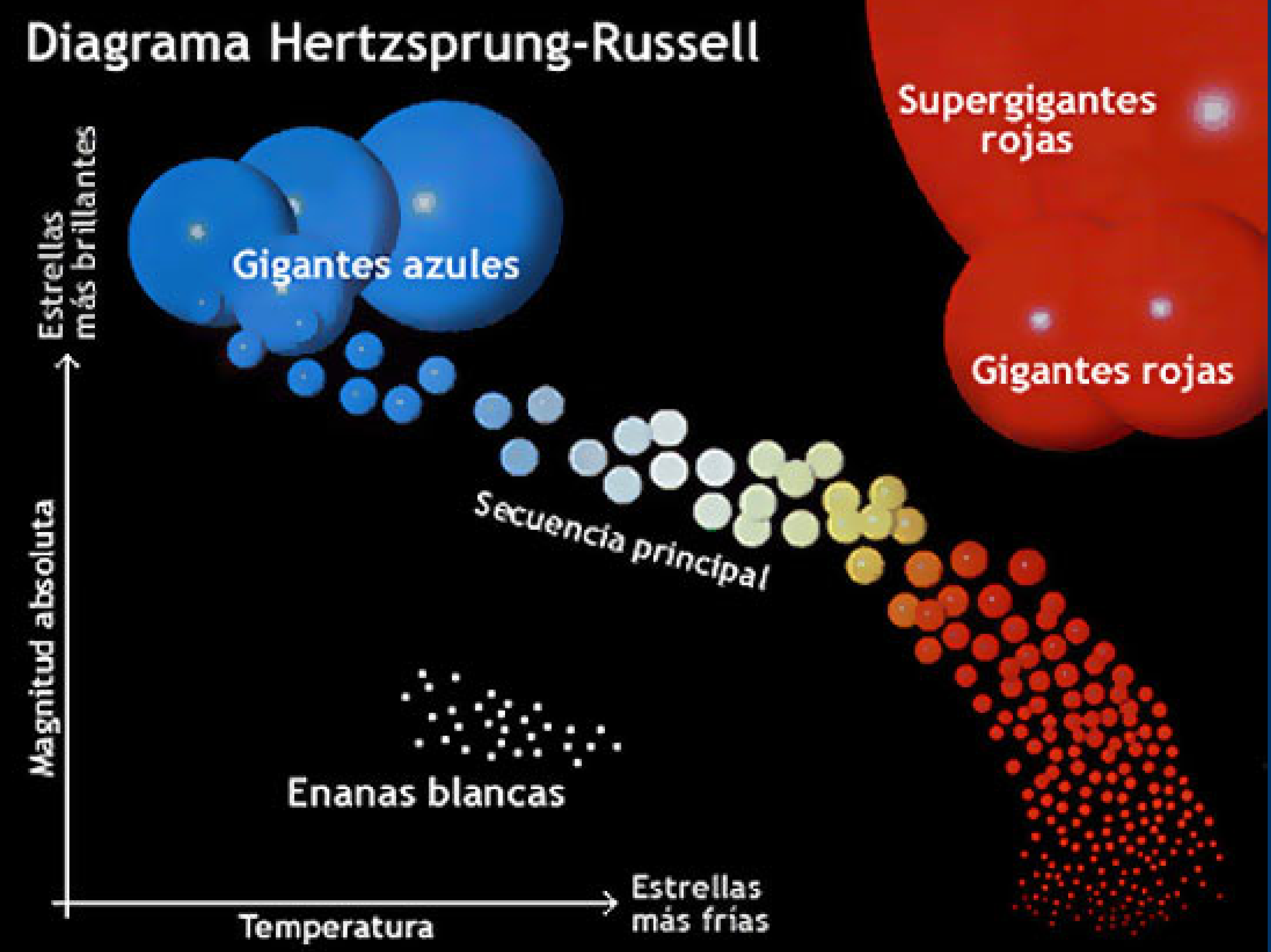
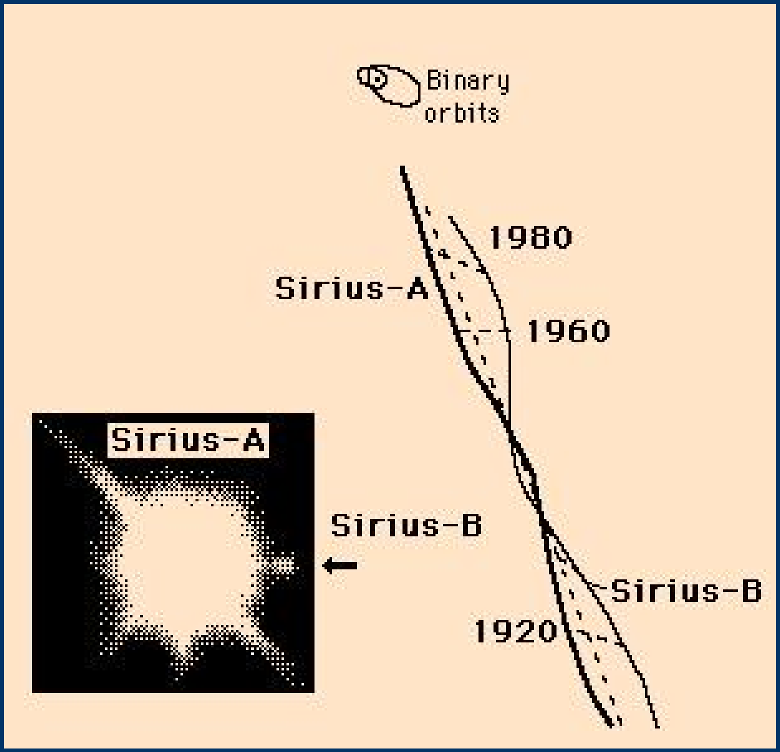


Diagrama Hertzsprung-Russell
Supergigantes rojas
Gigantes azules
Gigantes rojas
Estrellas más brillantes
Secuencia principal
Magnitud absoluta
Enanas blancas
Estrellas más frías
Temperatura

Las estrellas Enanas Blancas



1^{ras} EB conocidas

40 Eridani B	Herschel	1783
Sirio B	Clark	1862
Proción B	Schaberle	1896

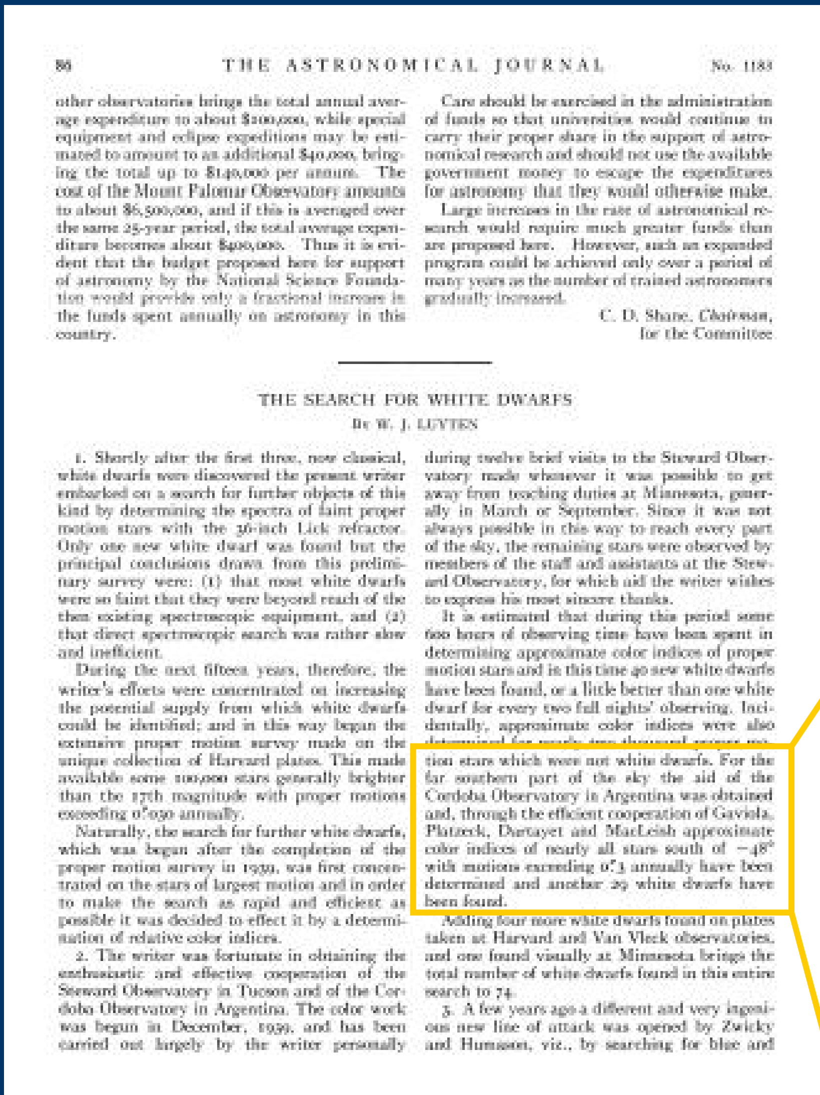
Año	EBs
1901	3
1939	18
1950	111
1999	2249

40 Steward
29 Córdoba
42 otros

EB: estrellas débiles con altos movimientos propios

Observatorio de Córdoba 1950

En la búsqueda de Enanas Blancas



other observatories brings the total annual average expenditure to about $200,000, while special equipment and eclipse expeditions may be estimated to amount to an additional $40,000, bringing the total up to $140,000 per annum. The cost of the Mount Palomar Observatory amounts to about $6,500,000, and if this is averaged over the same 25-year period, the total average expenditure becomes about $400,000. Thus it is evident that the budget proposed here for support of astronomy by the National Science Foundation would provide only a fractional increase in the funds spent annually on astronomy in this country.

Care should be exercised in the administration of funds so that universities would continue to carry their proper share in the support of astronomical research and should not use the available government money to escape the expenditures for astronomy that they would otherwise make.

Large increases in the rate of astronomical research would require much greater funds than are proposed here. However, such an expanded program could be achieved only over a period of many years as the number of trained astronomers gradually increased.

C. D. Shane, *Chairman*,
for the Committee

THE SEARCH FOR WHITE DWARFS

By W. J. LUYTEN

1. Shortly after the first three, now classical, white dwarfs were discovered the present writer embarked on a search for further objects of this kind by determining the spectra of faint proper motion stars with the 36-inch Lick refractor. Only one new white dwarf was found but the principal conclusions drawn from this preliminary survey were: (1) that most white dwarfs were so faint that they were beyond reach of the then existing spectroscopic equipment, and (2) that direct spectroscopic search was rather slow and inefficient.

During the next fifteen years, therefore, the writer's efforts were concentrated on increasing the potential supply from which white dwarfs could be identified; and in this way began the extensive proper motion survey made on the unique collection of Harvard plates. This made available some 100,000 stars generally brighter than the 17th magnitude with proper motions exceeding 0.″030 annually.

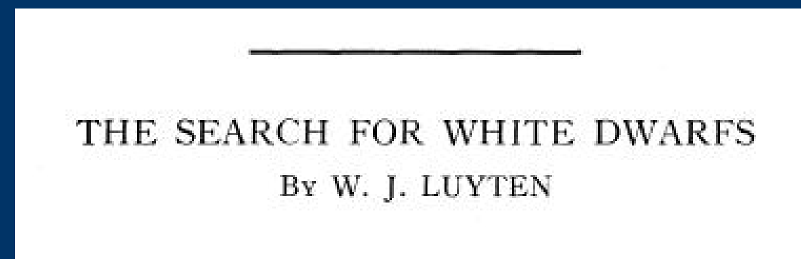
Naturally, the search for further white dwarfs, which was begun after the completion of the proper motion survey in 1939, was first concentrated on the stars of largest motion and in order to make the search as rapid and efficient as possible it was decided to effect it by a determination of relative color indices.

2. The writer was fortunate in obtaining the enthusiastic and effective cooperation of the Steward Observatory in Tucson and of the Cordoba Observatory in Argentina. The color work was begun in December, 1939, and has been carried out largely by the writer personally during twelve brief visits to the Steward Observatory made whenever it was possible to get away from teaching duties at Minnesota, generally in March or September. Since it was not always possible in this way to reach every part of the sky, the remaining stars were observed by members of the staff and assistants at the Steward Observatory, for which aid the writer wishes to express his most sincere thanks.

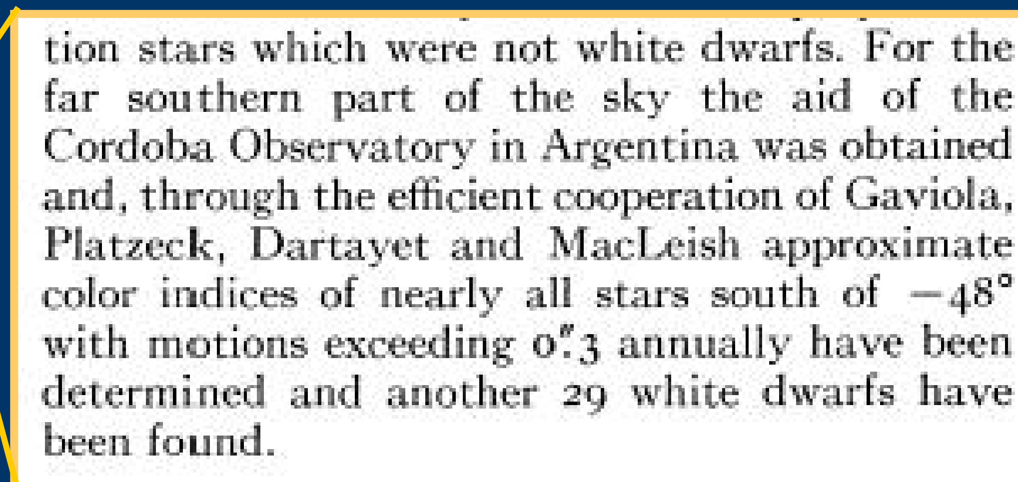
It is estimated that during this period some 600 hours of observing time have been spent in determining approximate color indices of proper motion stars and in this time 40 new white dwarfs have been found, or a little better than one white dwarf for every two full nights' observing. Incidentally, approximate color indices were also determined for nearly two thousand proper motion stars which were not white dwarfs. For the far southern part of the sky the aid of the Cordoba Observatory in Argentina was obtained and, through the efficient cooperation of Gaviola, Platzeck, Dartayet and MacLeish approximate color indices of nearly all stars south of $-48°$ with motions exceeding 0.″3 annually have been determined and another 29 white dwarfs have been found.

Adding four more white dwarfs found on plates taken at Harvard and Van Vleck observatories, and one found visually at Minnesota brings the total number of white dwarfs found in this entire search to 74.

3. A few years ago a different and very ingenious new line of attack was opened by Zwicky and Humason, viz., by searching for blue and



THE SEARCH FOR WHITE DWARFS
By W. J. LUYTEN



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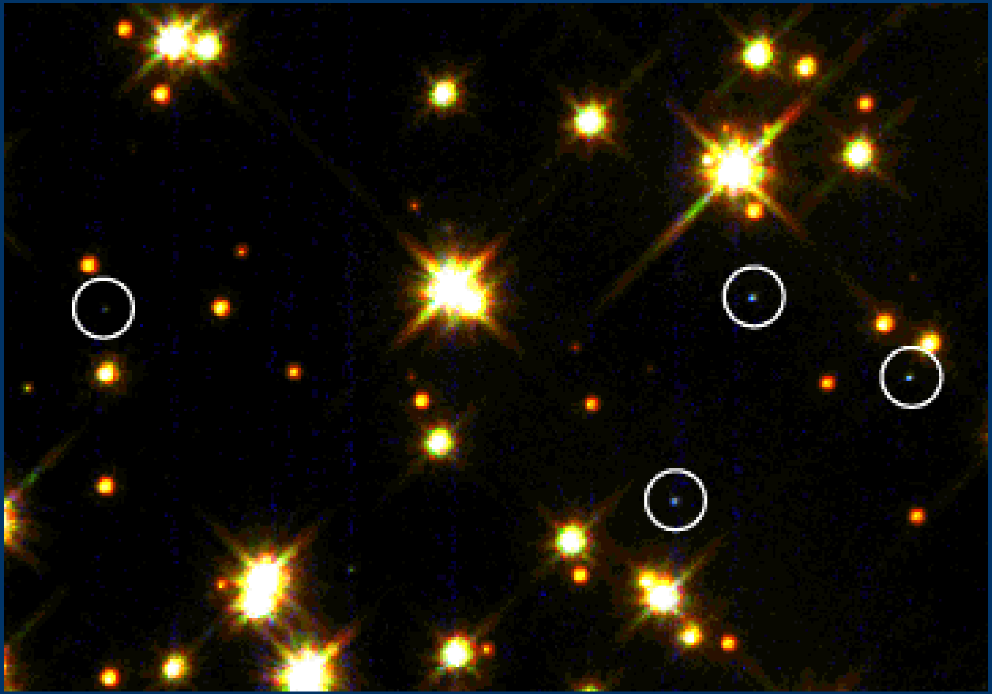
Detecciones actuales de EB

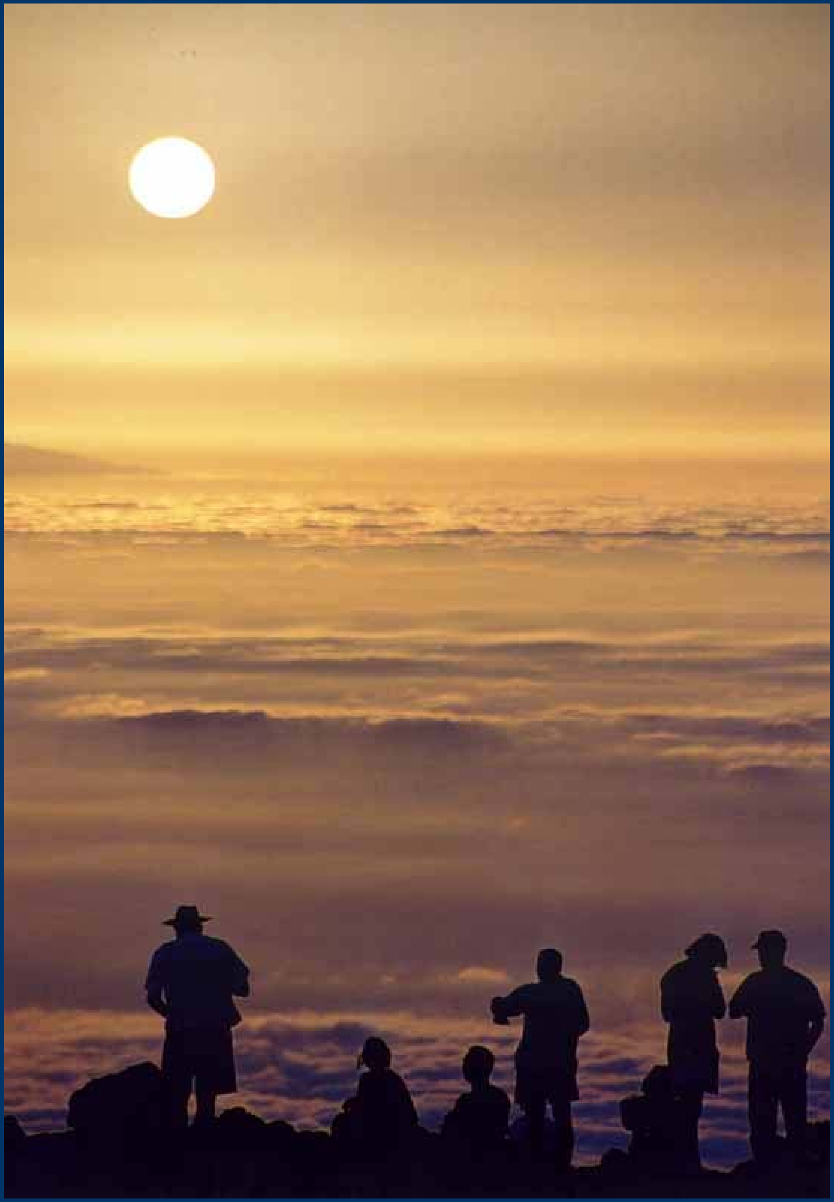
Cúmulo globular M4 (HST)
75 EB descubiertas (1995)



…en cúmulos de estrellas

…en la vecindad solar

Albus: 12ª EB + brillante (julio 2007)

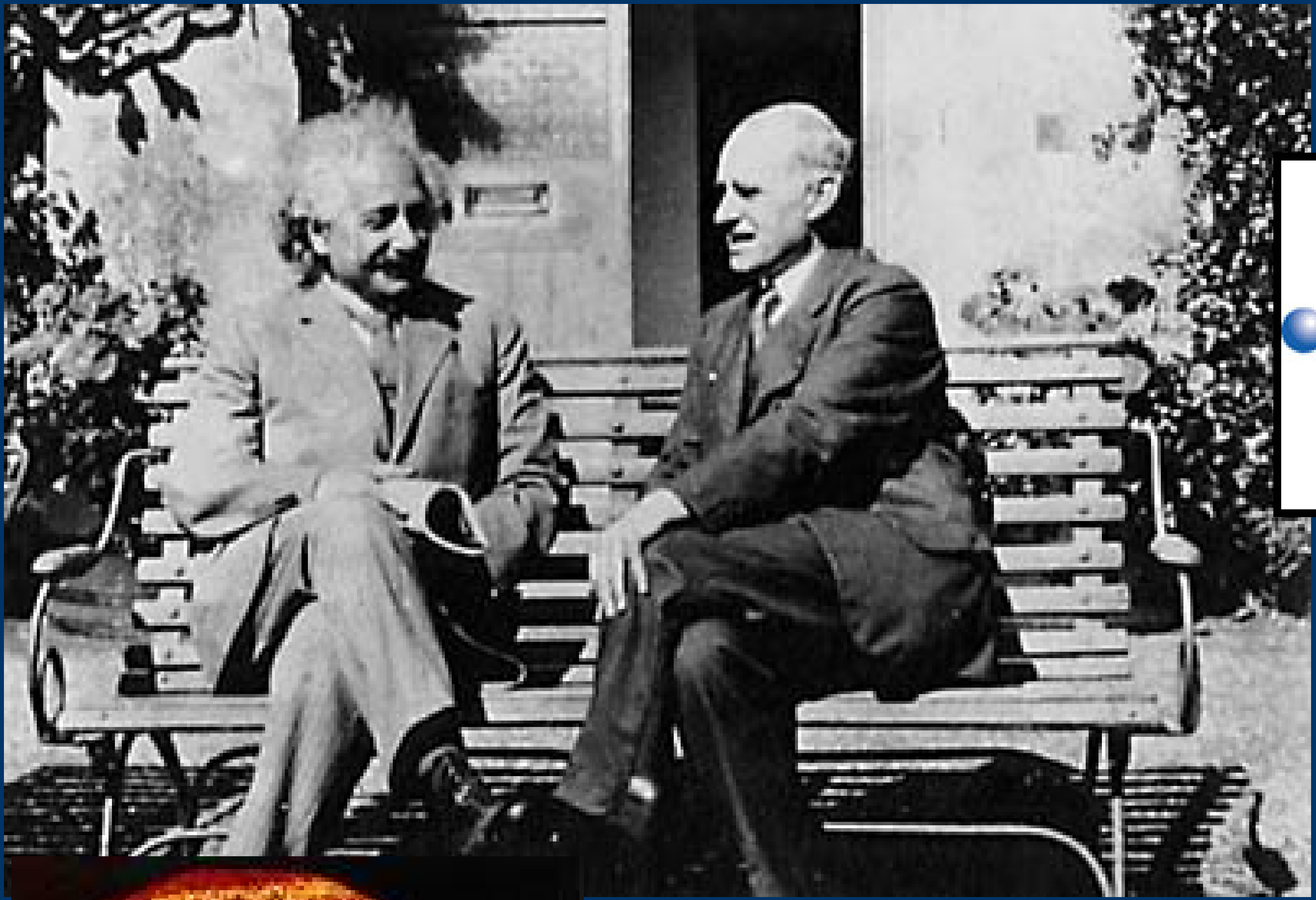


¿Porqué brillan las estrellas?

Gas incandescente

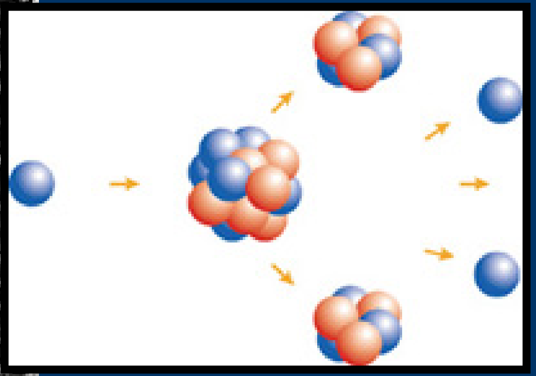
¿Fuente de energía?

- Contracción gravitatoria
- Radiactividad
- Combustión química
- Combustión nuclear

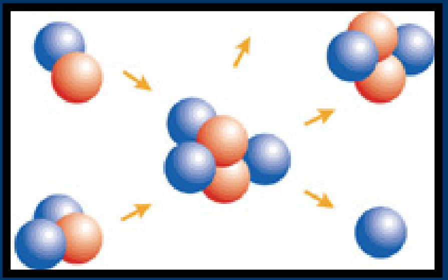


Einstein (1879-1955)
Eddington (1882-1944)

Fisión



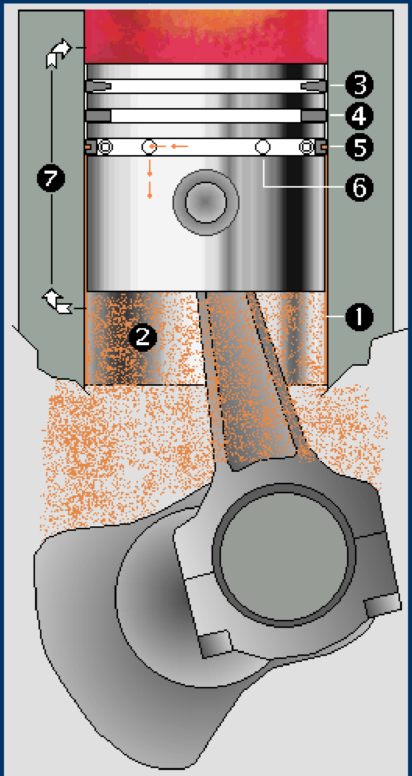
Fusión



$$\Delta E = \Delta m\, c^2$$

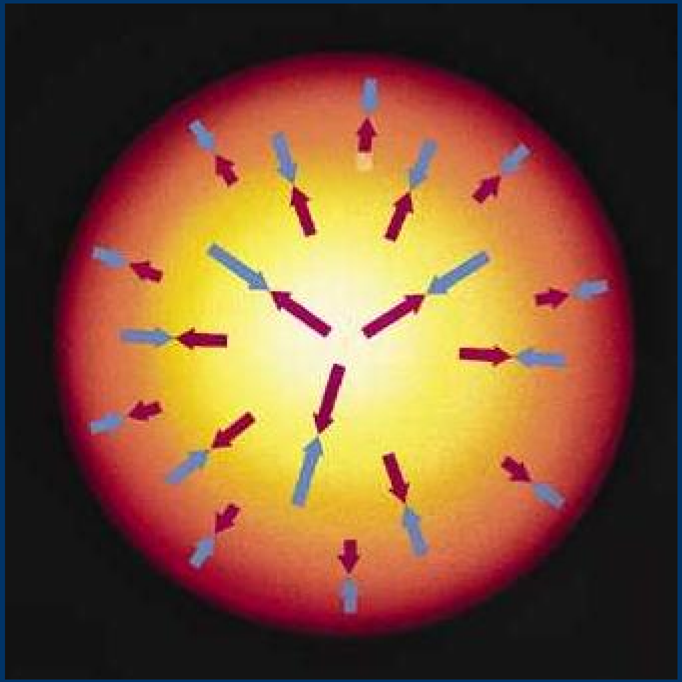
Presión: incremento de la temperatura

Motor Diesel



...por pistón

Estrella



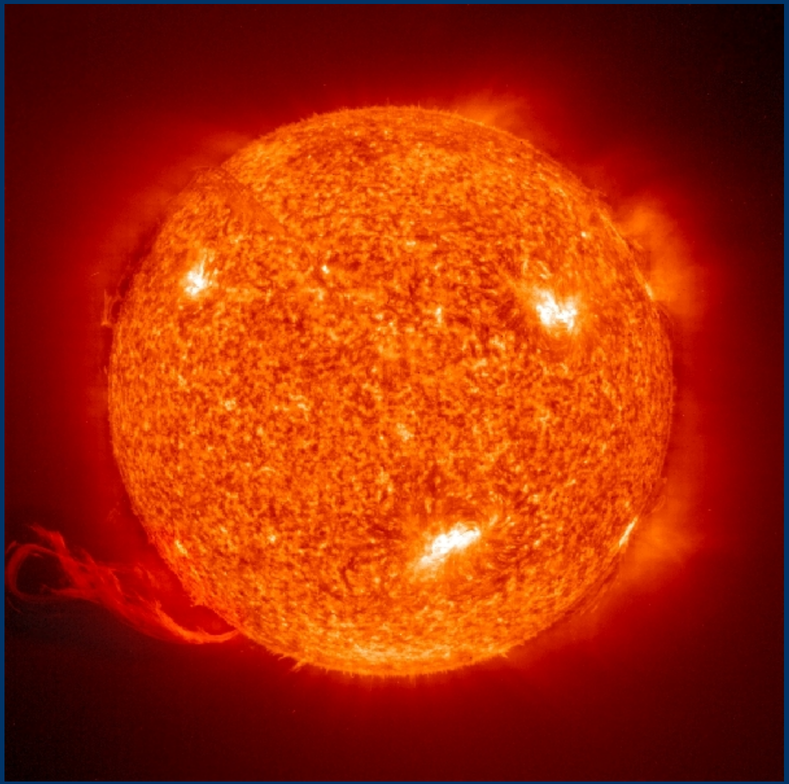
...por gravedad

Fusión Nuclear

Bomba H

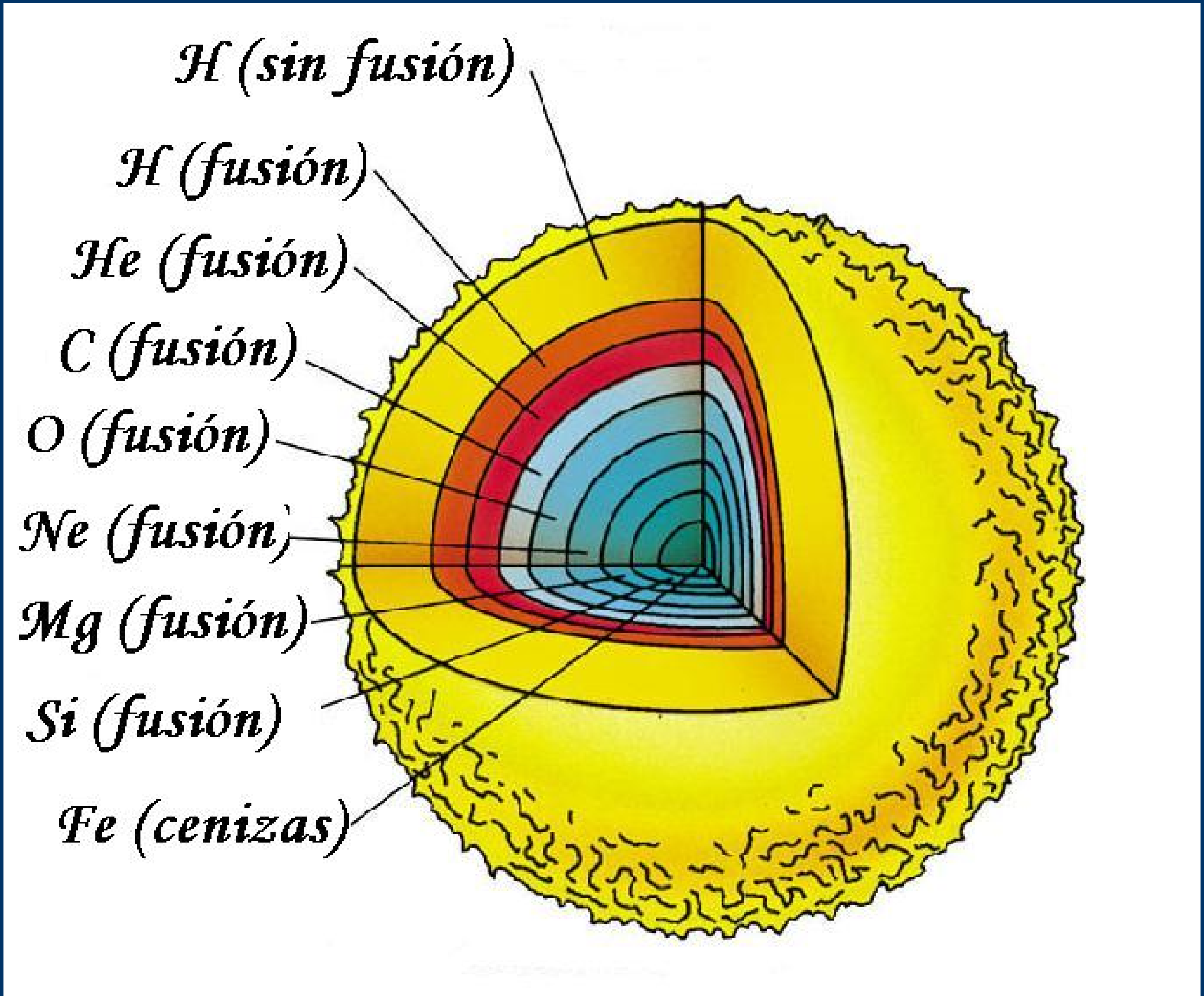
…por implosión

Estrella

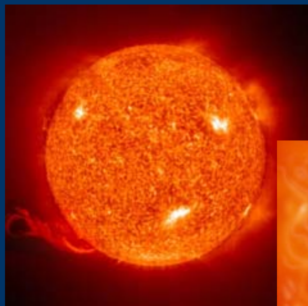


…por gravedad

Combustión nuclear



Evolución



Sol Actual

Gigante Roja

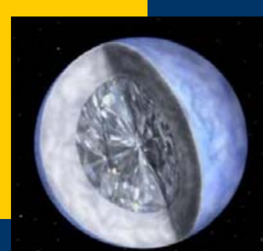
Nebulosa Planetaria

Enana Blanca:

Masa: 0,6 masas solares

Radio: 8000 km

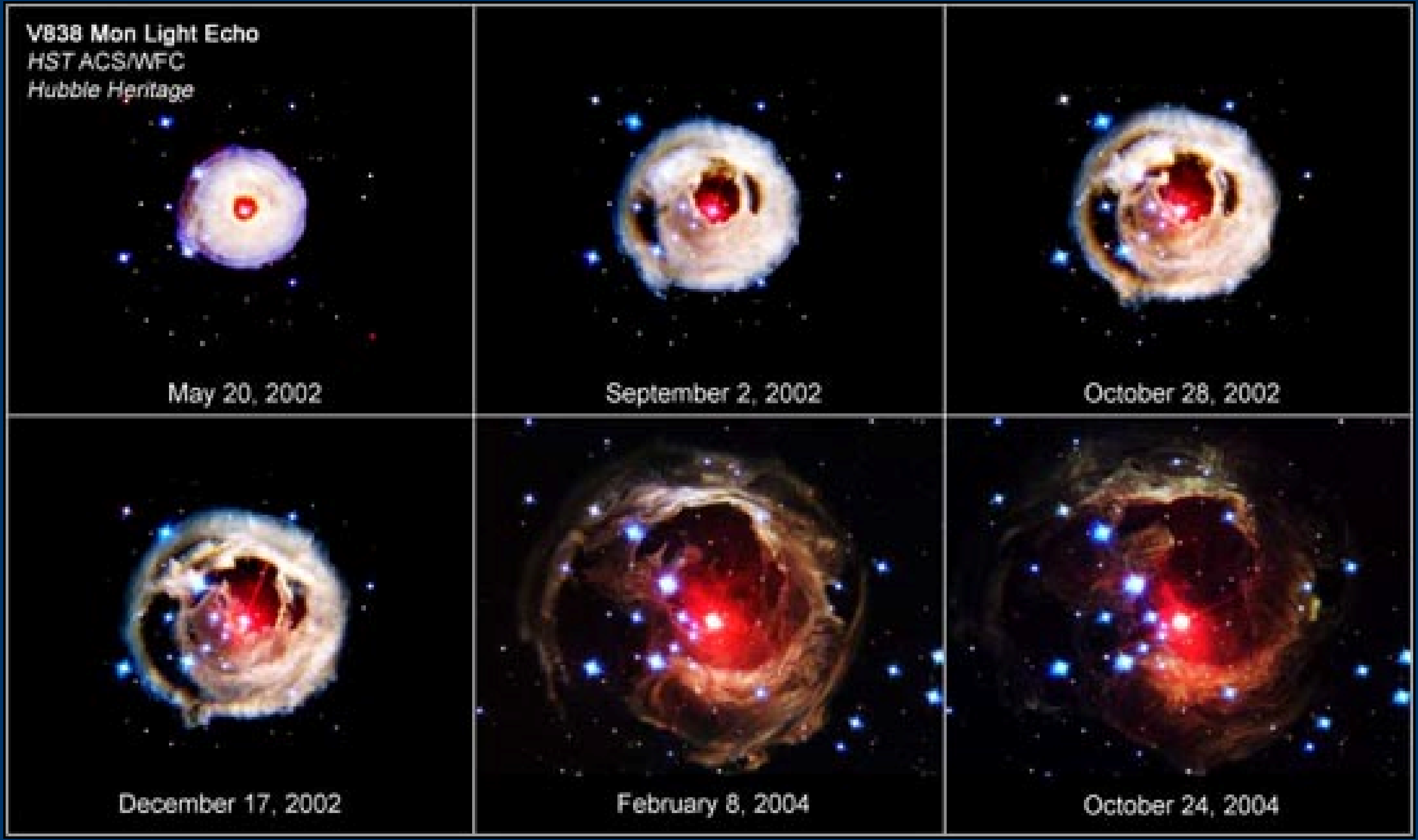
Densidad: 10^6 g/cc



Enana Blanca
y restos

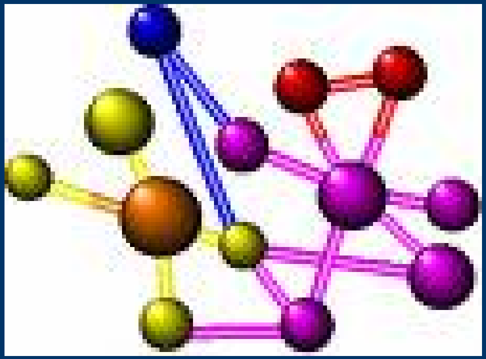
V838 Monocerotis
(20.000 años luz)

Expulsión de material (ej.)

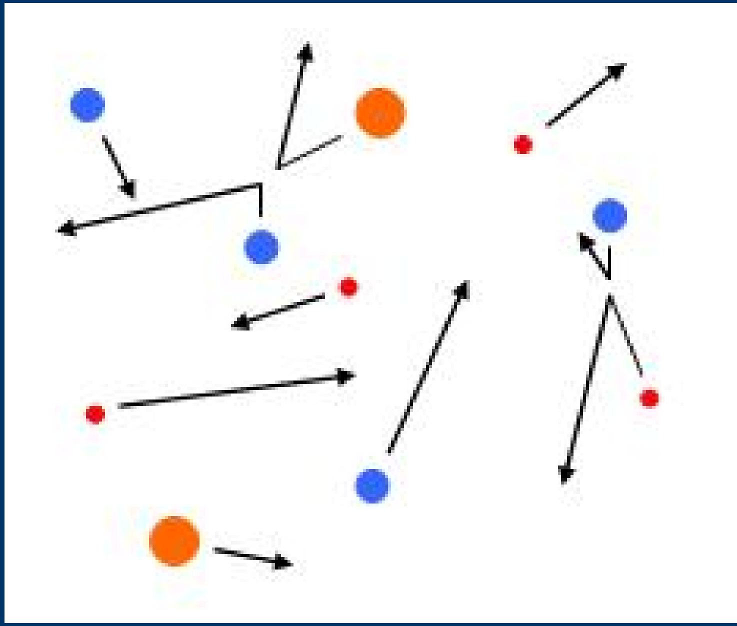


Quizás en la frontera entre supernovas y formación de una EB

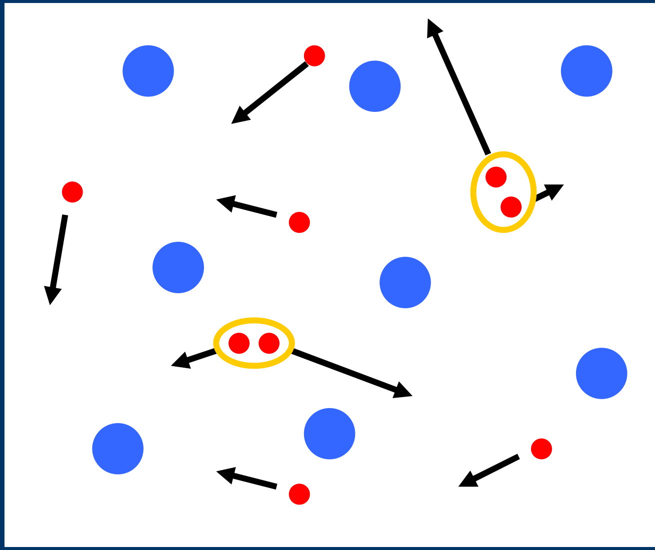
¿Cómo detener el colapso gravitatorio?



Electrostática, materiales habituales



Agitación térmica, gases



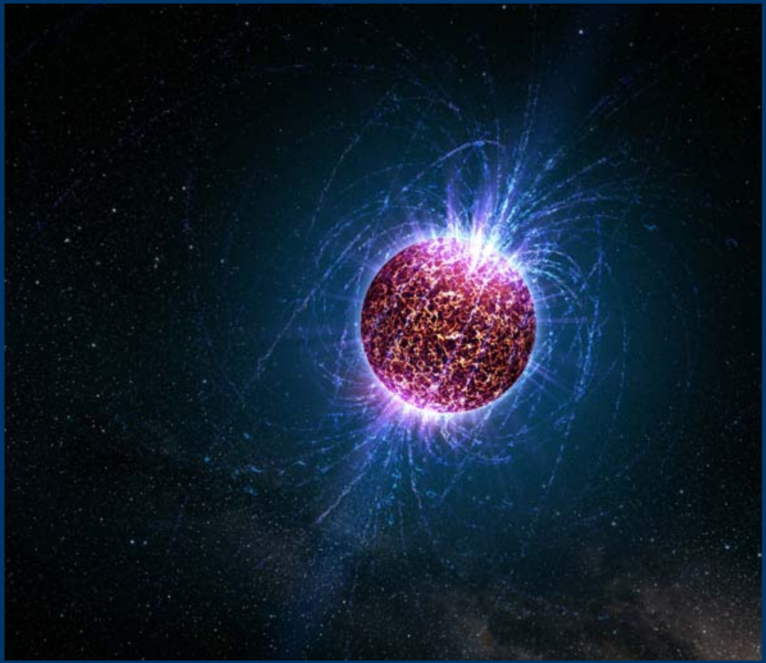
Degeneración electrónica, materia súper-densa

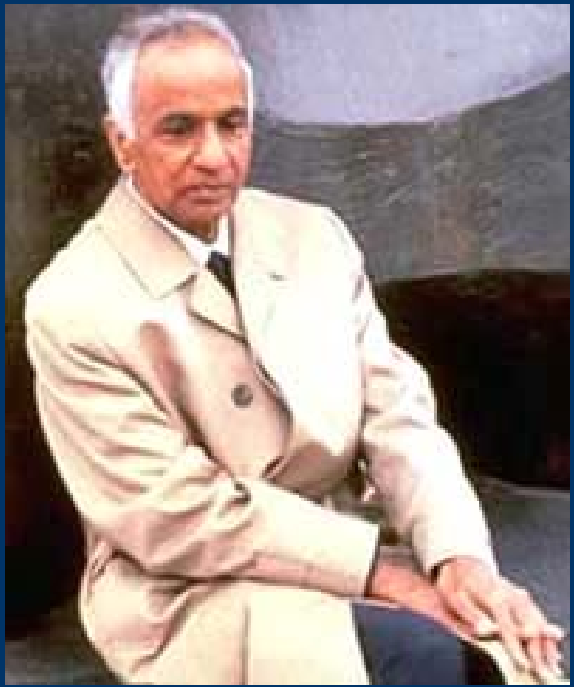
Límite de Chandrasekhar

$M < 1.44\ M_{Sol}$

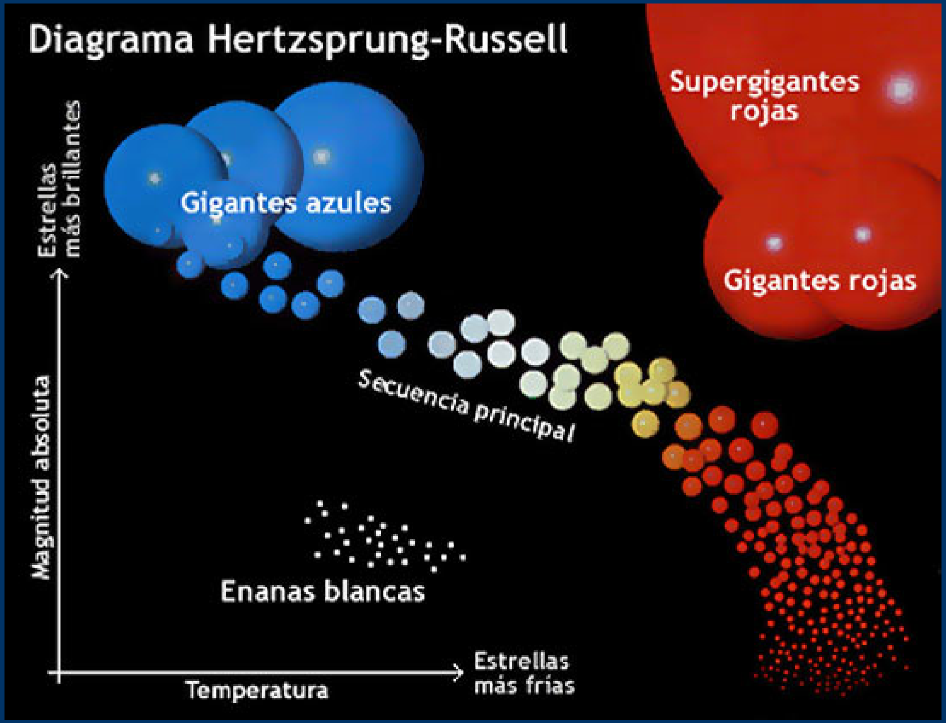
[1931-1935]

Subrahmanyan Chadrasekhar, astrofísico hindú (1910-1995)





Cronología



1785 Primera EB detectada

1913 EB como estrellas atípicas

1922 Se populariza su nombre

1926 Interior degenerado

1931 Límite de masa

1950 Origen en la evolución estelar

1984 Primer estudio evolutivo detallado

Predicciones para la Galaxia

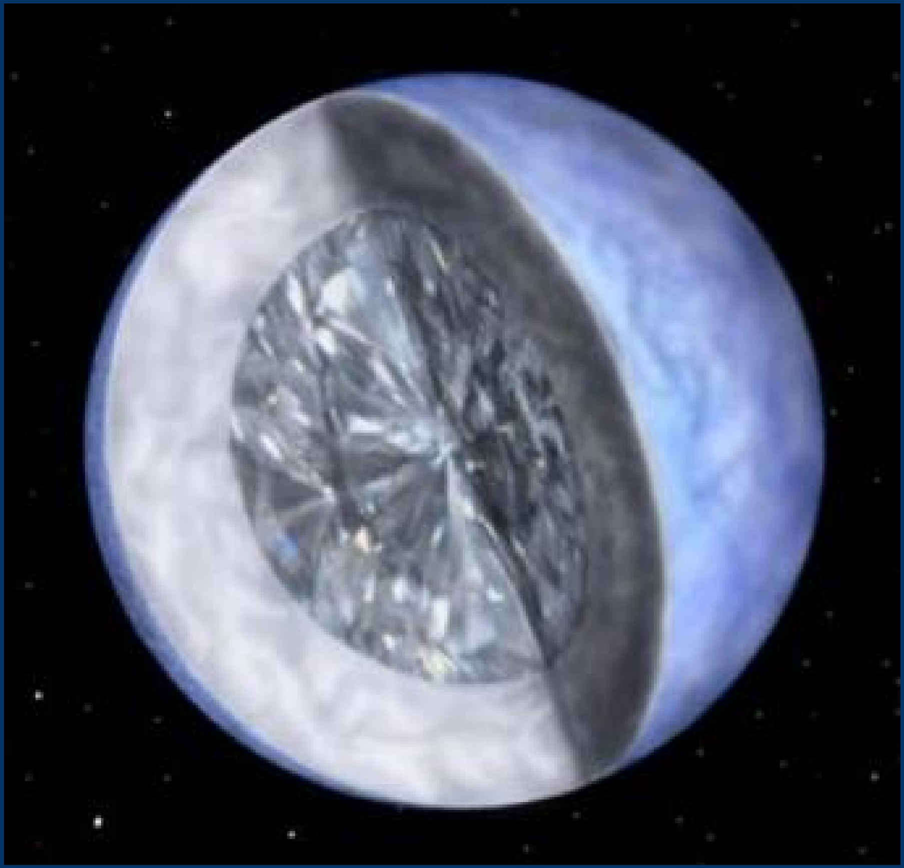
150.000 millones de estrellas
95-98% terminará como EB

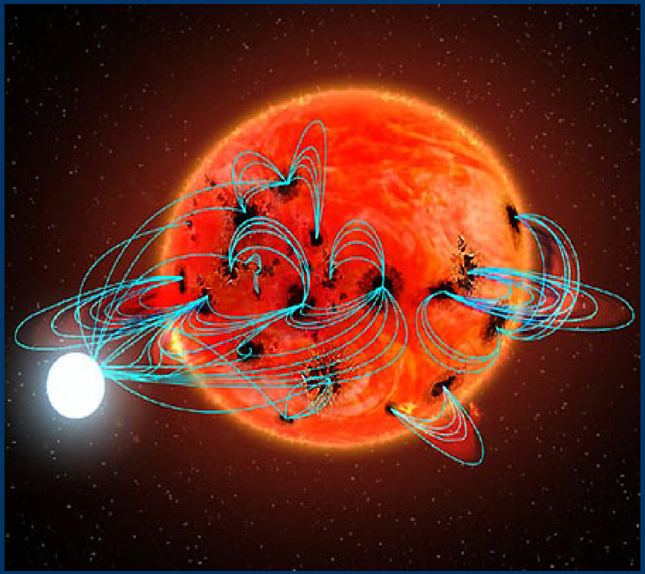
Actualmente:
1000 millones de EB
250 millones en binarias

Nace una EB cada 2 años

Enfriarse, sólo enfriarse …

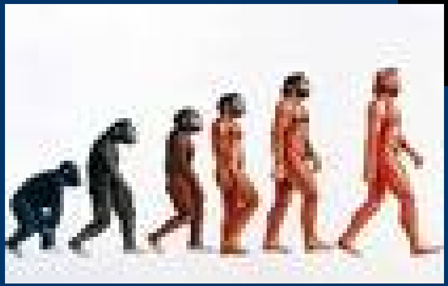
- Cristalización
- Sedimentación
- "Azulamiento"





Enanas Blancas: relojes cósmicos

10.000 millones de años



1 o 2 millones de años