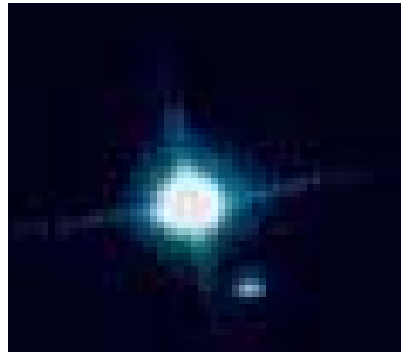# Discovery of White Dwarfs—7 Oct

- Hertzsprung-Russell diagrams
- Magnitude, apparent & absolute
- Adams' discovery
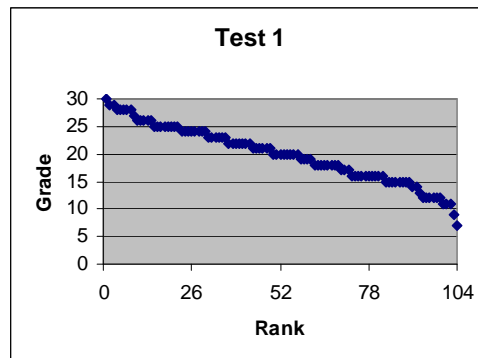

Sirius A & B
http://chandra.harvard.edu/photo/2000/0065/0065_optical.jpg

Test 1

- Statistics
  - Top quartile: 24, 80%
  - Median: 20, 67%
  - Bottom quartile: 16, 53%

Luminosity and flux

- Luminosity = amount of energy per second (Watt) produced by the star
  - $L = R^2 T^4$
- Flux = energy per second received by a detector on earth (Watt/m^2)
  - $F = L/D^2$
1. As viewed from Earth, which is the faintest star?
   - A. Sun
   - B. <u>Vega</u>
   - C. Sirius

   Use flux
2. As viewed from a distance of 10 pc from each star, which is the faintest star?
   <u>Sun</u>

   Use luminosity

Star	Apparent mag	Flux		Absolute mag	Luminosity		Distance
		[W/m^2]	[f$_{Vega}$]		[W]	[L$_{sun}$]	[pc]
Sun	-26.7	1400	5.2×10^{10}	4.8	3.9×10^{26}	1	5×10^{-6}
Vega	0.0	2.7×10^{-8}	1	0.5	2.1×10^{28}	54	8
Sirius	-1.45	1.1×10^{-7}	3.9	1.4	9.0×10^{27}	23	2.7

Apparent & Absolute Magnitude

- Apparent mag is a logarithmic expression of flux
- If the apparent mag <u>changes</u> by -2.5, the flux is brighter by a <u>factor</u> of 10.
  - If the apparent mag <u>changes</u> by +2.5, the flux is fainter by a <u>factor</u> of 10.
1. The apparent magnitude of a star is +2.5. Its flux is
   - A. 2.7×10^{-6} W/m^2.
   - B. 2.7×10^{-7} W/m^2.
   - C. 2.7×10^{-8} W/m^2.
   - D. <u>2.7×10^{-9} W/m^2.</u>
   - E. 2.7×10^{-10} W/m^2.
2. The apparent magnitude of a star is +5. Its flux is

Star	Apparent mag	Flux		Absolute mag	Luminosity		Distance
		[W/m^2]	[f$_{Vega}$]		[W]	[L$_{sun}$]	[pc]
Sun	-26.7	1400	5.2×10^{10}	4.8	3.9×10^{26}	1	5×10^{-6}
Vega	0.0	2.7×10^{-8}	1	0.5	2.1×10^{28}	54	8
Sirius	-1.45	1.1×10^{-7}	3.9	1.4	9.0×10^{27}	23	2.7

Apparent & Absolute Magnitude

- Apparent mag is a logarithmic expression of flux
- If the apparent mag <u>changes</u> by −2.5, the flux is brighter by a <u>factor</u> of 10.
- Fluxes and magnitudes of two stars A and B
  - $f_B/f_A = 10^{-(mB-mA)/2.5}$
  - $m_B - m_A = -2.5 \log(f_B/f_A)$
- Try it
  - If m_B is −2.5 more than m_A, $m_B - m_A = -2.5$, and
    $f_B/f_A = 10^{-(-2.5)/2.5} = 10^1 = 10$.
  - If B is brighter by a factor of 10, $f_B/f_A = 10$, and
    $m_B - m_A = -2.5 \log(10) = -2.5$.

Apparent & Absolute Magnitude

- Apparent mag is a logarithmic expression of flux
  - If the apparent mag <u>changes</u> by -2.5, the flux is brighter by a <u>factor</u> of 10.
- Absolute mag is a logarithmic expression of luminosity
  - Abs mag of a star is its apparent mag if the star is moved to a distance of 10 pc.
  - If the abs mag <u>changes</u> by -2.5 mag, the luminosity is brighter by a <u>factor</u> of 10.
1. The absolute magnitude of a star is -2. Its luminosity is
   A. 2.1×10^{26} W.
   B. 2.1×10^{27} W.
   C. 2.1×10^{28} W.
   D. <u>2.1×10^{29} W.</u>
   E. 2.1×1030 W.

Star	Apparent mag	Flux		Absolute mag	Luminosity		Distance
		[W/m²]	[f_{Vega}]		[W]	[L_{sun}]	[pc]
Sun	-26.7	1400	5.2×10^{10}	4.8	3.9×10^{26}	1	5×10^{-6}
Vega	0.0	2.7×10^{-8}	1	0.5	2.1×10^{28}	54	8
Sirius	-1.45	1.1×10^{-7}	3.9	1.4	9.0×10^{27}	23	2.7

Hertzsprung-Russell Diagram of a star cluster M15
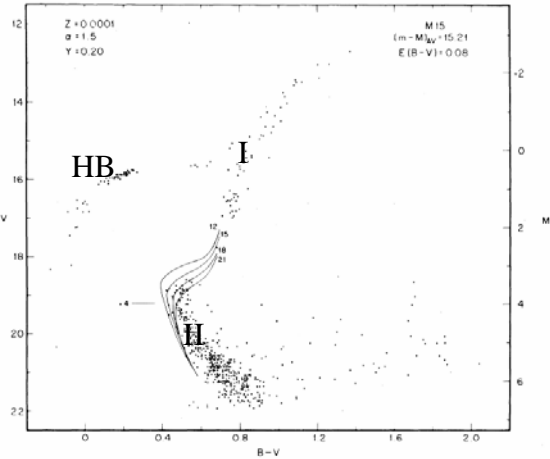
- Observations of M15 show
  - Main-sequence or dwarf stars
  - Giants
  - Horizontal-branch stars
  - White dwarfs are too faint for these observations.
1. Stars in region I and II are
   - A. MS & MS
   - B. MS & G
   - C. <u>G & MS</u>
   - D. G & G
2. The luminosity of a star at I is ___ times the luminosity of a star at II.
   - A. 1000
   - B. <u>100</u>
   - C. 10
   - D. 1/10
   - E. 1/1000

Hertzsprung-Russell Diagram of nearby stars

1. Stars in region X are
   - A. Dwarfs
   - B. Giants
   - C. <u>White dwarfs</u>