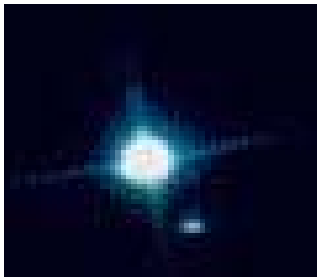
Discovery of White Dwarfs—1 Oct

- Adams' discovery
- Magnitude, apparent & absolute
- Why are white dwarfs much smaller than stars like the sun?
- Normal gas & degenerate gas



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

- Homework 4 and 5 are due on Wed, Oct 8. No late papers.
- Test 2 is on Fri, Oct 10.
  - Covers material through class on Fri, Oct 3.
  - It will be mostly on material not covered on Test 1.
  - Practice test (with answers) is on the web.
  - Last 15min of class of Wed, Oct 8 will be Missouri club.
- Observing session next week is cancelled. go to public observing on 10-11 (link on syllabus) if you are interested.
- I will be in Chile to set up the Spartan Infrared Camera during the week of 13-17.
  - Jack Baldwin will teach for me.

Luminosity and flux

- Luminosity = amount of energy per second (Watt) produced by the star
  - $L=R^2T^4$
- 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. Vega
   C. Sirius
2. As viewed from a distance of 10 pc from each star, which is the faintest star?

Use flux

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 logarithmetic expression of flux
- If the apparent mag changes by -2.5, the flux is brighter by a factor of 10.
  - If the apparent mag changes by +2.5, the flux is fainter by a factor 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. 2.7×10^{-9}W/m^2.
   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
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Apparent & Absolute Magnitude

- Apparent mag is a logarithmetic expression of flux
- If the apparent mag changes by –2.5, the flux is brighter by a factor of 10.
- Fluxes and magnitudes of two stars A and B
  - $f_B/f_A = 10^{-(mB-mA)/2.5}$
  - $m_B - m_A = -2.5 \log(f_B/f_A)$

Star	Apparent mag	Flux		Absolute mag	Luminosity		Distance
		[W/m^2]	[f_{Vega}]		[W]	[L_{sun}]	[pc]
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Apparent & Absolute Magnitude

- Apparent mag is a logarithmetic expression of flux
  - If the apparent mag changes by -2.5, the flux is brighter by a factor of 10.
- Absolute mag is a logarithmetic 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 changes by -2.5 mag, the luminosity is brighter by a factor 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. 2.1×10^{29} W.
   E. 2.1×1030 W.

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}
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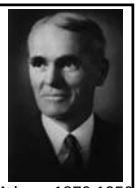
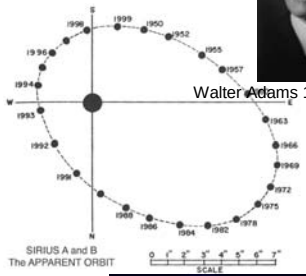
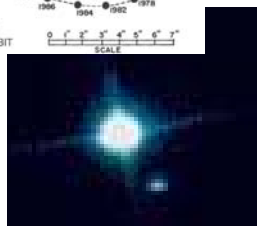
Sirius A and Sirius B

- We are Walter Adams of the Mt. Wilson Observatory in 1914. We are studying the double star Sirius A and B. (Sirius A & B orbit each other.)
- Sirius B is much fainter than Sirius A.



Walter Adams 1876-1956





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1. Sirius B may be faint for two reasons. It may be small or it may be
   A. farther away
   B. closer
   C. cooler
   D. hotter

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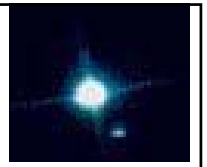
- Adams found that Sirius A and B have about the same color. Therefore Sirius B is smaller.

Sirius A and Sirius B



- Adams found that Sirius A and B have about the same color. Therefore Sirius B is smaller.
  - $L=R^2T^4$
- How much smaller is Sirius B?
- Apparent mag of Sirius A is –1.5
- Apparent mag of Sirius B is 8.7

1. The mag of Sirius B is approximately __ steps of 2.5 fainter than that of Sirius A.
   A. 4
   B. 5
   C. 6
   D. 10
2. The flux of Sirius B is approximately __ fainter.
   A. a factor 10
   B. a factor of 100
   C. a factor of 1000
   D. a factor of 10,000.

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Sirius A and Sirius B

- Adams found that Sirius A and B have about the same color. Therefore Sirius B is smaller.
  - $L=R^2T^4$
- How much smaller is Sirius B?
- Apparent mag of Sirius A is –1.5
- Apparent mag of Sirius B is 8.7

1. The mag of Sirius B is 4 steps of 2.5 fainter than that of Sirius B.
2. The flux of Sirius B is approximately __ fainter.
   A. a factor 10
   B. a factor of 100
   C. a factor of 1000
   D. a factor of 10,000.
- The radius of Sirius B is 1/100 that of Sirius A.
  - Sirius B is about the size of the Earth.

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Summarizing question

- Why was finding of Sirius B's spectral class crucial to discovery of white dwarfs?