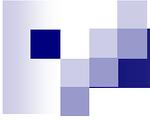


Development of the incandescent light bulb

Kai Lippert



Outline

- History of the light bulb
- Technical Details
- The Centennial Light
- Will the light bulb die out?





History of the light bulb

- 1 Mio. years ago fire was used as a lightsource and for protection.
- 40000 years ago oil lamps were used
- 4000 years ago candles were made from fat and wax
- 1800 first gas-lights were installed (London)

- 1801 Louis J. des Thenard observes that metall glows when it is connected to current.
- 1820 Arthur de la Rive observes a piece of Pt-wire glowing in the vacuum.
- 1854 Heinrich Göbel invents the first light bulb with a charred bamboo filament.
- 1878 J.W. Swan invents carbon filament lamp (UK)



- 1879 Thomas A. Edison also invents a light bulb with a bamboo filament. (USA)

27.01.1880 Patent Nr. 223898



- 1883 Edison and Swan establish a firm in London.
- 1883 first in Germany produced light bulb.
- 1890 Carl Auer von Welsbach gets a patent for the production of Os and W. He founds the firm Osram.

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- 1890 A.N. Lodygim tries to replace the bamboo filament by a metall wire.
 - 1897 W. Nernst invents the „Nernststift“ (today IR-radiator).
 - 1902 O. Feuerlein and W.von Bolton use Ta for their light bulbs.
 - 1903 W.Whitnew covers a carbon filament with metall to prevent the evaporation of the filament.

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- 1905 light bulbs with Ta are produced, till 1st World War more than 50 Mio. pieces.
 - 1906 GE gets a patent for the production of W filaments
 - 1910 W.D. Coolidge is able to produce cheap W.
 - 1911 I.Langmuir uses Ar-N₂ for filling the glas bulb and increases the lifetime

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- 1936 Krypton is used as filling gas. The so called “coiled coil” is invented.
 - 1958 Xenon is used as filling gas.
 - 1960 Halogen lamps were invented. First LEDs

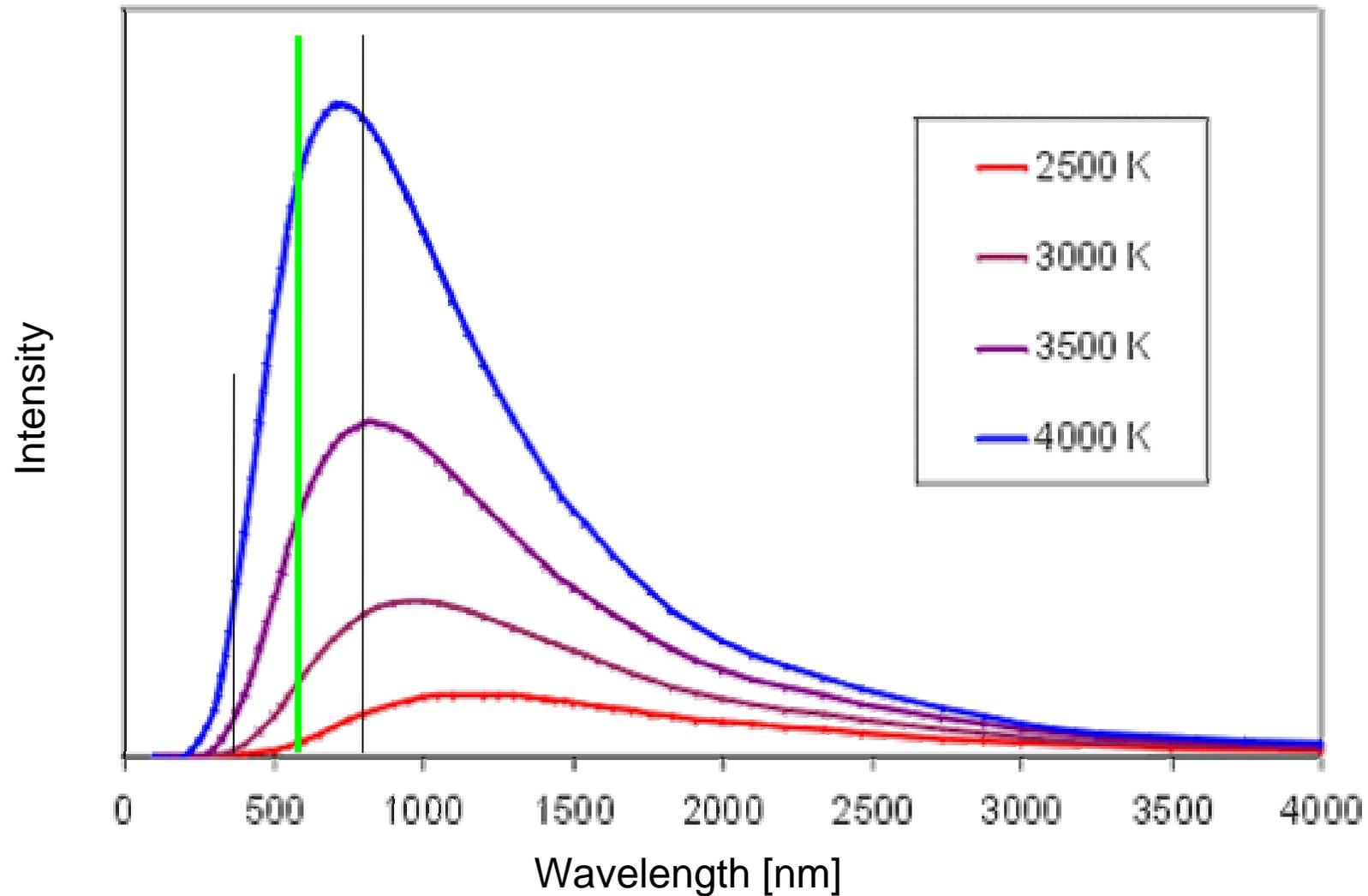
Technical Details

Comparison of different light bulbs

<i>Kohlenfaden-Lampen</i>		<i>Wolframdraht-Lampen</i>		
<i>Goebel-Lampe</i>	<i>Edison-Lampe</i>	<i>Einfachwendel-Lampe</i>	<i>Doppelwendel-Lampe</i>	
<i>1854</i>	<i>1881</i>	<i>Herstellungsjahr</i>	<i>1915</i>	<i>1935</i>
<i>75 W</i>	<i>75 W</i>	<i>Leistungsaufnahme</i>	<i>75 W</i>	<i>75 W</i>
<i>42.5 V</i>	<i>103 V</i>	<i>Spannung</i>	<i>110 V</i>	<i>110 V</i>
<i>70 lm</i>	<i>225 lm</i>	<i>Lichtleistung</i>	<i>1070 lm</i>	<i>1210 lm</i>
<i>~ 1 lm/W</i>	<i>~3 lm/W</i>	<i>Lichtausbeute</i>	<i>~14 lm/W</i>	<i>~16 lm/W</i>
<i>7 HK₀ (5,6 HK₀)</i>	<i>25 HK₀ (20 HK₀)</i>	<i>Lichtstärke</i>	<i>82 HK₀</i>	<i>96 HK₀</i>
<i>~100 Std.</i>	<i>~600 Std.</i>	<i>Lebensdauer</i>	<i>~800 Std.</i>	<i>~1000 Std.</i>



Dependence of the temperature and intensity





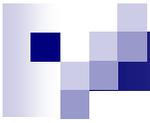
Some melting points of important materials

Ideal temperature for a
W-filament
would be 6600°C !

6600°C 95 lm/w

Max: 52 lm/w (3410°C)

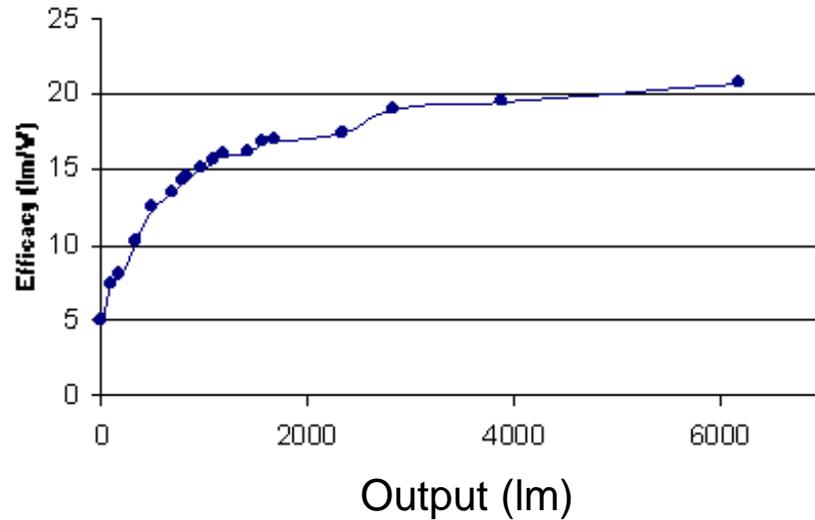
Element	Melting point
C	3550°C (3823K)
W	3410°C (3683K)
Re	3180°C (3453K)
Os	3045°C (3318K)
Ta	2996°C (3269K)
(Fe	1535°C (1808K))



Different types of light sources

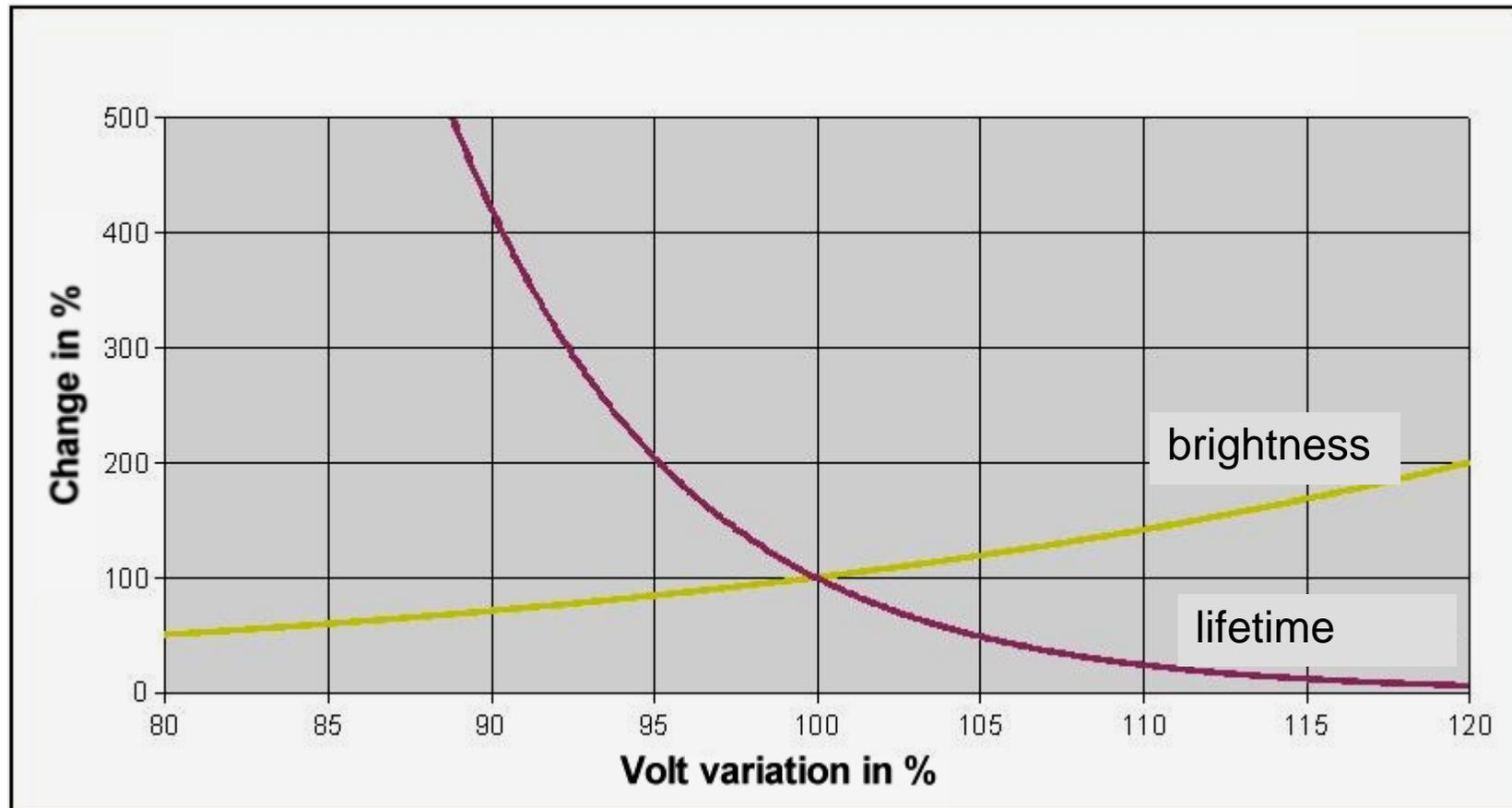
Type	Overall luminous efficiency	lm/w
40 W tungsten	1,9%	12,6
60 W tungsten	2,1%	14,5
100 W tungsten	2,6%	17,5
glass halogen	2,3%	16
quartz halogen	3,5%	24
high-temp. incandescent	5,1%	35
black body at 4000K	7,0%	47,5
black body at 7000K	14%	95
ideal white light source	35,5%	242,5
ideal green (555nm)	100%	683

Different lamps at 110 Volt

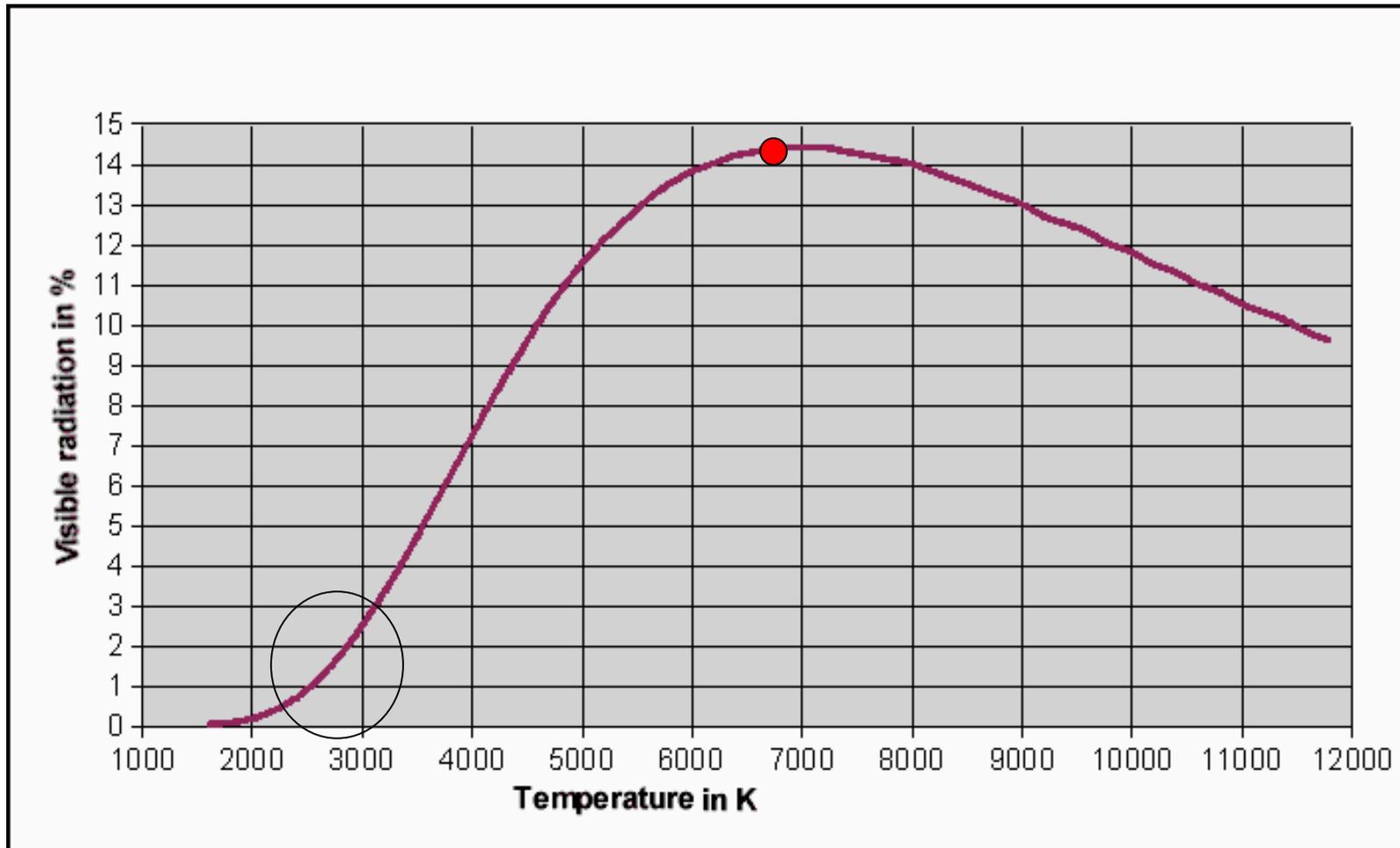


Power (W)	Output (lm)	Efficacy (lm/W)
5	25	5,0
15	110	7,3
25	200	8,0
35	350	10,3
40	500	12,5
50	700	13,5
55	800	14,2
60	850	14,5
65	1000	15,0
70	1100	15,7
75	1200	16,0
90	1450	16,1
95	1600	16,8
100	1700	17,0
135	2350	17,4
150	2850	19,0
200	3900	19,5
300	6200	20,7

Lifetime vs. Lumen output



Dependence of the temperature and the radiation



The Centennial Light

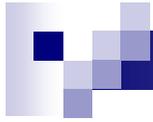
- Burns since 1901
- 4 Watts and 110 Volts
- C- filament





Will the light bulb die out?

- In 2005 F. Castro asks to use lamps with a maximum of 15 W
- Ireland forbids incandescent lights from 2009 on.
- Australia forbids incandescent lights from 2010 on.
- Italia also plans to bann the incandescent lights
- Canada wants to change 2012
- USA wants to change between 2012 and 2014



Thanks for Your attention



Sources

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