

radioactive substances within it.
0%
tidal action with Jupiter.
0%
chemical reactions.
0%
energy radiated from Jupiter and Sun.
0%

Saturn is unique in that it



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		_
ique in that it]
	is the only planet with rings.	0%
	is the only giant planet with more than 4	070
	moons.	0%
	is the brightest planet in our night sky.	006
	has the lowest average density of the	070
	planets	0%
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Pluto	's mass has been calculated from	
	its effect on passing spacecraft.	
		0%
	its effect on passing asteroids.	
		0%
	the motion of Charon.	
		0%
	all of the above.	
		0%
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They are mo	ore massive after the pa	ssage.	
			0%
They are mo	oving faster after passin	g the Sun.	
		5	0%
The Sun sta	rts nuclear reactions in	them.	
			0%
Their head a	ınd tail are larger after p	assing the Sun.	
			0%









OpenStax : chapters 15 & 16

Koupelis : chapter 12 OpenStax : chapters 17 & 18

Our Sun is an ordinary yellow star.



- 109 x diameter of Earth (orbit of Moon fits inside Sun!) • 333.000 x heavier than Earth • Density I.4 gr/cm³
- (comparable to Jupiter) • Rotation period 24.5 days
- (more slowly near the poles)
- Surface temp. is T = 5800 K• Power 3.9 x 10²⁶ Watt (at Earth: 1370 W/m²)

Note: I second supplies 500.000 years of energy consumption on Earth.. Note: 'limb darkening' of the solar disk.

Source of energy:

- Contraction : no only good for 100 million years
- Nuclear fusion : yes, through the 'proton-proton' cycle (via Deuterium and ³Helium to ⁴Helium)



Note: the Sun introduced the neutrino problem...



Energy transfer from the nucleus to the surface





distinguish: <u>Conduction</u> vs <u>Convection</u> vs <u>Radiation</u>

The atmosphere of the Sun

- <u>Photosphere</u> (H, He⁺), with sunspots and granulation
- Chromosphere, with prominences and spicules
- <u>Corona</u>
- <u>Solar wind</u> (and Coronal Mass Ejections)







Photosphere : <u>sunspots</u>

- relatively cool and dark areas
- visible for days to months
- indicate the rotation of the Sun
- appear within 35° latitude from the equator
 appear in cycles of 11, or better, 22 years





Sunspots...





During a cycle, Sunspots first appear at higher latitudes, and later on become visible near the equator: *butterfly diagram*.









minima in/around 1942, 1954, 1963, 1974, 1986, 1997

Compared to: 1940/41/42, 1947, 1954, 1956, 1963, 1985/86, 1997,



Also: minima in/around 1942, 1954, 1963, 1974, 1986, 1997

Compared to: 1940/41/42, 1947, 1954, 1956, 1963, 1985/86, 1997,



complex magnetic fields















From July 5 - 17,
2017, NASA spacecraft
observed a sunspot as
it grew and eventually
rotated out of view.

2017 Jul 7 04:40:00.000



CO'A -



the development of a prominence



























stars have different colours and brightnesses























Some of the brightest stars:

Star		Apparent magnitude	Distance (light years)	Absolute magnitude	Туре
Sun		-26.72	-	4.8	G2V
Sirius	(α CMa)	-1.46	8.6	1.4	AIVm
Canopus	(α Car)	-0.72	74	-2.5	A9II
Arcturus	(a Boo)	-0.04	34	0.2	K1.5IIIp
Rigel	(β Ori)	0.12	1400	-8.I	B81ae
Betelgeuse	(a Ori)	0.50	1400	-7.2	M2lab
Aldebaran	(α Tau)	0.85	60	-0.3	K5III















Interstellar matter & star formation			