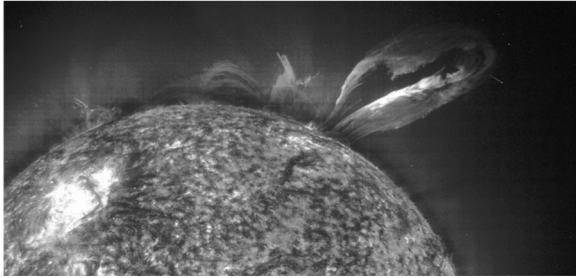
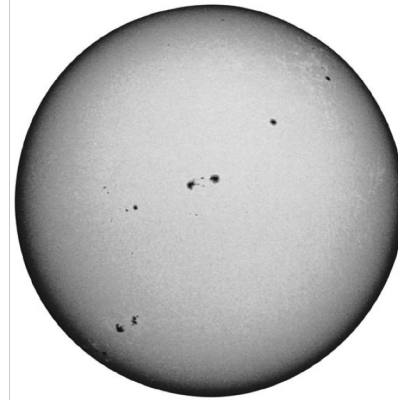


Chapter 14 The Sun: Our Star



1

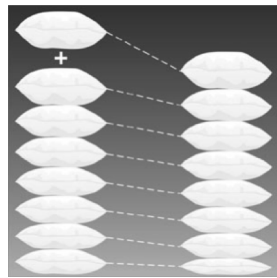


Radius:
 7×10^8 m
(109 times Earth)

Mass:
 2×10^{30} kg
(300,000 Earths)

Luminosity:
 3.8×10^{26} watts

2



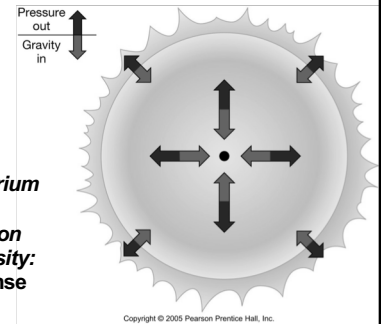
Weight of upper layers
compresses lower layers

3

The Solar Interior

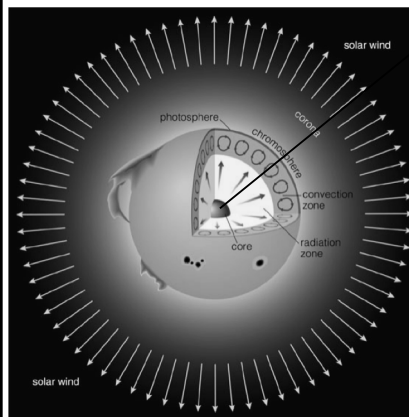
Inward
gravitational force
= **outward**
pressure changes:
hydrostatic equilibrium

Pressure depends on
temperature & density:
Interior is more dense
and hotter



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4

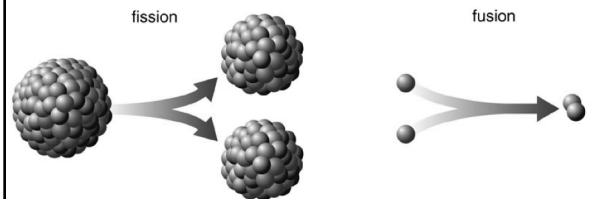


Core:
Hot enough for
nuclear fusion
~ 15 million K

Outer layers:
Temperature drops
towards surface
~ 5800 K

5

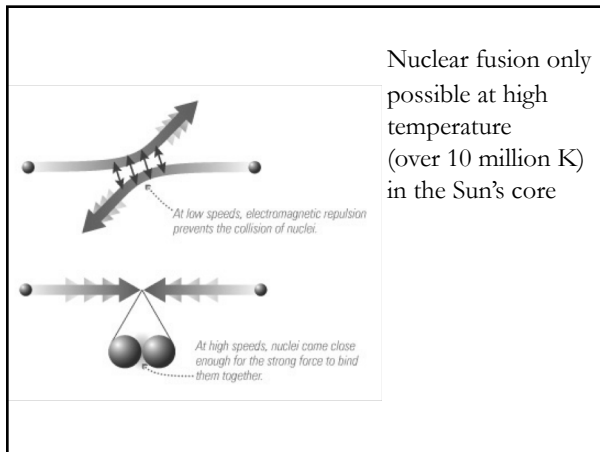
Nuclear Energy



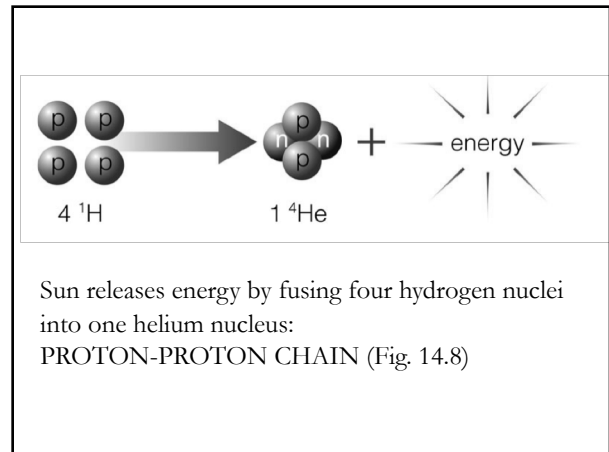
Fission
Big nucleus splits into
smaller pieces
(Nuclear power plants)

Fusion
Small nuclei stick
together to make a
bigger one
(Sun, stars)

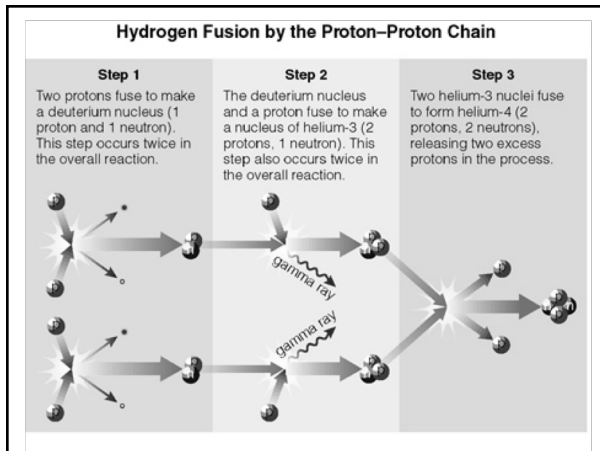
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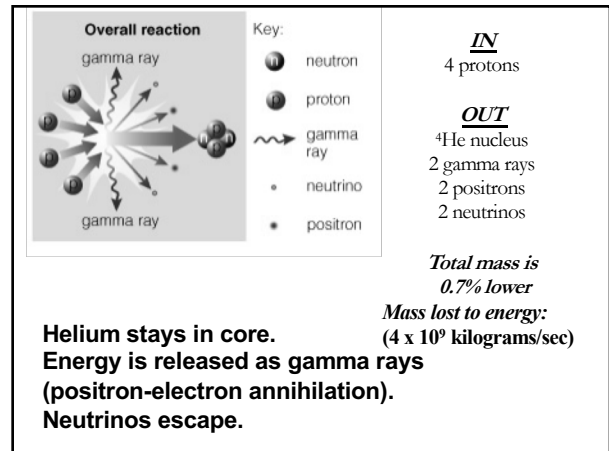
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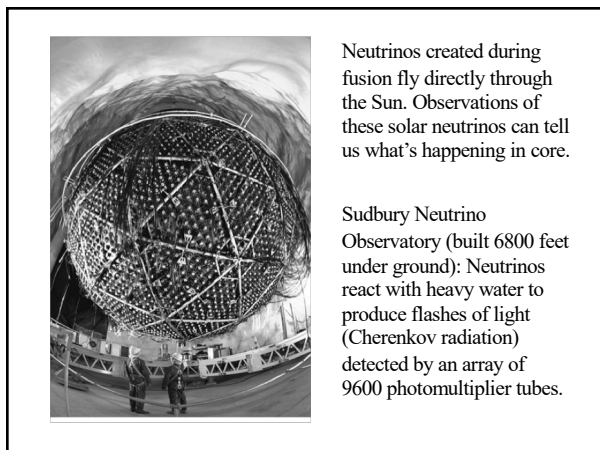
8



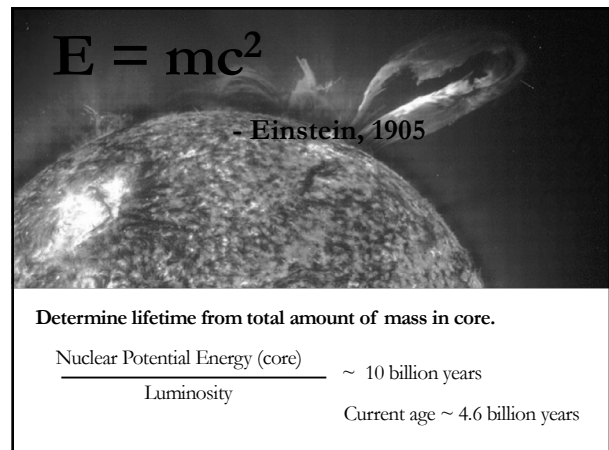
9



10



11



12

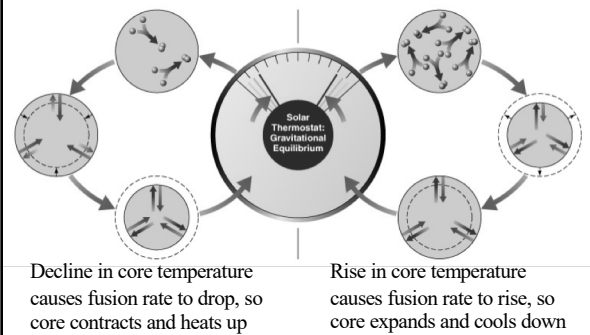
Thought Question

What would happen inside the Sun if a slight rise in core temperature led to a rapid rise in fusion energy?

- A. The core would expand and heat up slightly
- B. The core would expand and cool
- C. The Sun would blow up like a hydrogen bomb

13

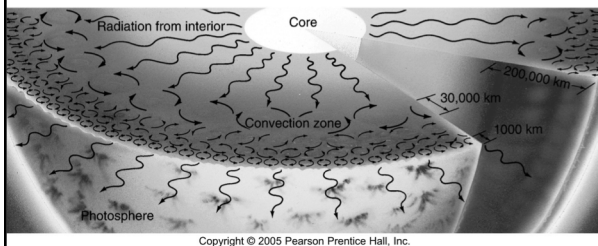
Solar Thermostat



14

Energy Transport in Solar Interior

The hotter radiation zone is relatively transparent (energy flow by light);
the cooler convection zone is more opaque (energy flow by convection)

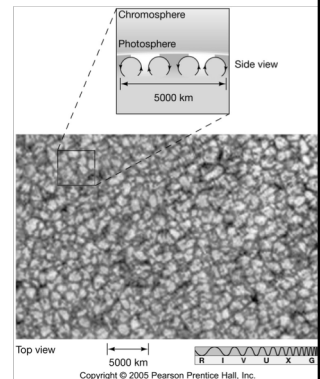


15

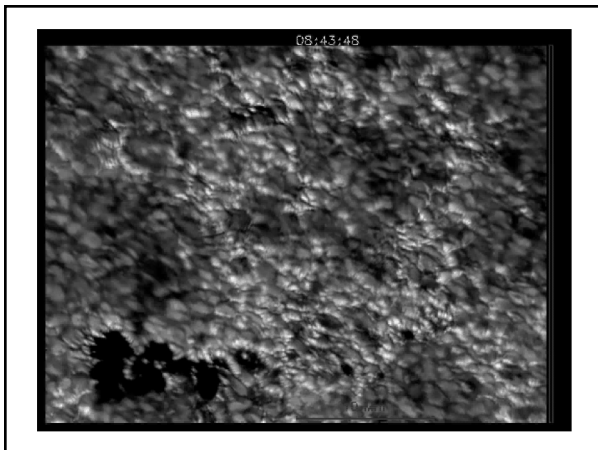
Convection at Surface

The visible top layer shows granulation, with areas of rising gas (hotter, brighter) surrounded by areas of sinking gas (cooler, darker)

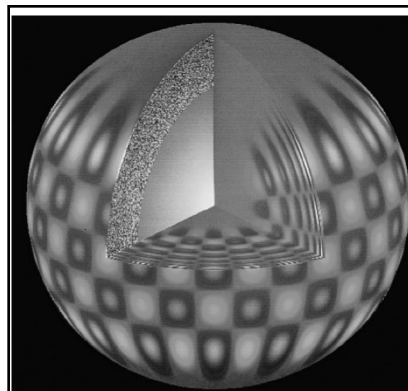
Movie from Swedish Solar Telescope



16

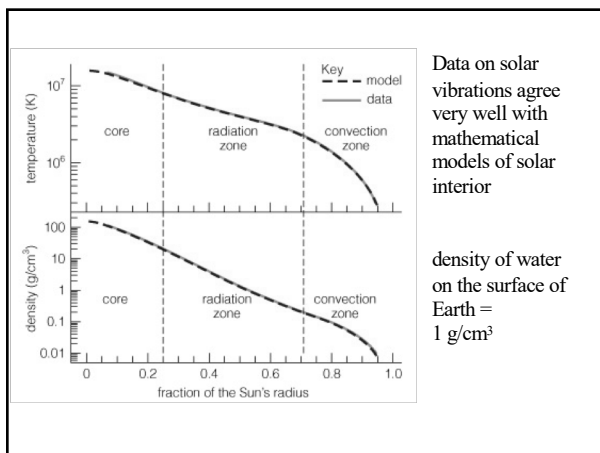


17

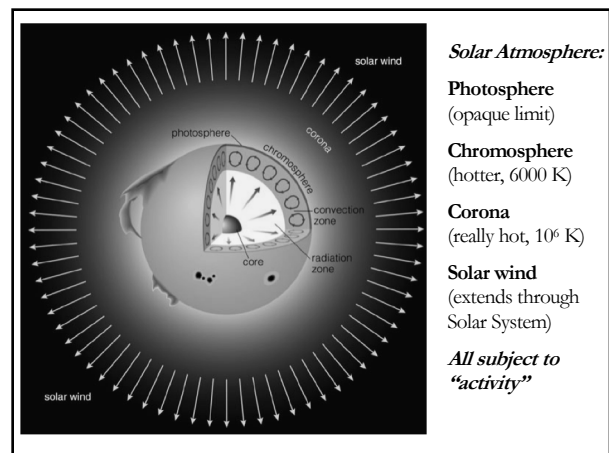


Patterns of vibration on surface ("ringing") tell us about what Sun is like inside (solar models = computer codes)

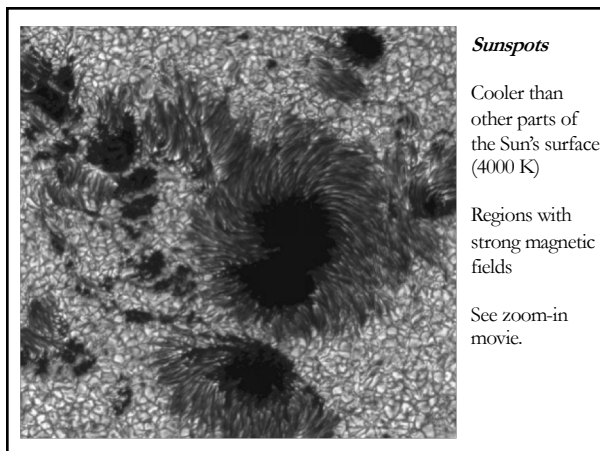
18



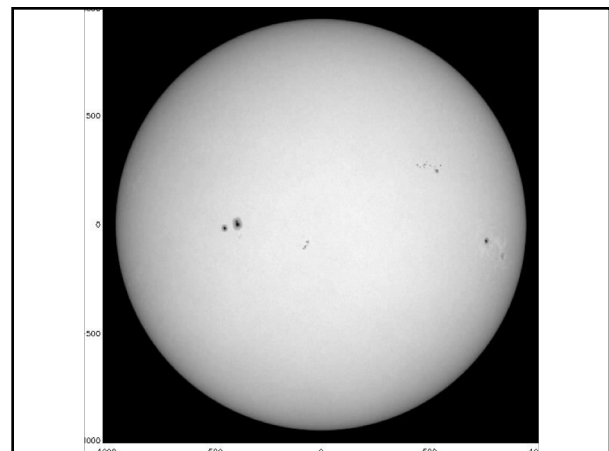
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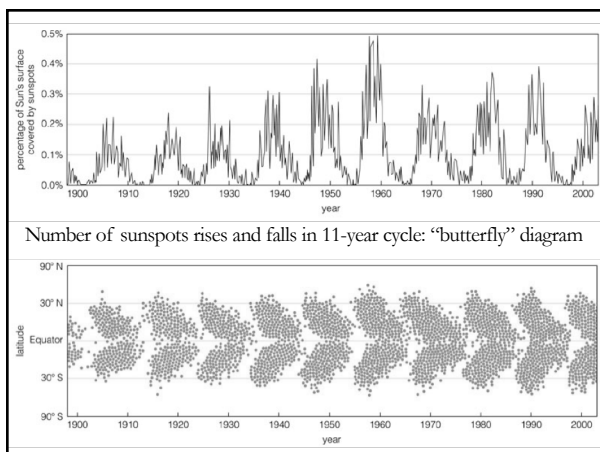
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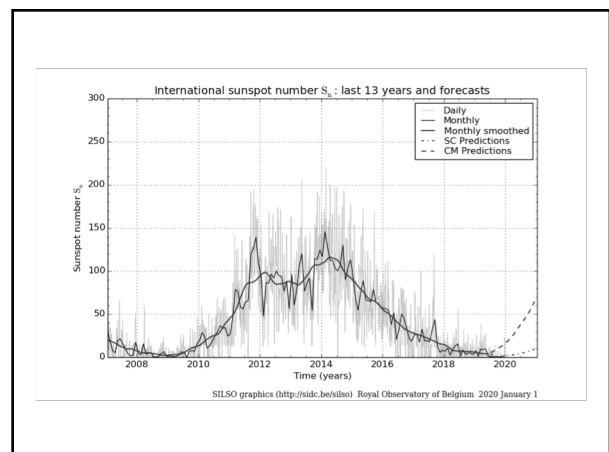
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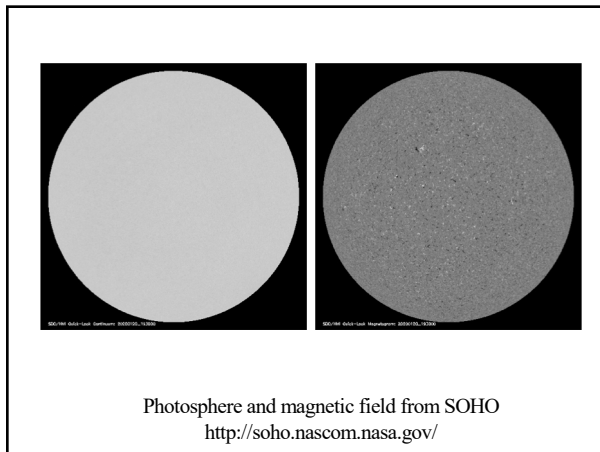
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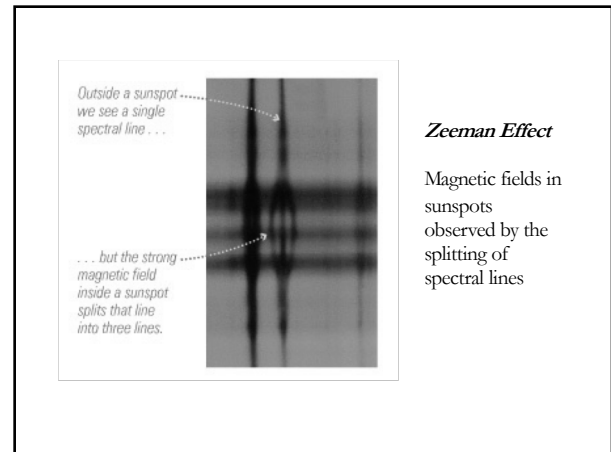
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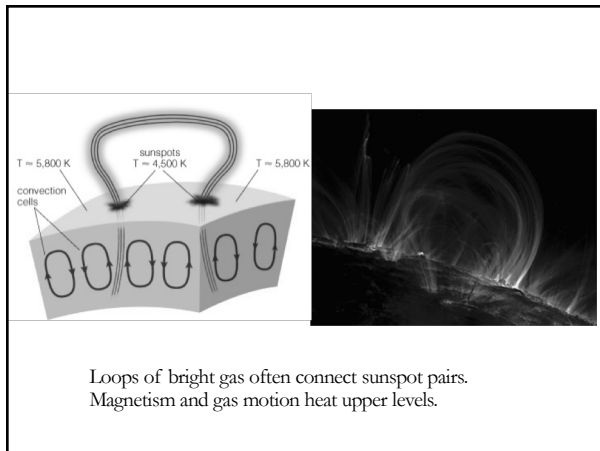
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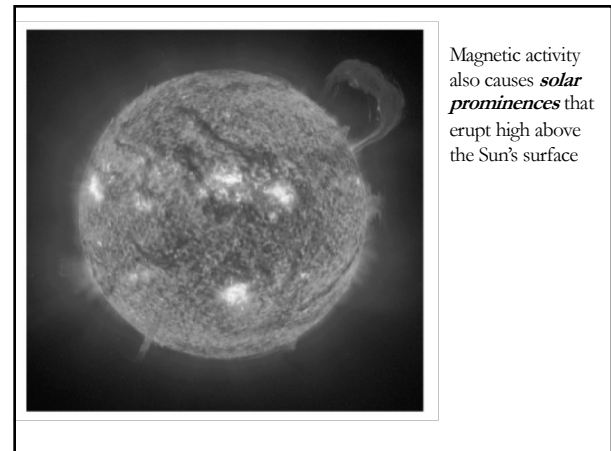
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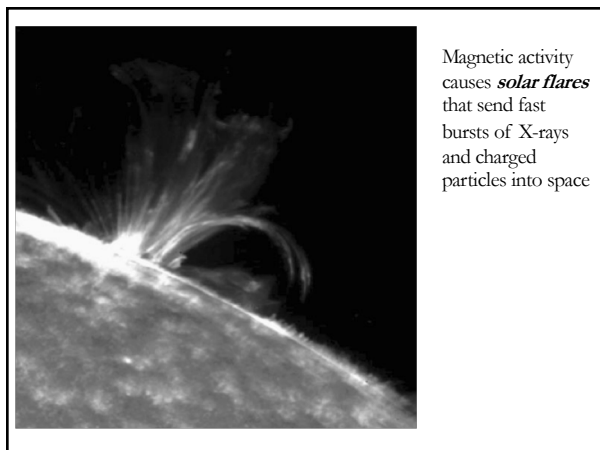
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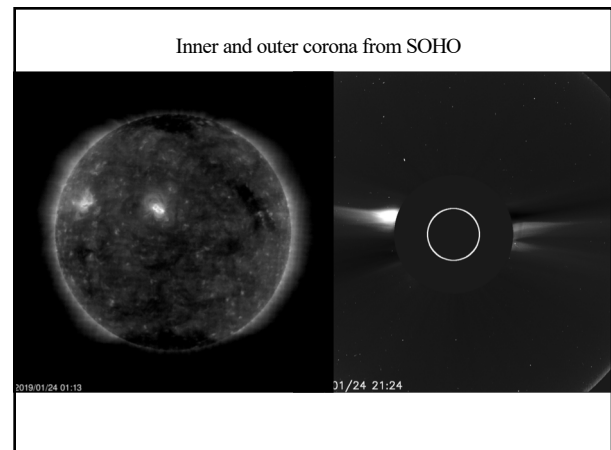
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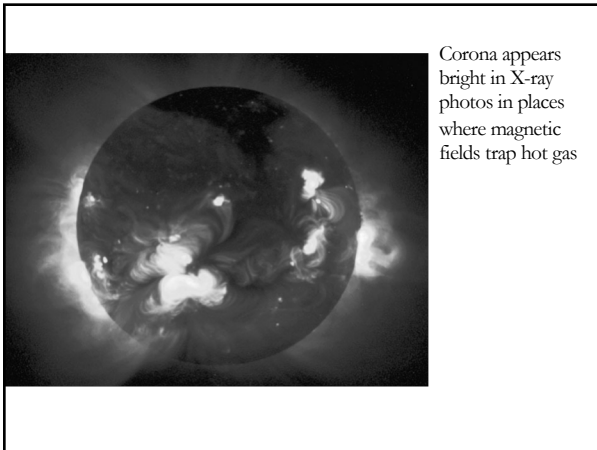
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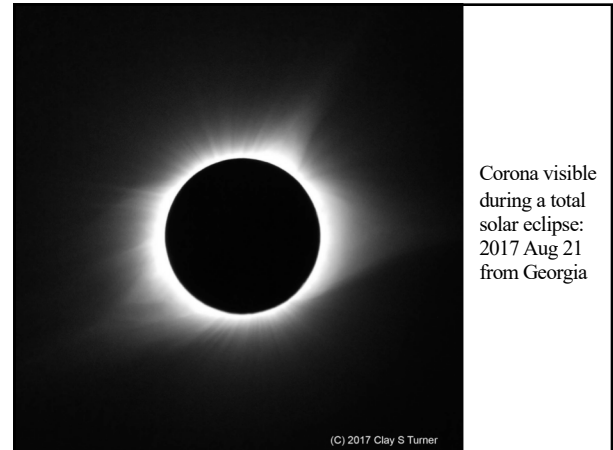
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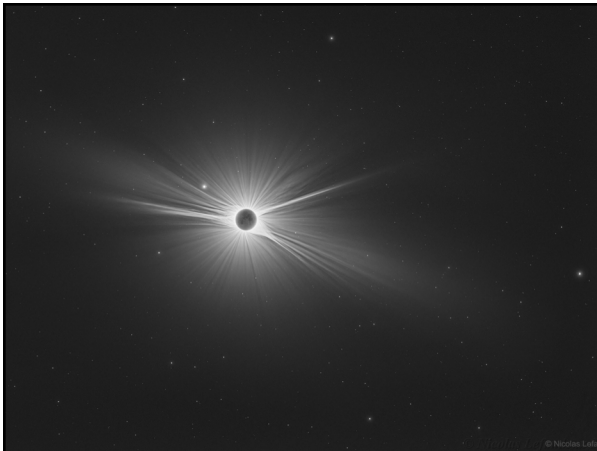
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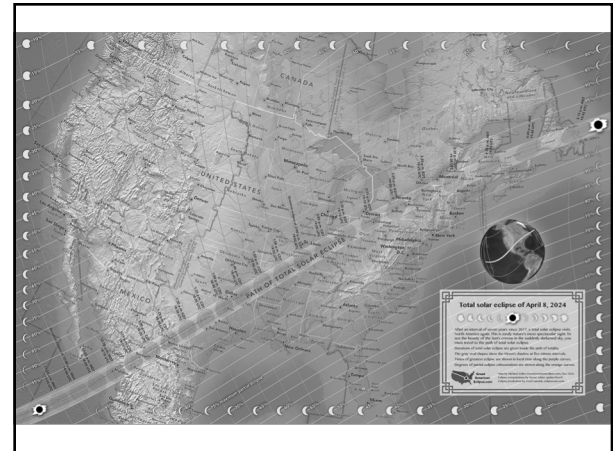
31



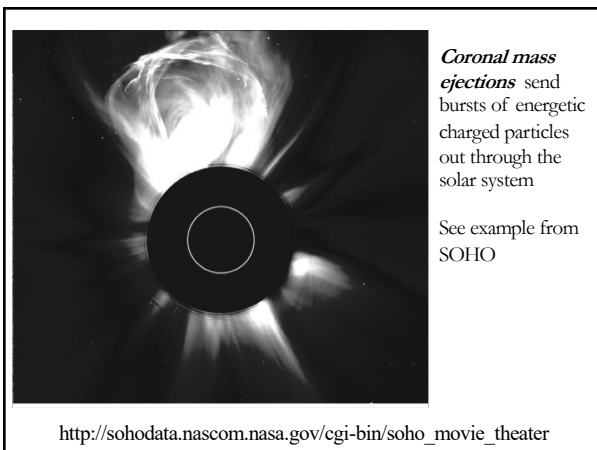
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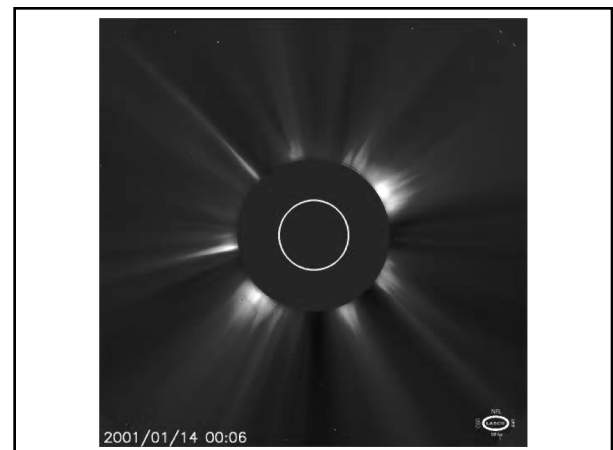
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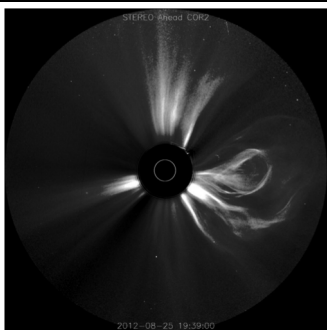
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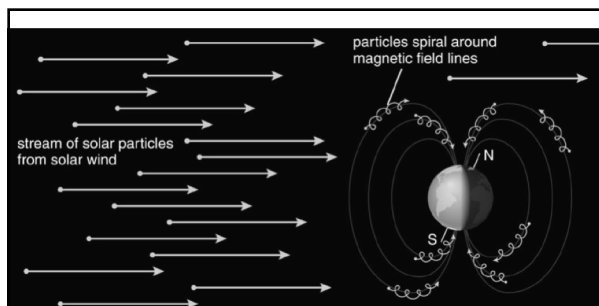


36



The Sun blasted out at least 16 coronal mass ejections (CMEs) in eight days (Aug. 20-27, 2012).

37



Charged particles streaming from Sun can disrupt electrical power grids and can disable communications satellites; produce auroral lights.

<http://spaceweather.com/>

38

Auroral displays



<http://apod.nasa.gov/apod/ap120321.html>
http://www.nasa.gov/mission_pages/sunearth/news/gallery/aurora-index.html#.VMcAp8ZEyRA

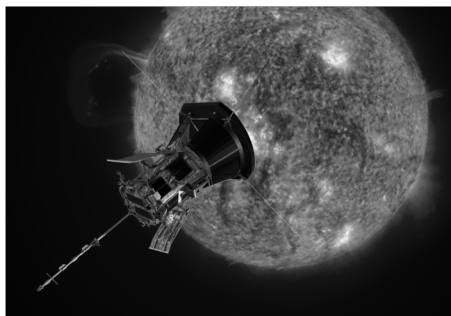
39



<https://www.youtube.com/watch?v=BDZj1CmsJ64>

40

NASA Parker Solar Probe



<https://www.nasa.gov/content/goddard/parker-solar-probe>

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