

# Asking questions

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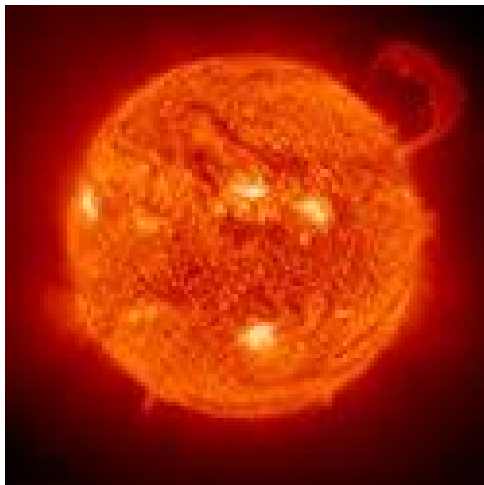
# Asking questions

- 1 Have you seen a nuclear reactor ?
- 2 How does the Sun shine ?
- 3 Where did all the gold come from ?

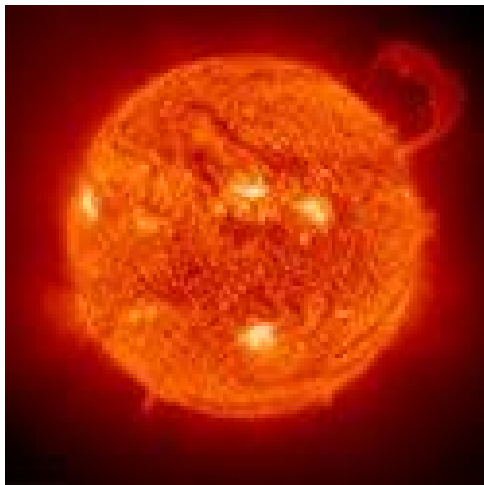
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# Burning ball of fire ?

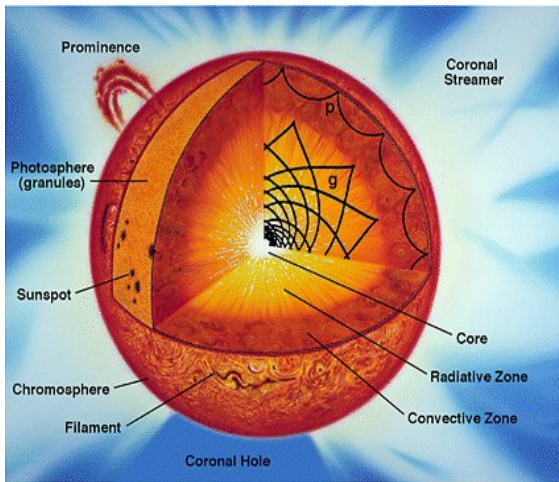


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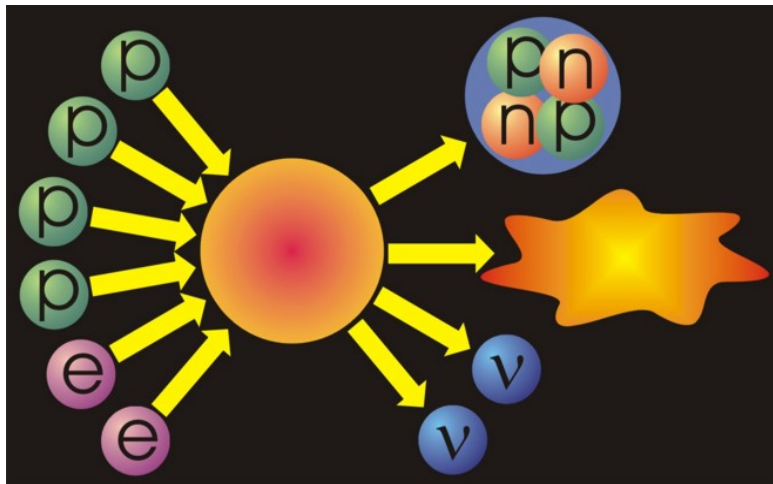
- Would have burnt out in a few thousand years
- But has been around for many more !!

# The structure of the Sun



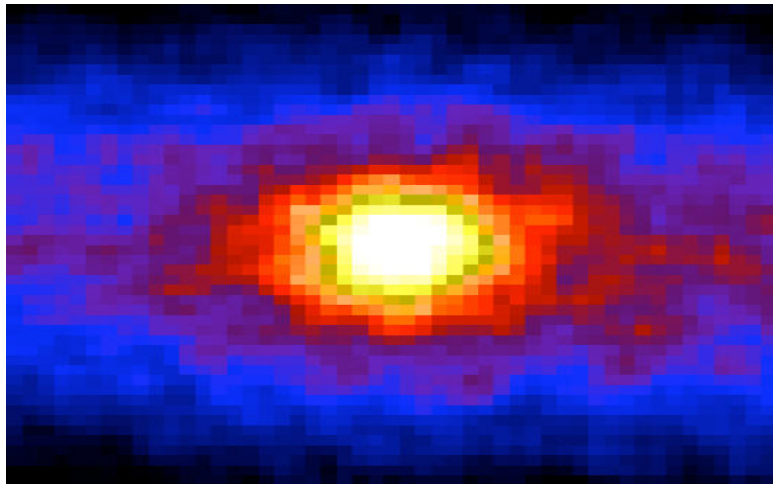
It is a nuclear reactor !

# The nuclear reactions



How do we know this ? Can we see some evidence ?

# Neutrinos from the Sun: tiny point particles



- Can indeed see neutrinos from the Sun now !



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- They interact very weakly !
- Pass through our bodies, the Earth, the Sun, ...
- Lead shielding of a few light years thickness would be needed to stop neutrinos from the Sun !

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## Important lesson from "how does the sun shine ?"

There are "neutrinos" around us that affect our lives !

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# Many forms of gold: origin ?



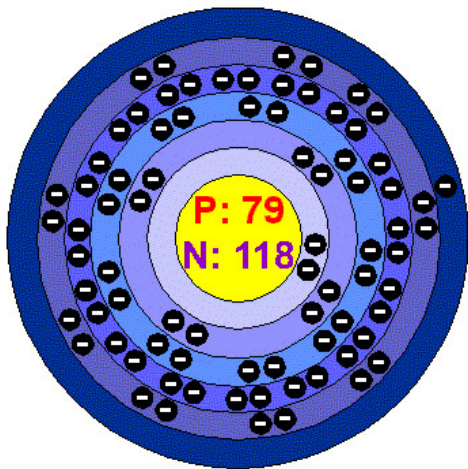
# The gold mine



But where did the gold in the mines come from ?



# The essence of gold



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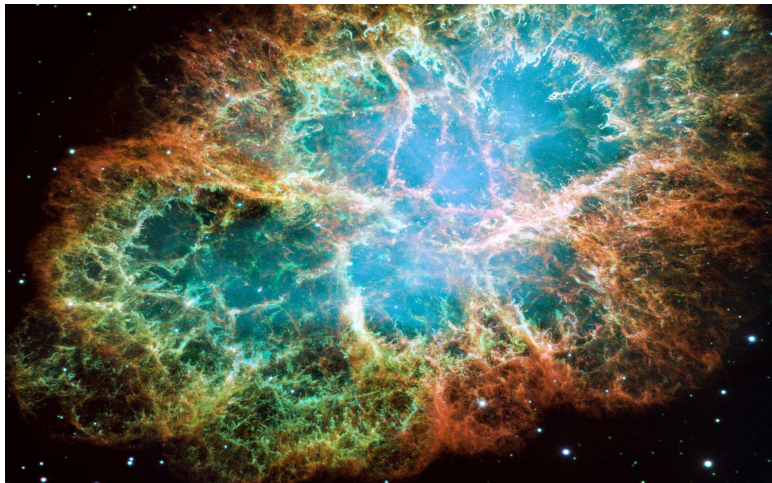
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- There is just one phenomenon we know in nature that can do this...

# A supernova !



Crab nebula, Supernova seen exploding in 1054

# So that's the story...

- Once upon a time, there was a big star, which exploded (supernova)
- The exploded material travelled far and wide in the galaxies
- It is from this material that the solar system was made.
- We are, literally, “Stardust”

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Important lesson from “where did gold come from ?”

The story of gold has become the story of our origin



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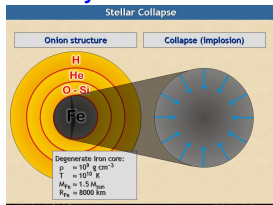
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A new question:

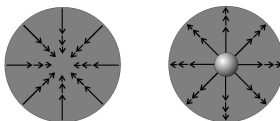
But how does a supernova explode ?

# Supernova: the death of a star

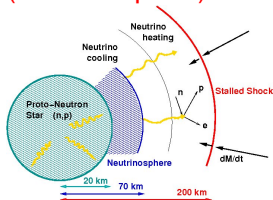
Gravity  $\Rightarrow$



Strong nuclear force  $\Rightarrow$



Weak nuclear force  
(Neutrino push)  $\Rightarrow$



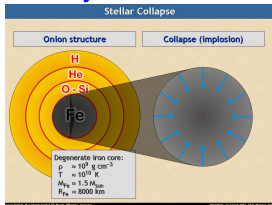
Electromagnetism  
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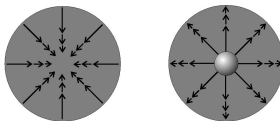
(Crab nebula, SN seen in 1054)

# Supernova: the death of a star

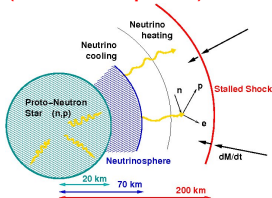
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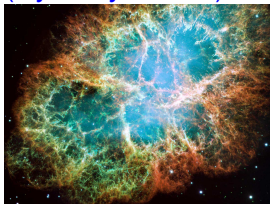
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The same invisible neutrinos brought us here !

# Final remarks

- **Doing research means asking questions:**  
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Examinations, medals and prizes are tools, not final goals
- **What is important is**  
    enjoying the process of  
    asking new questions  
    and looking for new answers...