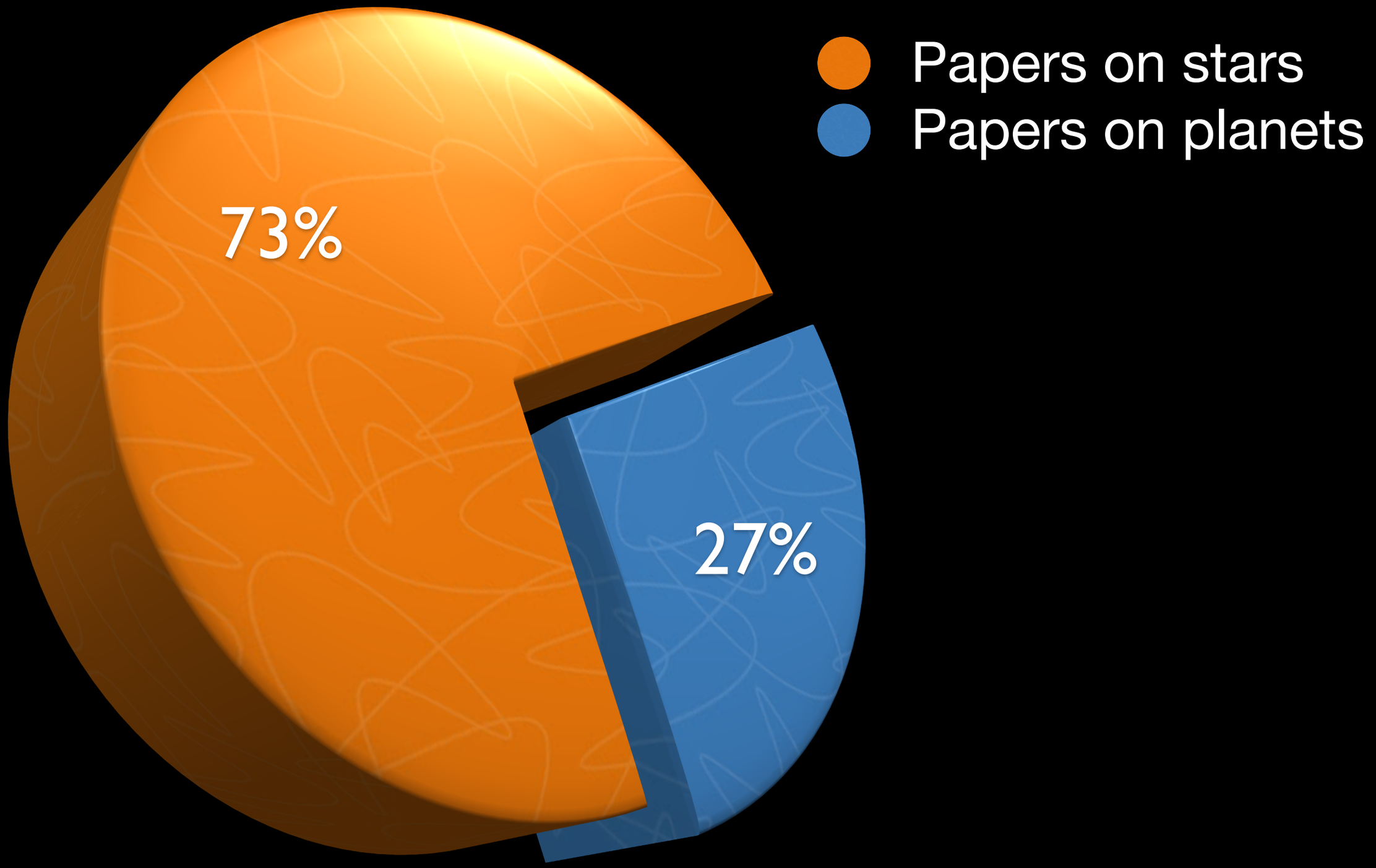
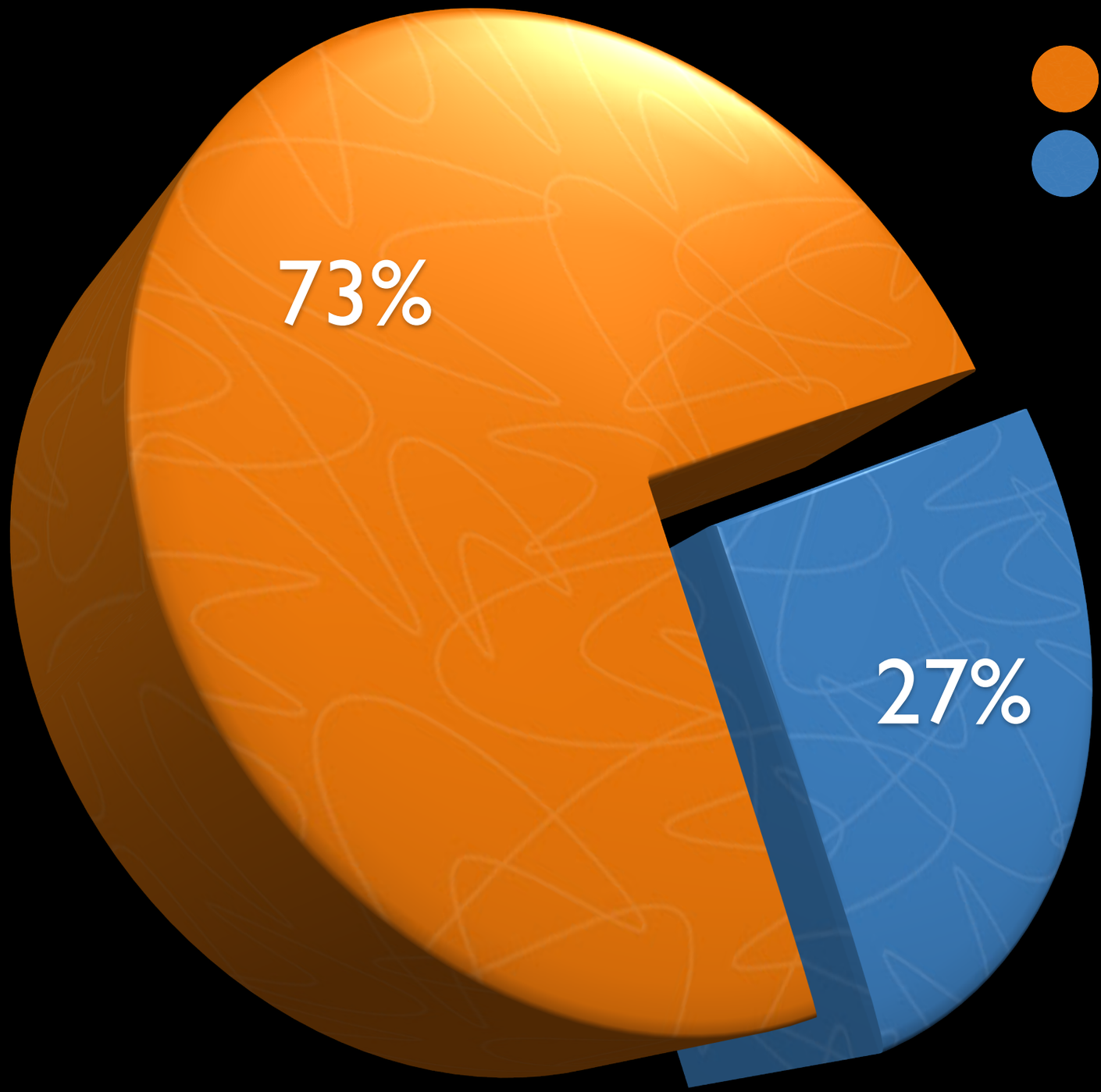
Publications



Publications



- Papers on stars
- Papers on planets

First Results from

The Kepler Cluster Study

First Results from

The Kepler Cluster Study

Søren Meibom
Harvard-Smithsonian Center for Astrophysics

Goal

To tell the ages of stars and planets

Goal

To tell the ages of stars and planets

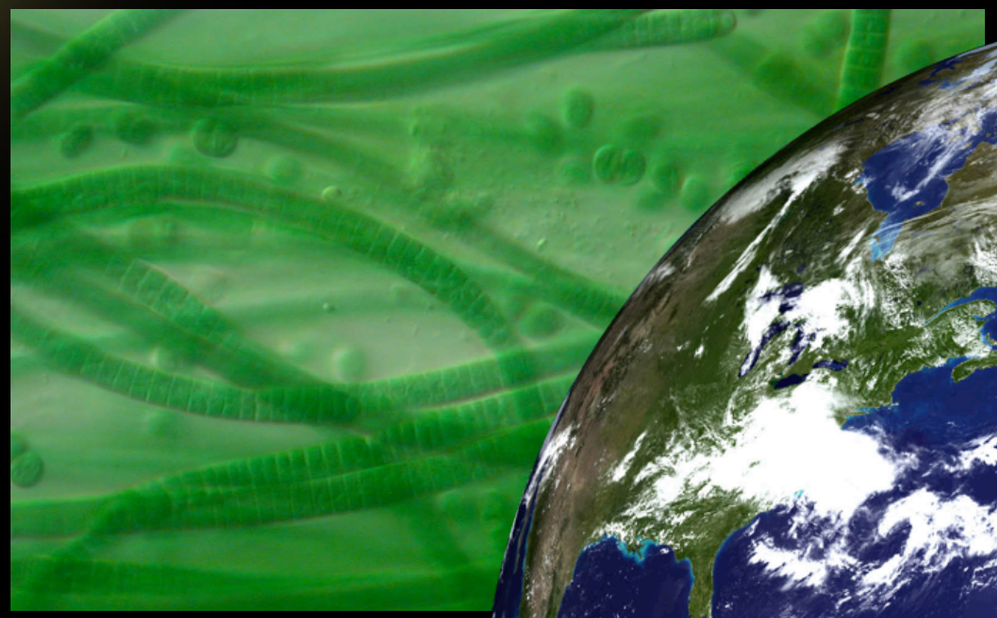
1 billion years old

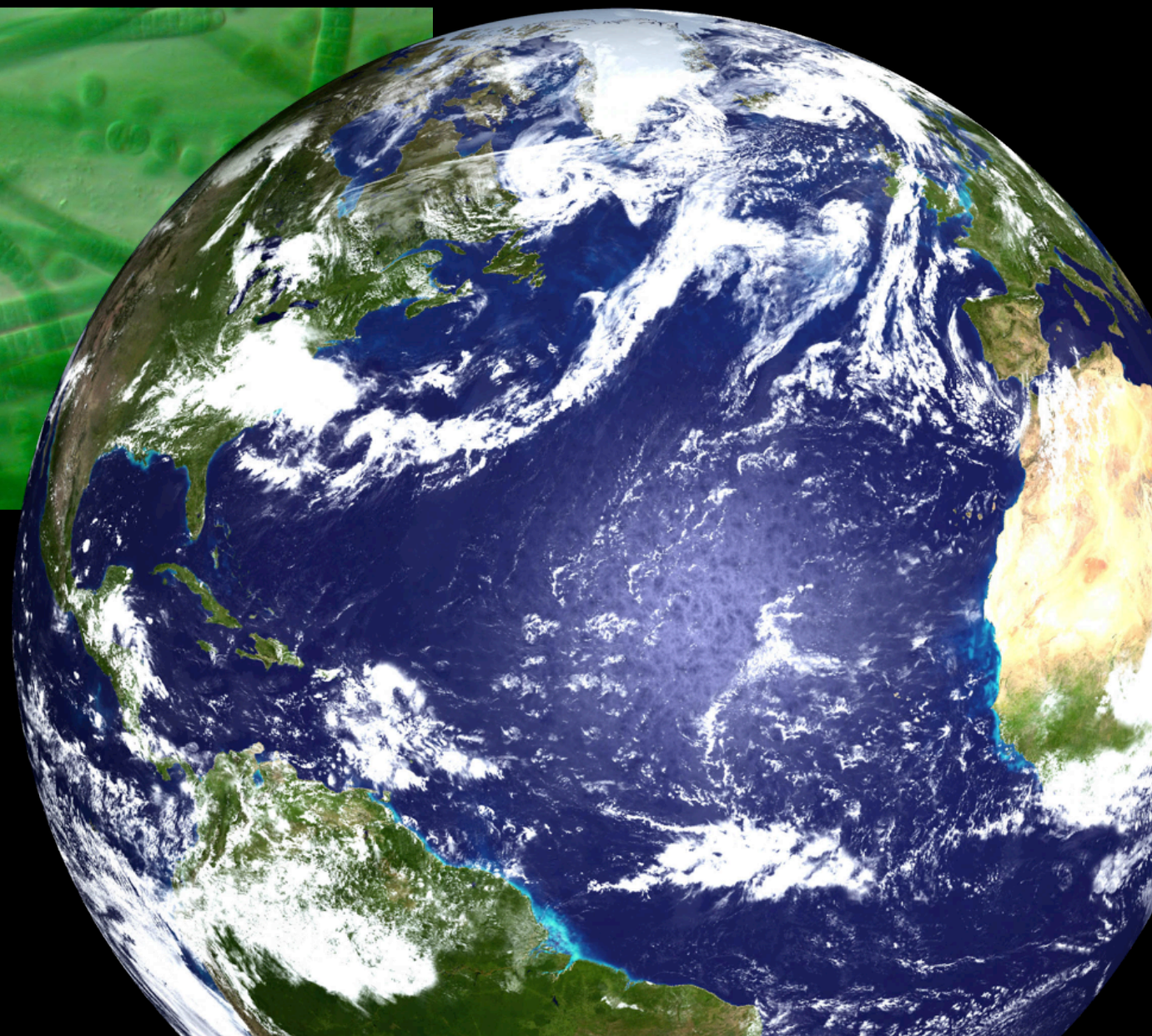
1 billion years old

3 billion years old

1 billion years old

3 billion years old

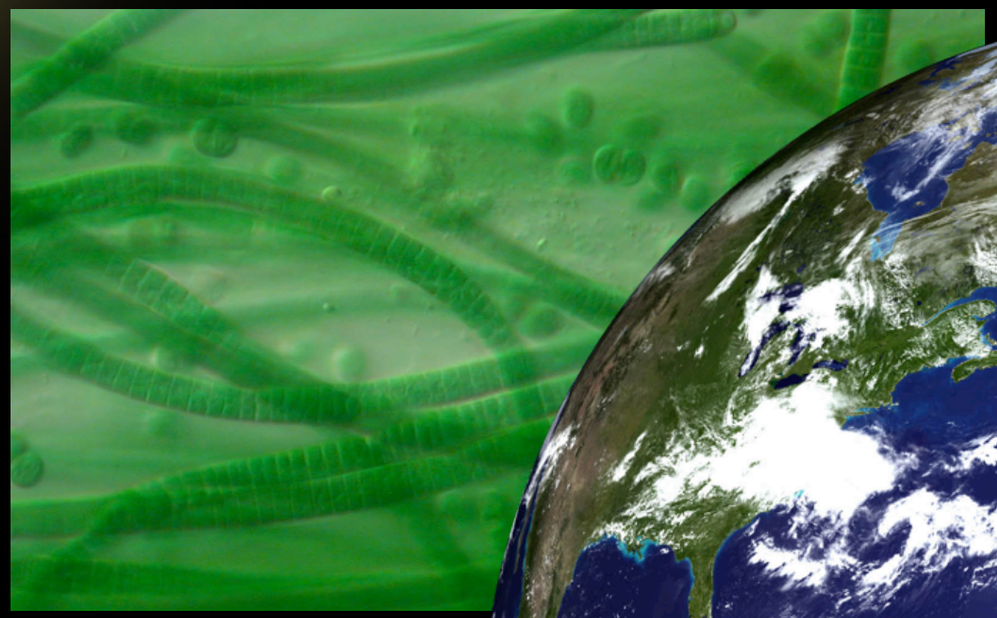


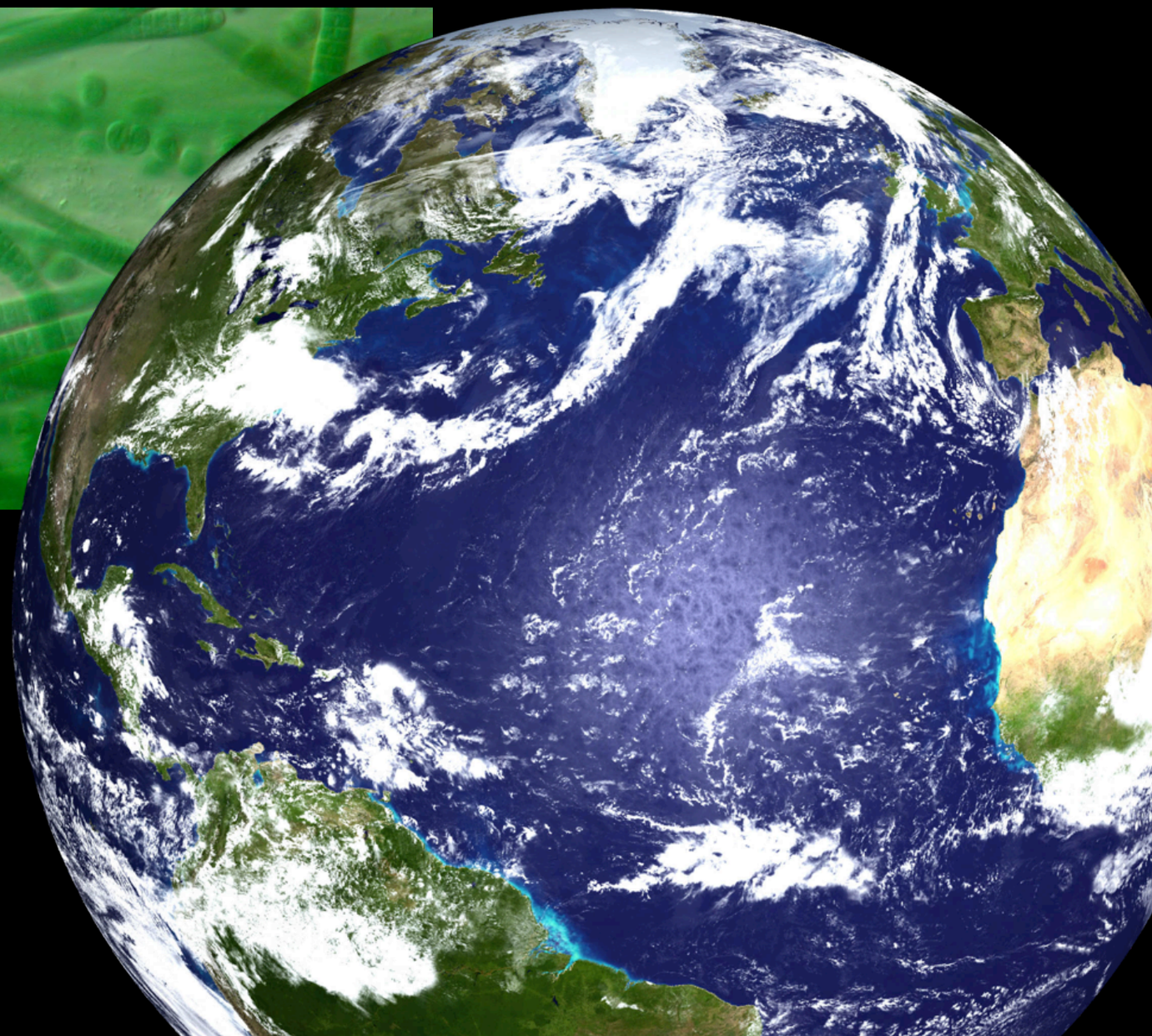


4.6 billion years old

1 billion years old

3 billion years old

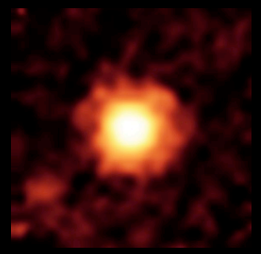




4.6 billion years old

10 billion years old ?

Newborn



100 million years old

1 billion years old

3 billion years old

5 billion years old

10 billion years old

> 10 billion years old

Newborn | 100 million years old | 1 billion years old | 3 billion years old | 5 billion years old | 10 billion years old | > 10 billion years old

Imagine if ...

Newborn | 1 year | 20 years | 40 years | 60 years | 80 years | Appear old

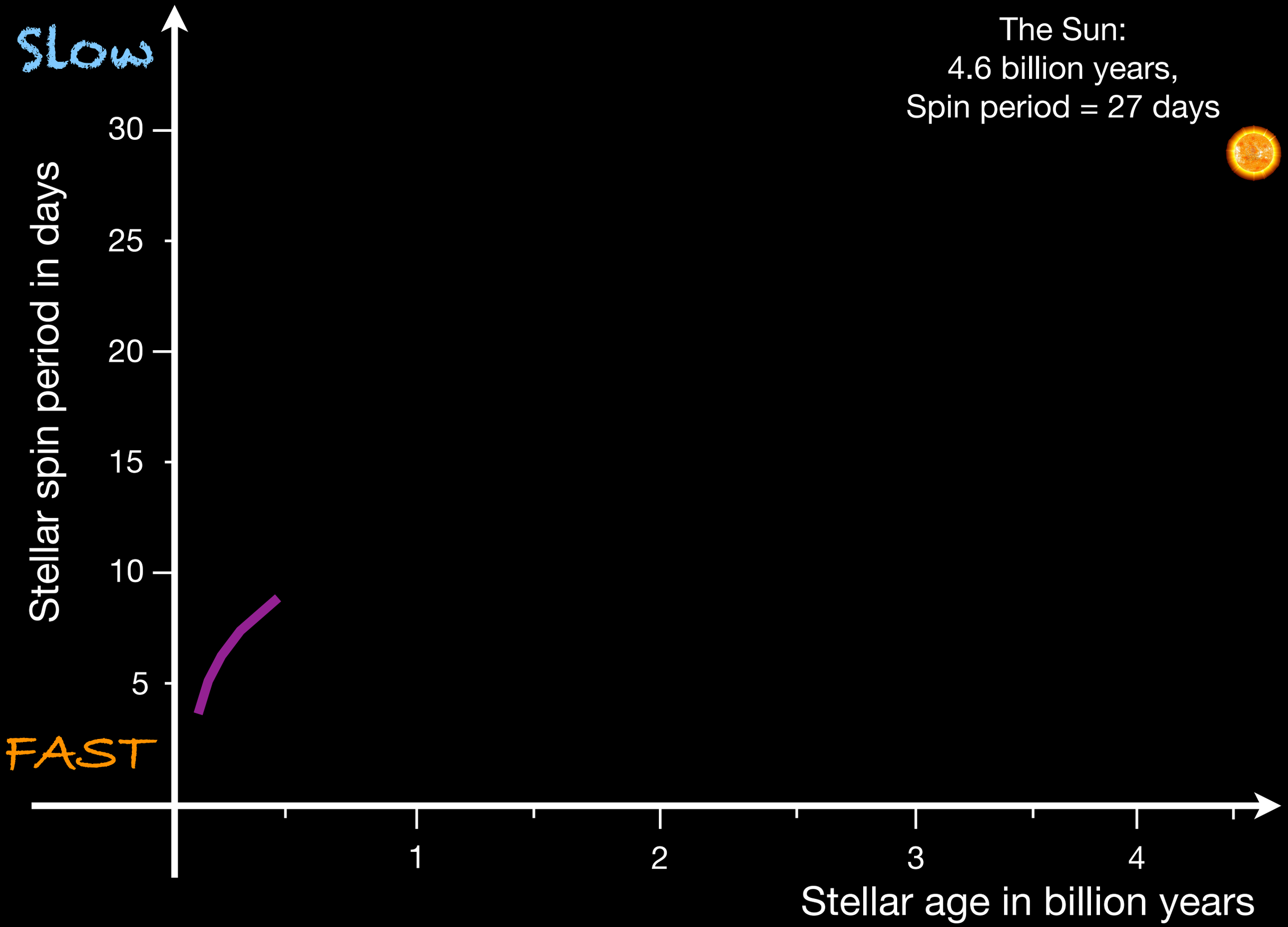
Solution

Use a star’s slowing spin rate as a clock...

Solution

Use a star’s slowing spin rate as a clock...

The Sun:
4.6 billion years,
Spin period = 27 days



The Sun:
4.6 billion years,
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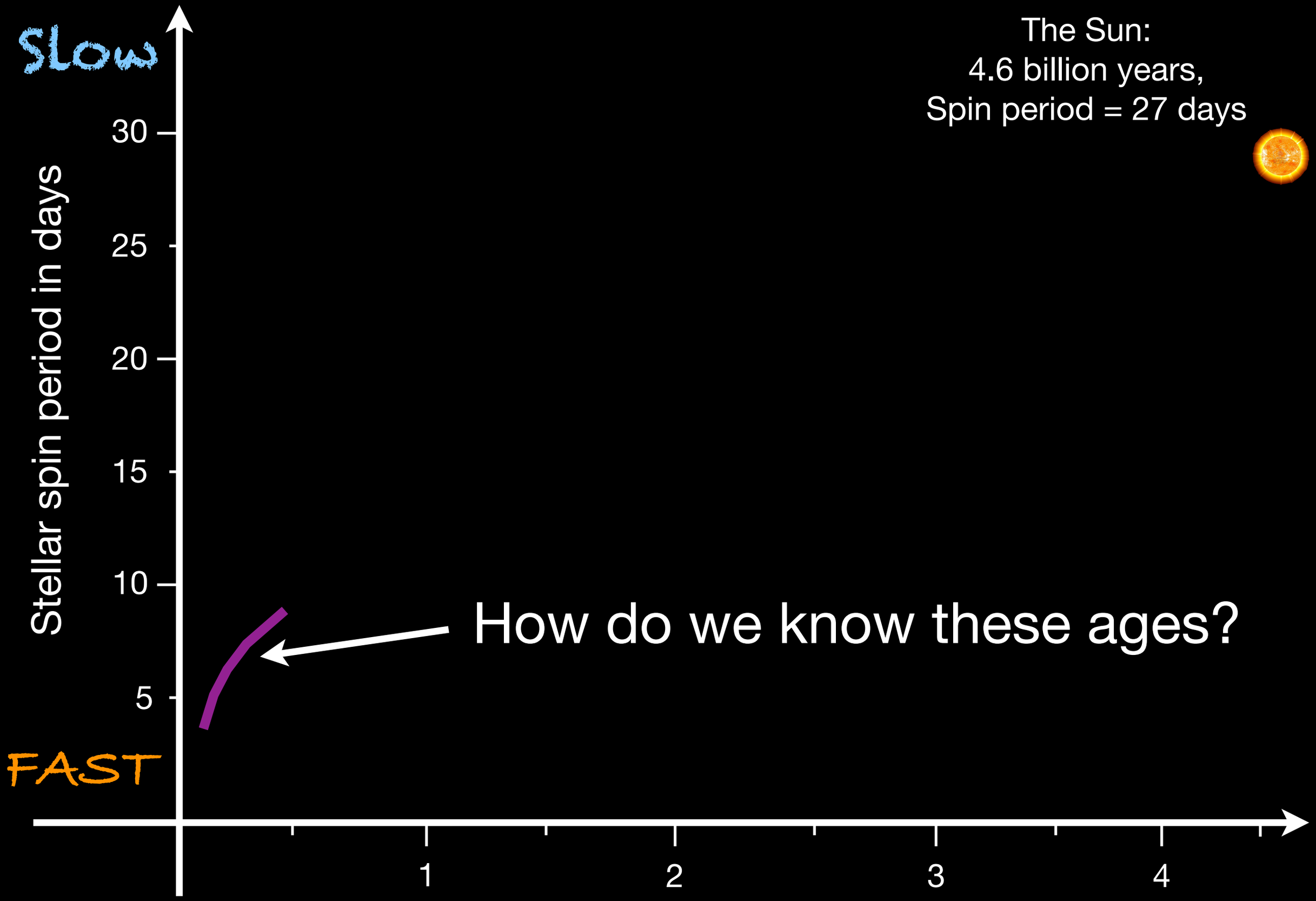
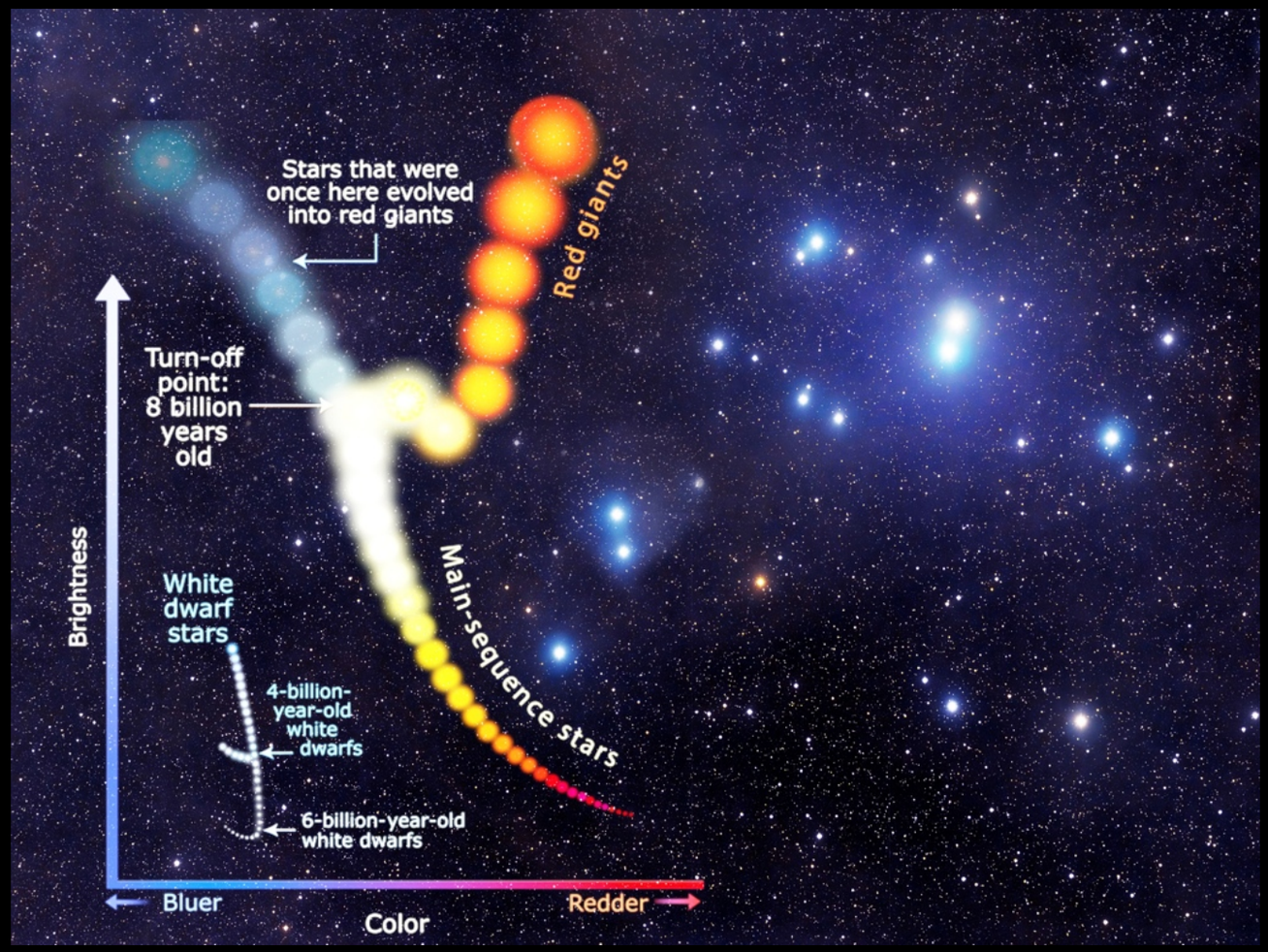


The Sun:
4.6 billion years,
Spin period = 27 days



SLOW

FAST

Stellar spin period in days

30
25
20
15
10
5

1
2
3
4

Stellar age in billion years

SLow

Stellar spin period in days

30

25

20

15

10

5

FAST

The Sun:
4.6 billion years,
Spin period = 27 days

?

1

2

3

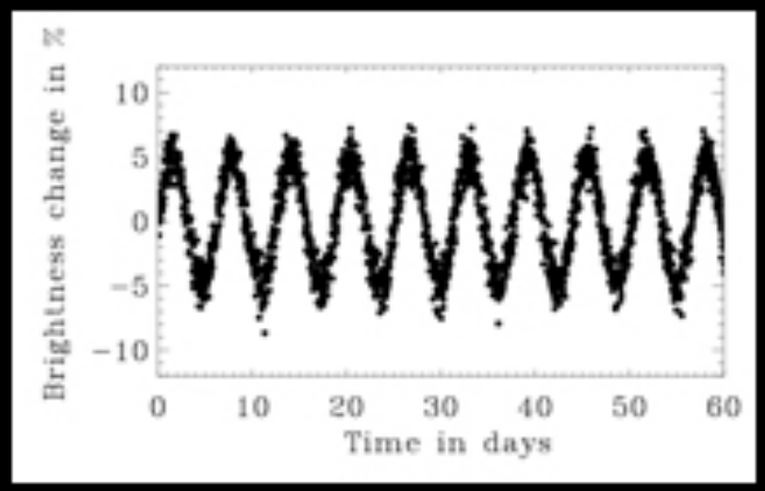
4

Stellar age in billion years

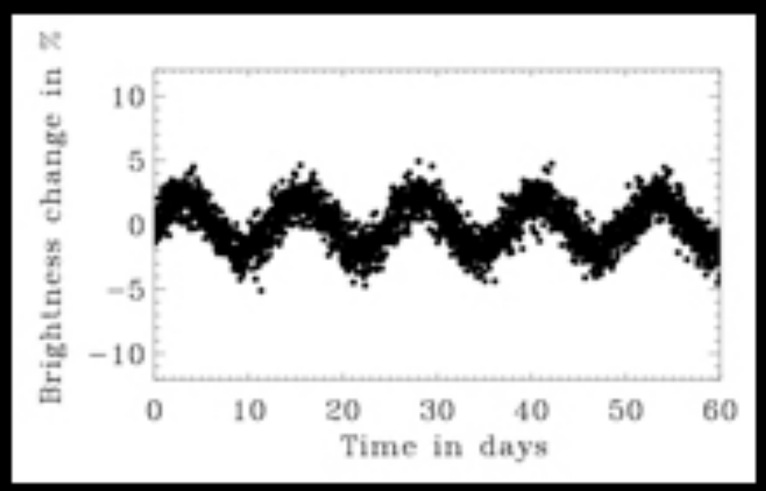
Challenge:

Measuring the spin rates for old stars

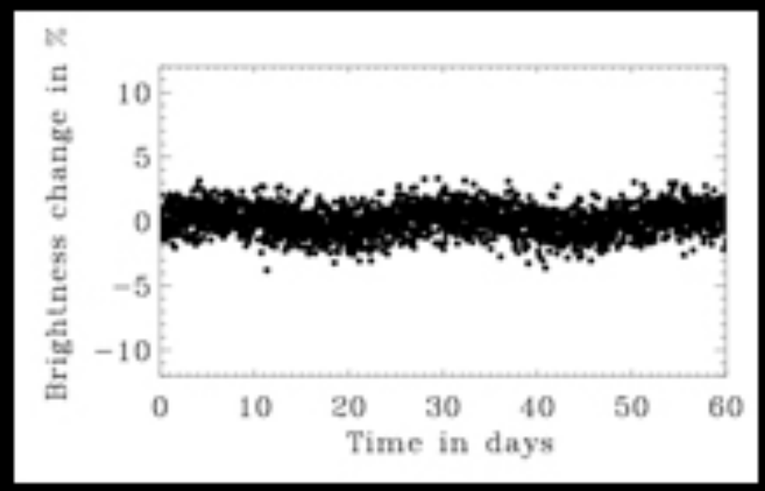
100 million year old star



1 billion year old star



5 billion year old star



SLOW

Stellar spin period in days

30

25

20

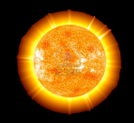
15

10

5

FAST

The Sun:
4.6 billion years,
27 days



1

2

3

4

Stellar age in billion years

SLow

Stellar spin period in days

30

25

20

15

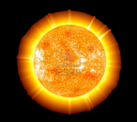
10

5

FAST

NGC 6811
(1 billion years)

The Sun:
4.6 billion years,
27 days



1

2

3

4

Stellar age in billion years

SLow

Stellar spin period in days

30

25

20

15

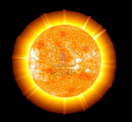
10

5

FAST

NGC 6811
(1 billion years)

The Sun:
4.6 billion years,
27 days



1

2

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4

Stellar age in billion years

SLow

Stellar spin period in days

30

25

20

15

10

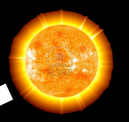
5

FAST

NGC 6811
(1 billion years)

?

The Sun:
4.6 billion years,
27 days



1

2

3

4

Stellar age in billion years

SLow

Stellar spin period in days

30

25

20

15

10

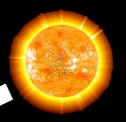
5

FAST

NGC 6811
(1 billion years)

NGC 6819
(2.5 billion years)

The Sun:
4.6 billion years,
27 days



?

1

2

3

4

Stellar age in billion years

SLow

Stellar spin period in days

30

25

20

15

10

5

FAST

NGC 6811
(1 billion years)

NGC 6819
(2.5 billion years)

The Sun:
4.6 billion years,
27 days

?

NGC 6791
(9 billion years)

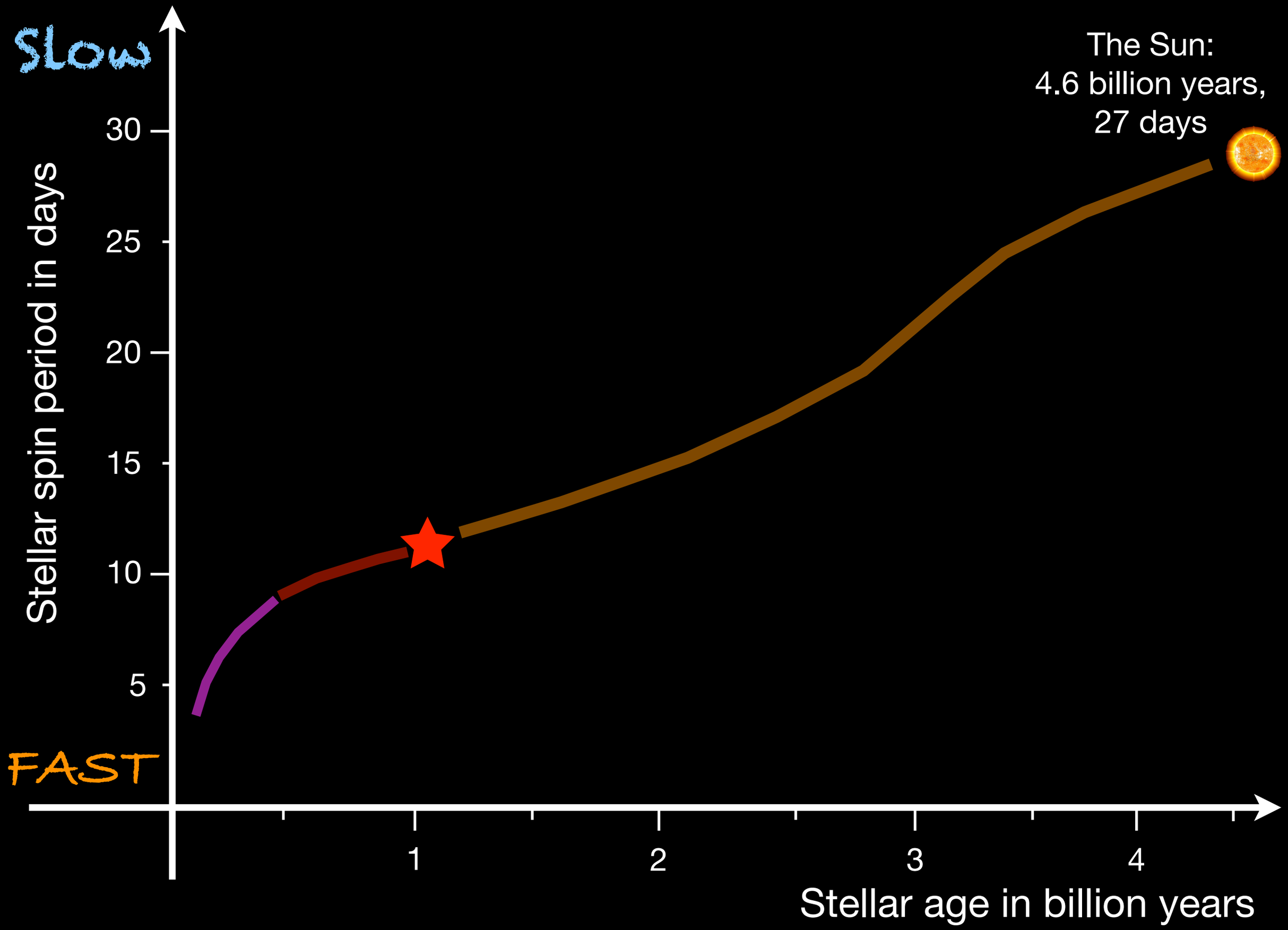
1

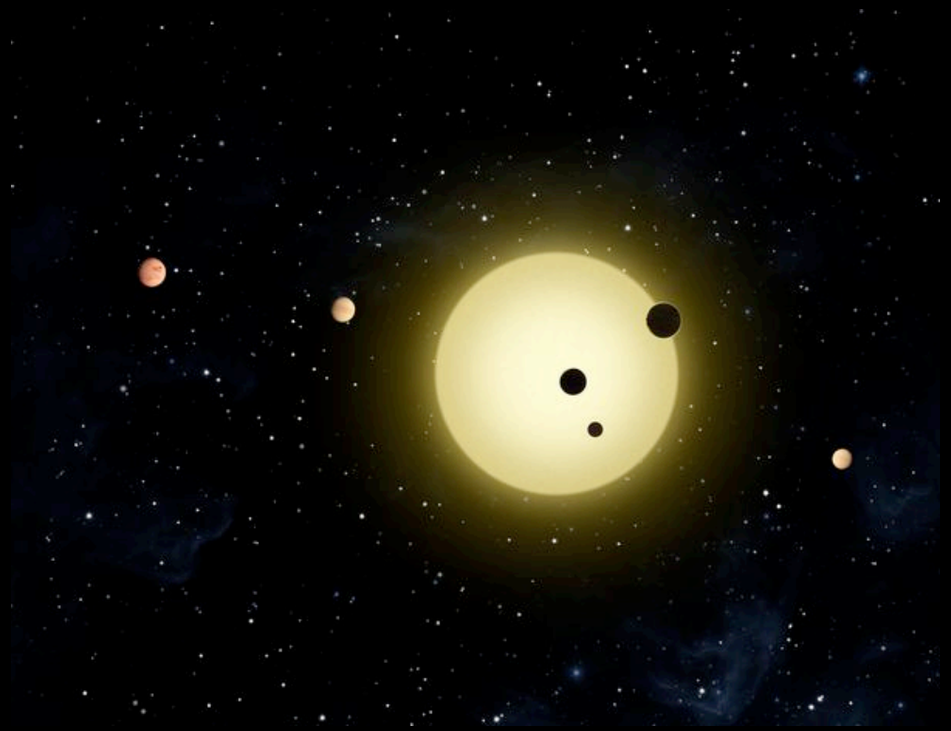
2

3

4

Stellar age in billion years


Slow
30
25
20
15
10
5
FAST
Stellar spin period in days
The Sun:
4.6 billion years,
27 days
1
2
3
4
Stellar age in billion years



SLOW

30

25

20

15

10

5

FAST

Stellar spin period in days

The Sun:
4.6 billion years,
27 days

Age =
2.6 billion years!

1

2

3

4

Stellar age in billion years