



Science, August 9, 2019

WHY IS THE WORLD THE WAY IT IS?

SCIENTIFIC QUESTIONS ABOUT THE UNIVERSE

HANS STRÖHER | GGSB23 (TBILISI), JUNE 25-30, 2023

Mitglied der Helmholtz-Gemeinschaft



PUZZLE OF OUR EXISTENCE

1



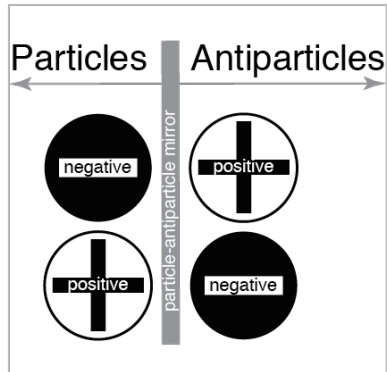
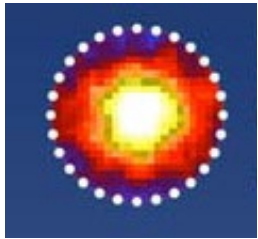
EVOLUTION OF OUR UNIVERSE (FROM THE BIG BANG TO TODAY)



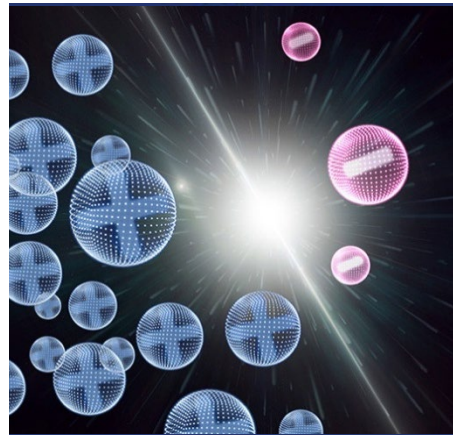
APPARENTLY THERE IS MATTER: „US“ → WHY NOT ONLY LIGHT?

Big Bang

→ Today



Equal #'s of
particles &
anti-particles

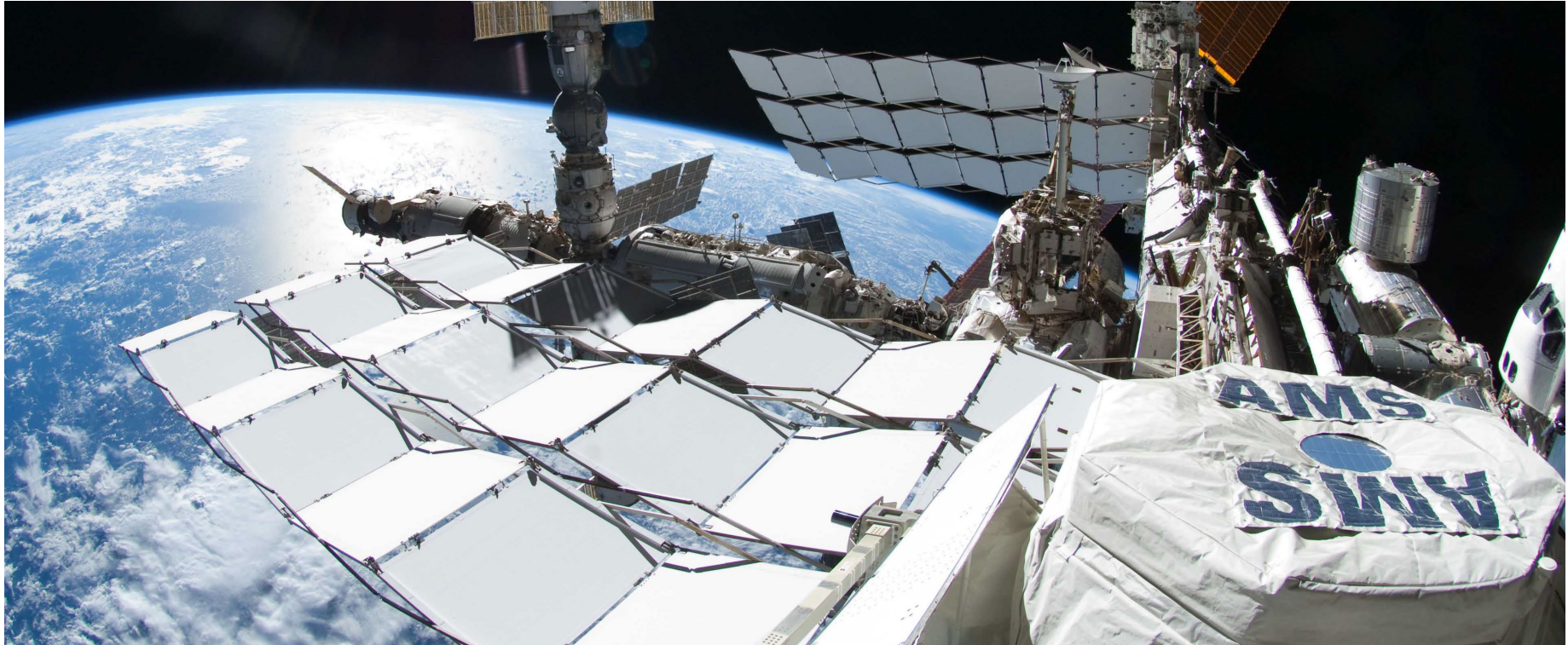


Annihilation
into photons



But: Matter – only Matter,
no Anti-matter

APPARENTLY THERE IS MATTER: „US“ → WHERE IS THE ANTI-MATTER?



FIND THE DIFFERENCE BETWEEN MATTER AND ANTI-MATTER!



Big Bang

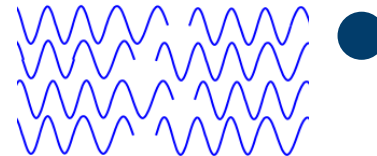
Matter ● ● ● ● ... ●
Anti-matter ● ● ● ● ... ●

Evolution
of the
Universe

?

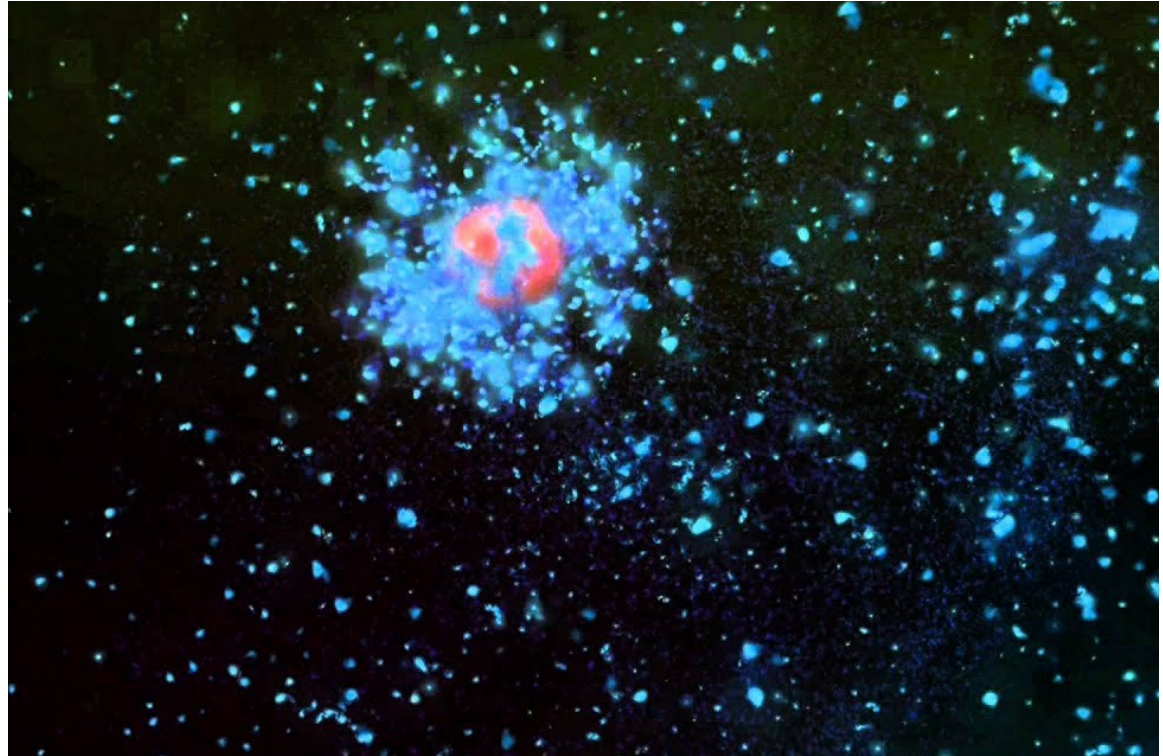


Matter-only Universe



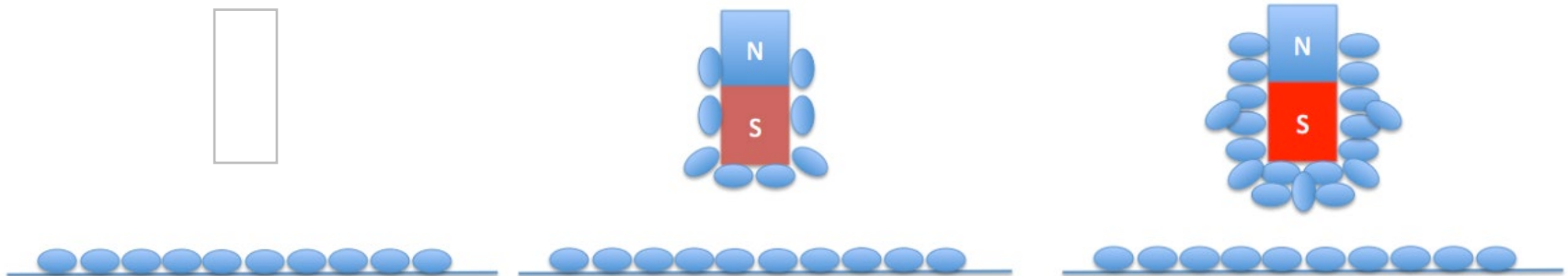
1

MASS OF PARTICLES



WHY DO PARTICLES HAVE MASS? (AND WHY ARE THEY SO DIFFERENT)

Analogy: think of **dipole** magnets of different strength ...



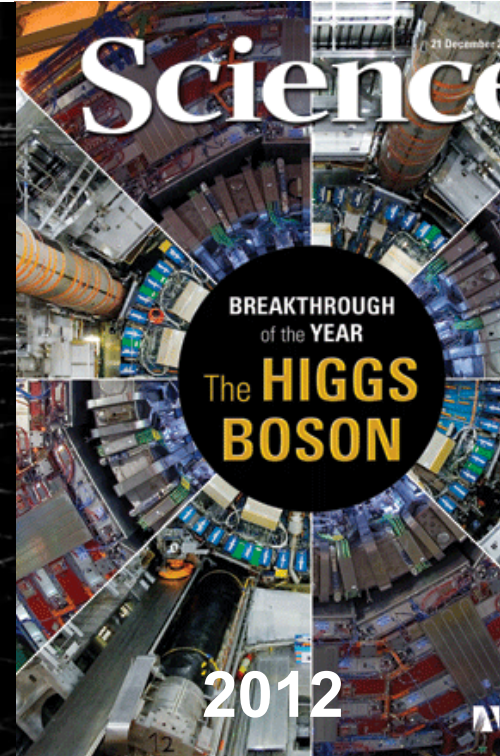
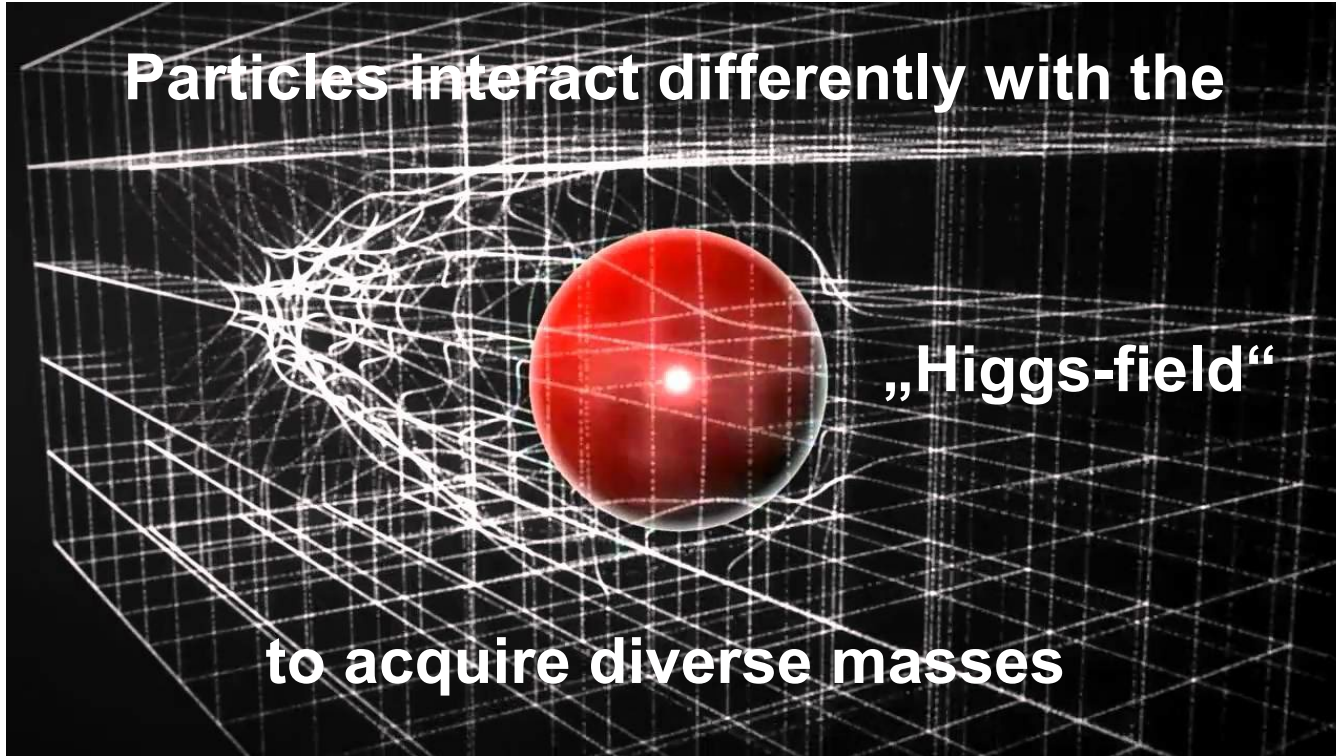
... and a „field“ of magnetized tiny particles ...

No mass

Low mass

High mass

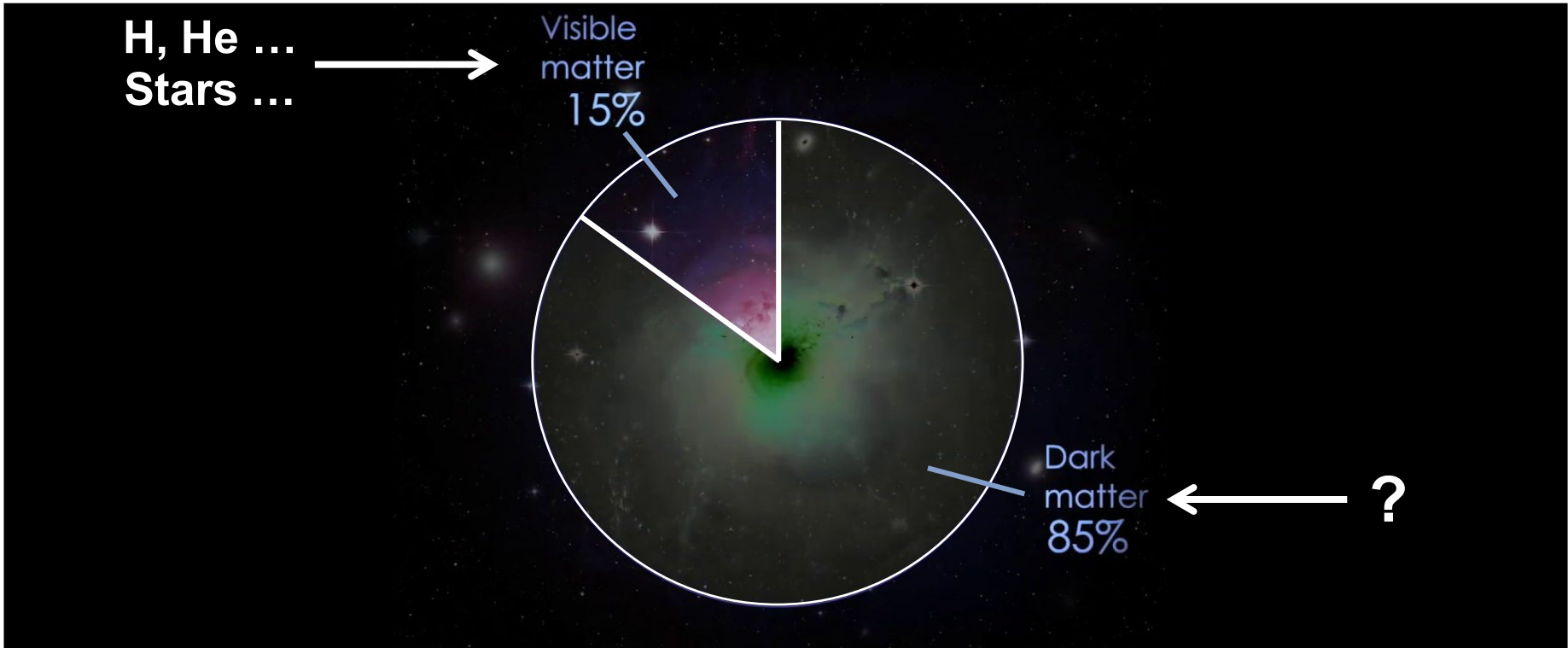
THERE IS SOMETHING ALL AROUND US IN WHOLE UNIVERSE



VISIBLE AND DARK UNIVERSE



WE CURRENTLY ONLY UNDERSTAND A TINY PART OF OUR UNIVERSE




UNKNOWN UNIVERSE: DARK MATTER

INVISIBLE



Dark matter doesn't emit, absorb or reflect light, so it's impossible to 'see'.

DARK MATTER
is
EVERYWHERE



Normal **5%** The other is a mystery **95%**



MYSTERIOUS

It's been many decades since we first theorised the existence of dark matter but we still haven't **PROVEN** it!

A PARTICLE?

Gravitational effect

Normal/visible Matter (5%)

Exotic DM particle(s)?

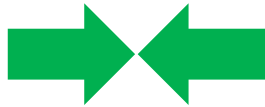
→ Search for DM particle(s) → many projects worldwide

FATE OF THE UNIVERSE

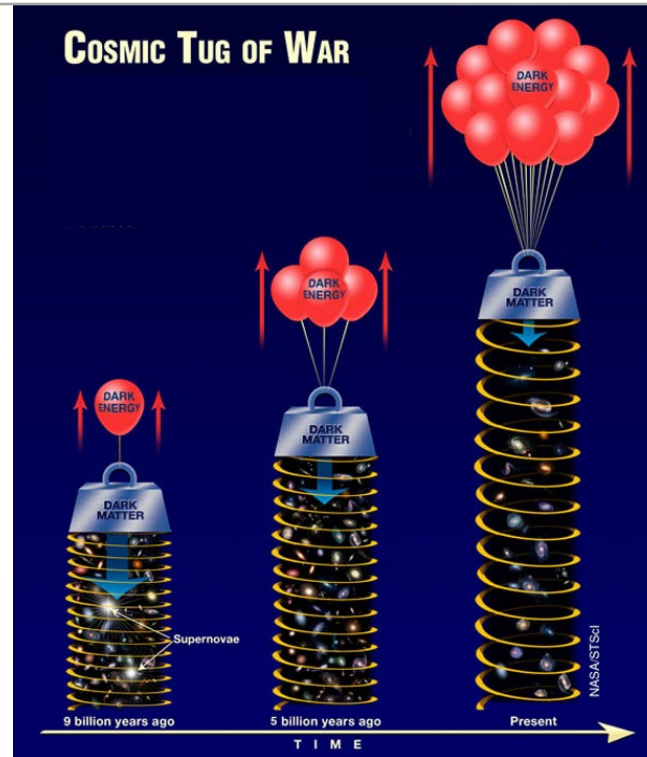


HOW WILL THE UNIVERSE DEVELOP AND EVENTUALLY END?

Dark Matter
+
Normal Matter



„Big Crunch“

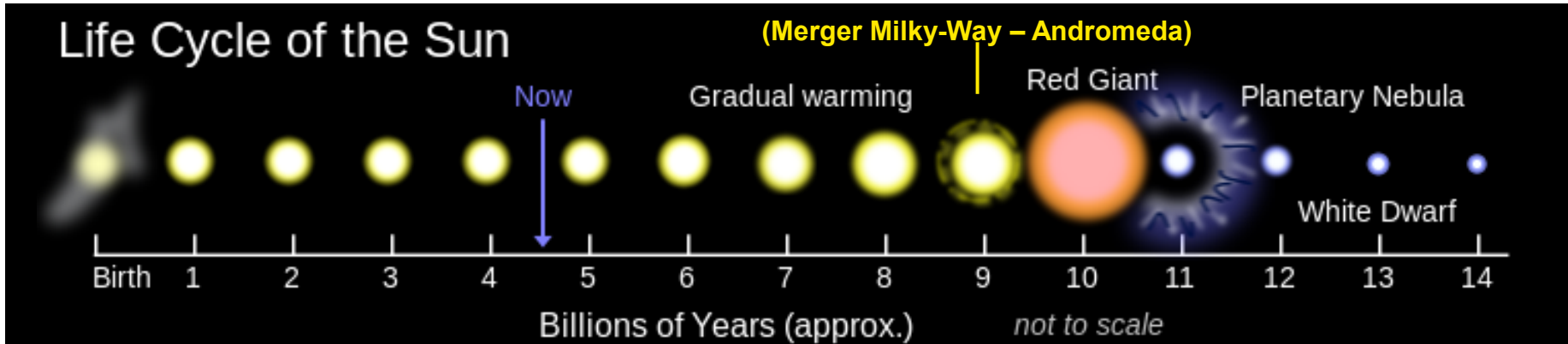


Dark Energy

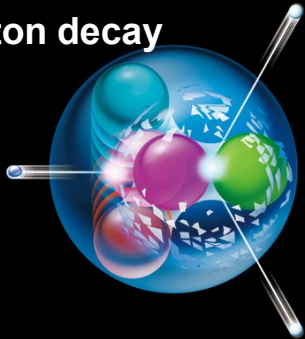


„Big Freeze“

OUR UNIVERSE WILL EVENTUALLY „DIE“ DON'T WORRY – IT'S A LONG WAY TO GO

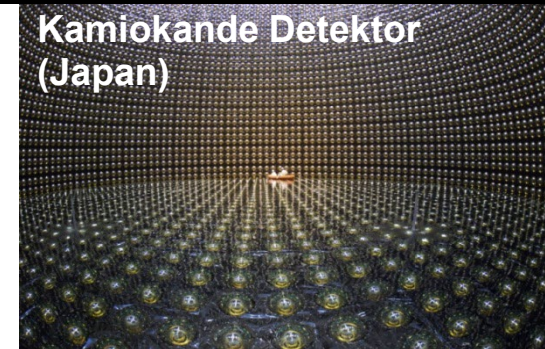


Proton decay



Are protons
eternally stable or
do they decay?

Kamiokande Detektor
(Japan)



SUMMARY

In addition to 1-4,
there are further
unsolved questions
about the Universe,
involving, e.g.:

- New forces
- Neutrinos
- Gravitational waves

...



SCIENCE – THE ENDLESS FRONTIER!



There are things we know that we know; there are things we know that we don't know,
and there are things **we don't know that we don't know.**
(after D. Rumsfeld)



გმადლობთ