

Cosmic rays and dark matter

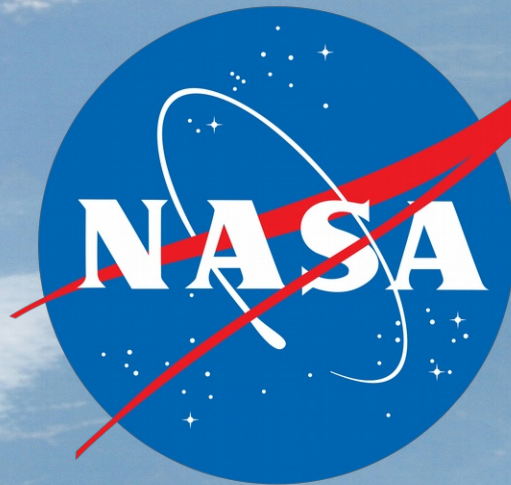
July 2015

Philip von Doetinchem

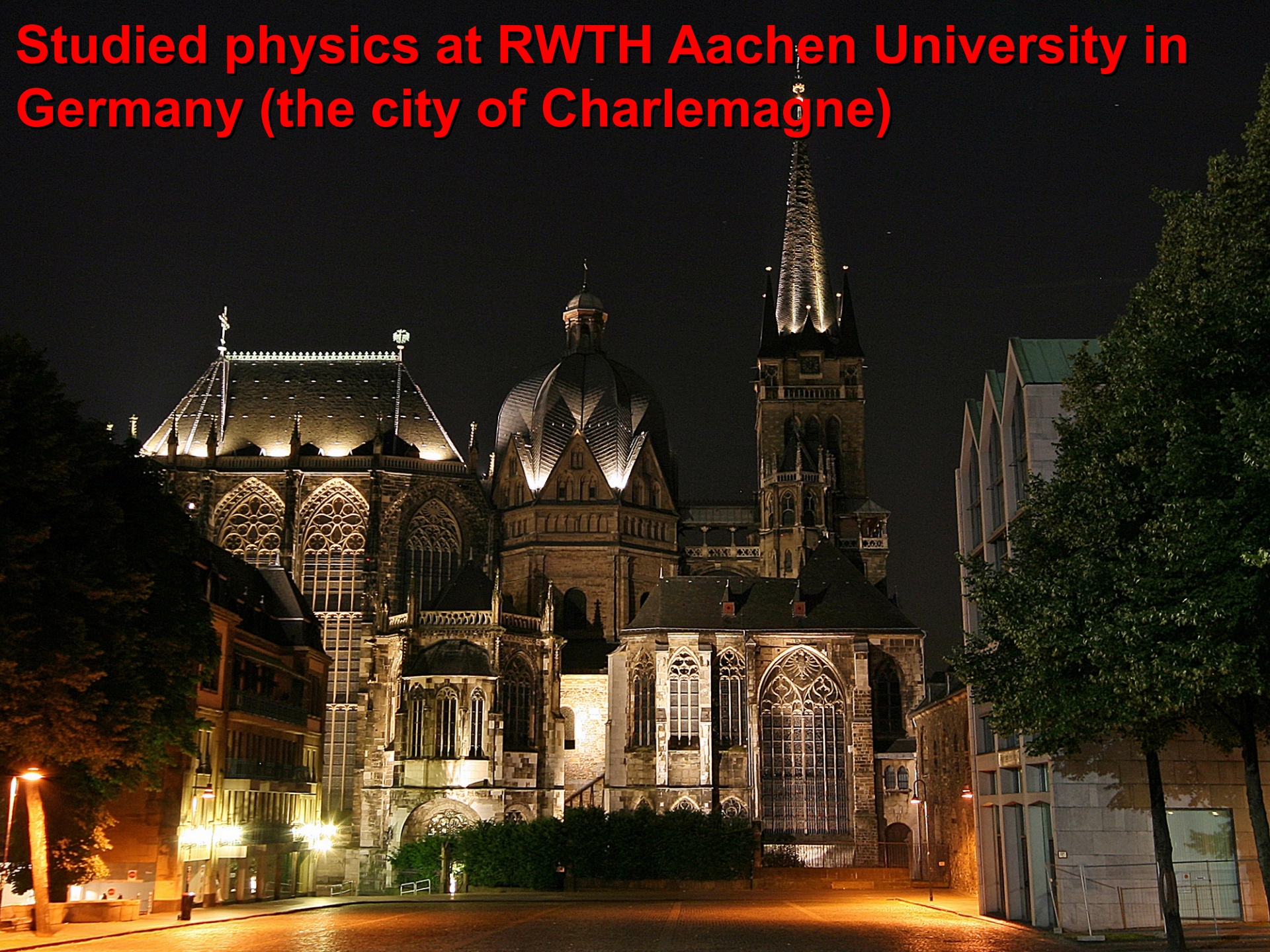
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Dark Matter:

We know it's there!

**Otherwise our whole Universe
would look different.**

**So far: no proof for what it is
exactly! :-)**

stuff we know

**stuff we don't know:
dark matter**

Now what?



**Why not ask someone
who has been there and**

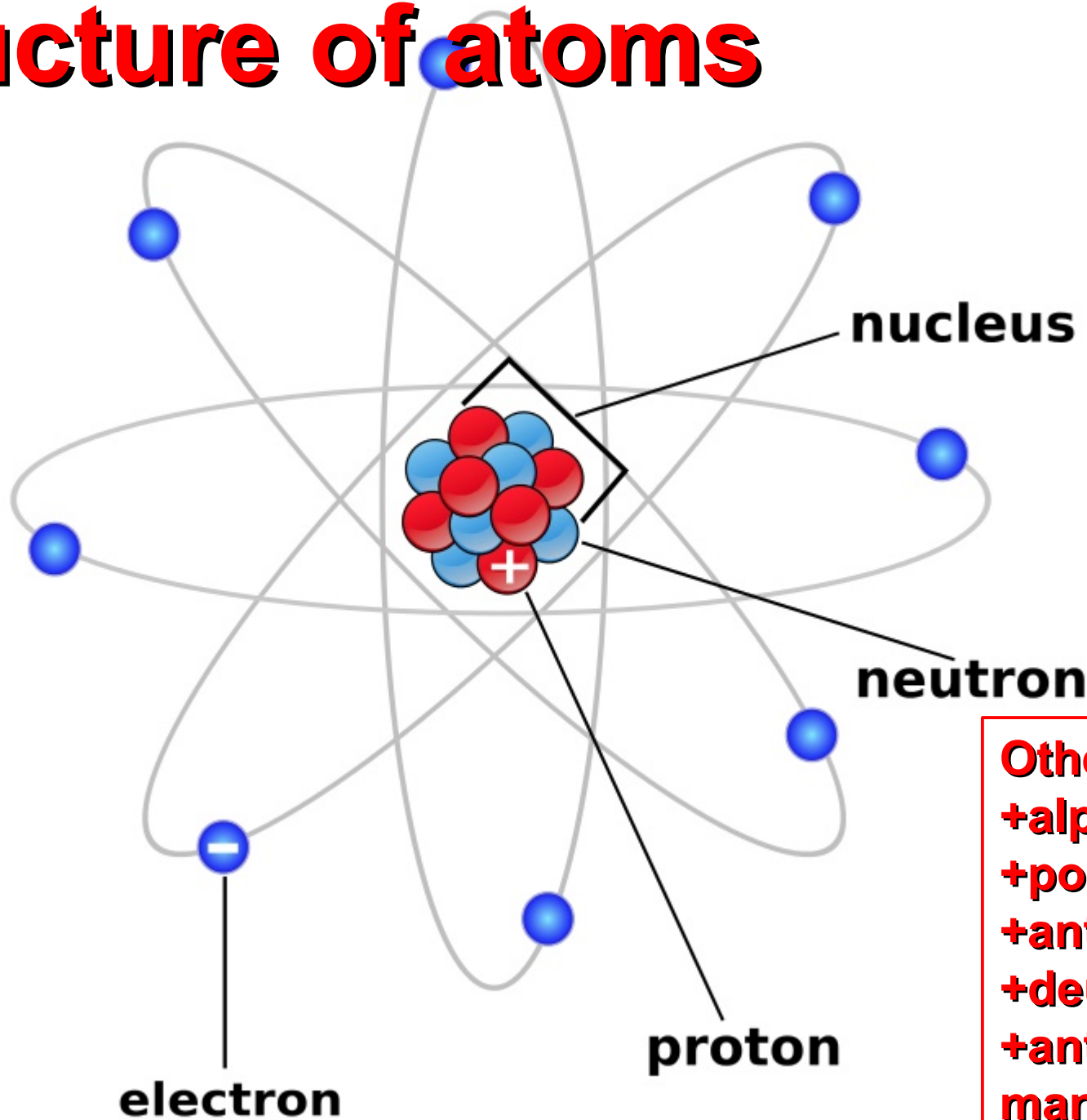
**These
guys could
be cosmic
rays**

Cosmic rays - What is that?



Products of star explosions.

Structure of atoms



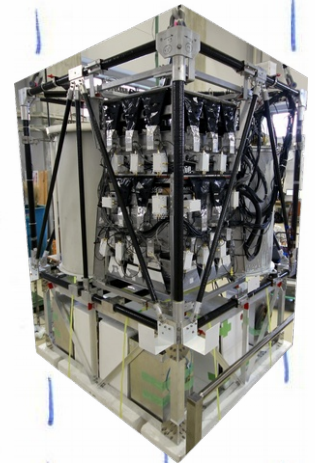
Other types:
+alpha
+positron
+antiproton
+deuteron
+antideuteron
many more...

Where to put such an experiment?

Imagine you wanted
to collect rain...



too dry



**The atmosphere acts as a
roof for cosmic rays**

atmosphere



***Which is good to stay
healthy, but bad to
measure cosmic rays***

**when you are hiking
at high altitudes**

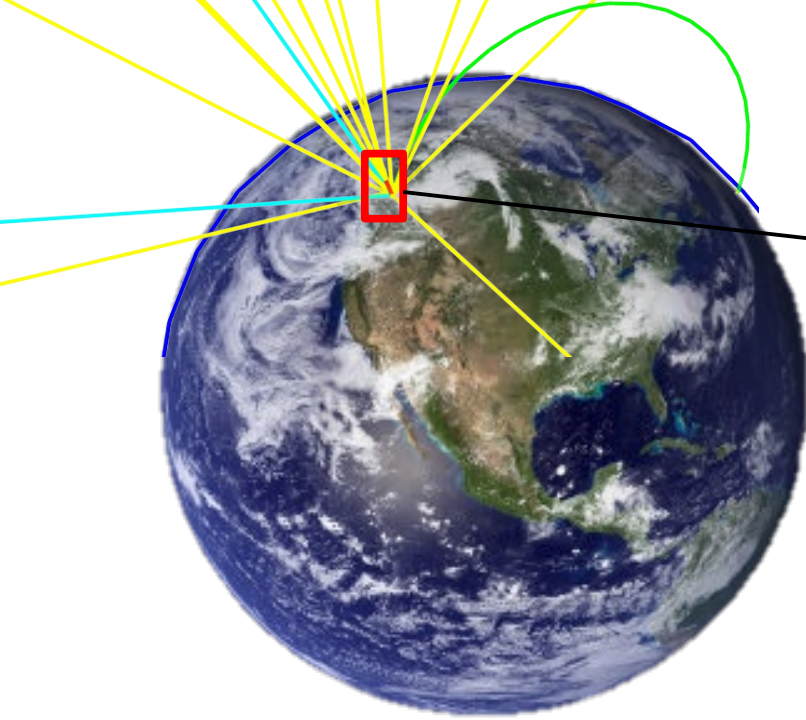
**→ you are exhausted
much faster**

**→ because there is
less air to breathe**

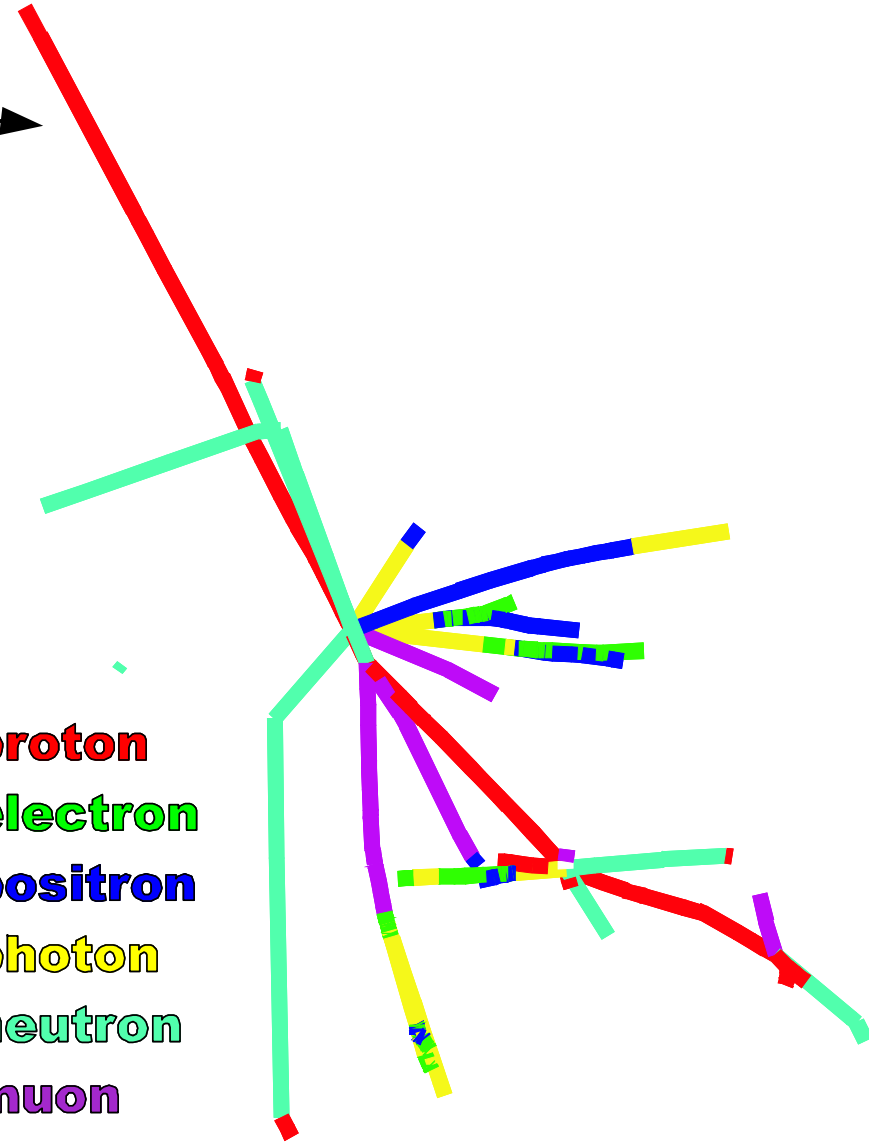
**→ roof for cosmic
rays is getting weaker**



computer simulation of interaction of a proton with the atmosphere



zoom

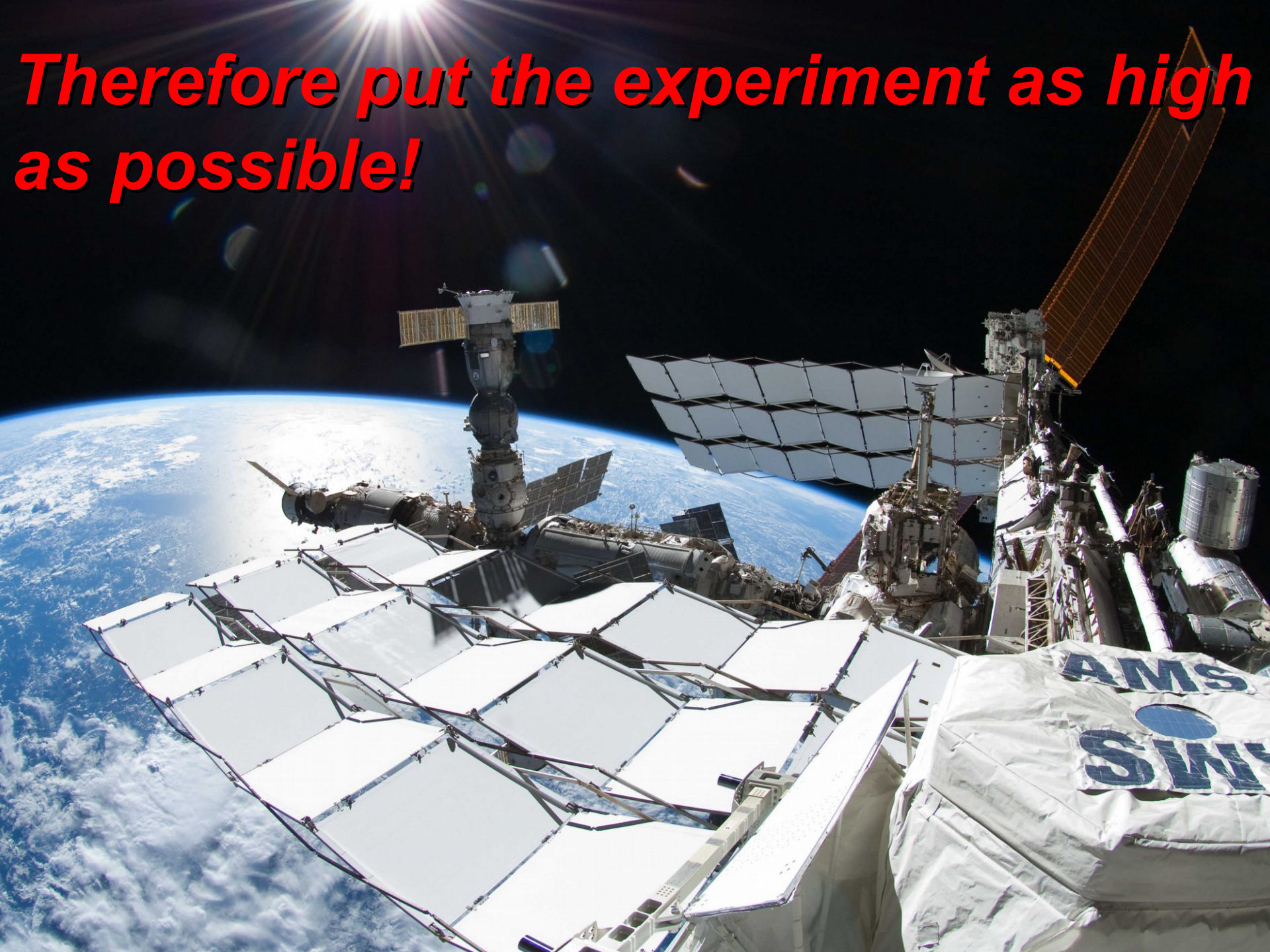


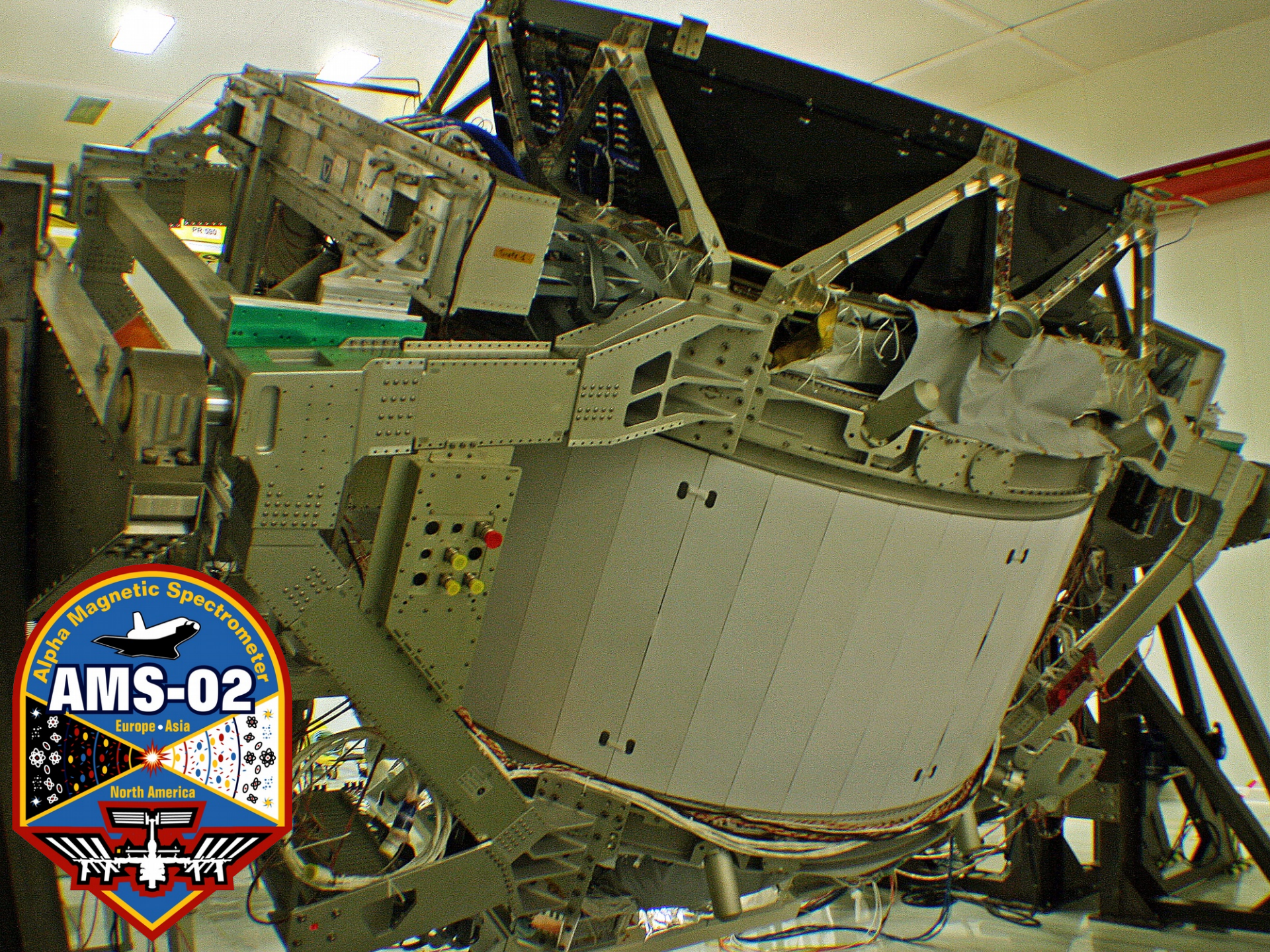
Cosmic ray interacts with atmosphere

- slows down
- composition changes a lot with altitude
- we are exposed to hundreds of cosmic rays this very moment

- proton
- electron
- positron
- photon
- neutron
- muon

Therefore put the experiment as high as possible!



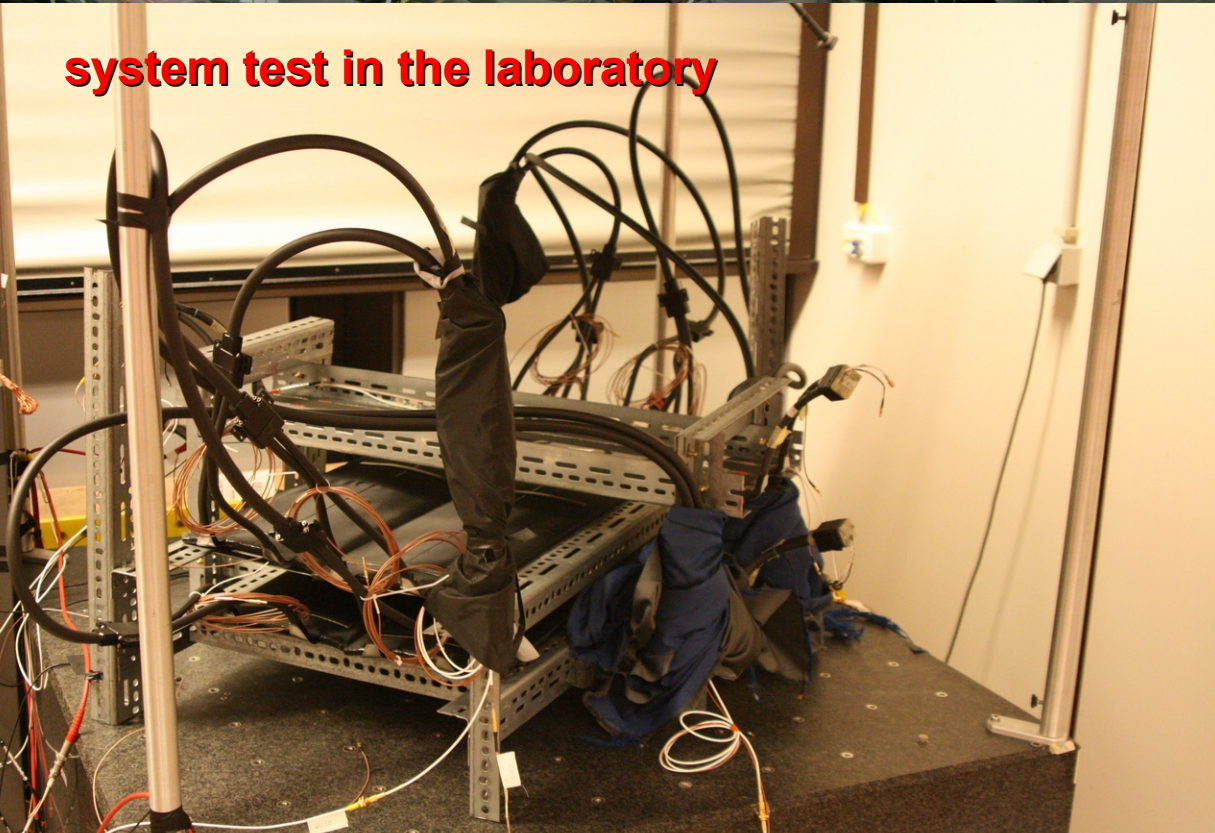




payload integration



vibration testing

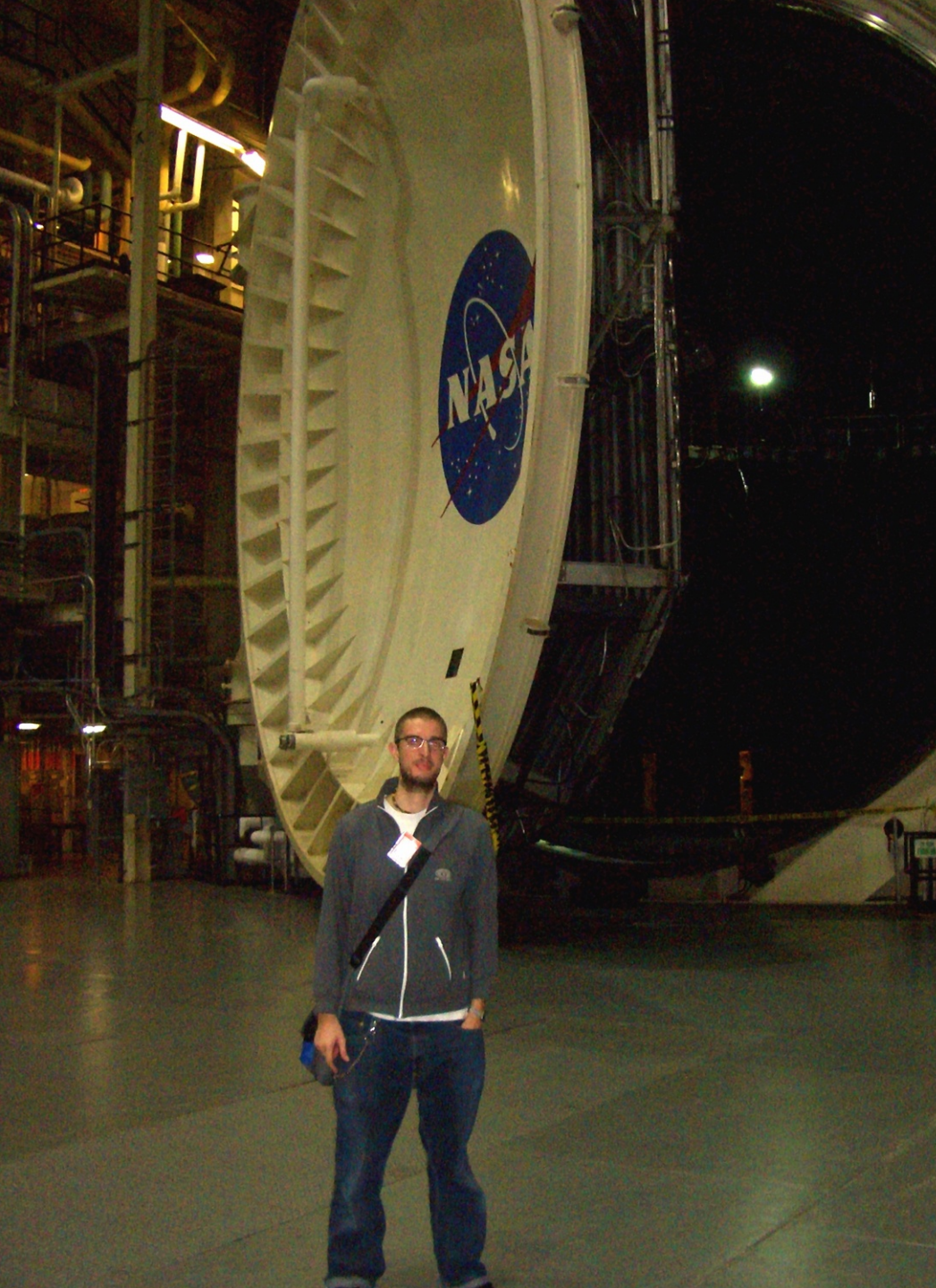


system test in the laboratory



vacuum testing

Meetings at NASA



Integration of AMS-02 at CERN with STS-134 astronauts



MW

PvD

AG

Mark E. Kelly

Gregory H. Johnson

Andrew J. Feustel

Gregory E. Chamitoff

Roberto Vittori

TK

Edward M. Fincke

Samuel C. C. Ting



AMS-02 on the launchpad



**Therefore put the experiment as high
as possible!**

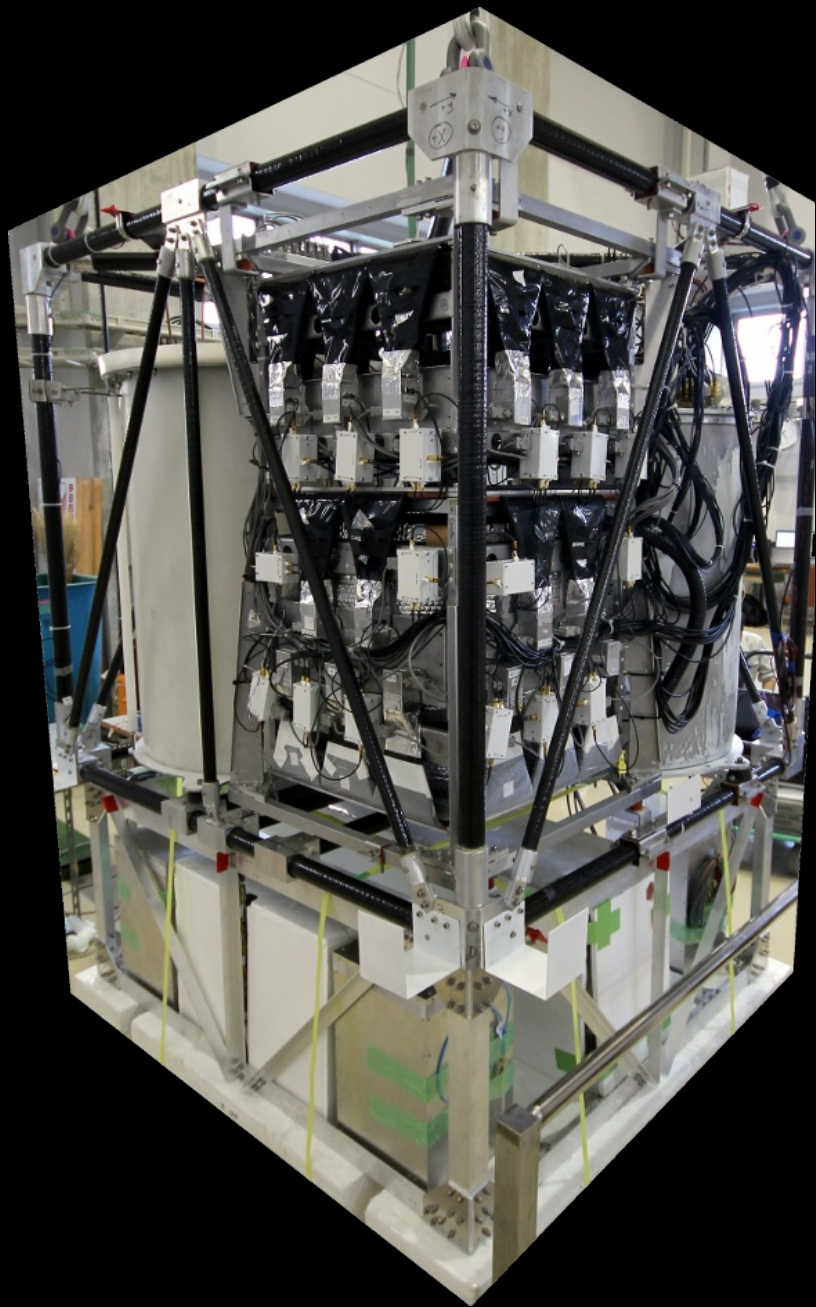
**Space is great, but super expensive
(\$1,000,000 for 2lbs)**



**use balloons
that go up very very high**

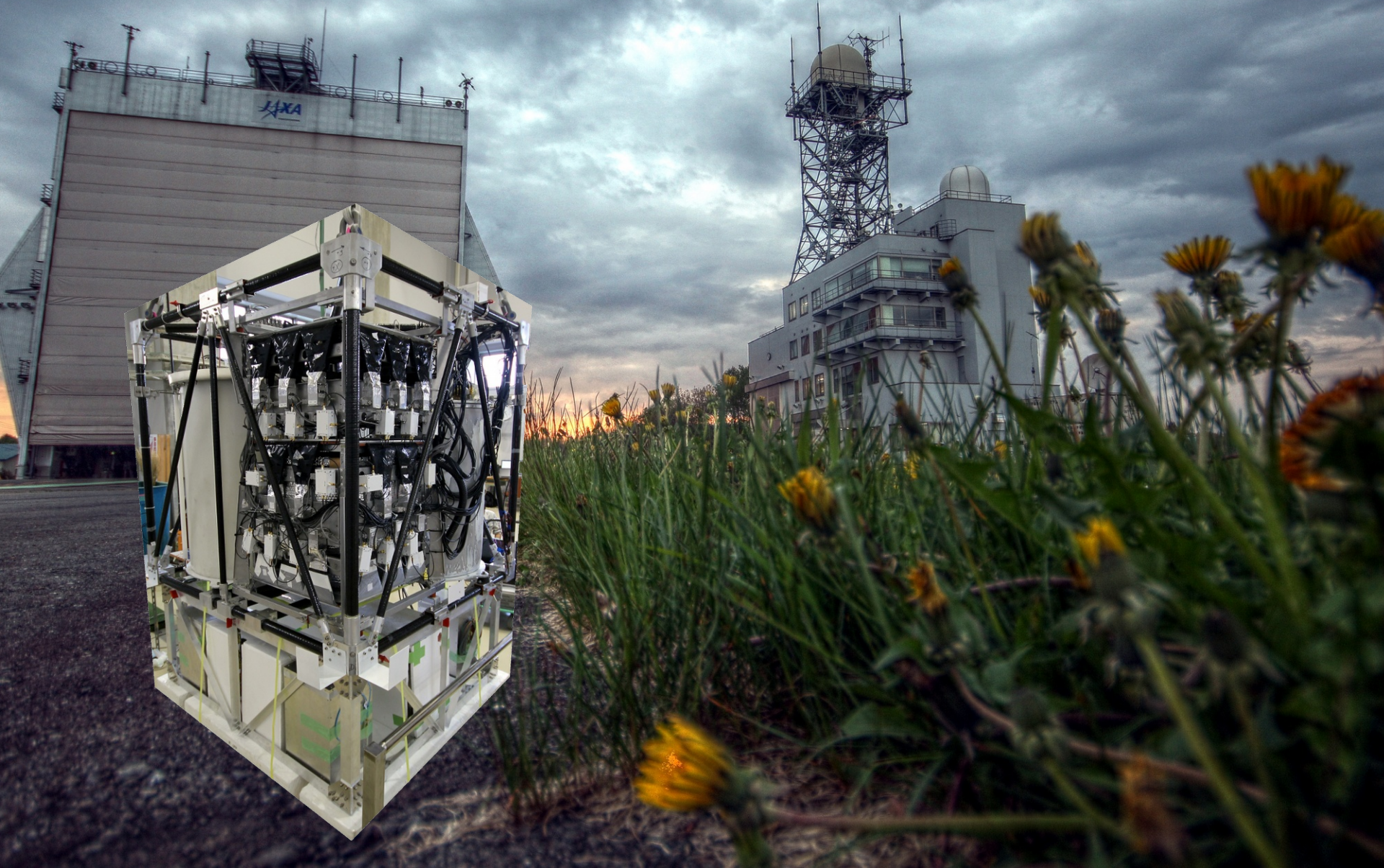
→ 25 miles above ground





***A lot of hands on
work with all sorts of
different tasks!
Playground for big kids***

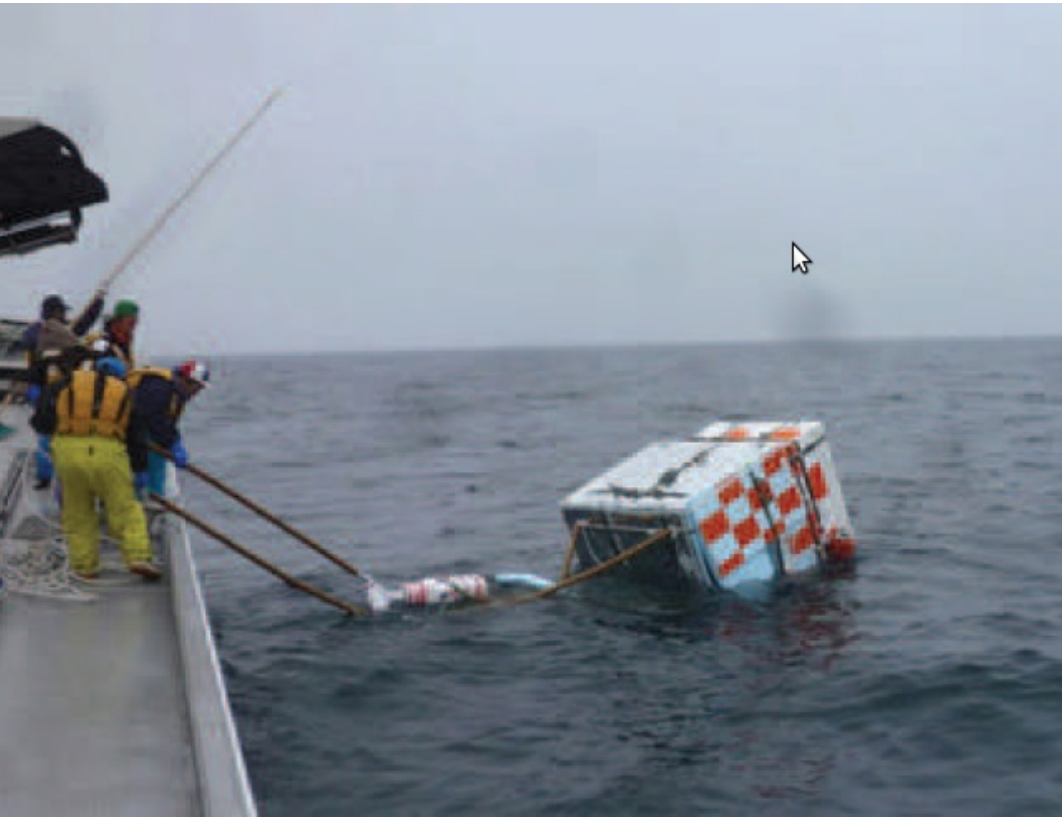
GAPS balloon experiment launched from Japan



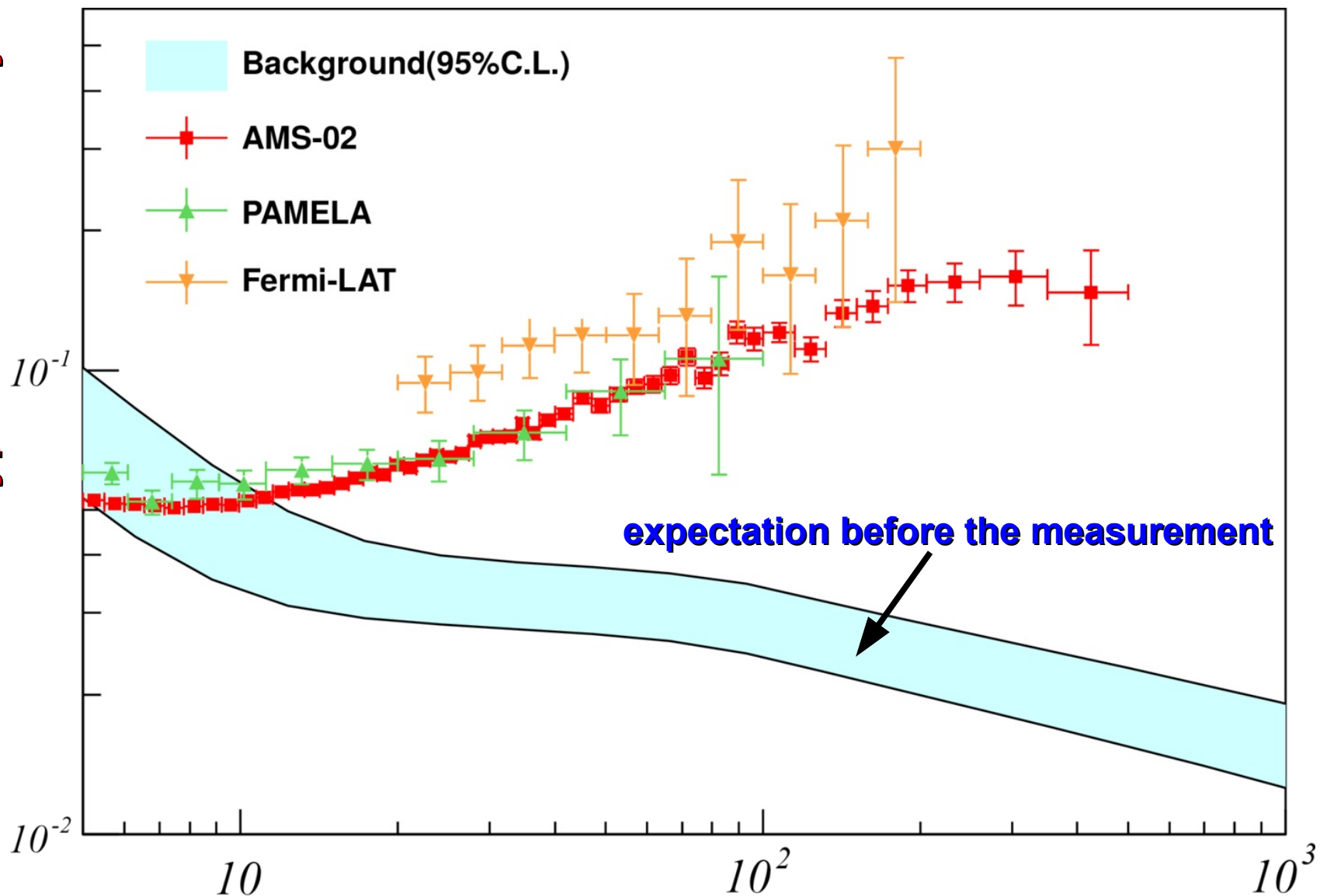


2012:06:03 02:29:14

Experiment landed in the Pacific ocean!



ratio of two types of cosmic rays



How fast are the cosmic rays going



***We are just at the beginning to
understand dark matter!***

**I could only present one way to look
at the question.**