National Institutes for
Quantum Science and Technology
Naka Fusion Institute

ITER Japan Domestic Agency

A small Sun on Earth

ITER

イーター

Vol.5 ～The Spirit of Monozukuri: Gyrotrons～

CHARACTERS

TAIYO TENNO

As a student he met Soléane, and ever since has developed a strong interest in ITER.
This spring, he graduated from university and entered the workforce.

MIRAI MITSUHASHI

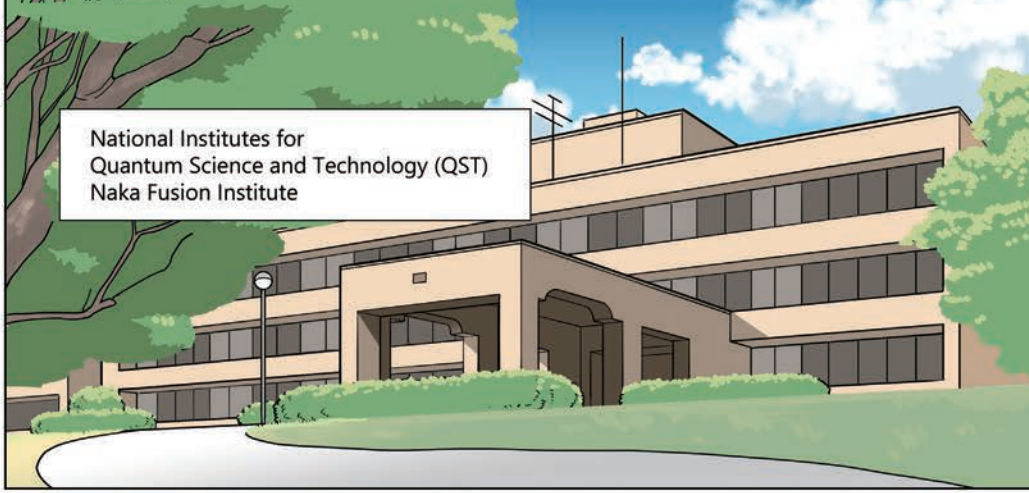
Administrative staff at QST (National Institutes for Quantum Science and Technology), the Japanese Domestic Agency of the ITER project.

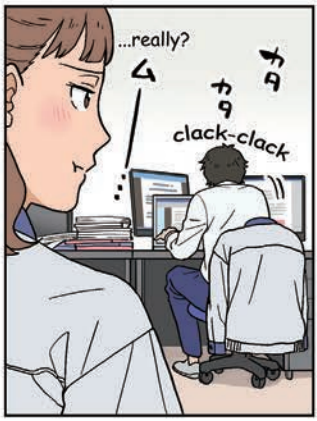
RENJI GŌDA

QST employee in charge of R&D for the gyrotrons, part of a radiofrequency heating system used in ITER.

SOLÉANE

A French researcher working at ITER in Saint-Paul-les-Durance. Currently lives in Aix-en-Provence. She was the one who initially got Taiyo interested in ITER.

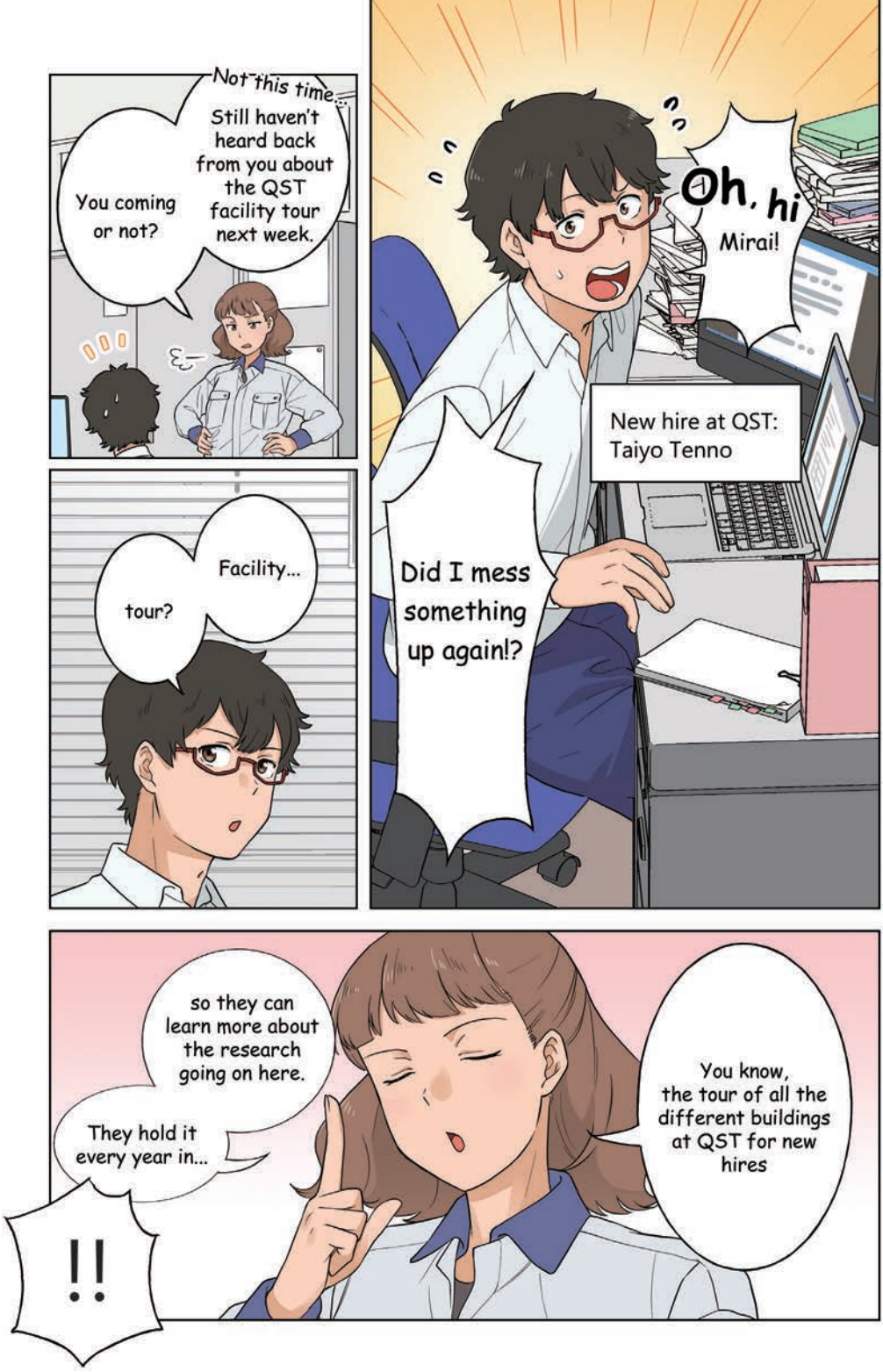

National Institutes for
Quantum Science and Technology (QST)
Naka Fusion Institute


...really?
clack-clack

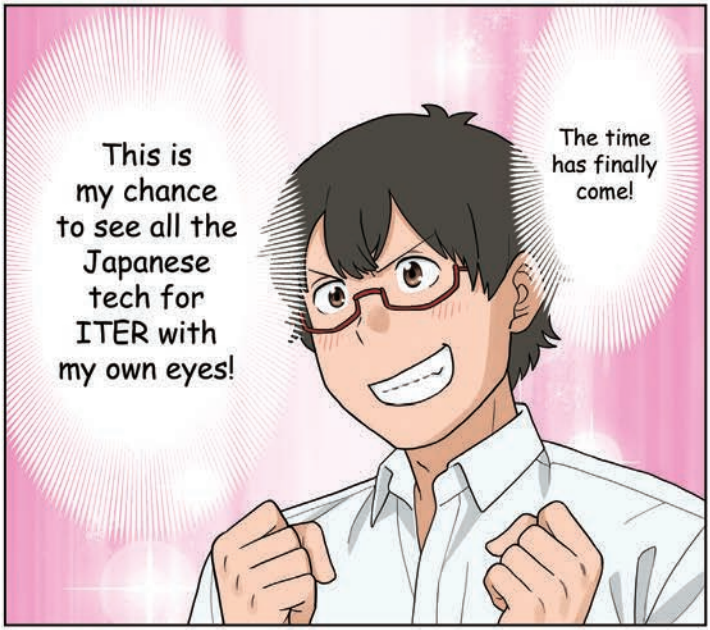

Hello!
... Earth
to Taiyo!


Hey!
Taiyo!
You got a sec?
!!


footsteps
footsteps

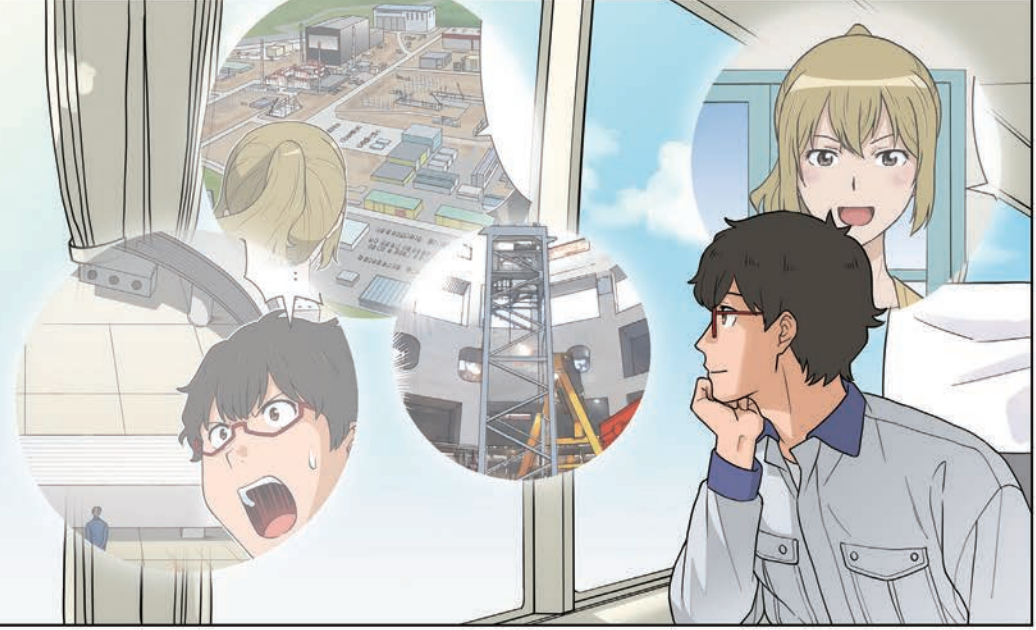

Not this time...
Still haven't heard back from you about the QST facility tour next week.
You coming or not?
Oh, hi Mirai!
New hire at QST: Taiyo Tenno
Did I mess something up again!?
Facility...
tour?
You know, the tour of all the different buildings at QST for new hires
so they can learn more about the research going on here.
They hold it every year in...
!!


surprised
びくっ
I wouldn't miss it for the world!!!
Count me in!

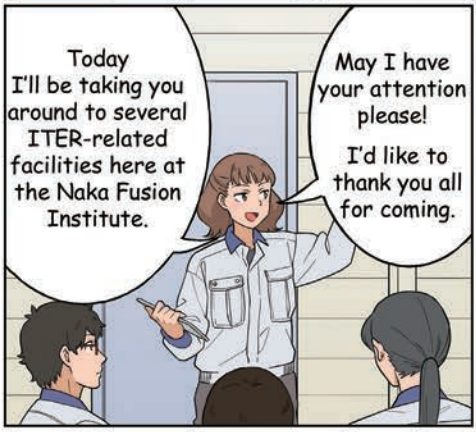

This is my chance to see all the Japanese tech for ITER with my own eyes!
The time has finally come!

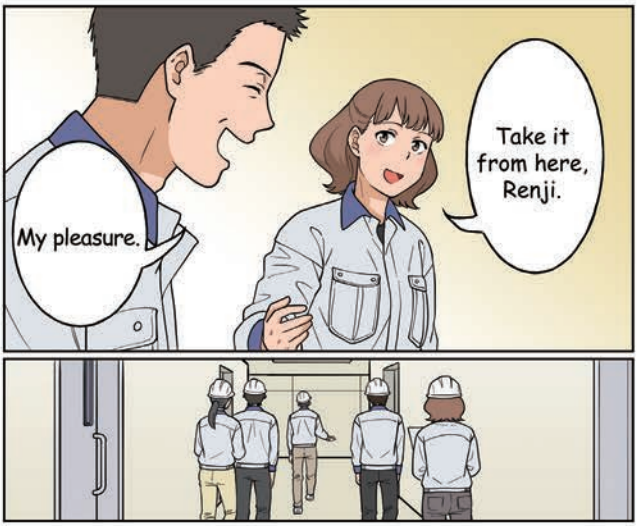

Alright then... Don't forget to sign up.
I'll be giving the tour.
nearly gave me a heart attack...


1 week later
This place is huge you need a bus to go around.

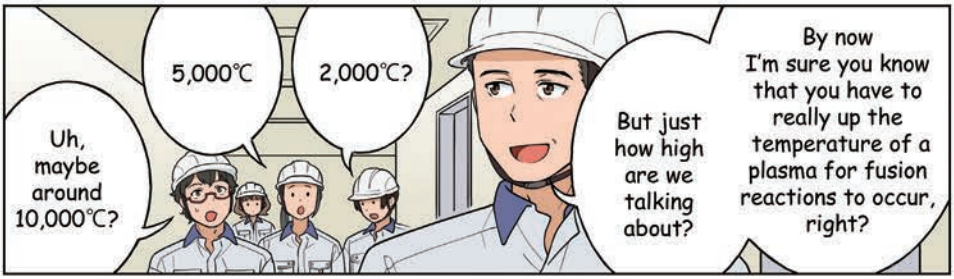


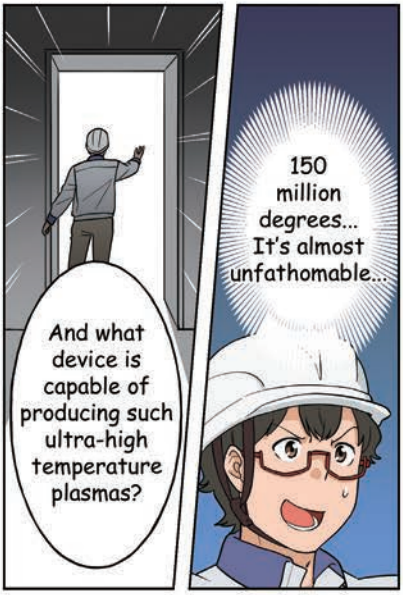

So this is where the magic happens...

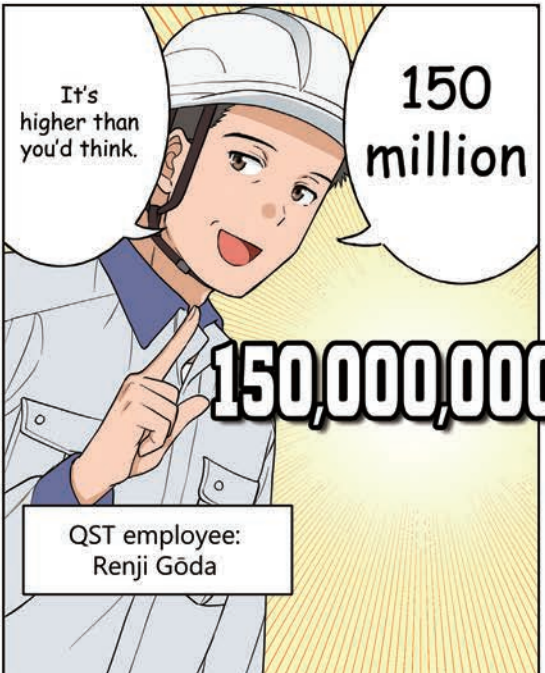

Today I'll be taking you around to several ITER-related facilities here at the Naka Fusion Institute.
May I have your attention please!
I'd like to thank you all for coming.


Take it from here, Renji.
My pleasure.


Our first stop is the Gyrotron Test Facility, where one of the heating systems for ITER is made.

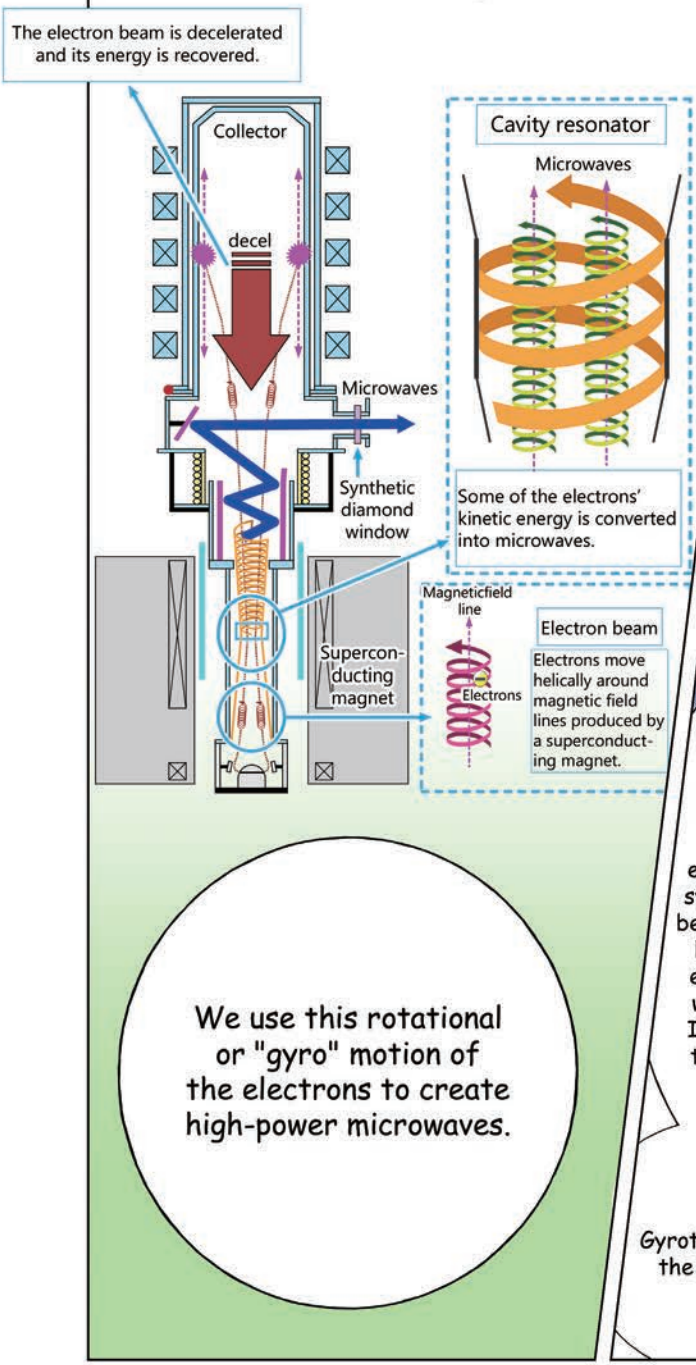

Uh, maybe around 10,000℃?
5,000℃
2,000℃?
But just how high are we talking about?
By now I'm sure you know that you have to really up the temperature of a plasma for fusion reactions to occur, right?

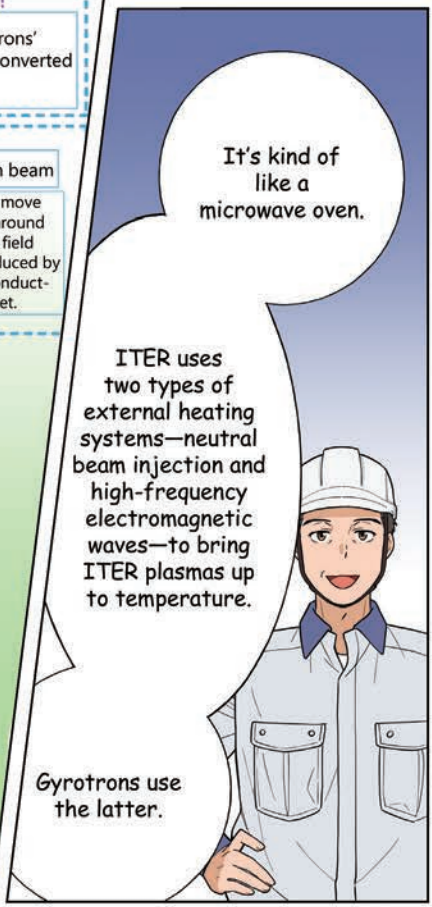

And what device is capable of producing such ultra-high temperature plasmas?
150 million degrees... It's almost unfathomable...

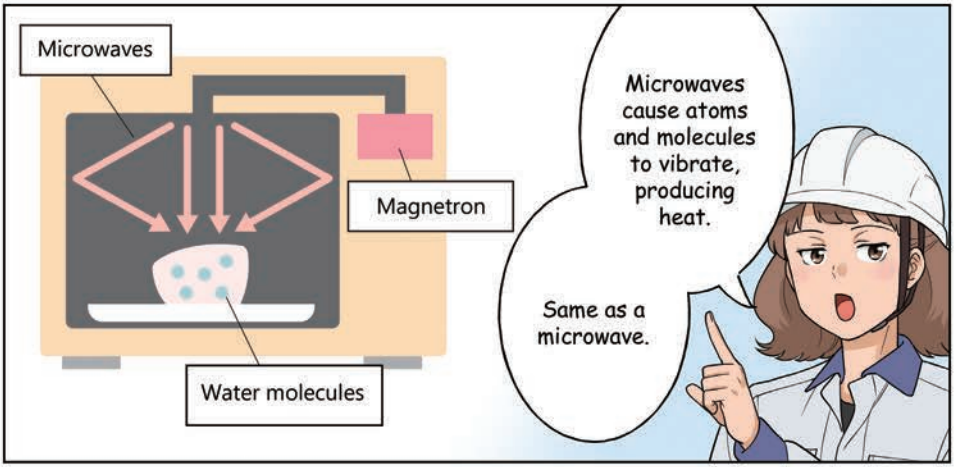

It's higher than you'd think.
150 million
150,000,000℃
QST employee: Renji Gōda

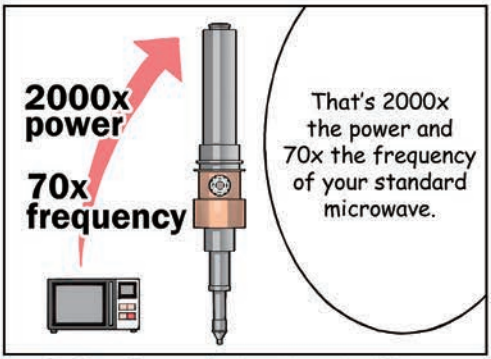

It's called a gyrotron!
!!

Gyrotrons Basics

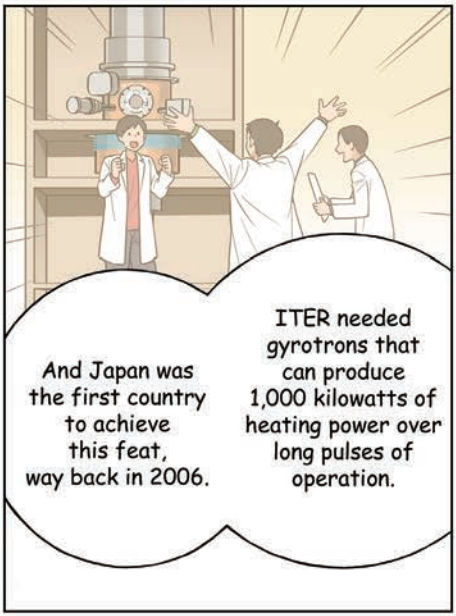


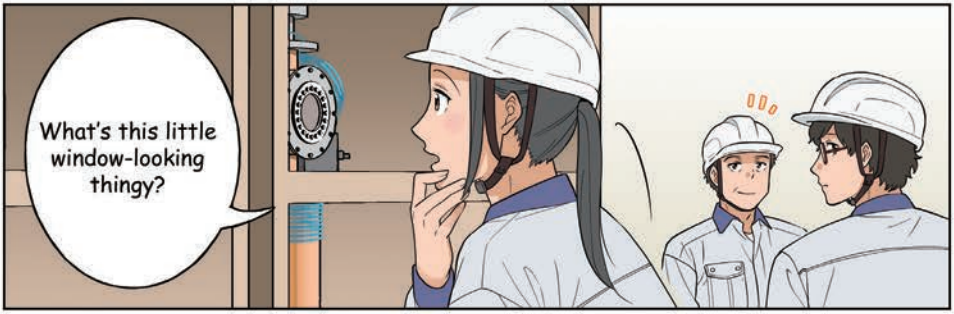



Microwaves
Magnetron
Water molecules
Microwaves cause atoms and molecules to vibrate, producing heat.
Same as a microwave.

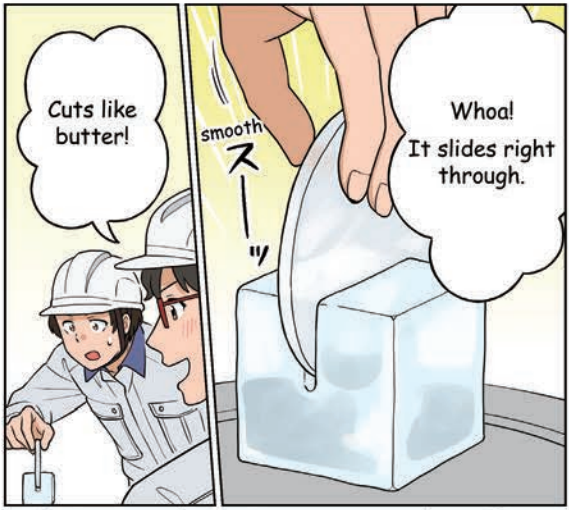

2000x power
70x frequency
That's 2000x the power and 70x the frequency of your standard microwave.


That's got to be the world's strongest "microwave"!
2000 times more powerful...

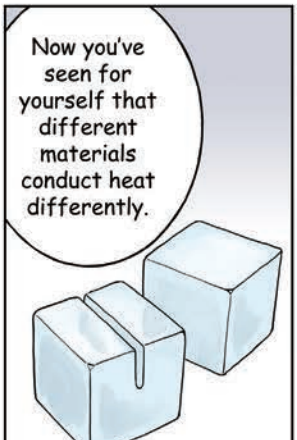

And Japan was the first country to achieve this feat, way back in 2006.
ITER needed gyrotrons that can produce 1,000 kilowatts of heating power over long pulses of operation.

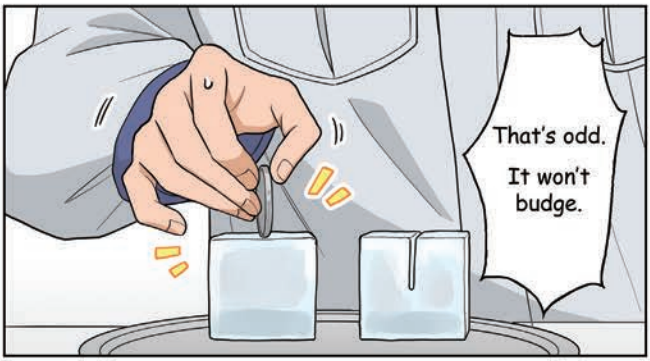

What's this little window-looking thingy?


DIAMOND!?
That "window" is made of diamond.


Cuts like butter!
smooth
スーッ
Whoa! It slides right through.
Now try it with a coin.

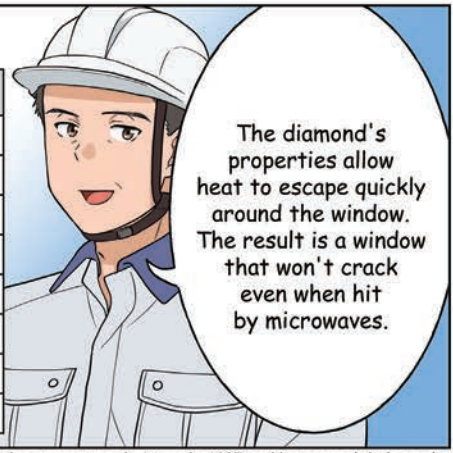

Yes, diamond.
Here, try cutting the ice with it.
For ice-cutting experiment, we're reusing damaged and unusable items.


Now you've seen for yourself that different materials conduct heat differently.

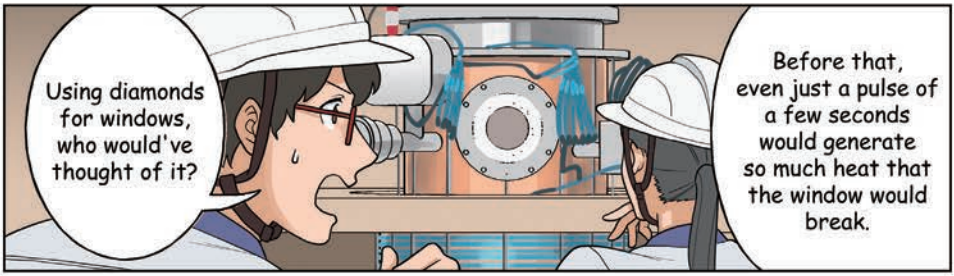

That's odd. It won't budge.

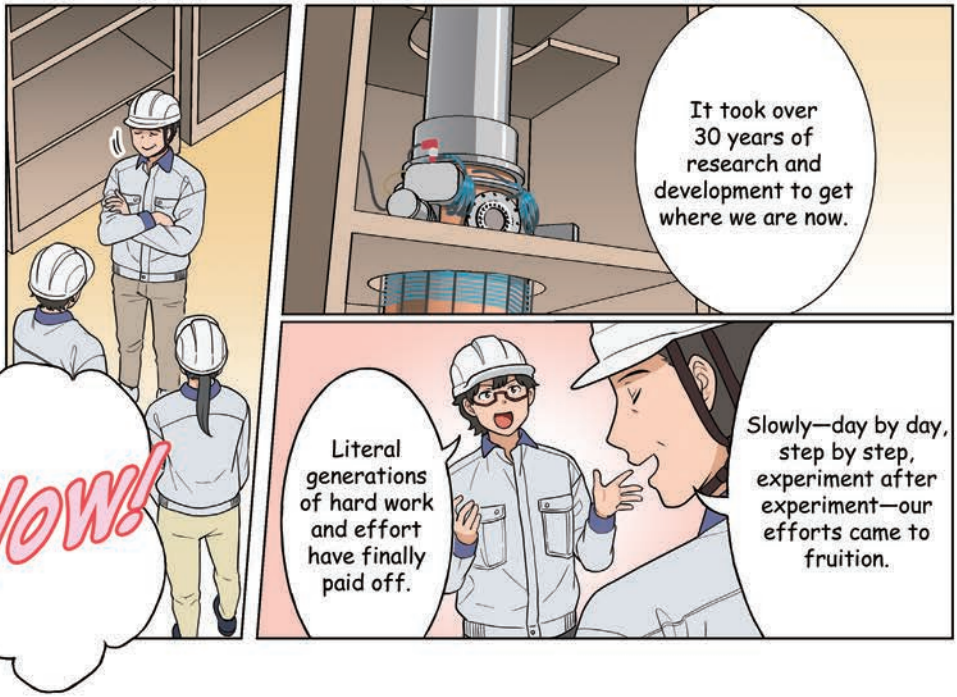
Thermal conductivity of metals

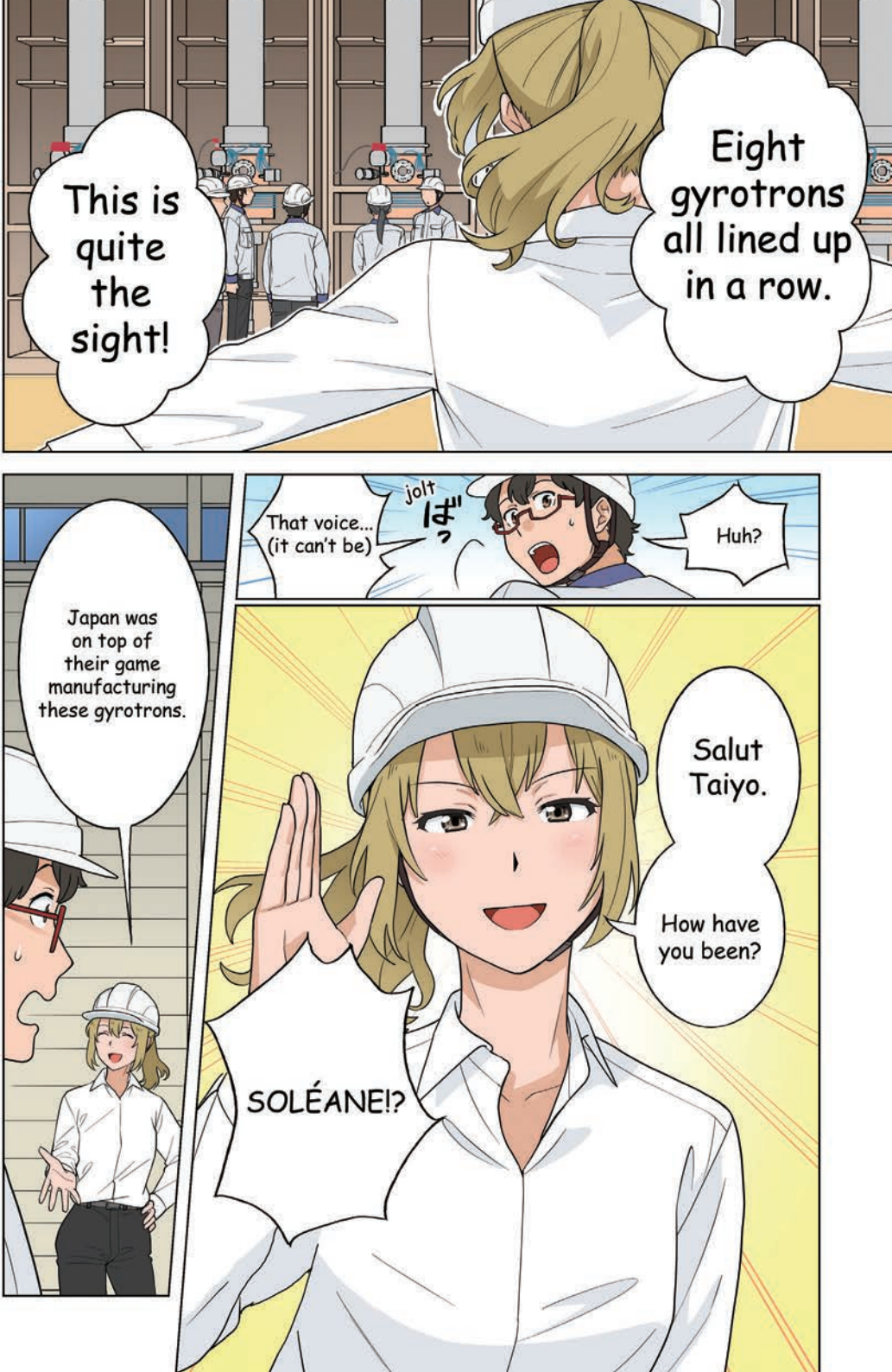
Metal	Thermal conductivity (W/m K)
Diamond	1000 ～ 2000
Silver	420
Copper	398
Gold	320
Aluminum	236
Iron	90.9
Glass	1
Water	0.6

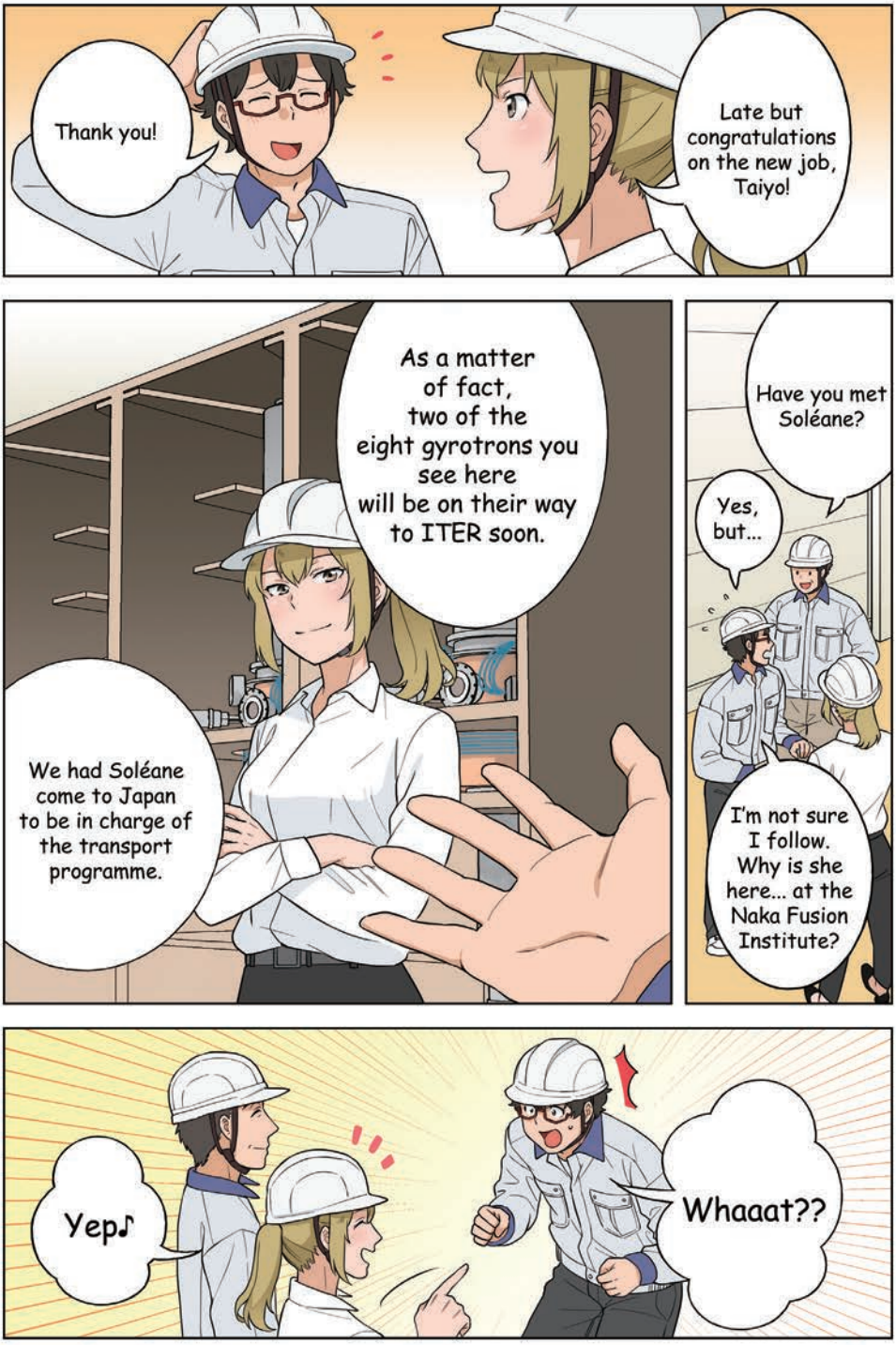


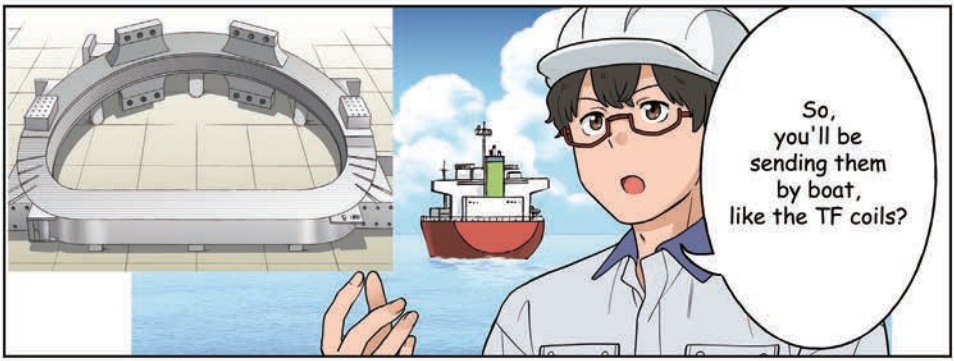
*The artificial diamond window used in the gyrotron was first installed on a gyrotron in Japan in 1997 and is now a global standard.

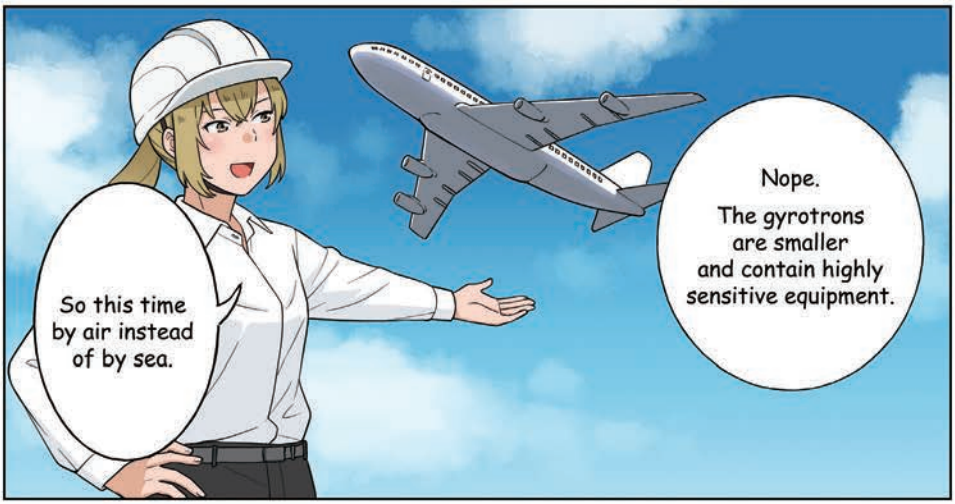


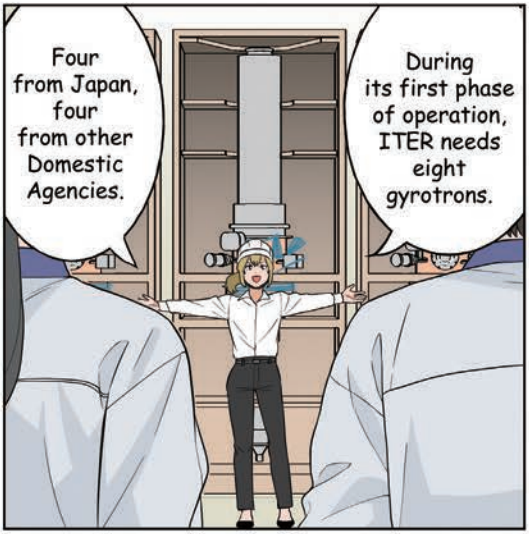


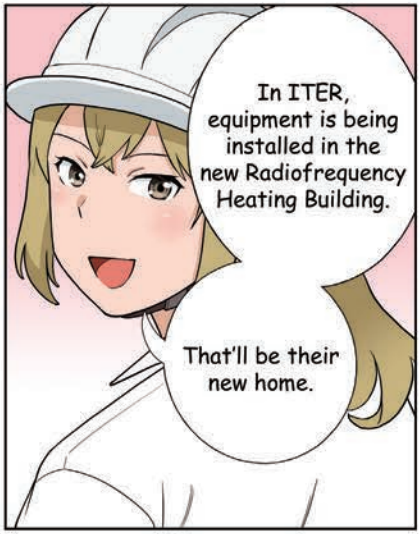

Eight gyrotrons all lined up in a row.
This is quite the sight!
Huh?
jolt
ばっ
That voice... (it can't be)
Salut Taiyo.
How have you been?
SOLÉANE!?
Japan was on top of their game manufacturing these gyrotrons.

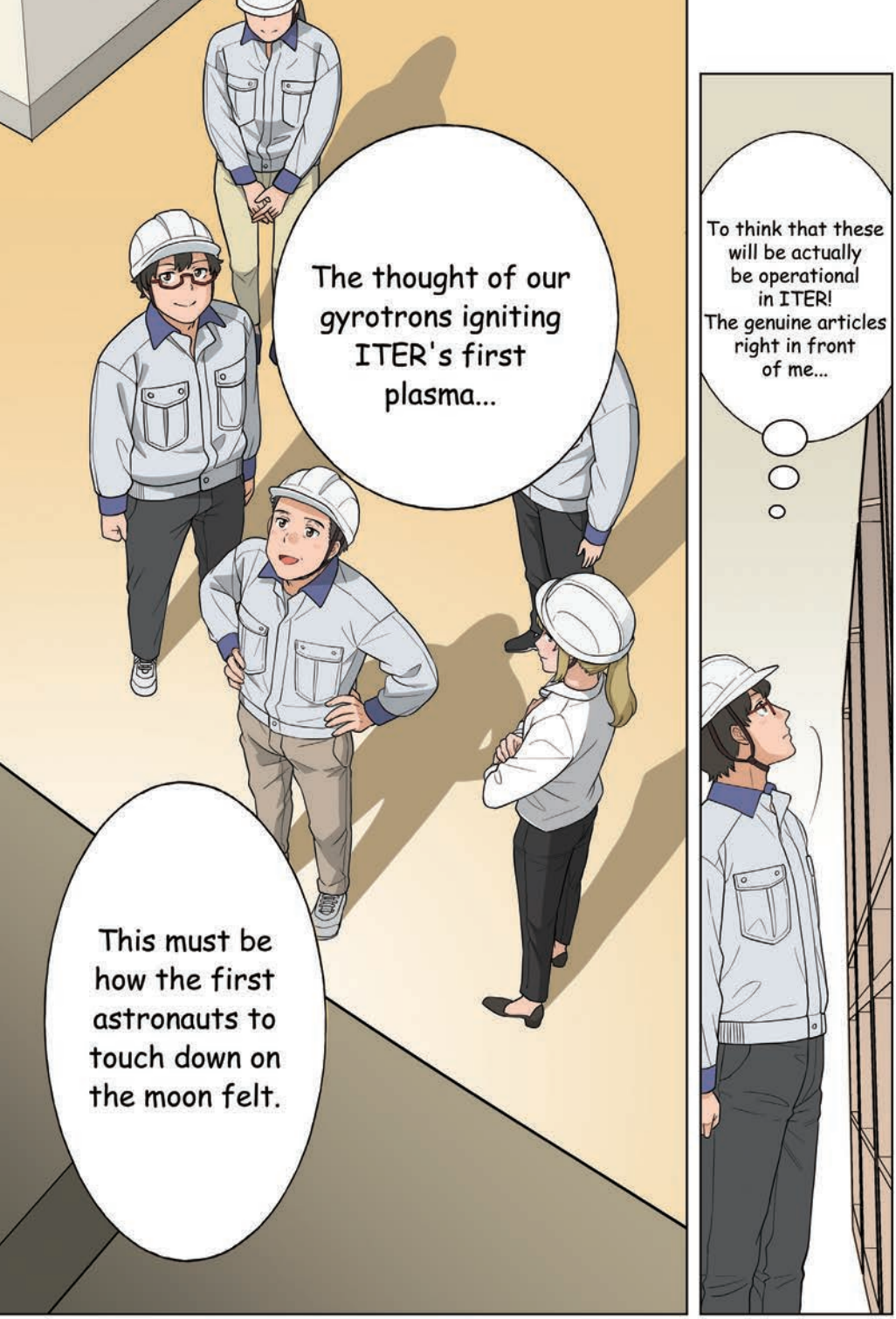

Thank you!
Late but congratulations on the new job, Taiyo!
As a matter of fact, two of the eight gyrotrons you see here will be on their way to ITER soon.
We had Soléane come to Japan to be in charge of the transport programme.
Have you met Soléane?
Yes, but...
I'm not sure I follow. Why is she here... at the Naka Fusion Institute?
Yep♪
Whaaat??


So,
you'll be
sending them
by boat,
like the TF coils?


So this time
by air instead
of by sea.
Nope.
The gyrotrons
are smaller
and contain highly
sensitive equipment.


Four
from Japan,
four
from other
Domestic
Agencies.
During
its first phase
of operation,
ITER needs
eight
gyrotrons.

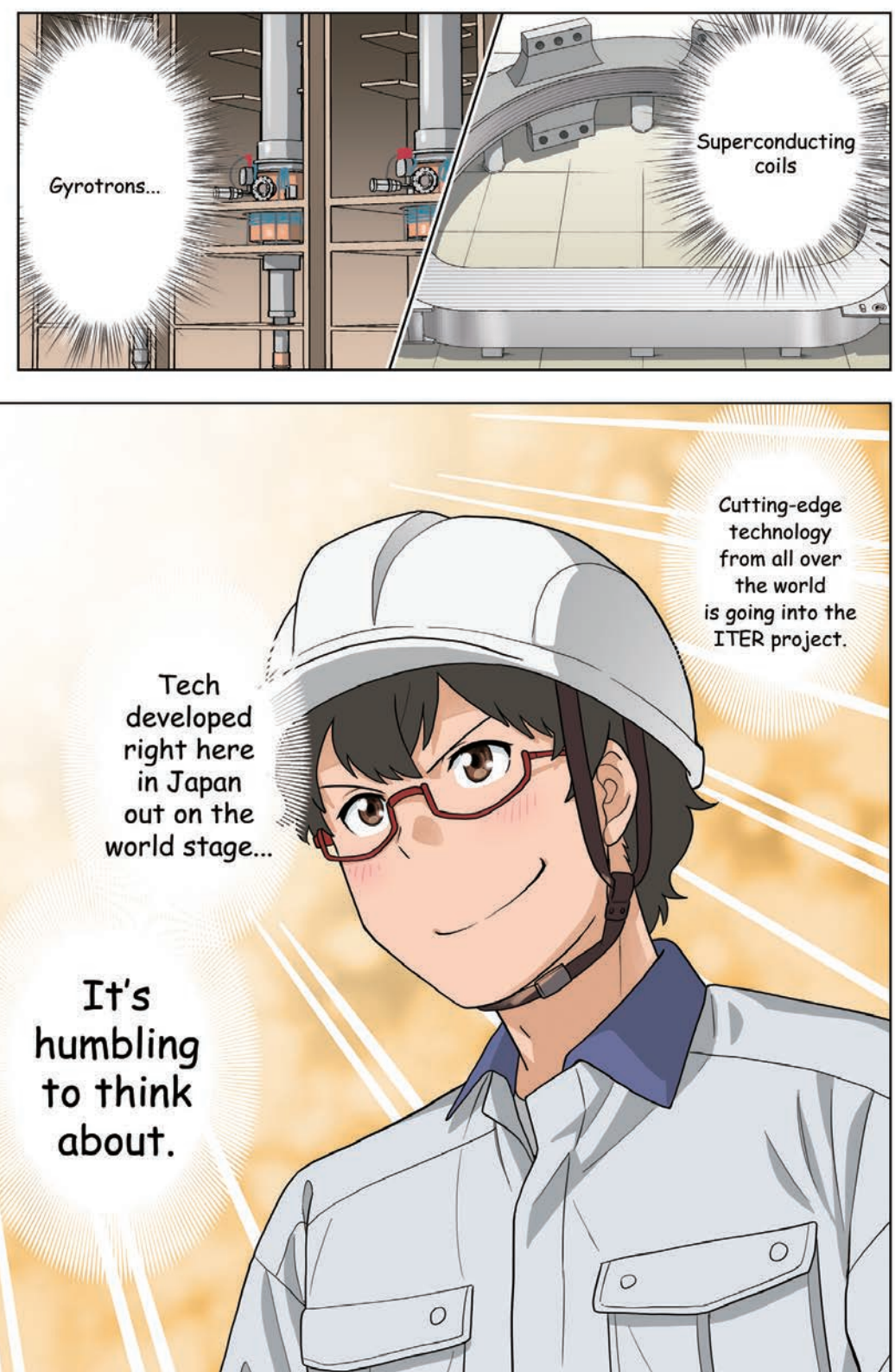

In ITER,
equipment is being
installed in the
new Radiofrequency
Heating Building.
That'll be their
new home.


The thought of our gyrotrons igniting ITER's first plasma...
This must be how the first astronauts to touch down on the moon felt.
To think that these will be actually be operational in ITER! The genuine articles right in front of me...


That's a good note to end on. Let's move on to the next stop of our tour.


I will!
Give it your all.
Because Japan is responsible for the development of various other equipment needed for ITER.


Don't worry, they'll be in good hands.
I hope everything goes smoothly. Safe travels!
We're counting on you.
Okay then, I'm headed back to ITER with the gyrotrons.


Gyrotrons...
Superconducting coils
Cutting-edge technology from all over the world is going into the ITER project.
Tech developed right here in Japan out on the world stage...
It's humbling to think about.

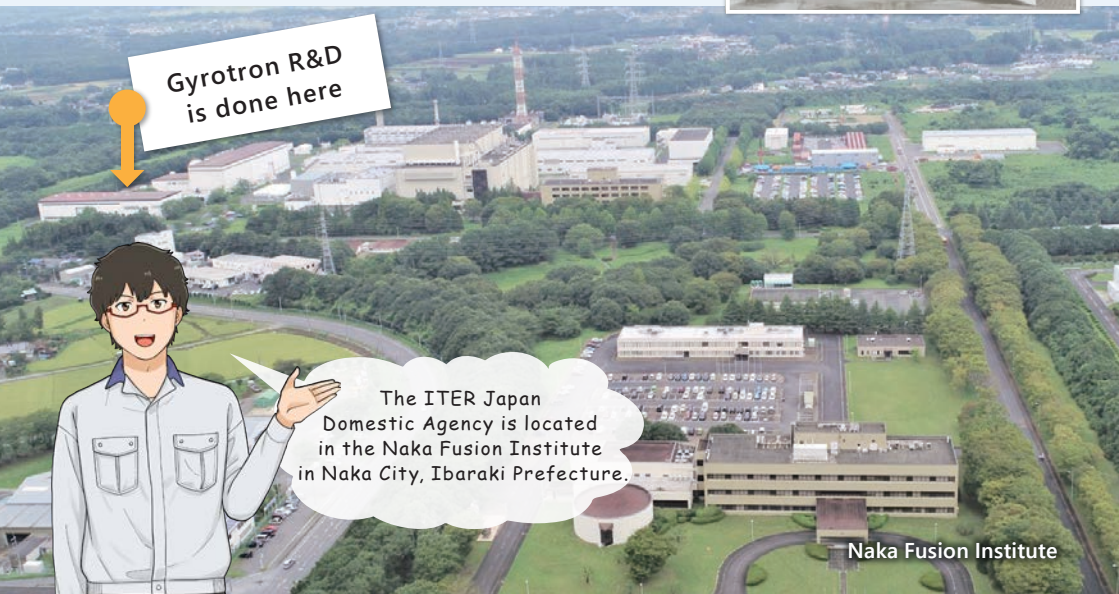
ITER component procured from Japan: Gyrotrons

Members of the RF Heating Technology Group in front of the 8 completed gyrotrons

In April 2021, all eight of the Japanese gyrotrons for ITER were completed, two of which were transported by air and delivered to the ITER site in 2022.

These gyrotrons will play an important role in generating ITER's first plasma.

For more information, see the ITER Japan News article"The first two gyrotrons arrive at the ITER Organization"



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ITER Comic
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National Institutes for
Quantum Science and Technology
Naka Fusion Institute

801-1 Mukoyama, Naka-shi, Ibaraki 311-0193 Japan
[Web] https://www.qst.go.jp/site/fusion/
[Tel] +81-(0)29-270-7213

ITER Japan Domestic Agency
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