



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





Not this time...  
Still haven't  
heard back  
from you about  
the QST  
facility tour  
next week.

You coming  
or not?



Facility...  
tour?



Oh, hi  
Mirai!

New hire at QST:  
Taiyo Tenno

Did I mess  
something  
up again!?

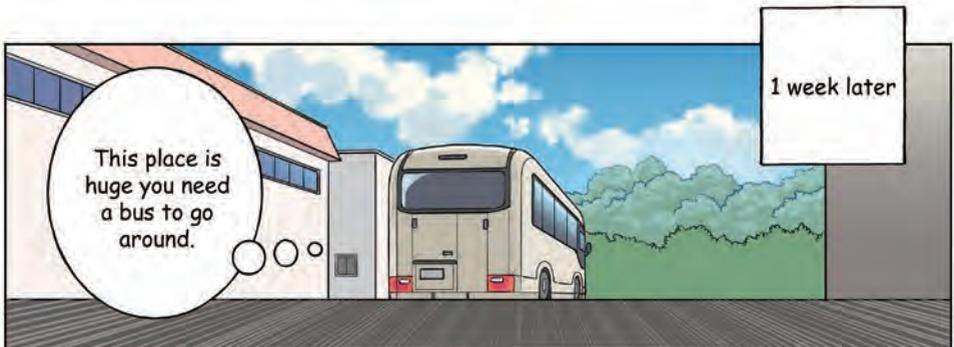


so they can  
learn more about  
the research  
going on here.

They hold it  
every year in...

You know,  
the tour of all the  
different buildings  
at QST for new  
hires

!!







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



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°C

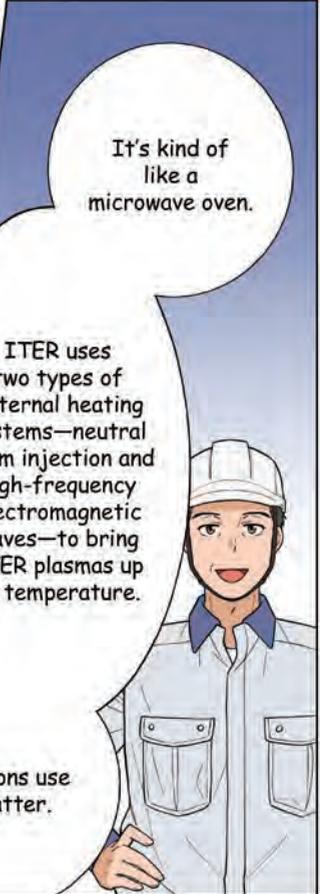
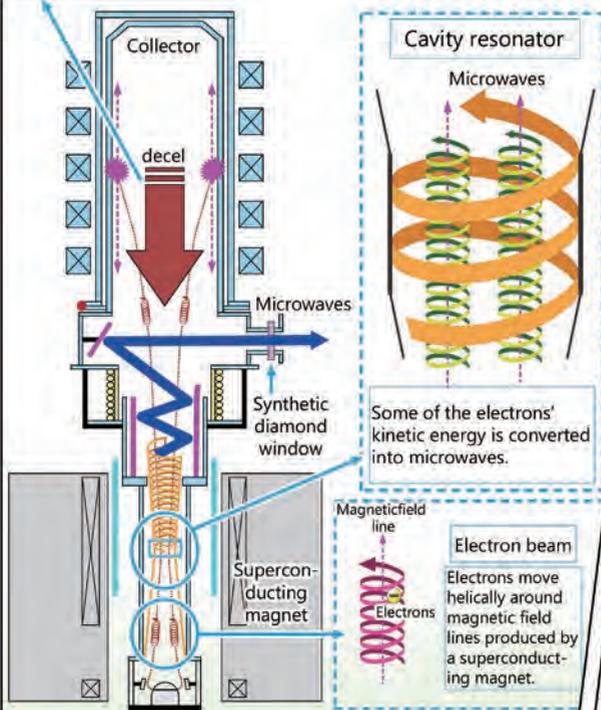
QST employee: Renji Gōda

It's called a  
gyrotron!

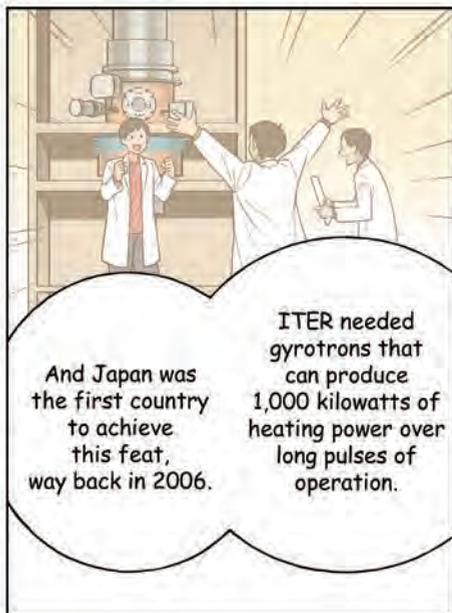
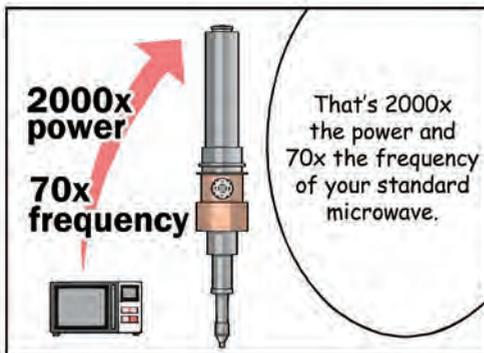
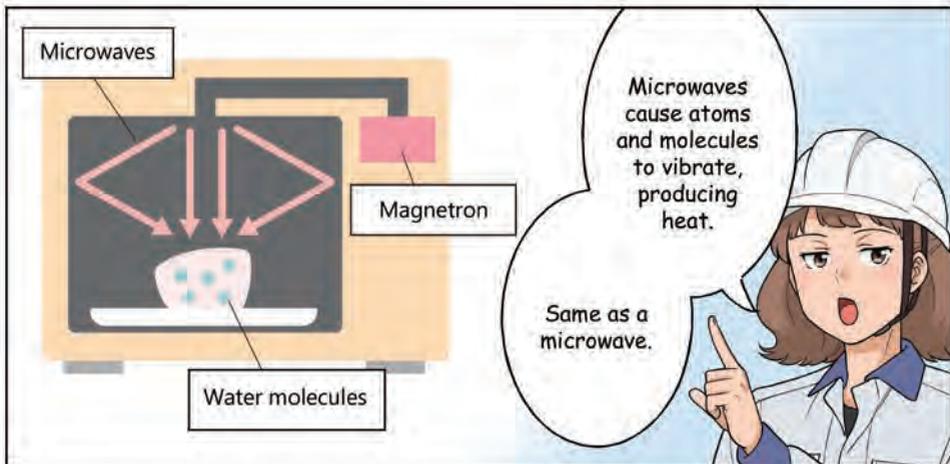


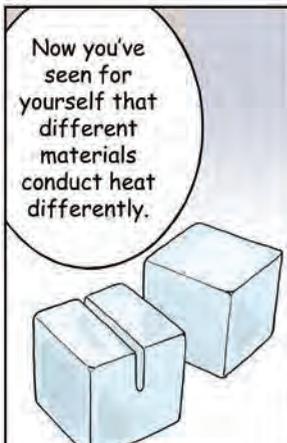
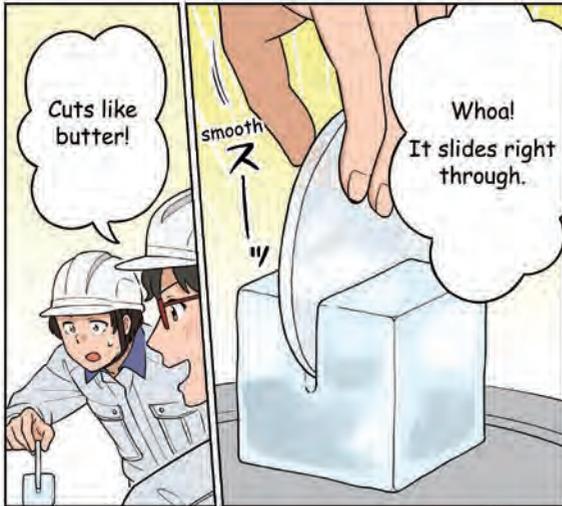
# Gyrotrons Basics

The electron beam is decelerated and its energy is recovered.



We use this rotational or "gyro" motion of the electrons to create high-power microwaves.





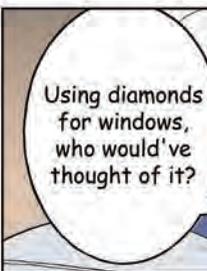
## Thermal conductivity of metals

Metal	Thermal conductivity (W/m K)
Diamond	1000 ~ 2000
Silver	420
Copper	398
Gold	320
Aluminum	236
Brass	106
Iron	90.9
Stainless steel	84



The diamond's properties allow heat to escape quickly around the window. The result is a window that won't crack even when hit by microwaves.

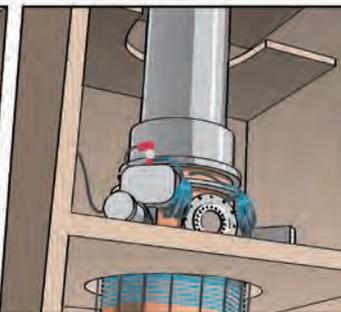
\*The artificial diamond window used in the gyrotron was first installed on a gyrotron in Japan in 1997 and is now a global standard.



Using diamonds for windows, who would've thought of it?



Before that, even just a pulse of a few seconds would generate so much heat that the window would break.



It took over 30 years of research and development to get where we are now.



Literal generations of hard work and effort have finally paid off.



Slowly—day by day, step by step, experiment after experiment—our efforts came to fruition.



Wow!



This is quite the sight!

Eight gyrotrons all lined up in a row.



Japan was on top of their game manufacturing these gyrotrons.



That voice... (it can't be)

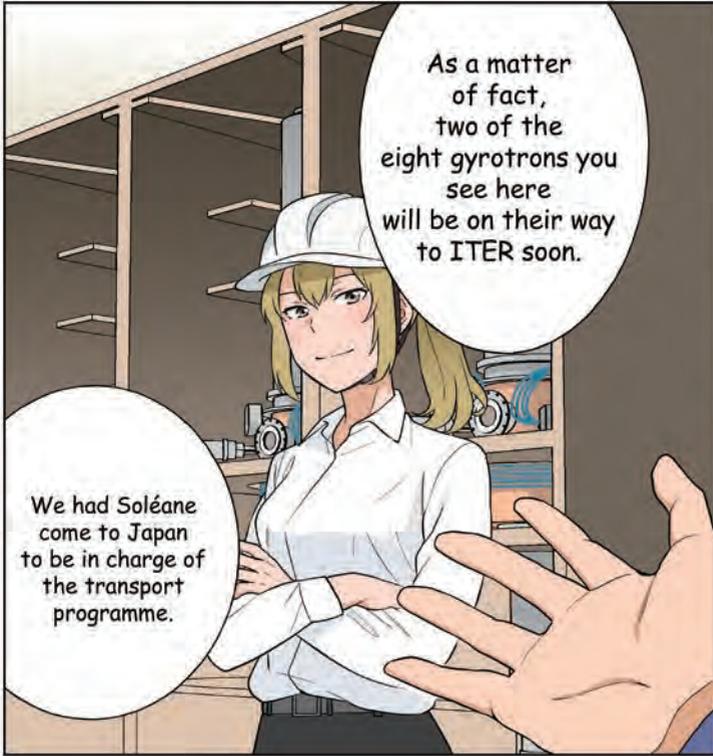
Huh?

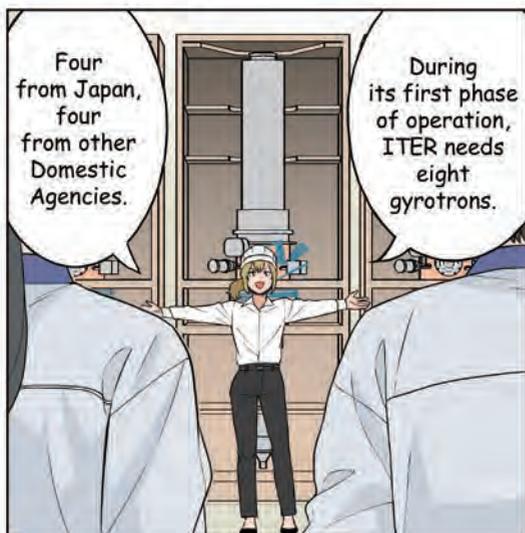


Salut Taiyo.

How have you been?

SOLÉANE!?







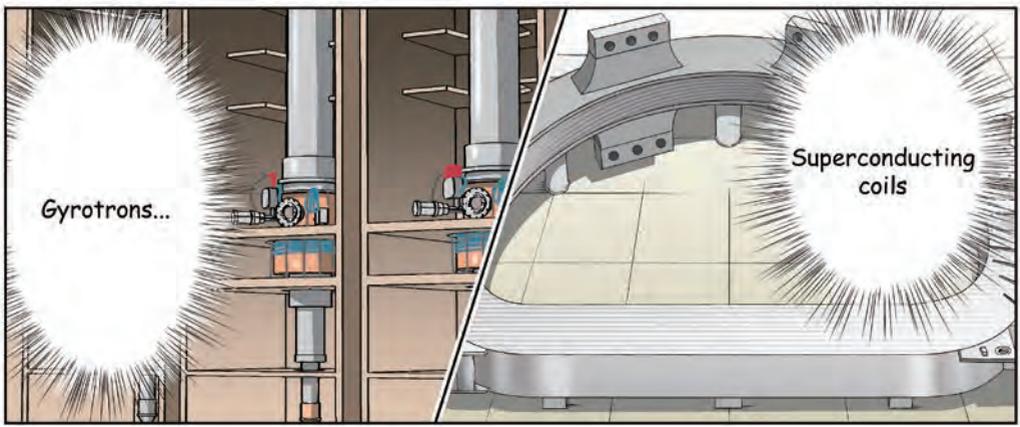
The thought of our  
gyrotrons igniting  
ITER's first  
plasma...

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...





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"



Gyrotron R&D is done here



The ITER Japan Domestic Agency is located in the Naka Fusion Institute in Naka City, Ibaraki Prefecture.

Naka Fusion Institute



# A small Sun on Earth

## ITER ~ Vol.5 ~

4 / 2023

Design : *Tarrows*

Translation : Nathaniel Duncan

Publisher \_\_\_\_\_

A small Sun on Earth  
ITER Comic  
QR code



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

<https://www.fusion.qst.go.jp/ITER/>

Be sure to check out  
ITER Japan's  
social media!

