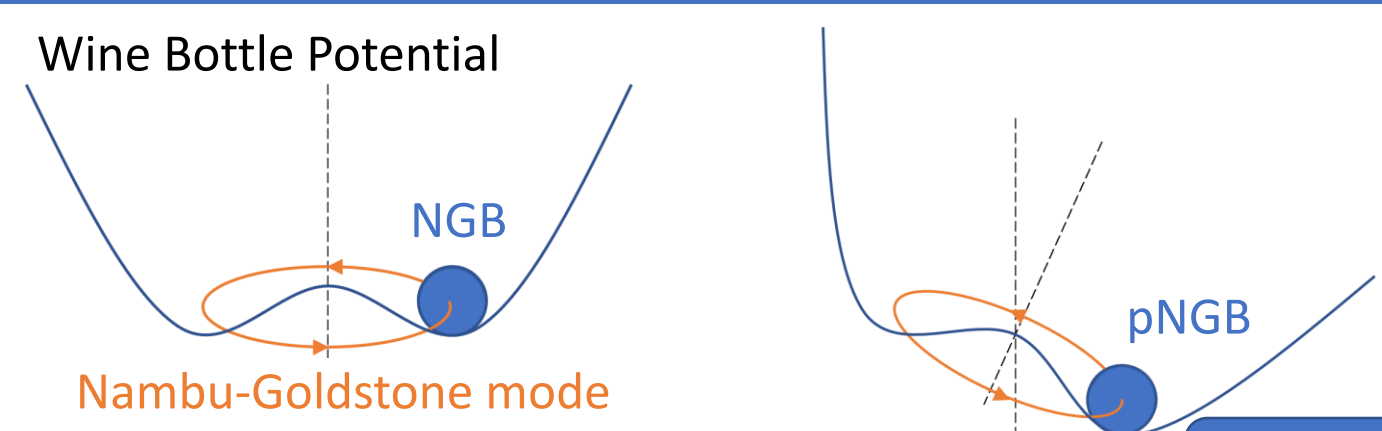


# Activities toward pilot search for axion in the micro-eV mass range with a stimulated resonant photon collider with X-band circularly polarized dual-frequency focused beams

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## Axion like particle(ALP) Search

### pseudo Nambu-Goldstone Boson(pNGB) and axion



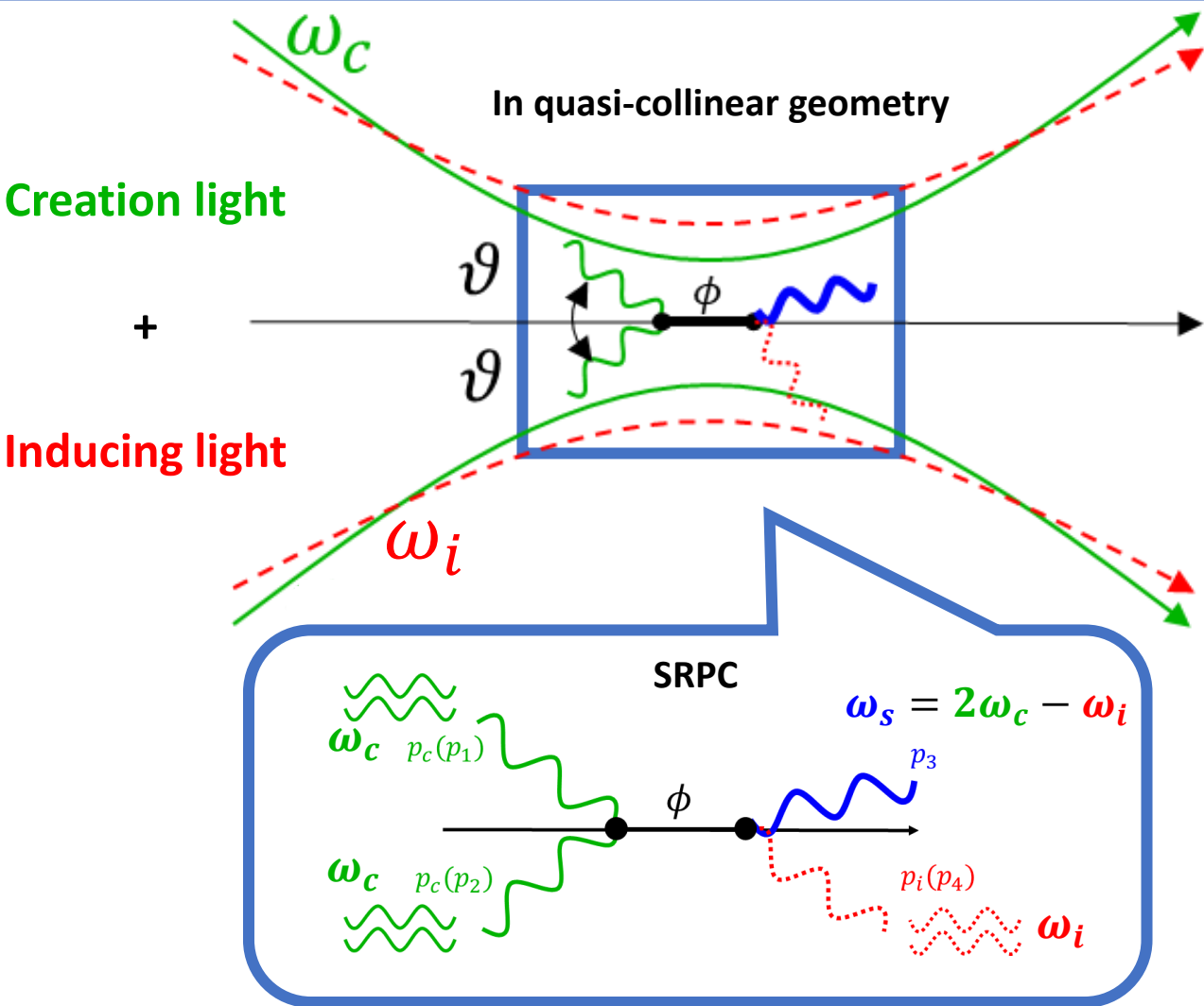
pNGB	Global and continuous symmetry
$\pi^0$	Chiral symmetry
axion	Peccei-Quinn symmetry

Dark Matter Candidate To solve a strong CP problem

Tilting angle and mass are directly related  
→ If tilt angle is small, very light particles may appear.

- Low rate of spontaneous decay
- low-mass unknown field
- Can couple weakly with photons

### Stimulated resonant photon scattering



Photon-photon collision system for direct generation of very light pNGB

Dark matter candidate pNGB should be long lifetime  
→ introducing background induction field to stimulate decay  
→ Observe Signal light

Possible to search for pNGB corresponding to Center-of-mass system energy

$$E_{CMS} = 2\omega_c \sin \vartheta$$

## Laser to Microwave

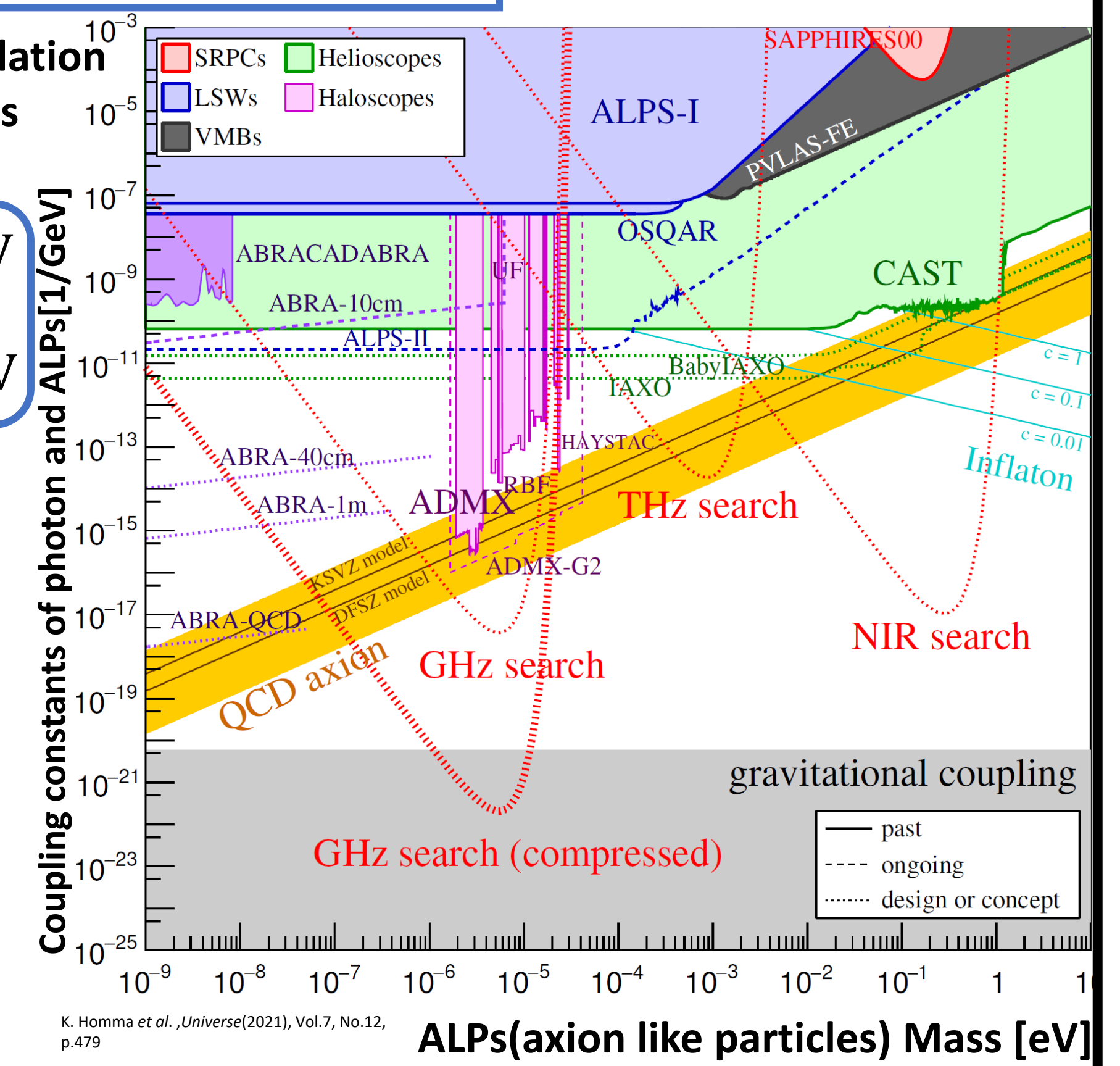
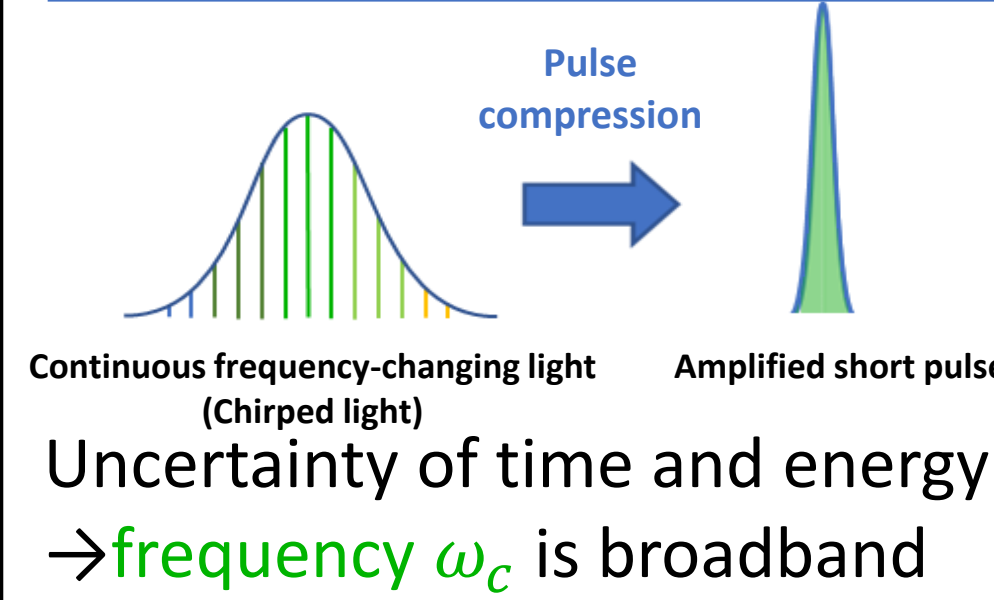
Upper limits on the coupling-mass relation for pseudoscalar fields exchanges

Laser  $\lambda \sim 10^{-6} \text{ m}$   $\omega_c \sim 1 \text{ eV}$   
X-band  $\lambda \sim 10^{-2} \text{ m}$   $\omega_c \sim 10^{-4} \text{ eV}$

Realistic energy per pulse  
→ with upper limit

Using long-wavelength light drops the energy per photon  
→ Increase the number of photons per pulse

Sensitivity improvement using uncertainties



Uncertainty of position and momentum  
→ Incident angle  $\vartheta$  fluctuates

$E_{CMS}$  widely distributed  
→ A wide mass range search at a time

## Purpose

### Constructing the X-band focusing system

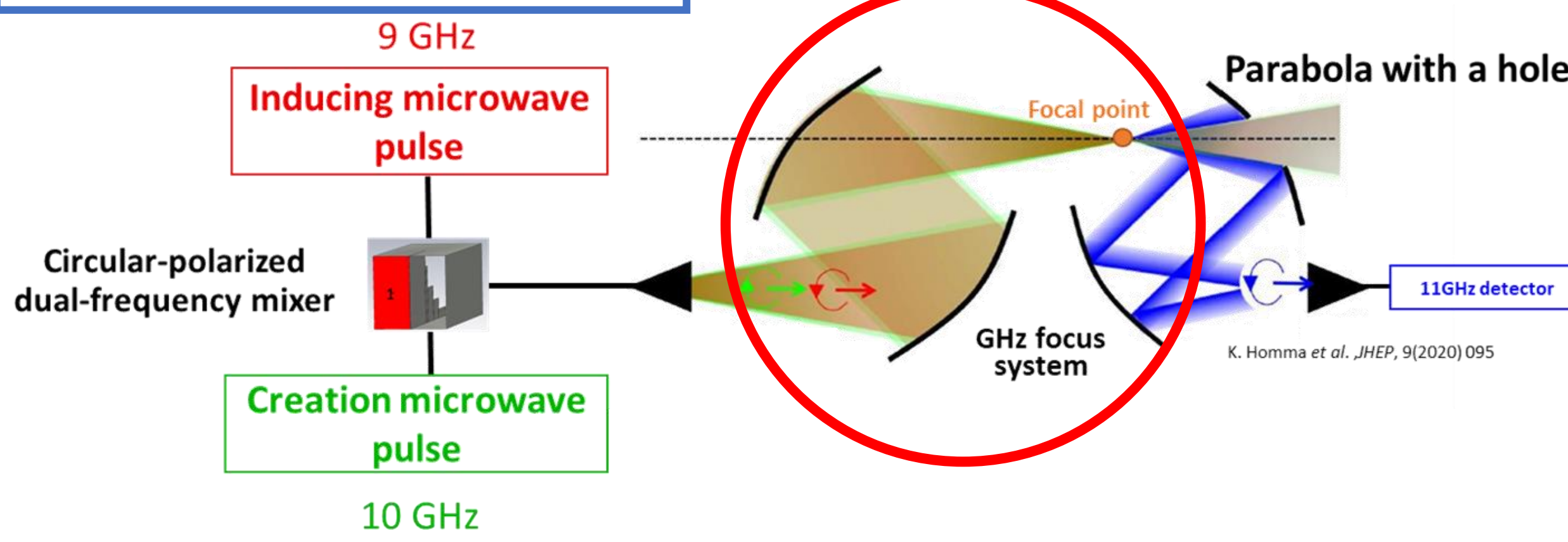
- Explore quick, flexible, inexpensive, and simple ways to fabricate parabolas
- Explore focusing system alignment methods
- Explore methods for measuring focal point profiles

## Conclusion

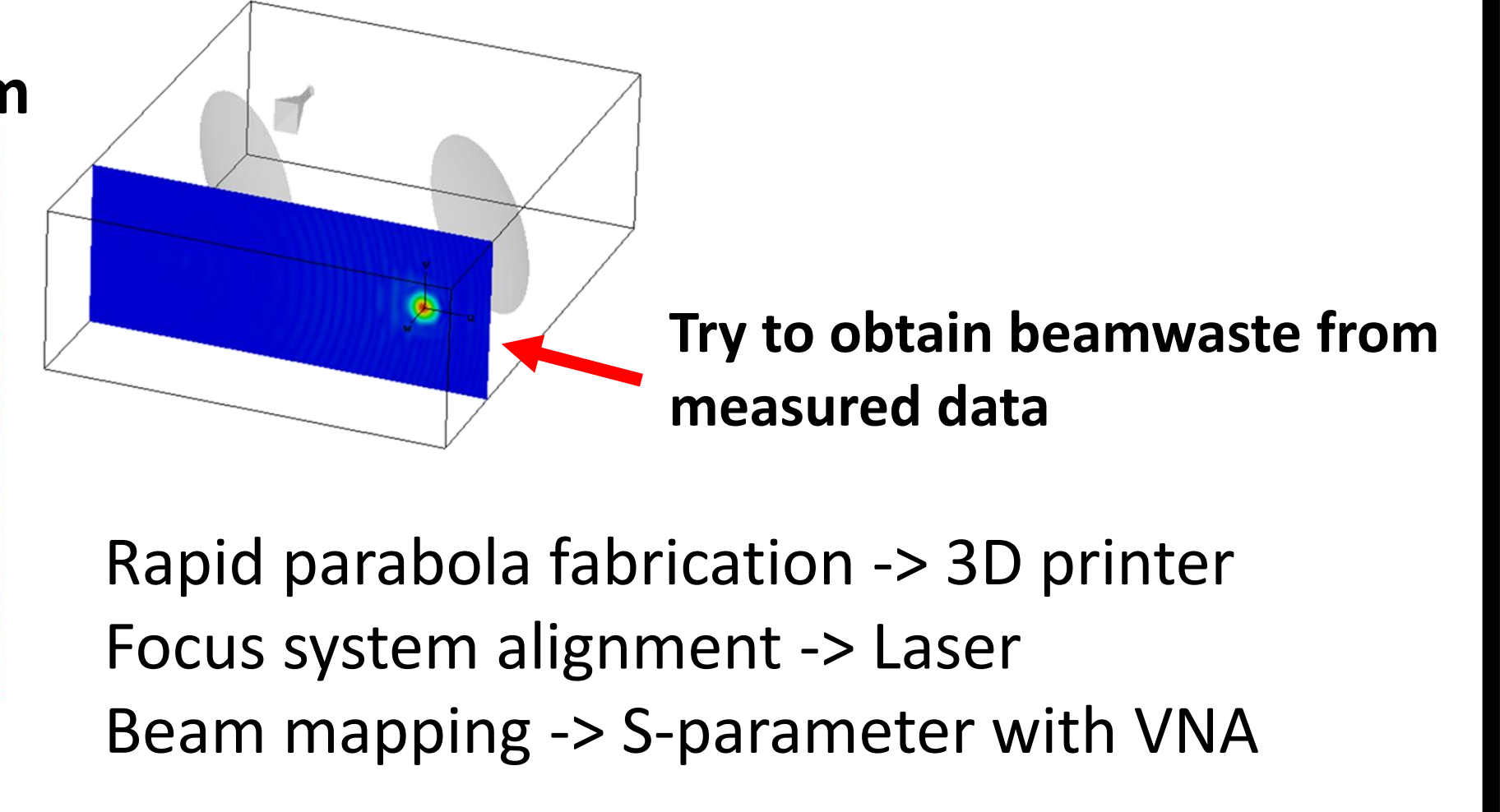
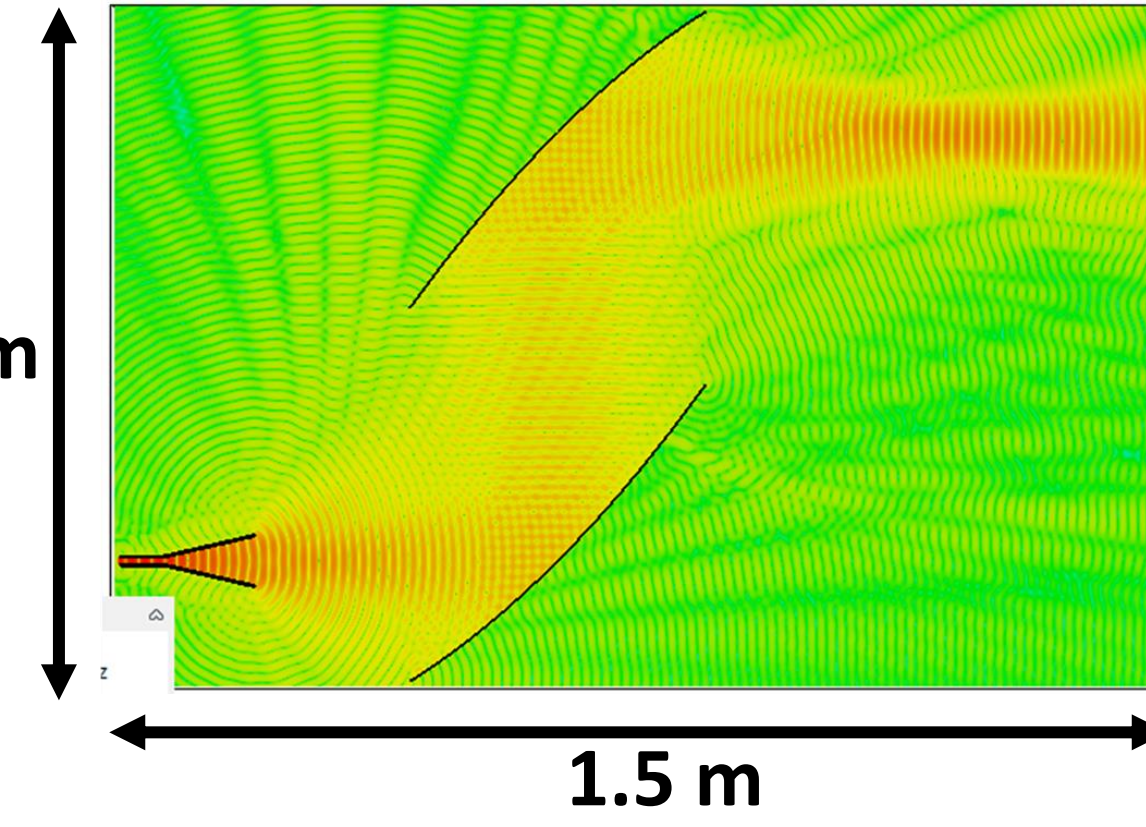
- Quick, flexible, inexpensive, and simple X-band parabola fabrication method using a 3D printer was found.
- A focusing system alignment technique for X-band beams was found, even with an incomplete parabola.
- Verification of a VNA-based focused point intensity distribution measurement system was possible.

## Overview

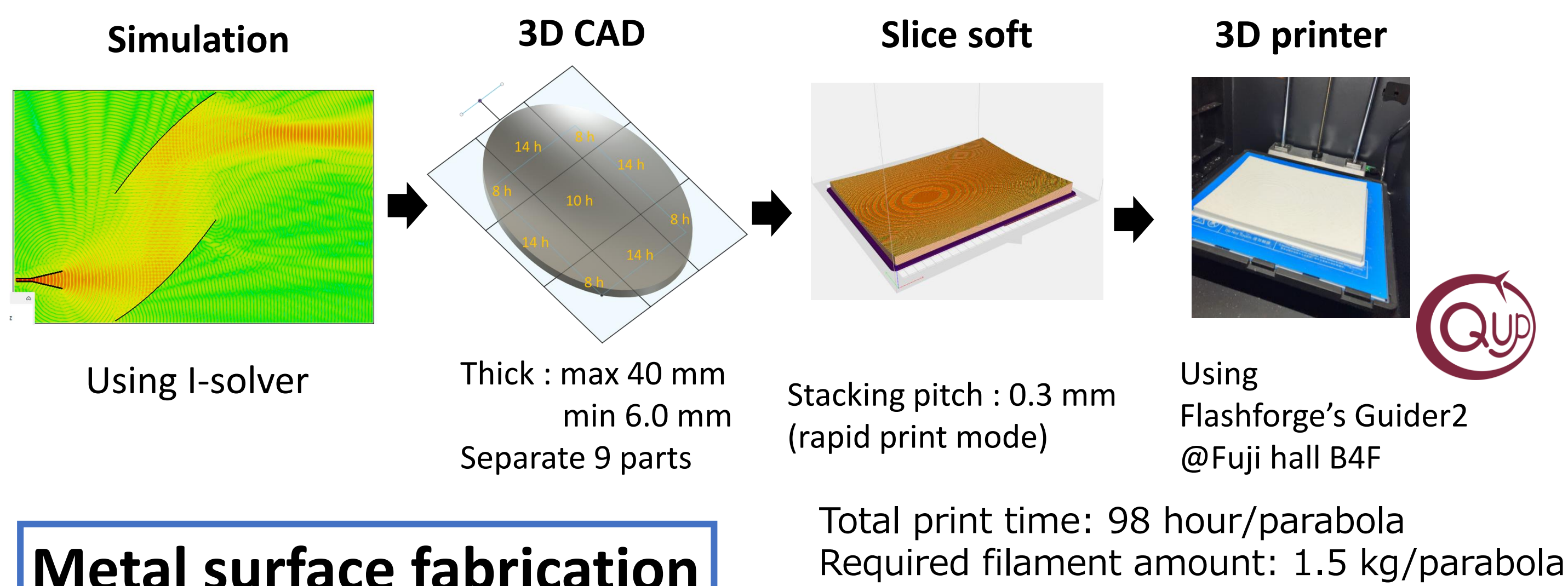
### Conceptual Diagram



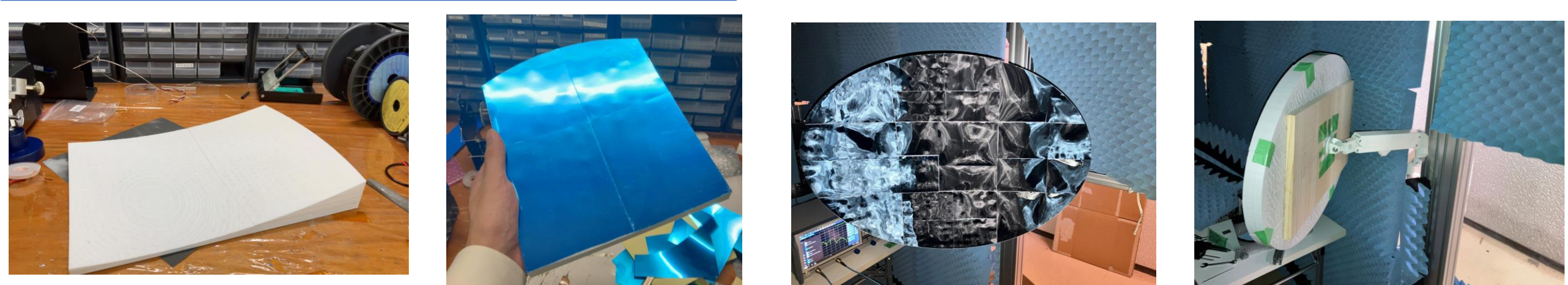
### Compact X-band focusing system



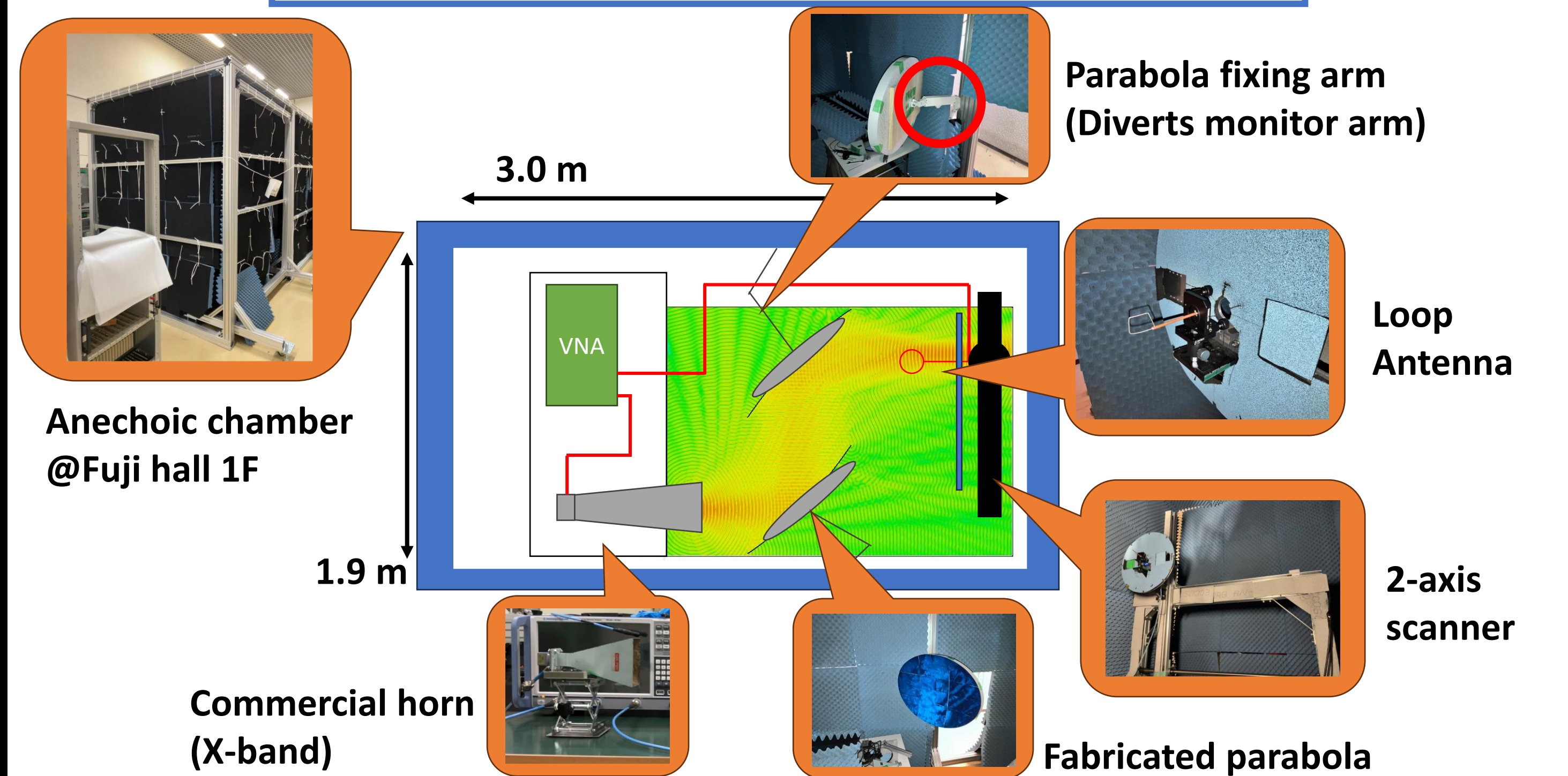
## Parabola fabrication with 3D printer



## Metal surface fabrication



## Overall view of measurement system



The entire focusing system is regarded as a microwave circuit, and the propagation efficiency between horn and antenna is measured by VNA  
2-axis scanner scans the cross direction centered on the focal point and acquires the focused beam intensity distribution.

## VNA profile measurement

