JWB4

Absolute distance measurement with asynchronous-optical-sampling terahertz impulse radar

T. Yasui, Y. Ohgi, Y. Kabetani, S. Yokoyama, and T. Araki
Grad. Sch. Engg. Sci, Osaka Univ., Japan

CLEO2010@SanJose (2010.5.19)

Background

Automobile radar

- Adaptive cruise control
- Collision mitigation system

Important for safe driving support

NIR laser radar

- Precise distance measurement
- Weak in bad weather

mm-wave radar

- Available in bad weather
- Low precision

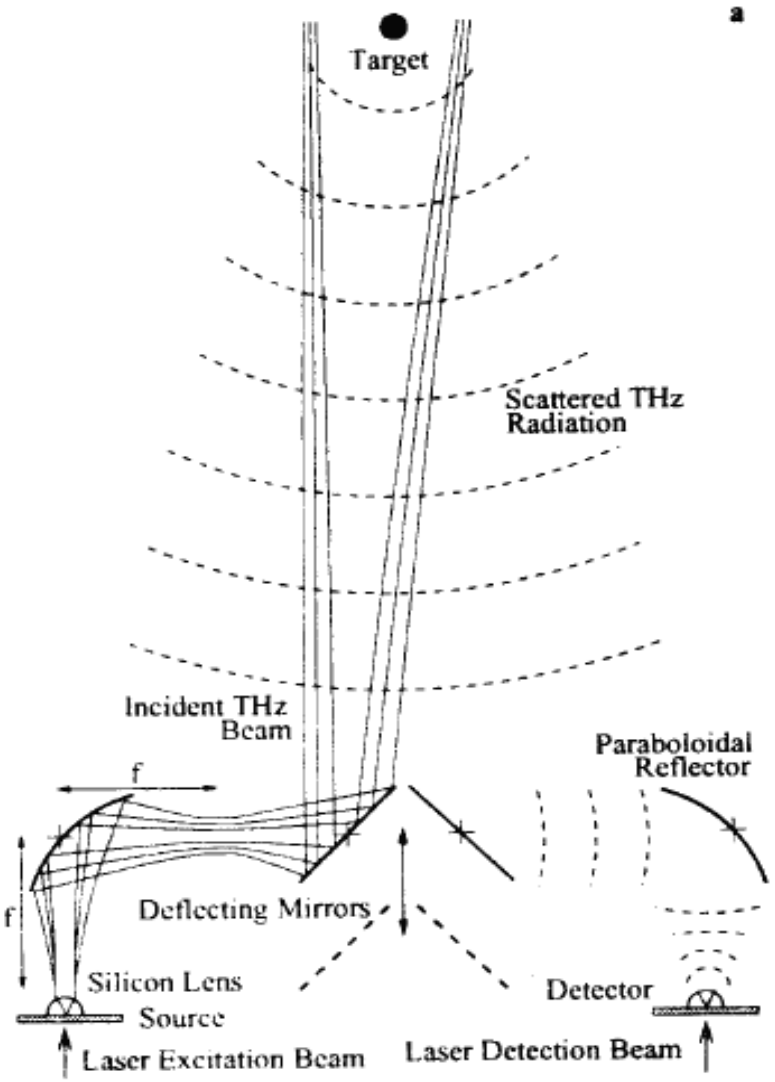
New radar technique combining both merits of them

THz electromagnetic wave

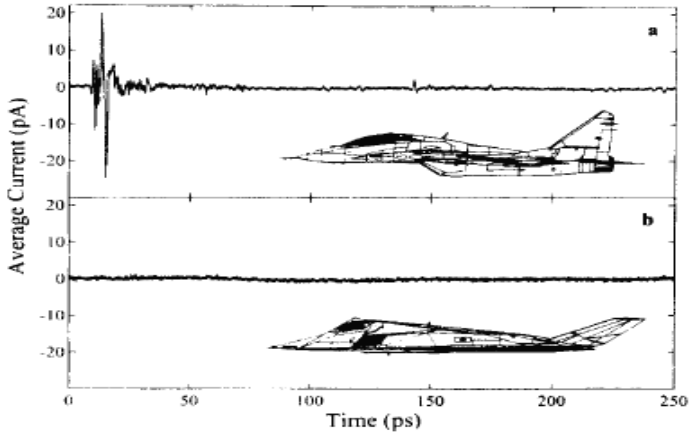
lying at boundary between NIR light and mm-wave

THz impulse ranging

for scale model simulator of microwave radar



*ref) Cheville, APL **67**, 1960 (1995).*



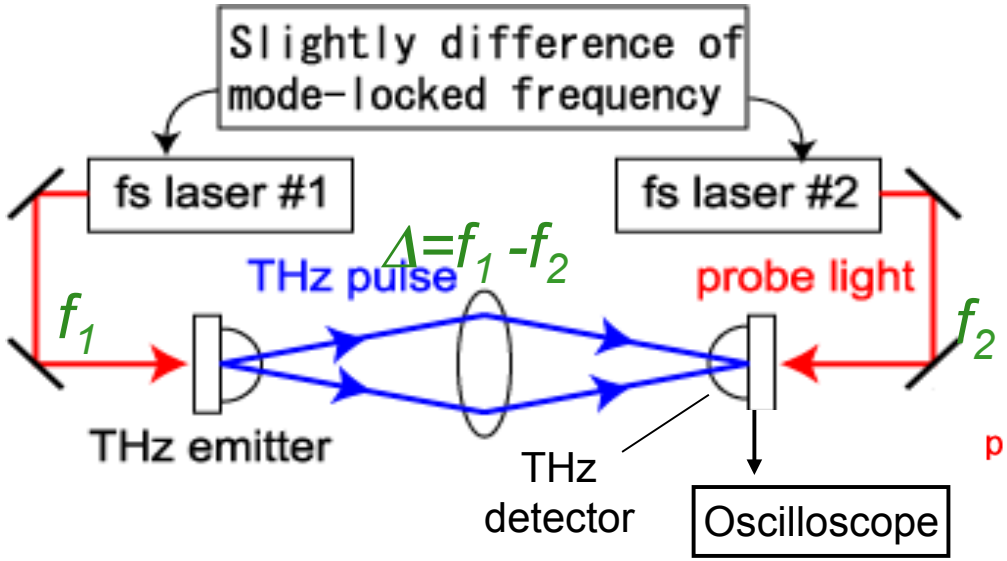
Mechanical stage scanning for time delay

→ Long measurement time
Only applied to stationary objects

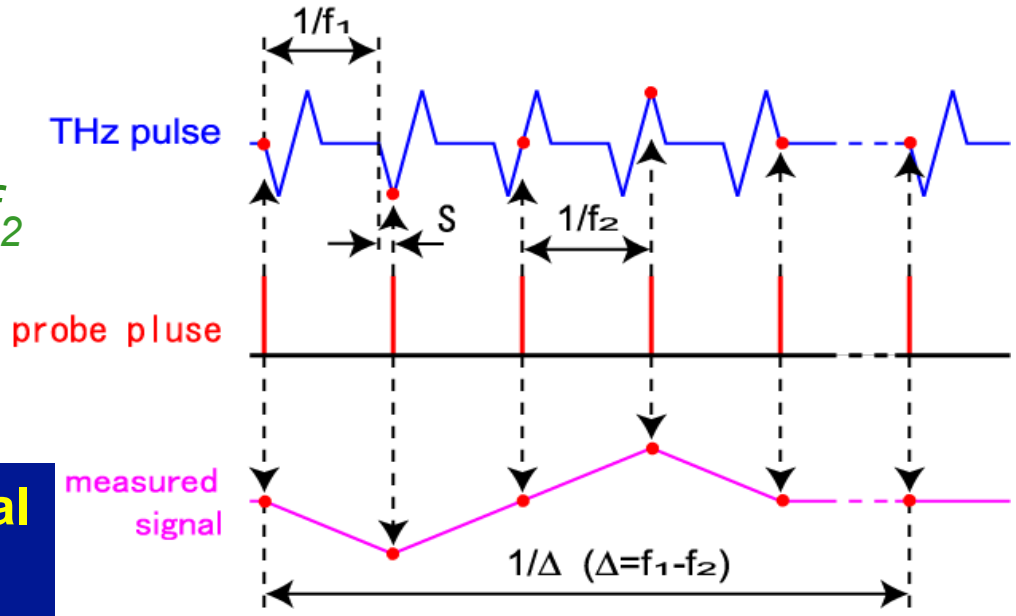
Coincidence of optical path length between THz and probe pulse

→ Limited to objects at a known distance

Asynchronous-optical-sampling (AOS) method



Overlap timing between THz and probe pulse is automatically shifted every pulse

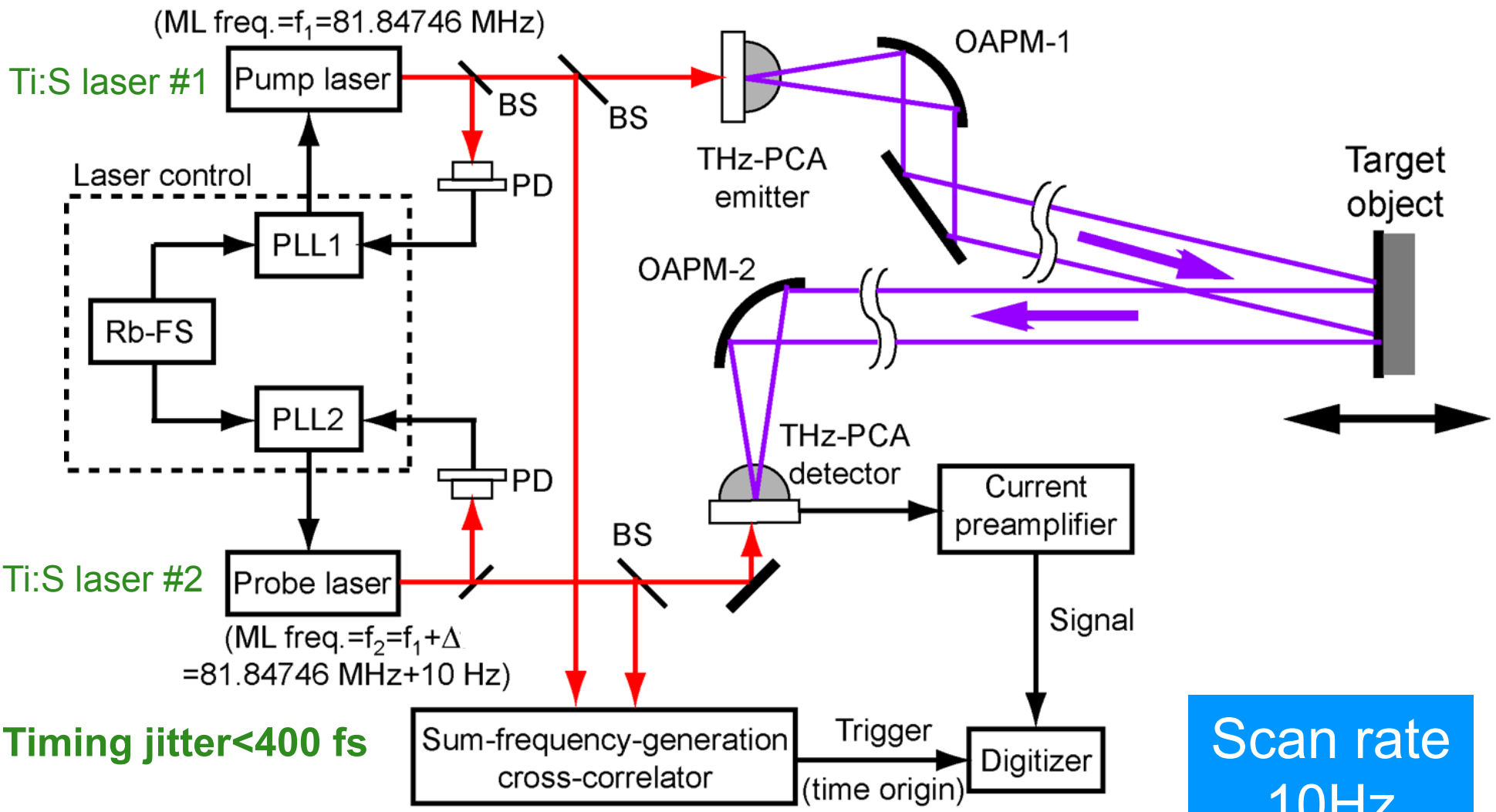


- **No need for time-consuming, mechanical time-delay scanning**
- **No need for coincidence of optical path length between THz and probe pulses**
- **Real-time measurement at scan rate of Δ**

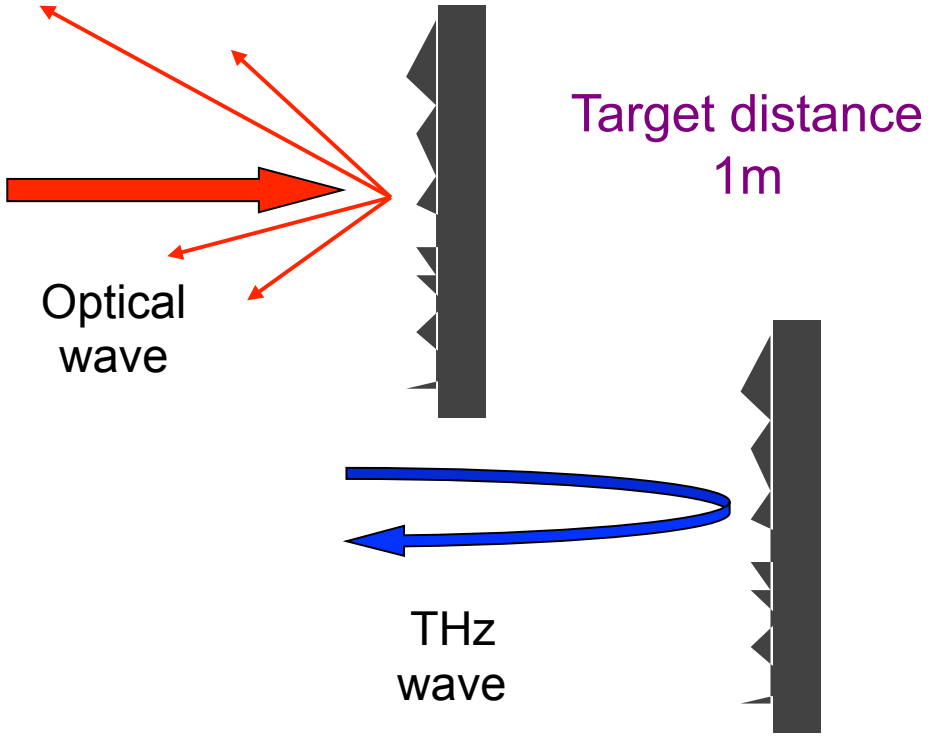
Time scale of ps THz pulse is linearly expanded to μs order

Present talk: real-time THz impulse radar based on AOS technique

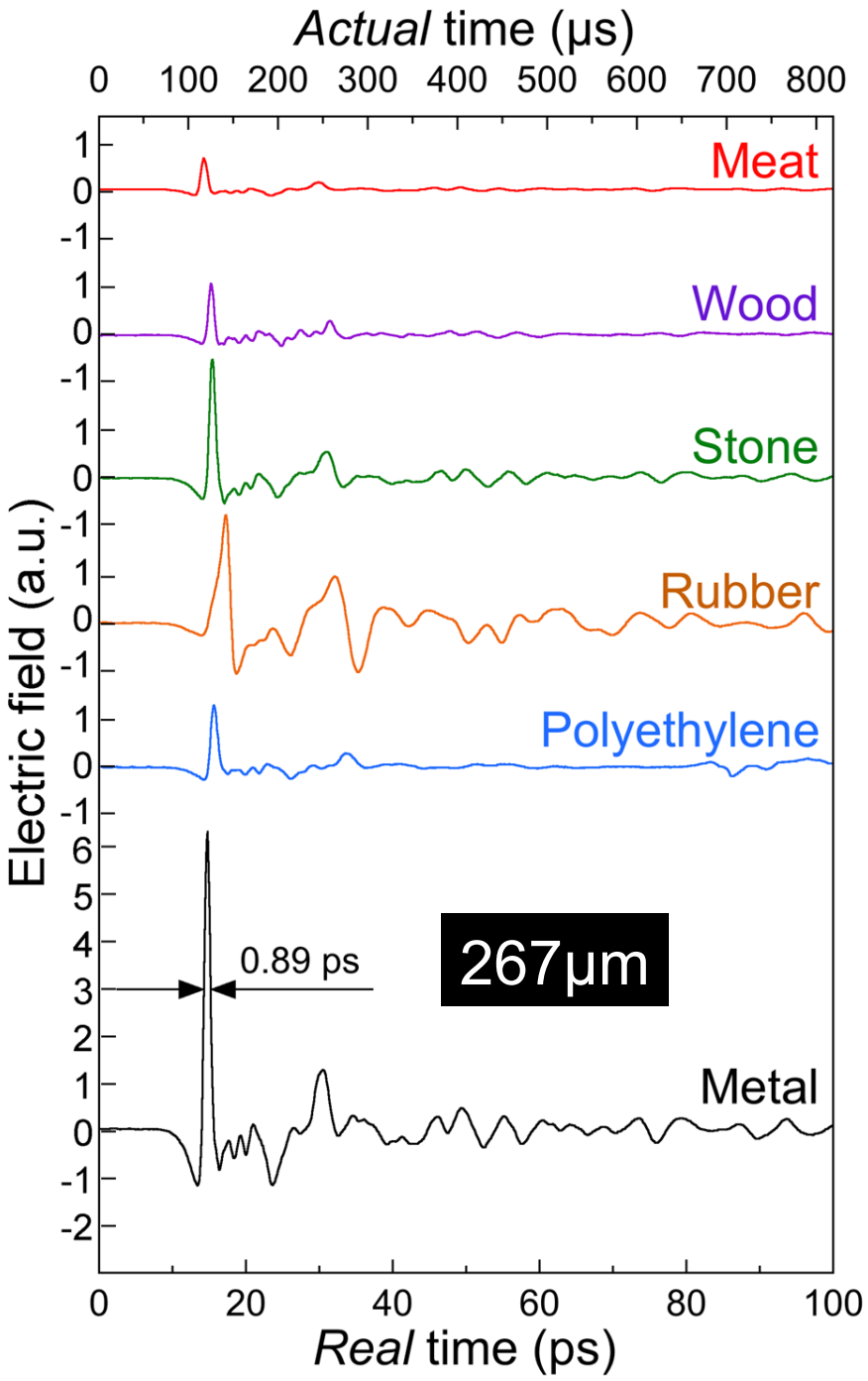
Experimental setup



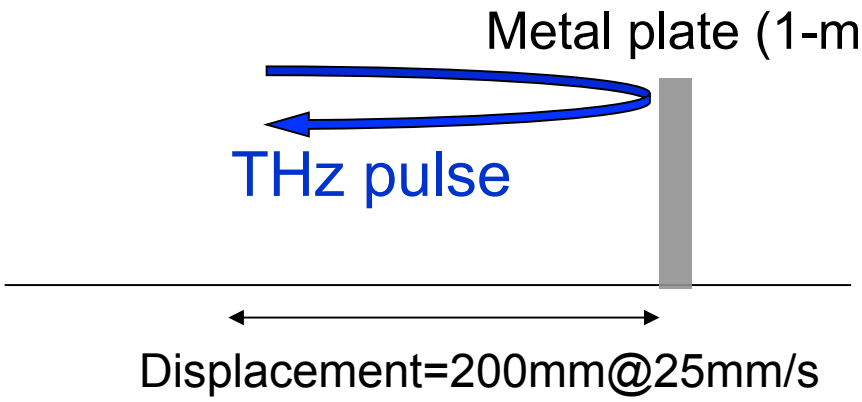
Applicability to objects of various materials

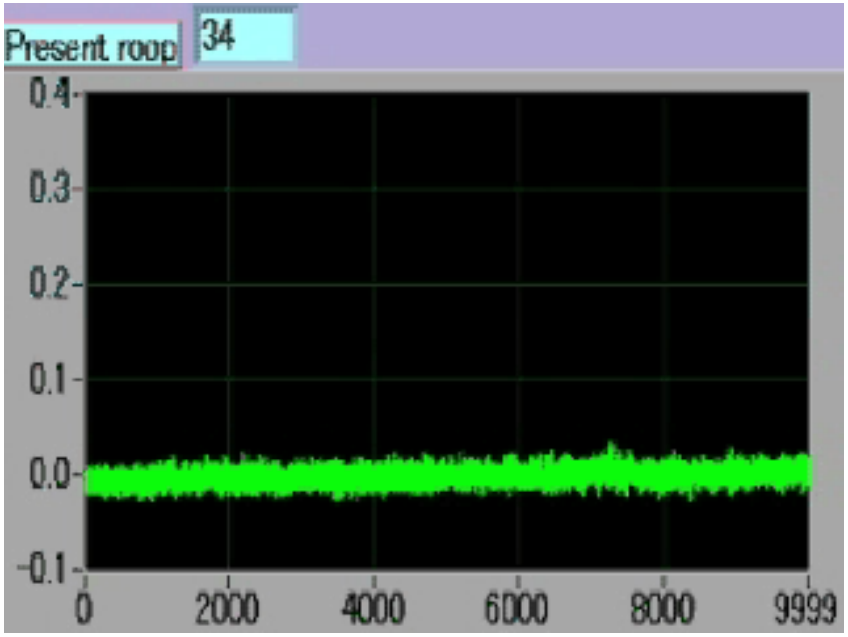


Insensitivity of THz wave to optical scattering enables to detect objects covered with optically rough surface!



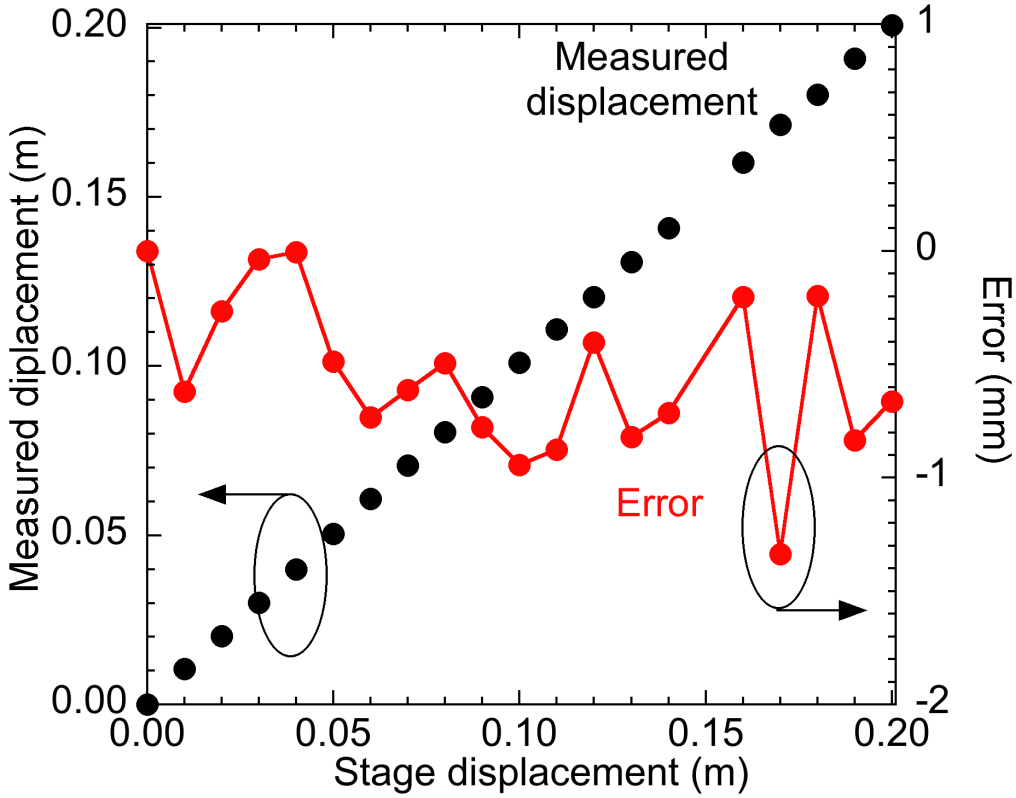
Real-time displacement measurement of moving object





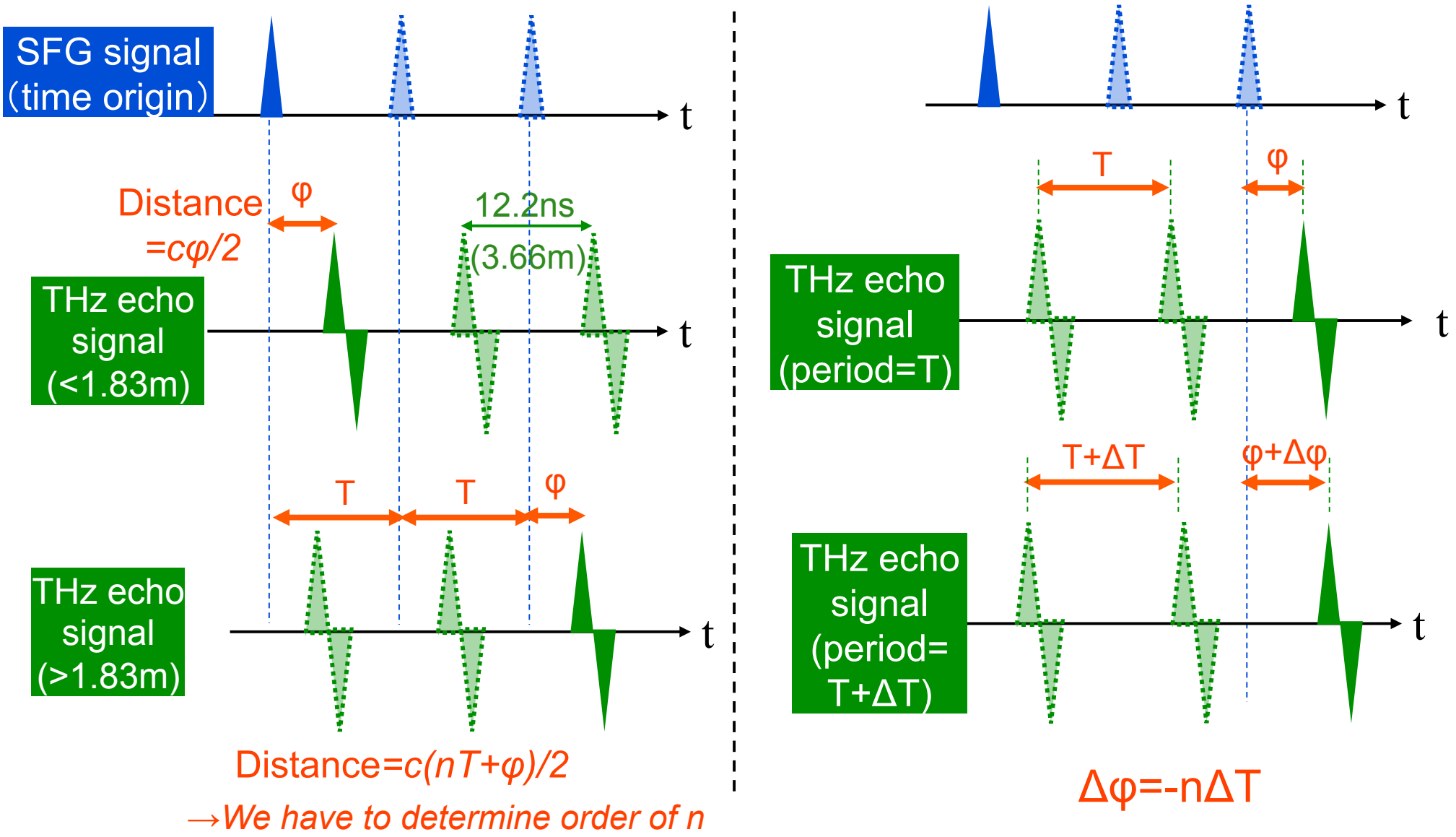
Dynamic monitoring of moving target

Scan rate = 10Hz



Precision = 354μm

Absolute distance measurement of a distant target



Result

Target: metal plate

Time period（T）=12.2351ns

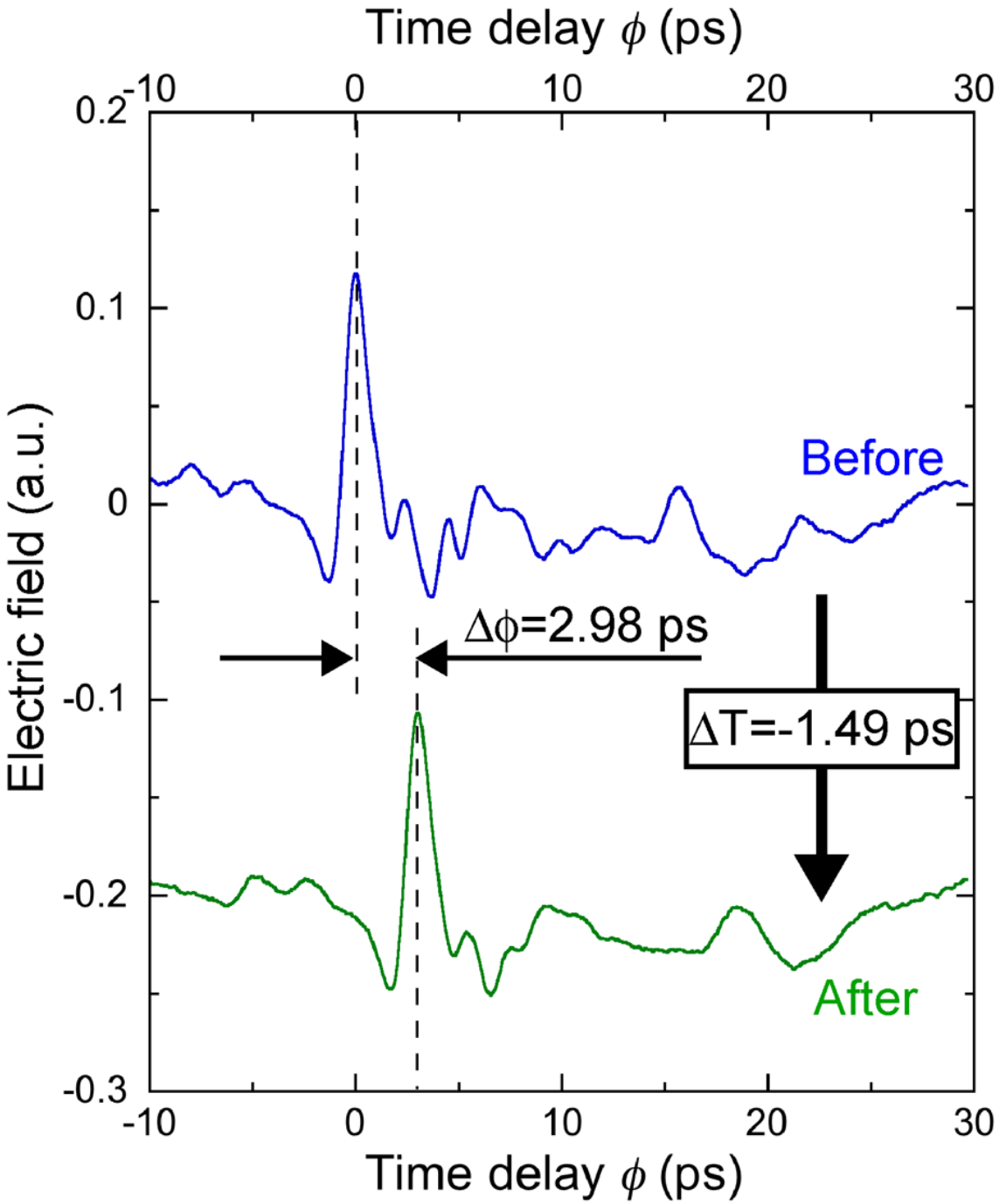
ΔT=-1.49ps

Time period（T+ΔT）=12.2202ns

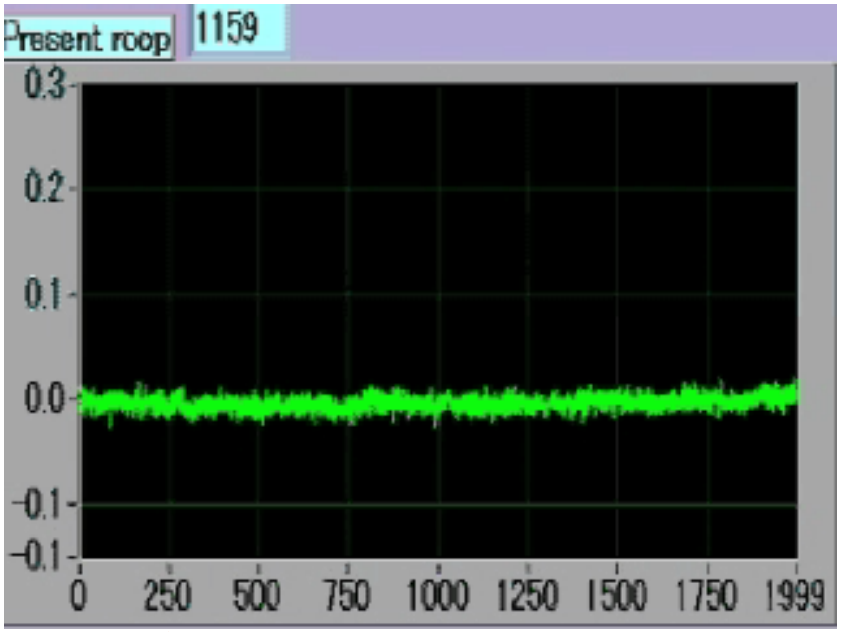
Δϕ=2.98ps

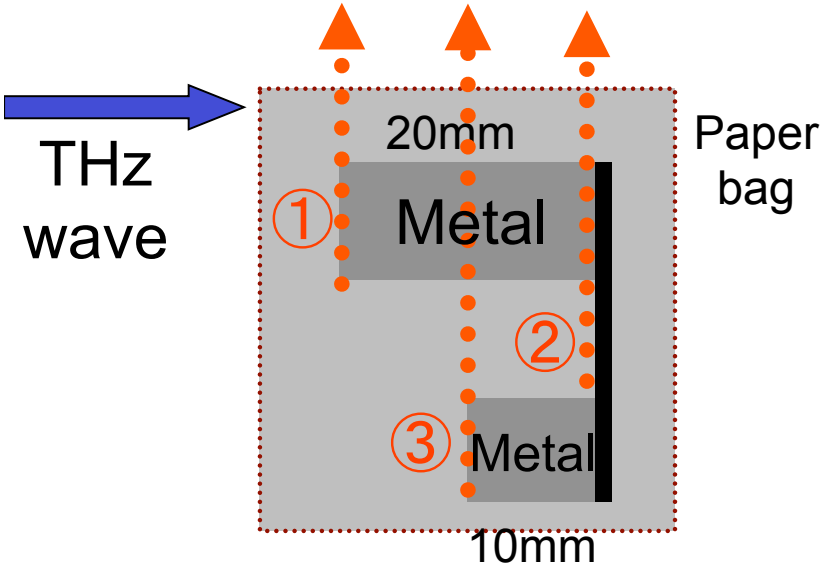
n=-Δφ/ΔT=2

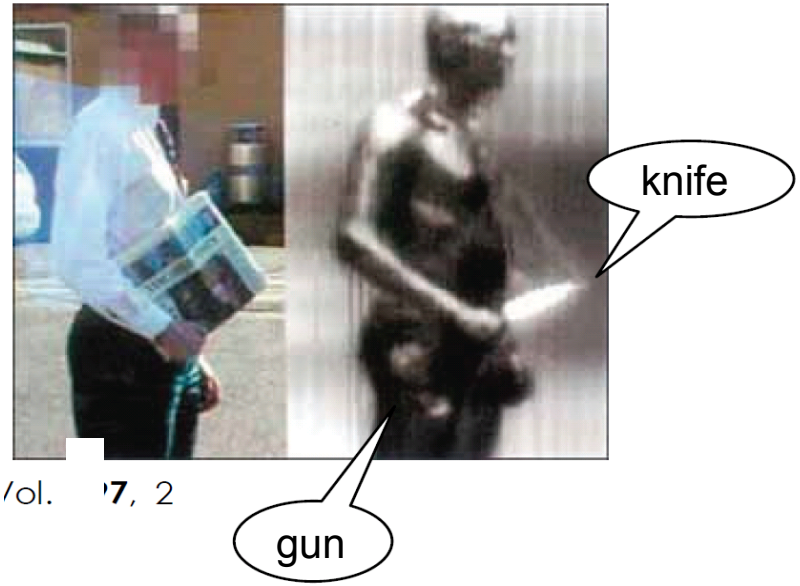
Absolute distance
=c(nT+φ)/2=3.663m



Real-time monitoring of hidden target







ref) http://www.THzNetwork.org/wordpress/wp-content/galleries/THz-Images/images/tlight.jpg

Powerful tool for security monitoring

Summary

AOS-THz impulse radar

- Real-time monitoring of moving target at 10 Hz
- Precision of displace measurement = 354μm
- Absolute distance measurement
- Possible to detect hidden target