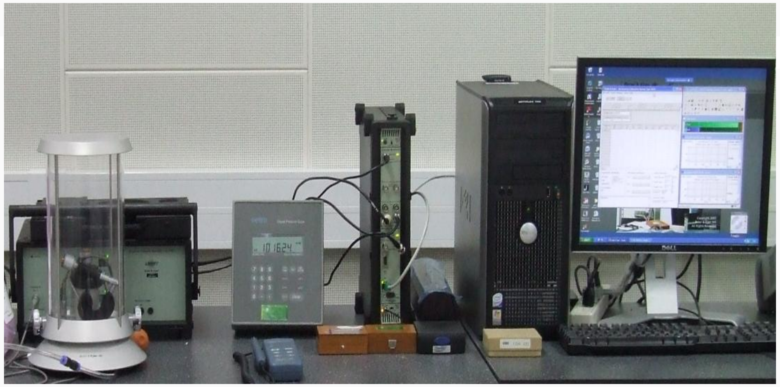
CCAUV/15-21

中国计量科学研究院
National Institute of Metrology

## National standards report from NIM, China

# Part I: Acoustics & Ultrasound

# Current status of national standards



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***Coupler Reciprocity National Standard: 2 Hz ~ 31.5 kHz***

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***Free-field Reciprocity National Standard: 1 kHz ~ 25 kHz***

# Current status of national standards

***Infrasound Standard - ( 0.1 Hz ~ 20 Hz, 90 dB ~ 140dB )***

Laser Pistonphone Technology

*Dr HE Longbiao*
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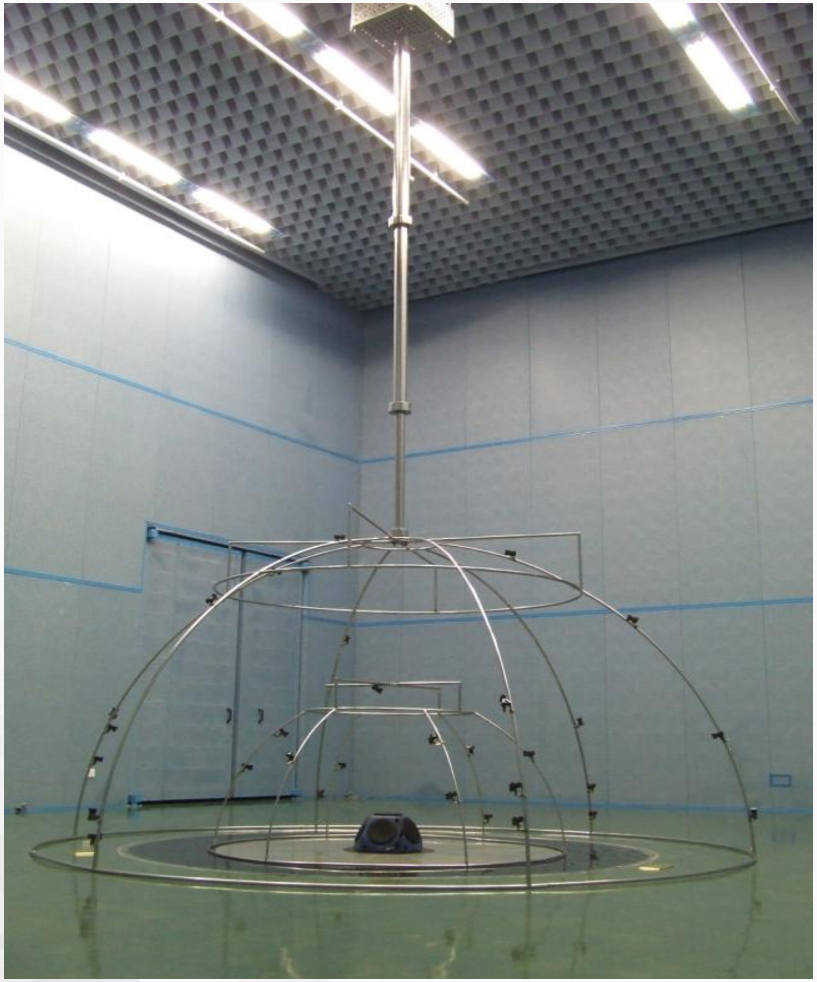
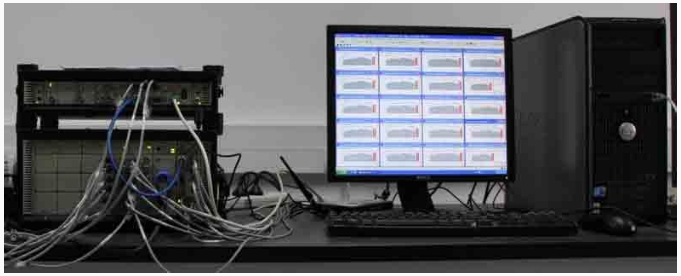
# Current status of national standards

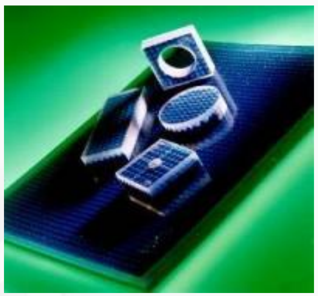


*Mr NIU Feng*
*niufeng@nim.ac.cn*



***Sound Power Standard : 50 Hz ~ 20 kHz U=1.8 dB (k=2)***

# Current status of national standards



Target

Voltage

Measurement


## Ultrasonic Power Standards

*Frequency: (1-25) MHz  Power: (0.1-20)W*

| |
|---|
| CCAUV.U- K1 |
| CCAUV.U- K3 |

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中国计量科学研究院
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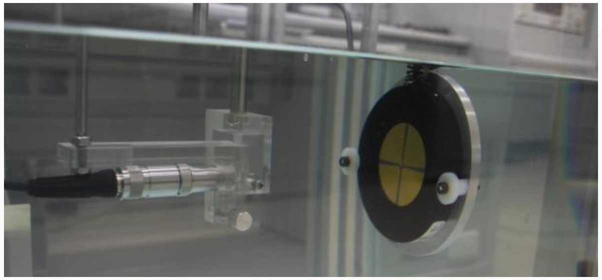
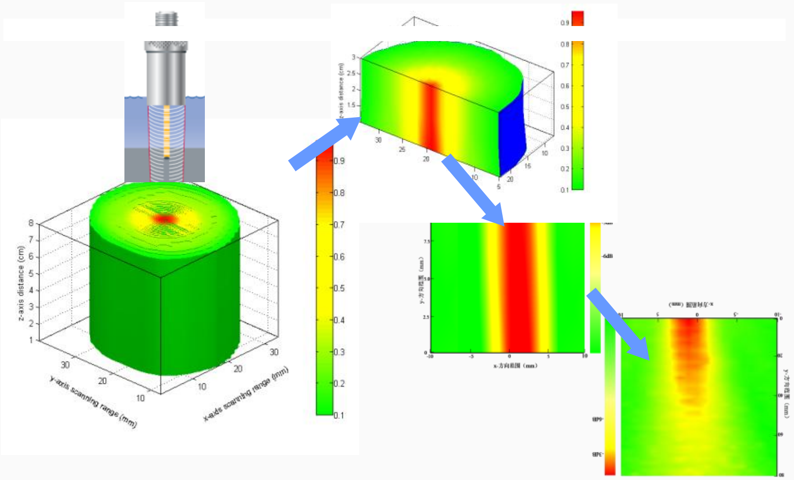
# Current status of national standards

*High-frequency hydrophone calibration by two-transducer Reciprocity*

*Uncertainty of Different Frequency Range*

| Frequency Range | *U* （*k*=2） |
|---|---|
| 0.5 MHz ～ 5 MHz | 7% |
| 5 MHz ～ 10 MHz | 10% |
| 10 MHz ～ 15 MHz | 15% |





**Sound Field Mapping**

**CCAUV.U- 4**

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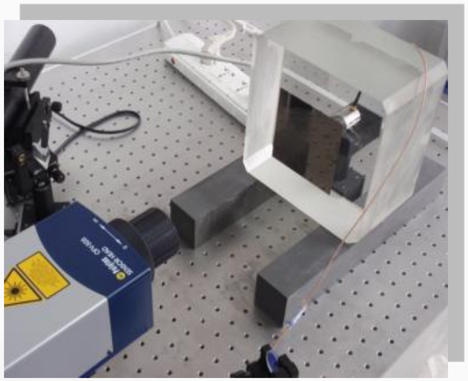
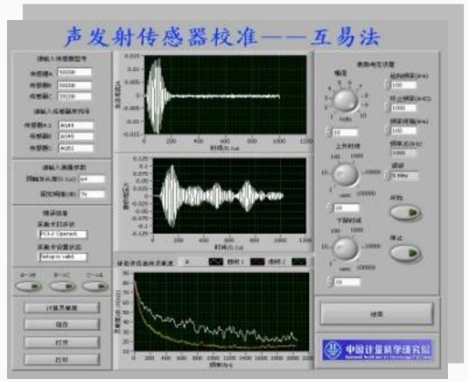
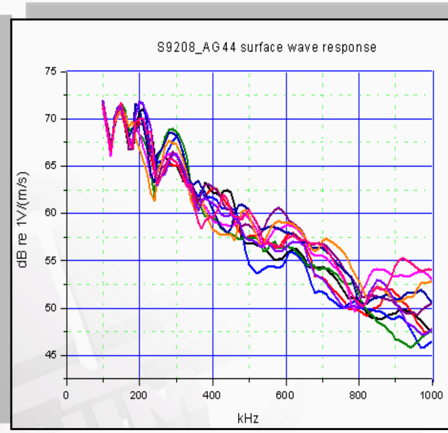
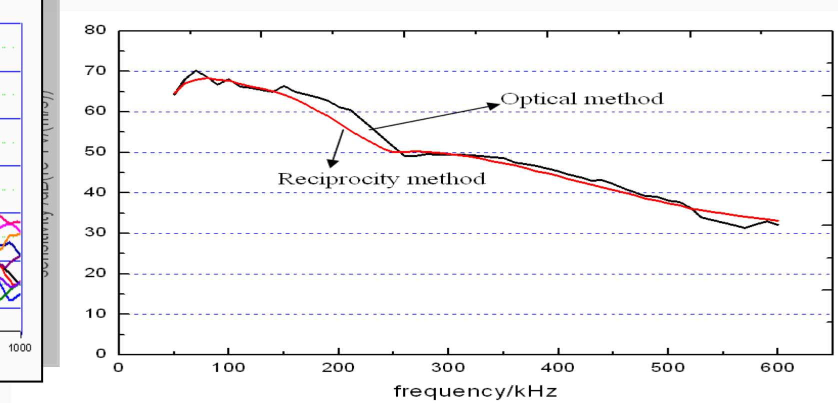
# Current status of national standards






***Acoustic Emission Standard : 100 kHz ~ 1 MHz***

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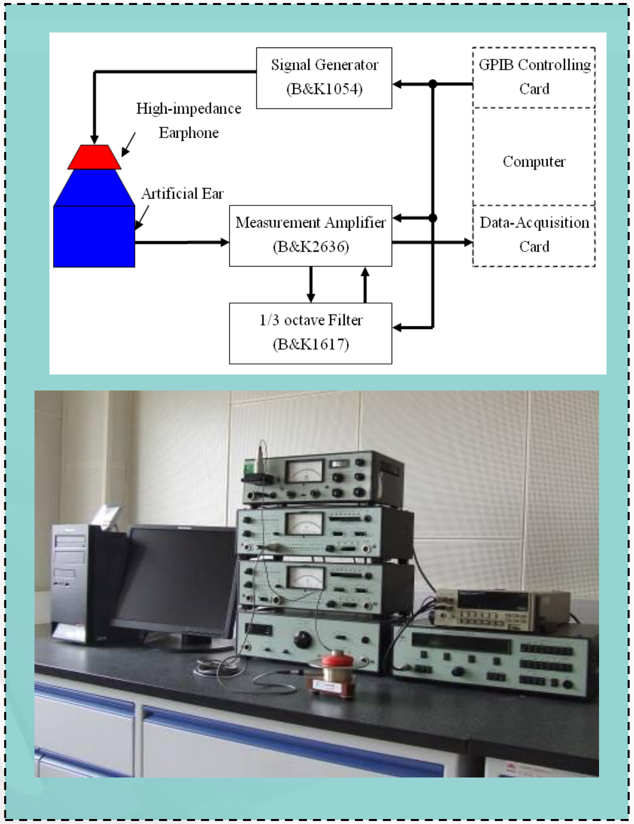
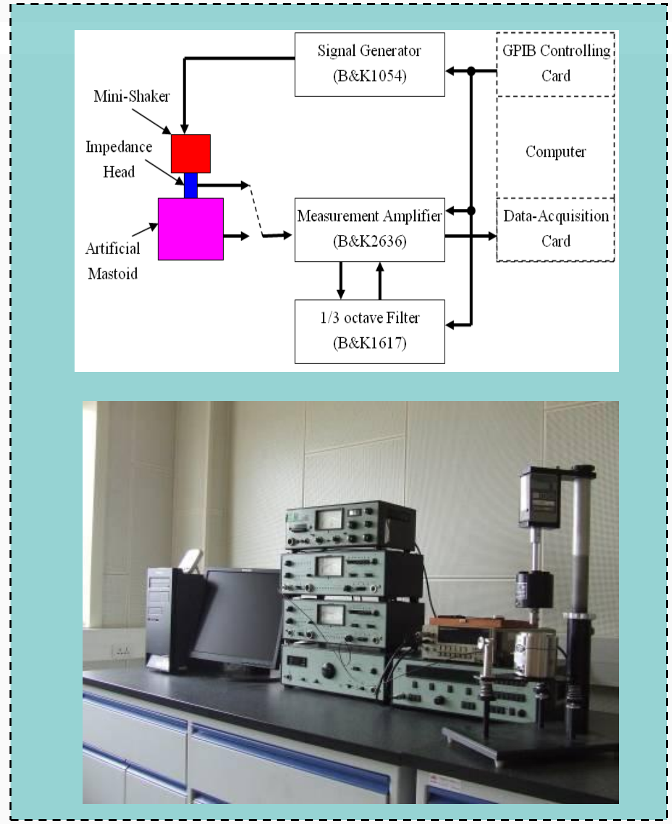
# Current status of national standards




***Zero Level of Air Conduction***

**50 Hz ~10 kHz**

***U*=0.7 dB (*k*=2)**




***Zero Level of Bone Conduction***

**250 Hz ~ 8 kHz**

***U*=1.0 dB (*k*=2)**

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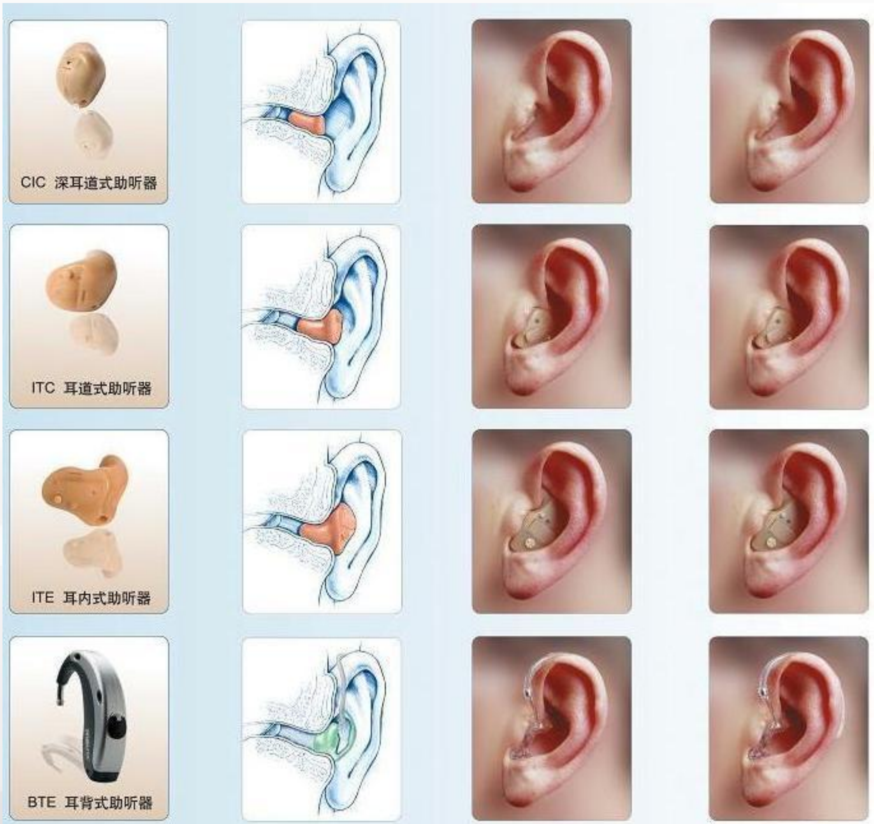
# Current status of national standards




***Hearing Aids Inspection System***

**Air-conduction SPL: 125 Hz ~ 8 kHz, *U*=1.5 dB (*k*=2)**

**Bone-conduction FL: 250 Hz ~ 8 kHz, *U*=2.5 dB (*k*=2)**

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# Recent Research Activities

# Ultrasound Power Measurement - Completed

*Ultrasound Power Standard-Radiation Force Balance*

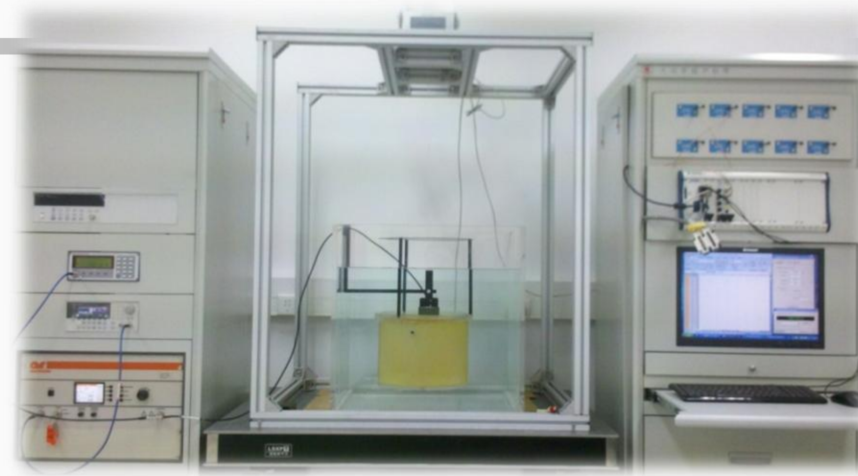


*Target and Voltage Measurement*

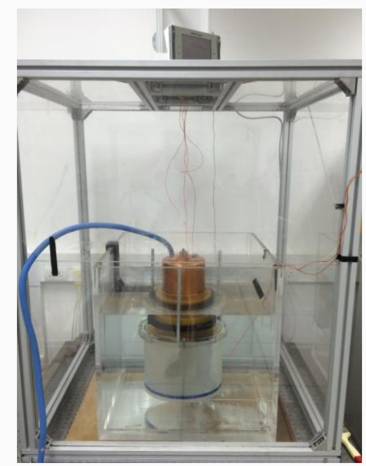
***Power range:*** *3 mW - 20 W*

***Frequency***: *(1-25) MHz*

***Typical Uncertainty***: *U=5.0%(k=2)*



*Ultrasound Power – Calorimetric Method*

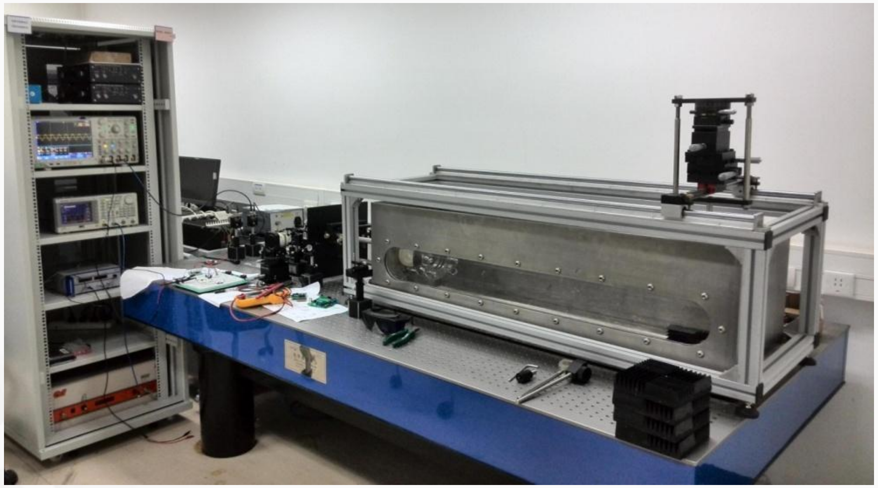


***Power range:*** *(20-300) W;*

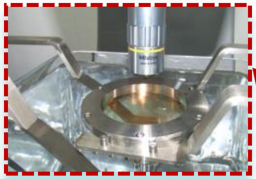
***Frequency:*** *（1-5）MHz*

***Typical Uncertainty:*** *5%(k=2)*

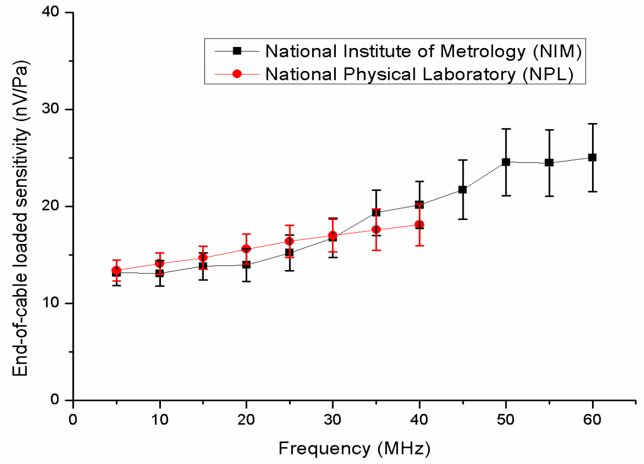
# Hydrophone Calibration for Ultrasound Field Characterization (Partly Completed)

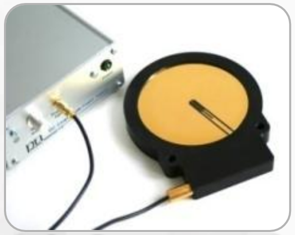


Laser Homodyne Calibration System



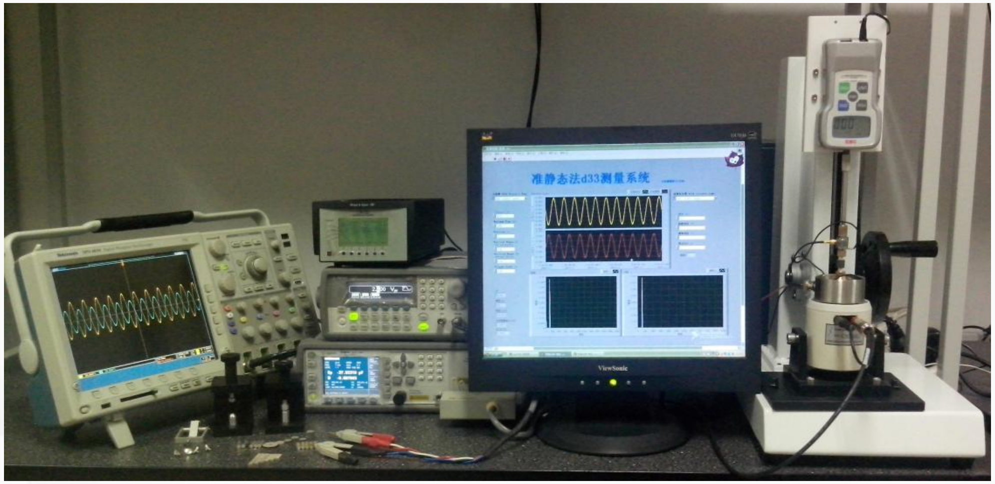
Laser Heterodyne Calibration System



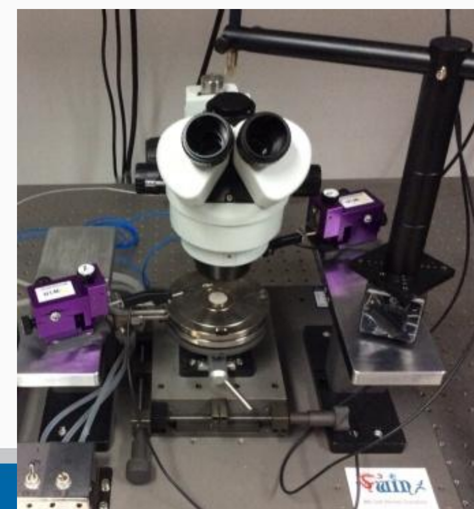
Needle, Membrane and Optic-fiber hydrophones

# *Piezoelectric constant measurement (ongoing)*



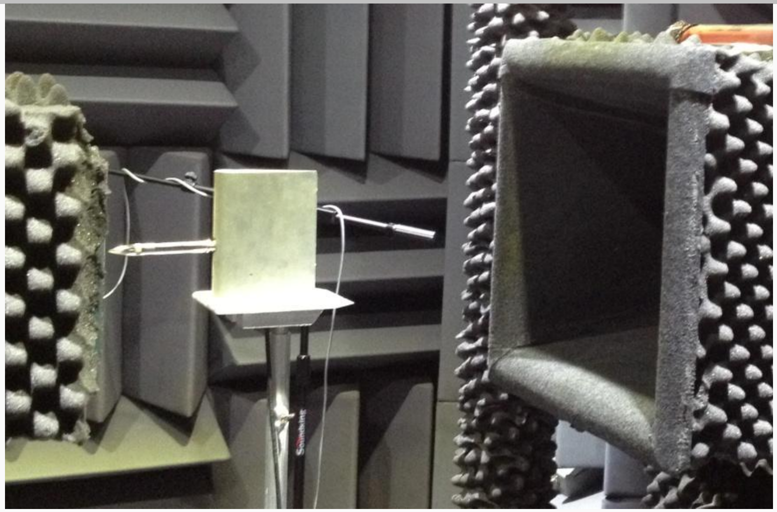

*Quasi static and Dynamic resonance method*


*Gas chamber pressure method*



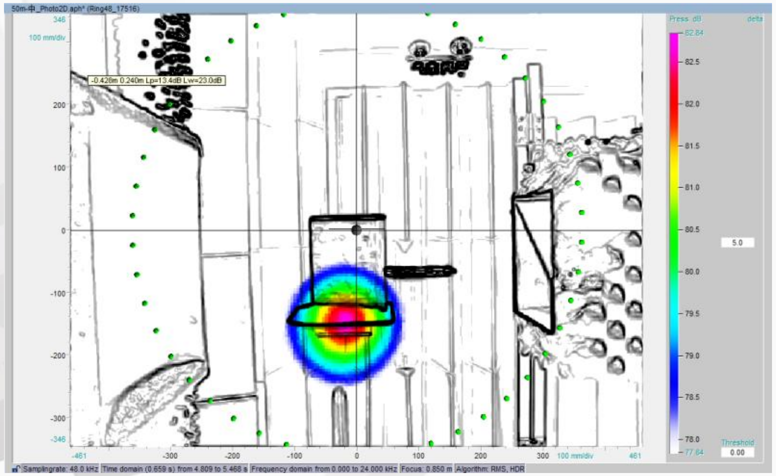
*Laser method and test table*

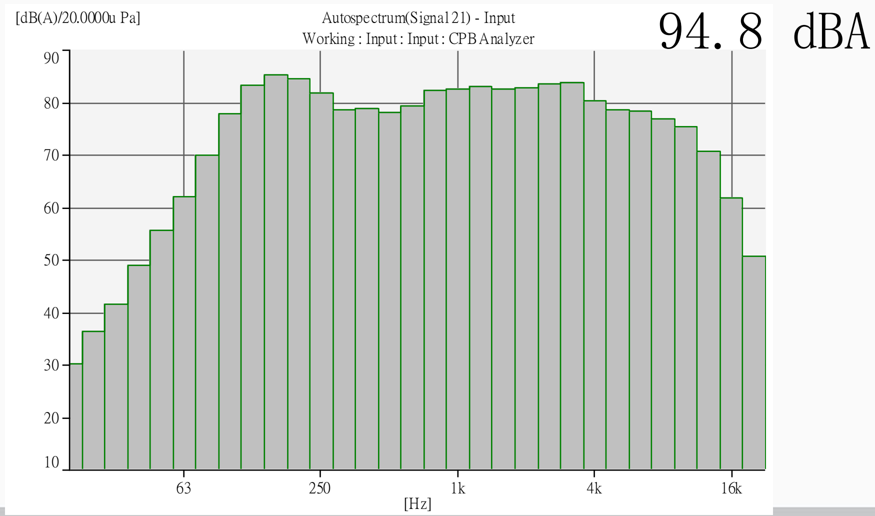
# Microphone calibration in high speed wind



The maximum speed is 83 m/s.

Acoustic camera by beamforming

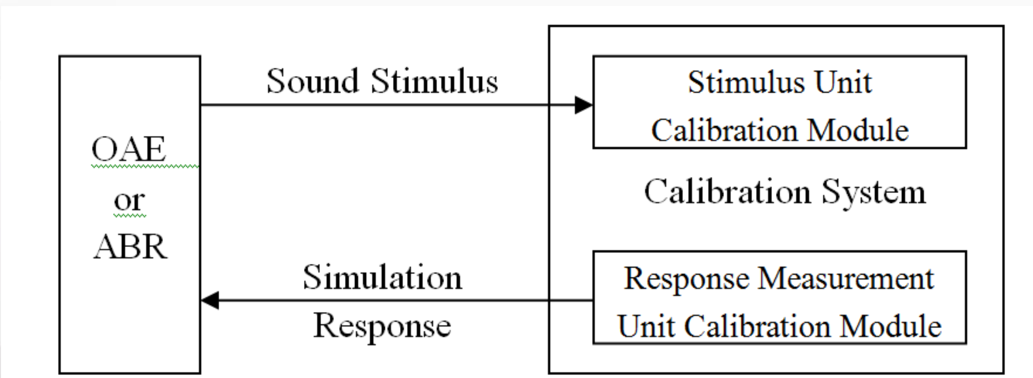




# Objective Audiometry Equipment Calibration

*Oto-Acoustic Emission Audiometer*

*Auditory Brainstem Response Audiometer*




*NIM is developing a calibration system for OAE and ABR equipment.*

*(1) Sound Pressure Level Measurement Uncertainty ：U = 0.9 dB ，k = 2. (ISO 389-6 )*

*(2) Generating signal simulating the human ear response (OAE or ABR).*

*Prototype system has been finished, measurement experiments is going on.*

# Publication List


*[1] Ping Yang, Guangzhen Xing, Working-point control technique for the homodyne interferometery in hydrophone calibration, Ninth International Symposium on Precision Engineering Measurement and Instrumentation, 94464A (March 6, 2015);*

*[2] Shou Wende, Yu Li-li ,Yang Ping, etc, Self-reciprocity calibration method of ultrasonic transducer as well as its application in power measurement and relation with radiation force banlance method, Technical Acoustics, 2014, vol. 33,pp 446-453.*

*[3] Guangzhen Xing, Ping Yang, etc, Calibration of ultrasonic hydrophones based on spherically focused self-reciprocity technique, WESPEC2015, Singapore.*

*[4] Longbiao He, Xiujuan Feng, Feng Niu,Bo Zhong, etc. DISCUSSION ON LDV SIGNAL PROCESSING FOR AIR-BORNE ACOUSTIC PARTICLE VELOCITY MEASUREMENT,22nd International Congress on Sound and Vibration,2015*

*[5] He, Wen,ZhangFan,He, Longbiao,etc.A study on the pressure leakage correction of pistonphones at infrasonic frequencies,Journal of Sound and Vibration,335(2015): 105-114*

*[6] Wu Hong,He Longbiao,Zhou Jinglin,etc.The displacement characteristics of piezoelectric ceramic micro actuators evaluated by laser interferometer, Key Engineering Materials 645(2015):920-925*

*[7] Zhang Ruiwen, He Longbiao,Zhu Haijiang,etc,Uncertainty Evaluation of Piezoelectric Constant Measurement Based on Dynamic Resonance Method, ACTA Metrologica Sinica, 2015,36(7):344-347(In Chinese)*

# Publication List

*[8]Bo Zhong, Li Zhang, Ying Bai, etc. Design and Implementation of Filter for Simulating Hearing Loss, IEEE International Conference on Mechatronics and Automation,2015*

*[9] Li Zhang, Xiaomei Chen, Bo Zhong, etc. Objective Evaluation System for Noise Reduction Performance of Hearing Aids, IEEE International Conference on Mechatronics and Automation,2015*

*[10] Zhong Bo, He Longbiao, Xu Huan, etc. Introduction of Metrology Standards for Hearing Screening Equipment, Chinese Scientific Journal of Hearing and Speech Rehabilitation, 13[5], 2015 (in Chinese)*

中国计量科学研究院
National Institute of Metrology

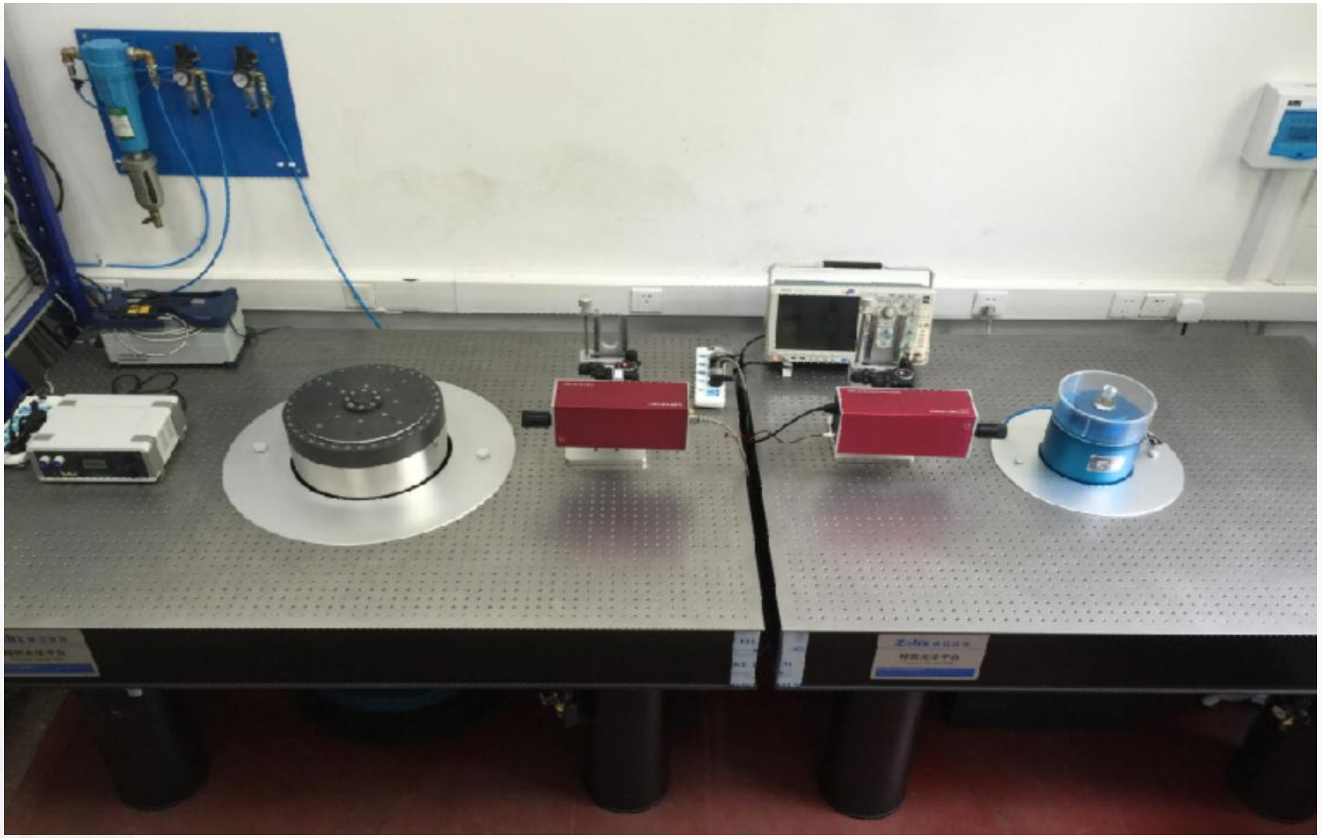
National standards report from NIM, China

# Part II: Vibration & Shock

# Project1 on angular vibration (completed)

| Parameters | Low frequency angular vibration standard | Medium frequency angular vibration standard |
|---|---|---|
| Frequency | 0.0005Hz～160Hz,<br>0.05Hz～160Hz<br>（angular acceleration）；<br>0.0005Hz～0.05Hz<br>（angular velocity and displacement） | 0.1Hz～1200 Hz<br>（angular acceleration） |
| Angular acceleration | （0.04～100 ）$rad/s^2$ | （0.06～2000 ）$rad/s^2$ |
| Angular displacement | 300° | 60° |
| Waveform distortion | <1.0% (0.0005Hz≤ $f$ <0.05Hz);<br><1.0% (0.05Hz≤ $f$ ≤100Hz);<br><2.0% (100Hz< $f$ ≤160Hz) | <1.0% (angular acceleration) |
| Uncertainty of complex sensitivity ($k$=2) | angular accelerometer：<br>1.0%，0.5° (0.05Hz≤ $f$ <0.1Hz)；0.5%，0.5° (0.1Hz≤ $f$ ≤ 630Hz)；<br>0.8%，1.0 ° (630Hz< $f$ ≤1200Hz)<br>angular velocity or displacement transducer：<br>0.4%，0.5° (0.0005Hz≤ $f$ <0.05Hz) | |

# Project1 on angular vibration (completed)



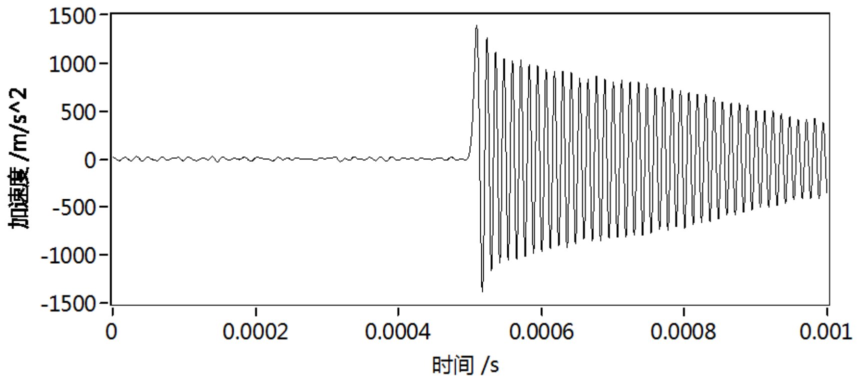
**Low and medium frequency angular vibration standards**

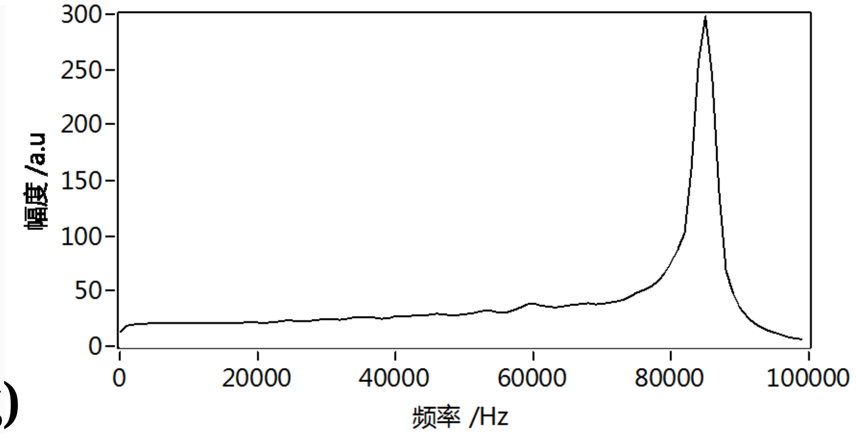
**Mr. LIU: liuad@nim.ac.cn**

# Project2 on parameter identification (on-going)

Exciting system (steel ball dropping)

## Test result

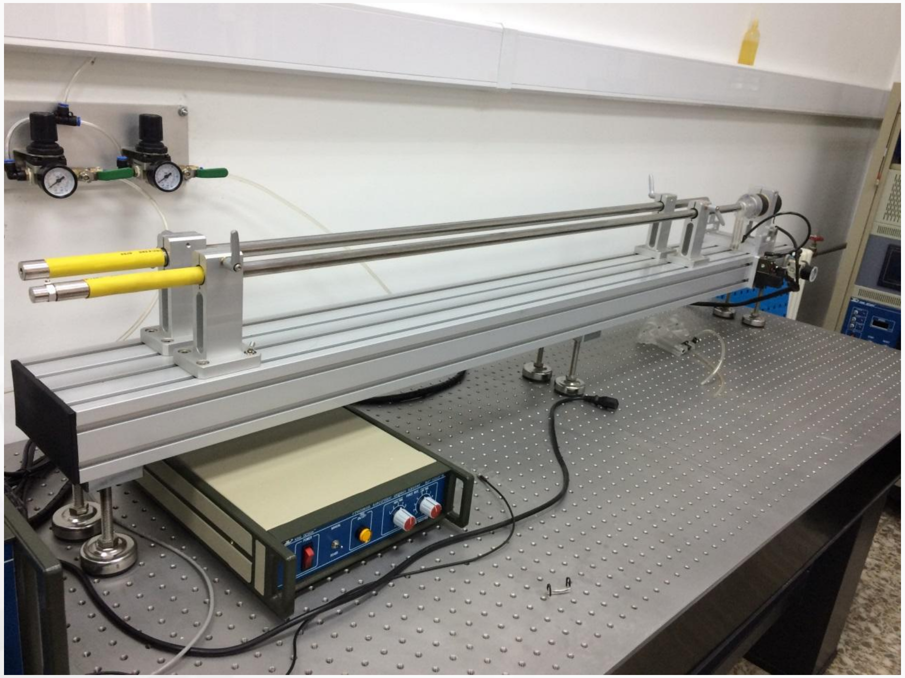


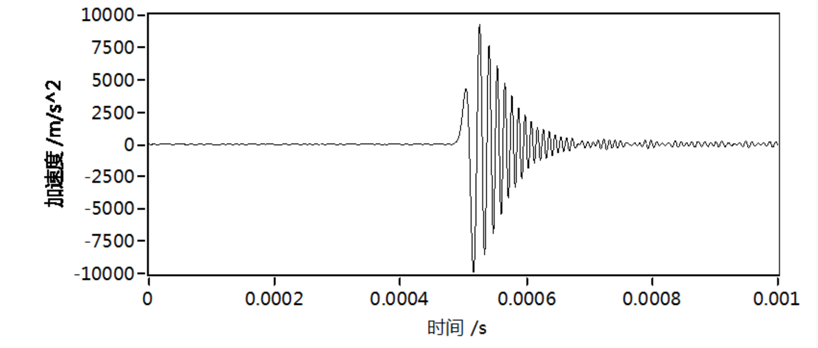

**Band width >80kHz**

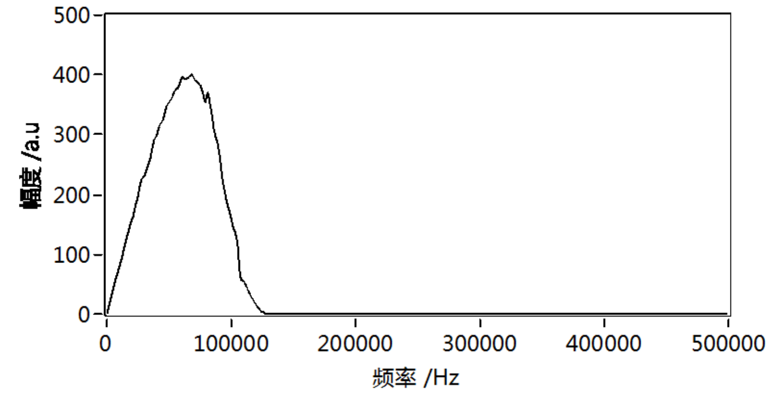
# Project2 on parameter identification (on-going)

## Test result



Exciting system (Hopkinson bar)

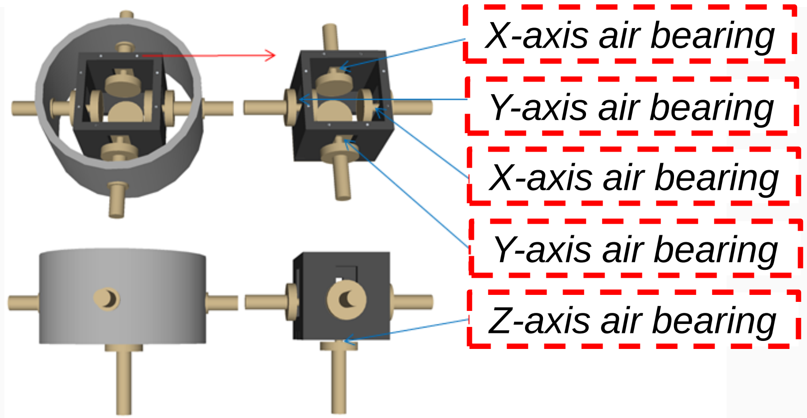


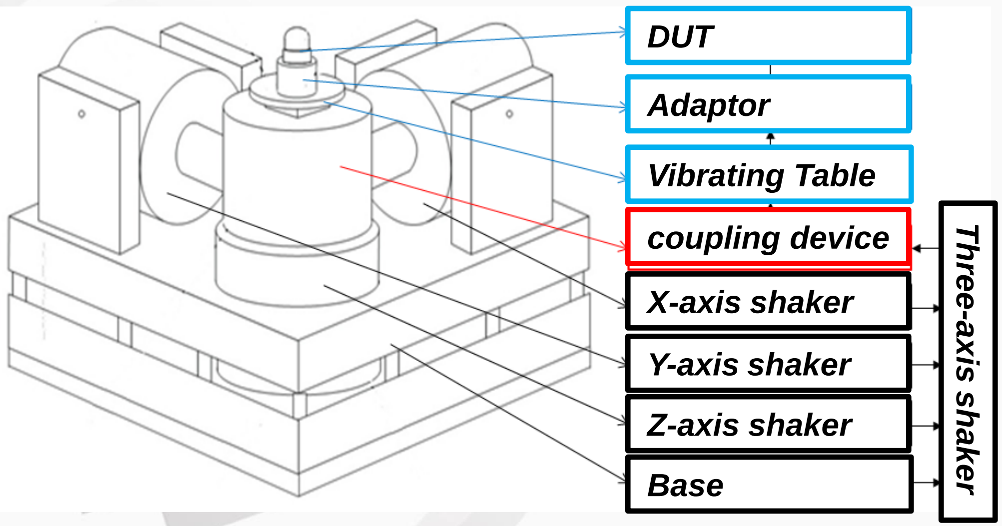




**Band width >100kHz**

Mr. HU: huhb@nim.ac.cn

# Project3 on multi-component vibration (on-going)




***Three-axis coupling device***

1. ***Force transmission and guiding based on air bearing***
2. ***Using square air bearings to eliminate torsional resonance***
3. ***Magnesium alloy is used to reduce the weight***

**Dr. CAI: caichenguang@nim.ac.cn**

# *Thank you for your attention!*