STATUS REPORT

FOR

THE CALIBRATION OF THE QUARTZ CRYSTAL MICROBALANCE CASCADE IMPACTOR USING THE BERGLUND-LIU MONODISPERSE AEROSOL GENERATOR FOR AEROSOL STUDIES IN THE ATMOSPHERE: NSG 1593

TO

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The Calibration of the Quartz Crystal Microbalance Cascade Impactor using the Berglund-Liu Monodisperse Aerosol Generator for Aerosol Studies in the Atmosphere

Objective

The objective of this grant is to calibrate the Quartz Crystal Microbalance (QCM) and determine its response to particule size and mass concentration.

Instrument Description

The QCM is the most promising of the instruments capable of giving real time data of aerosols' characteristics from stratospheric and surface sampling. It is a ten stage cascade impactor that collects pollutants aerodynamically according to their size distribution and density.[1] The QCM is flown on the NASA-U-2, Saberliner, and the P-3 for sampling stratospheric aerosols,[2] ambient tropospheric aerosols, exhaust plumes from rocket motors,[3] exhaust plumes from active volcanoes,[4] and exhaust plumes from coal fired burners from industrial plants when mounted on a Van.[5]

Since both the sizing characteristics and the mass sensivity values are based on design parameters of the QCM, the calibration will endeavor to produce laboratory values to compare with these calculated values.

The experimental procedure was begun using monodisperse latex spherical particles of known size and density. The Royco 256 particle generator which employs the nebulize method was used to generate the particles. The monodispersity of the generated particles was checked with an optical particle counter (Particle Data System FSSP-100) to assure that no doublets were present. Particles of the following sizes 0.312, 0.500, 0.714, 1.011 and 2.020 micrometers were generated using the above method.

The results of these measurements show the maximum response (Change in Frequency) occuring in the stage of the QCM which has a 50% efficiency nearest to the size of the particle used. There is, therefore, agreement between the calculated and measured response to particle size over the size range considered.

The Berglund-Liu Aerosol Generator[6] will be used to generate particles of large size (up to 25 micrometers) and using materials of a variety of mass density. Which may have different aerodynamic behaviors. This technique not only will enable me to extend the particle size calibration up to the maximum limit of the QCM, it is also a useful technique for calibrating mass concentration.

REFERENCE

[1]Chuan, R.L.,"Rapid Measurement of Particulate Size distribution in the Atmospher", AIAA J, Vol. 10, No. 12, Dec. 1972, pp. 1701-1704.

[2]_____, 1965, Stratopheric Particles at 20km Altitude: Geochim. Cosmochim. Acta, V 29, p. 201-207.

[3]Chuan, R. and Woods, D.C., "Morphology and Elemental Composition Analysis by Size of Rocket Particulete Effluent," Proceedings of the 4th Joint Conference on Sensing of Environmental Pollutants.

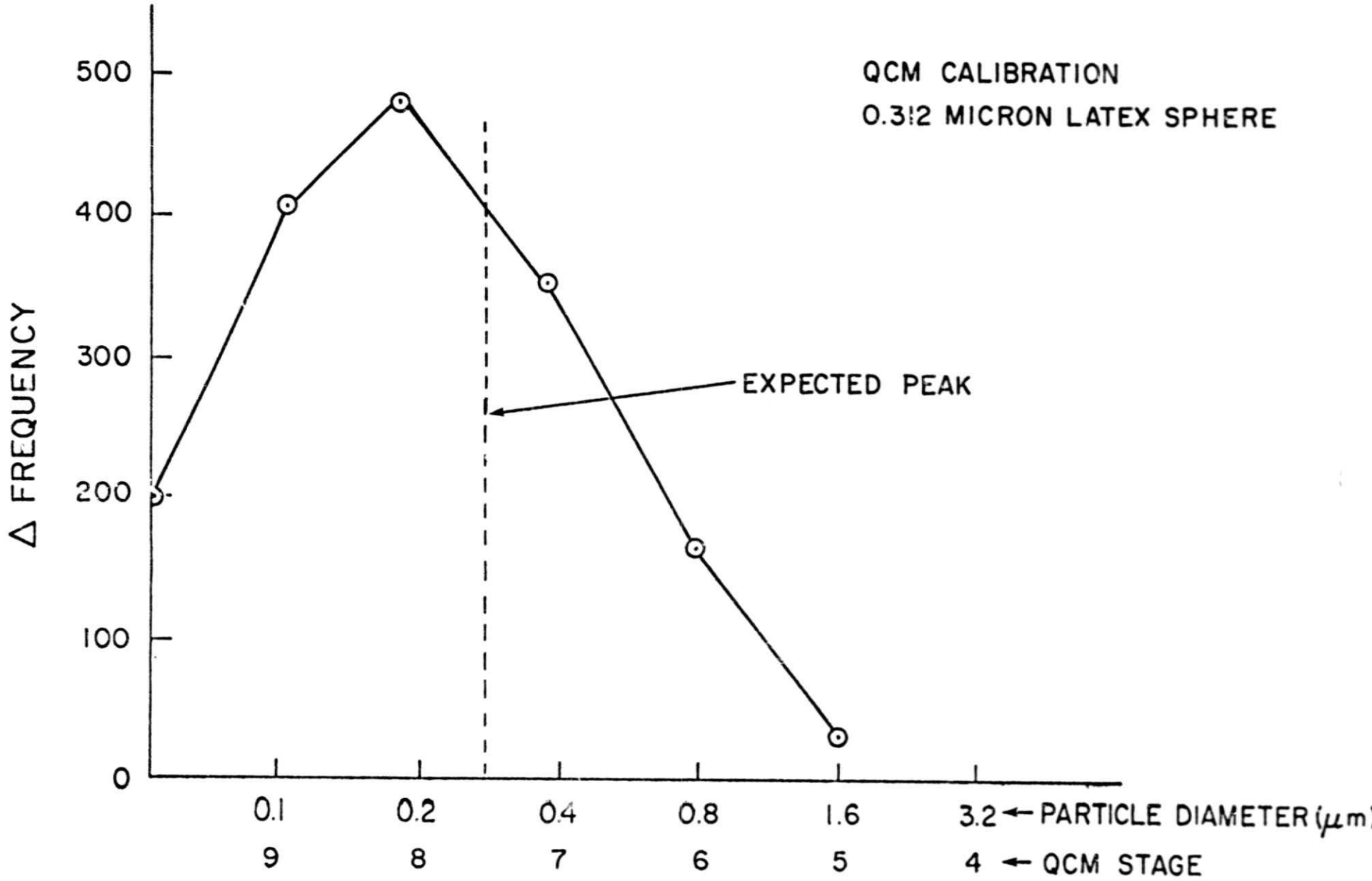
[4]Davies, D.K., etc, "Airfall from the 1974 eruption of Volcano de Fuc go, Guatemala: Gcol. Scol. Amer. Bull., V. 89 (in press).

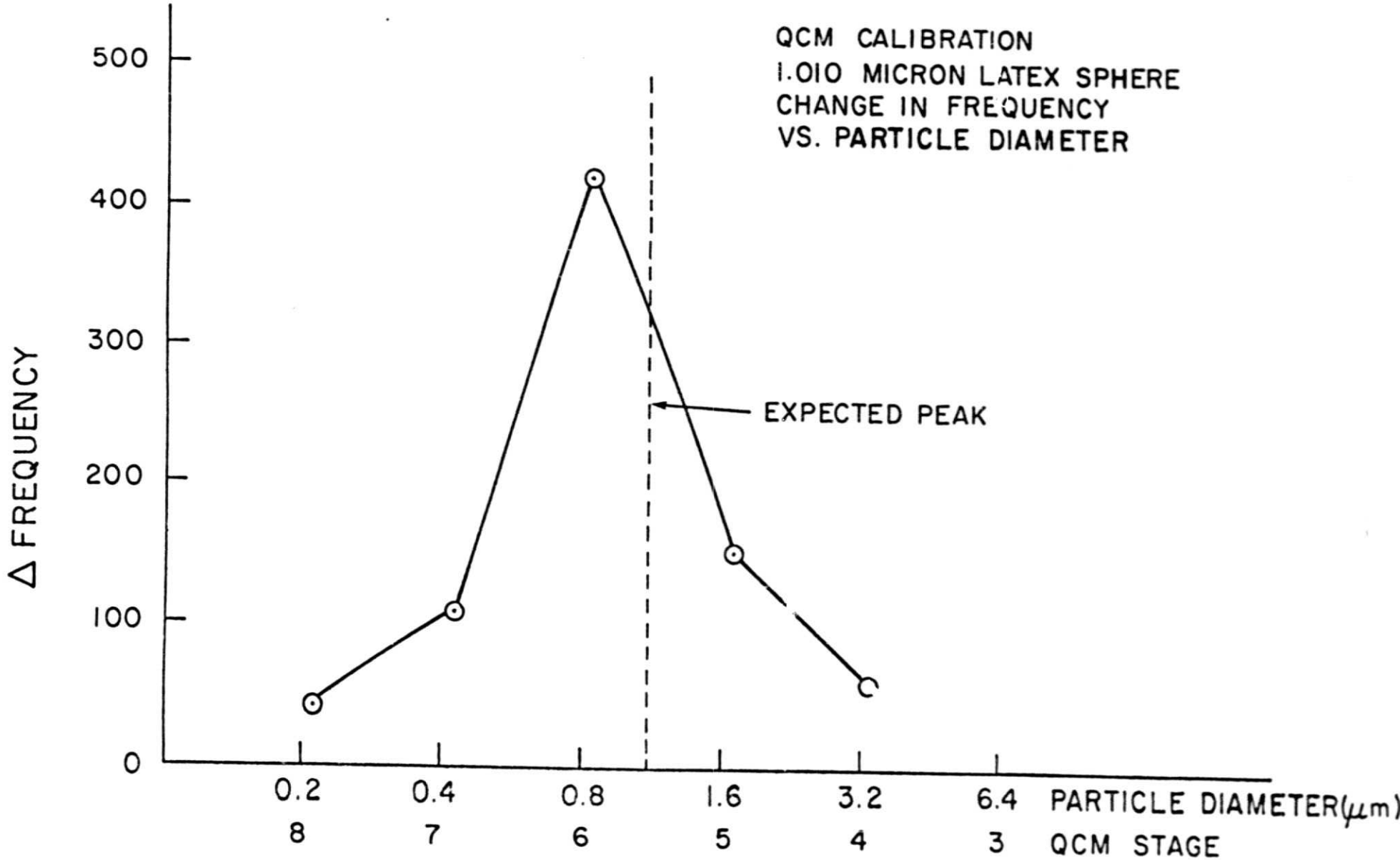
[5]Woods, David, G. Storey, R. W., Jr., Sentell, Smith, Harris, "Atmospheric Particulate Measurements in Norfork,VA," NASA TMX 3285.

[6]Berglund, R.N.,"Basic Aerosol Standards and Optical Measurements of Aerosol Particles," University Microfilms, 1972.

Appendices

The following two graphs represent the data from the QCM Calibration Using 0.312 micron latex sphere and the 1.010 micron latex sheres. The data from the graphs support the close agreement between the Calculated Values and the Laboratory Values. The Other plots (0.714 μ, 0.500 μ and 2.020 μ) offer similar results.


QCM CALIBRATION
0.312 MICRON LATEX SPHERE
Δ FREQUENCY
500
400
300
200
100
0
EXPECTED PEAK
0.1
0.2
0.4
0.8
1.6
3.2 ← PARTICLE DIAMETER (μm)
9
8
7
6
5
4 ← QCM STAGE


QCM CALIBRATION
1.010 MICRON LATEX SPHERE
CHANGE IN FREQUENCY
VS. PARTICLE DIAMETER
Δ FREQUENCY
500
400
300
200
100
0
EXPECTED PEAK
0.2
0.4
0.8
1.6
3.2
6.4
PARTICLE DIAMETER(μm)
8
7
6
5
4
3
QCM STAGE