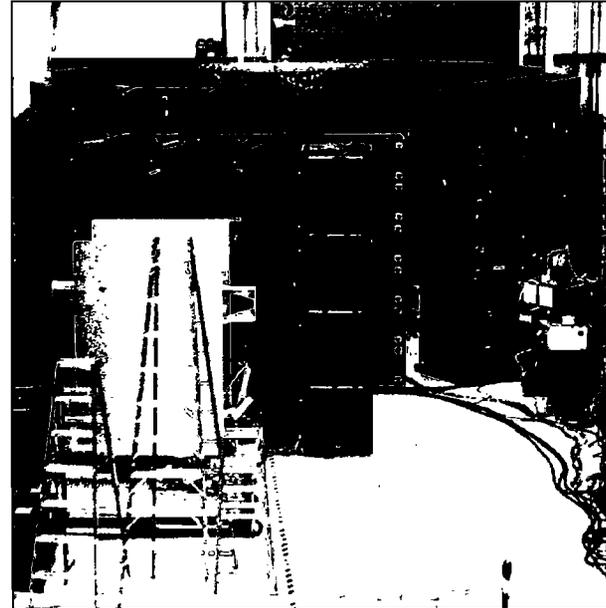

Direct Field and Reverberant Chamber Acoustic Test Comparisons

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Acoustic Test Data Set

- CloudSat antenna subjected to PF reverberant chamber acoustic test
- CloudSat subjected to a PF direct speaker acoustic test
- DAWN HGA subjected to assembly PF reverb chamber test
 - Plus 2 spacecraft acoustic tests
- DAWN flight spacecraft subjected to a PF direct speaker acoustic test
- DAWN flight spacecraft subjected to a workmanship reverberant chamber acoustic test



Response Data Compared

- Vibration at assemblies compared for acoustic tests in reverberant chambers vs. with speakers
- Test response data scaled by appropriate acoustic inputs to compare responses induced by reverberant chambers and speakers

Pertinent Test Parameters

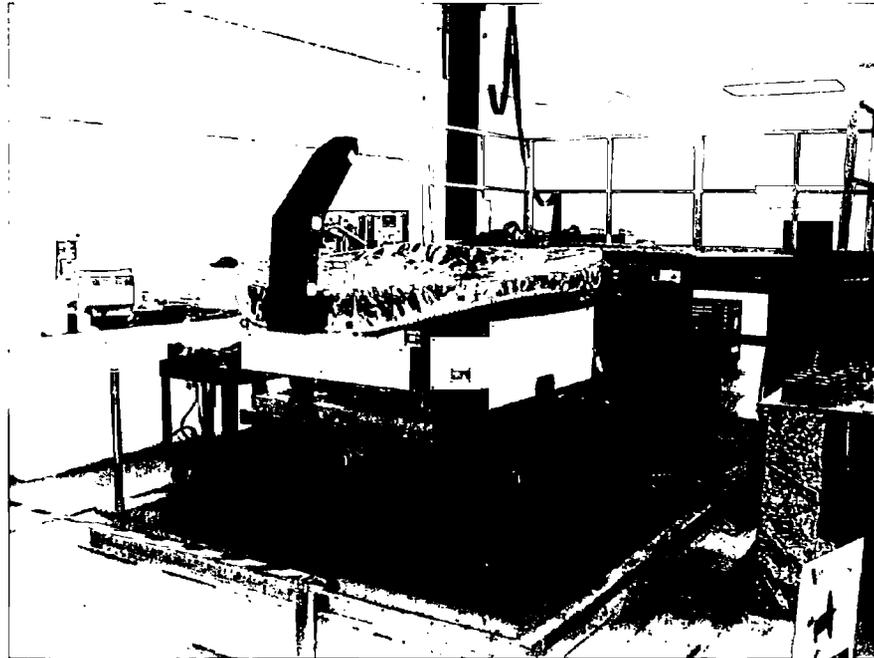
- Test articles listed, methods and facilities compared

Test Article	Test Method	Chamber Dimensions W X D X H	Chamber Size ft ³	Speaker Circle	Control Mic Distance to S/C
CloudSat Antenna	Revererant Chamber, TRW, Redondo		Not available	-	24"
CloudSat Spacecraft	Speaker Test		-	228" dia circle	2' to 4'
DAWN HGA	Revererant Chamber, Wyle, El Segundo, CA	18' X 14' X 10'	2520	-	24"
DAWN Spacecraft	Speaker Test		-	300" dia circle	24"
DAWN Spacecraft	Revererant Chamber, NRL, D. C.	17' X 22' X 27.4'	10000	-	2' to 4'



Cloud Profiling Radar (CPR)

- CPR Structure shown on shaker to illustrate instrument and reflector configuration



CloudSat Speaker Acoustic Test Setup

- Speakers in 228" circle
- Control microphones about 24" minimum from spacecraft

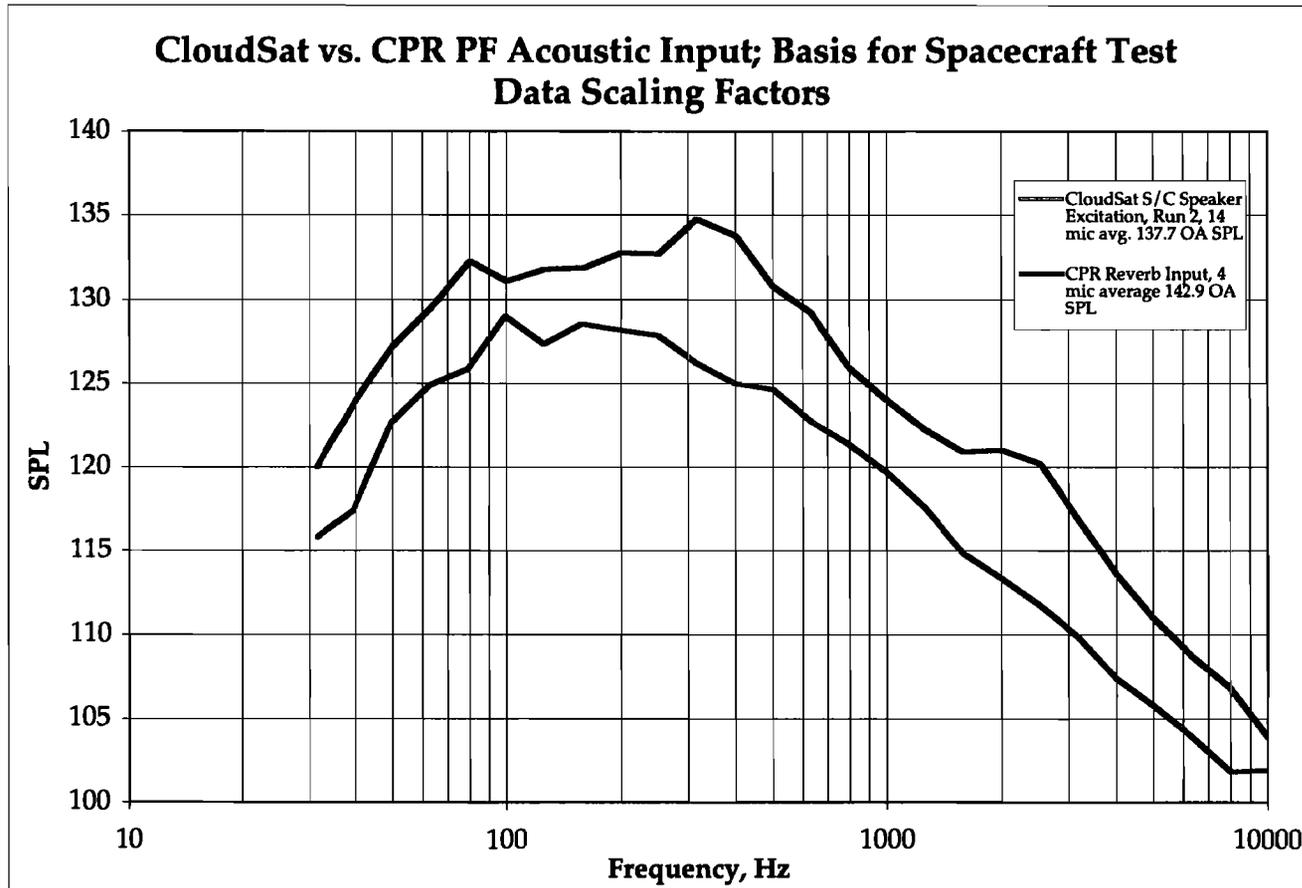


CPR Acoustic Test Configurations

- CPR instrument structure acoustic tested in TRW reverberant chamber
 - Mass mockups in place of electronics
 - Tested to initial program PF acoustic specification of 143.0 dB OA
- Cloud Profiling Radar (CPR) on CloudSat spacecraft PF acoustic test using speakers

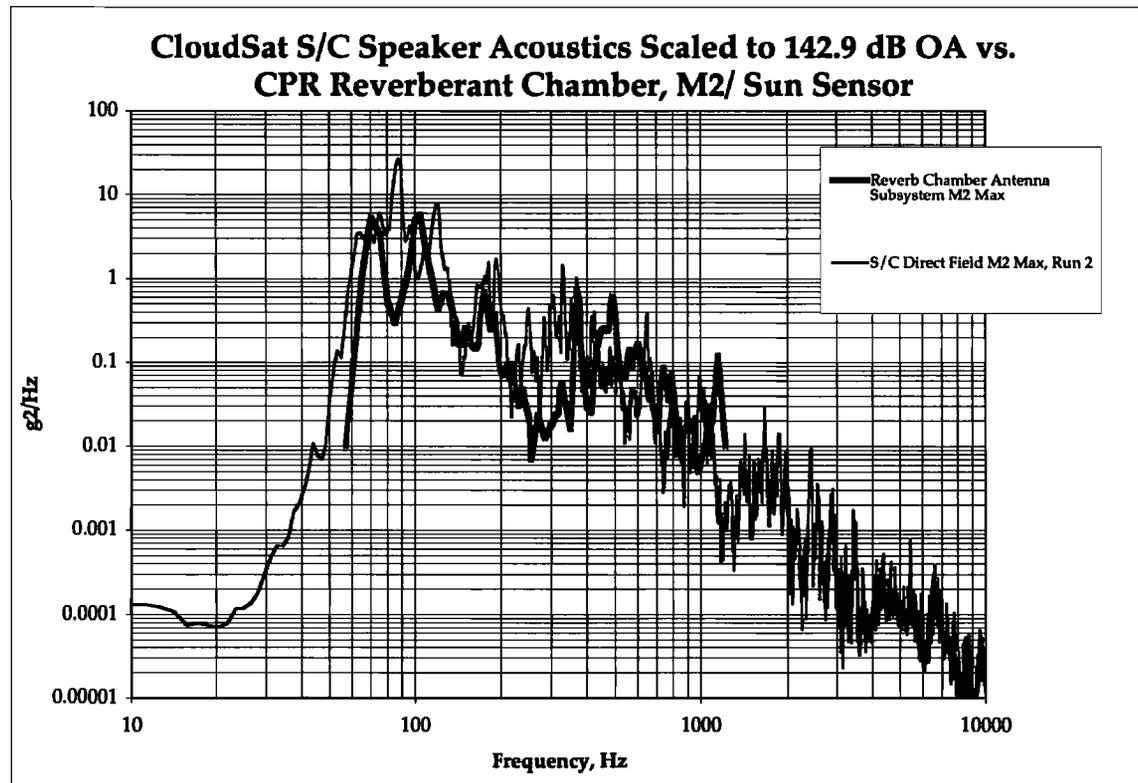


CloudSat Acoustic Input Comparison



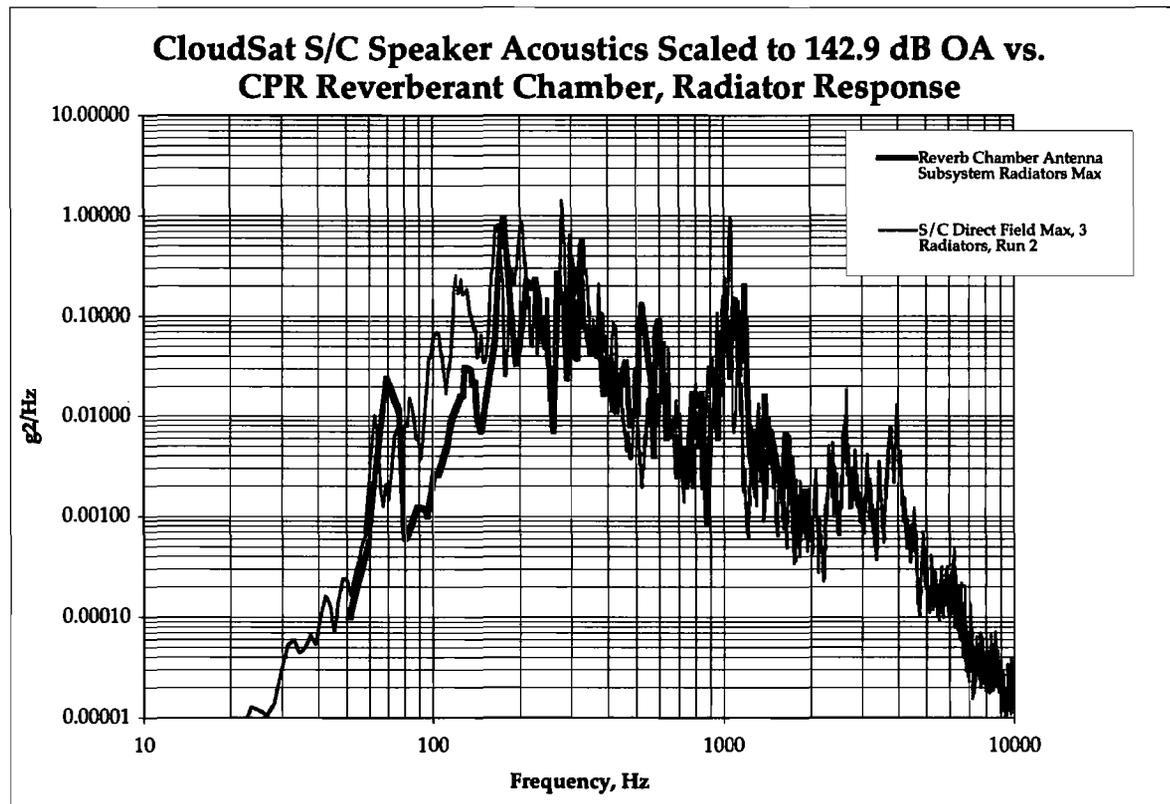
CloudSat M2 Reflector Response

- Speaker acoustic test M2 response peaks were 10 dB + higher below 350 Hz
 - M2 attached to edge of main reflector parallel to floor - grazing incidence



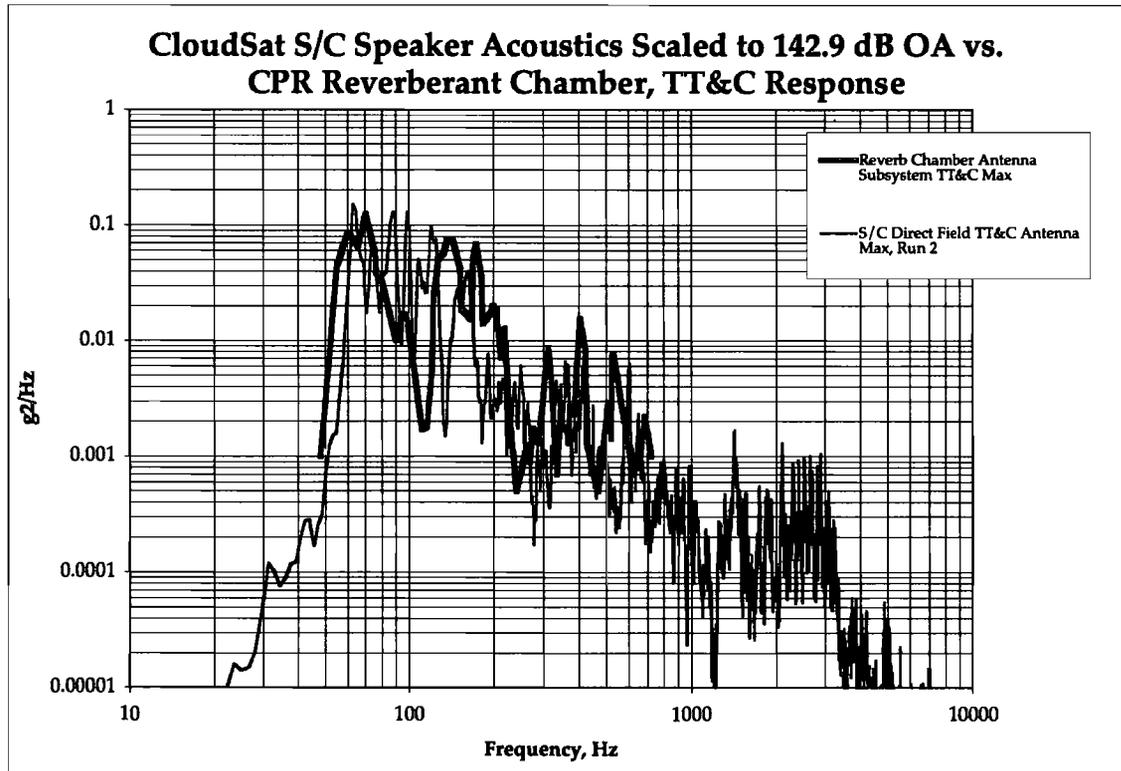
Radiator Response Comparison

- Speaker tests resulted in 10 dB + higher vibration response peaks between 80 Hz and 120 Hz
 - radiators normal to sound source



TT&C Antenna Response Comparison

- Speaker tests resulted in 10 dB + higher vibration response peaks between 80 Hz and 120 Hz

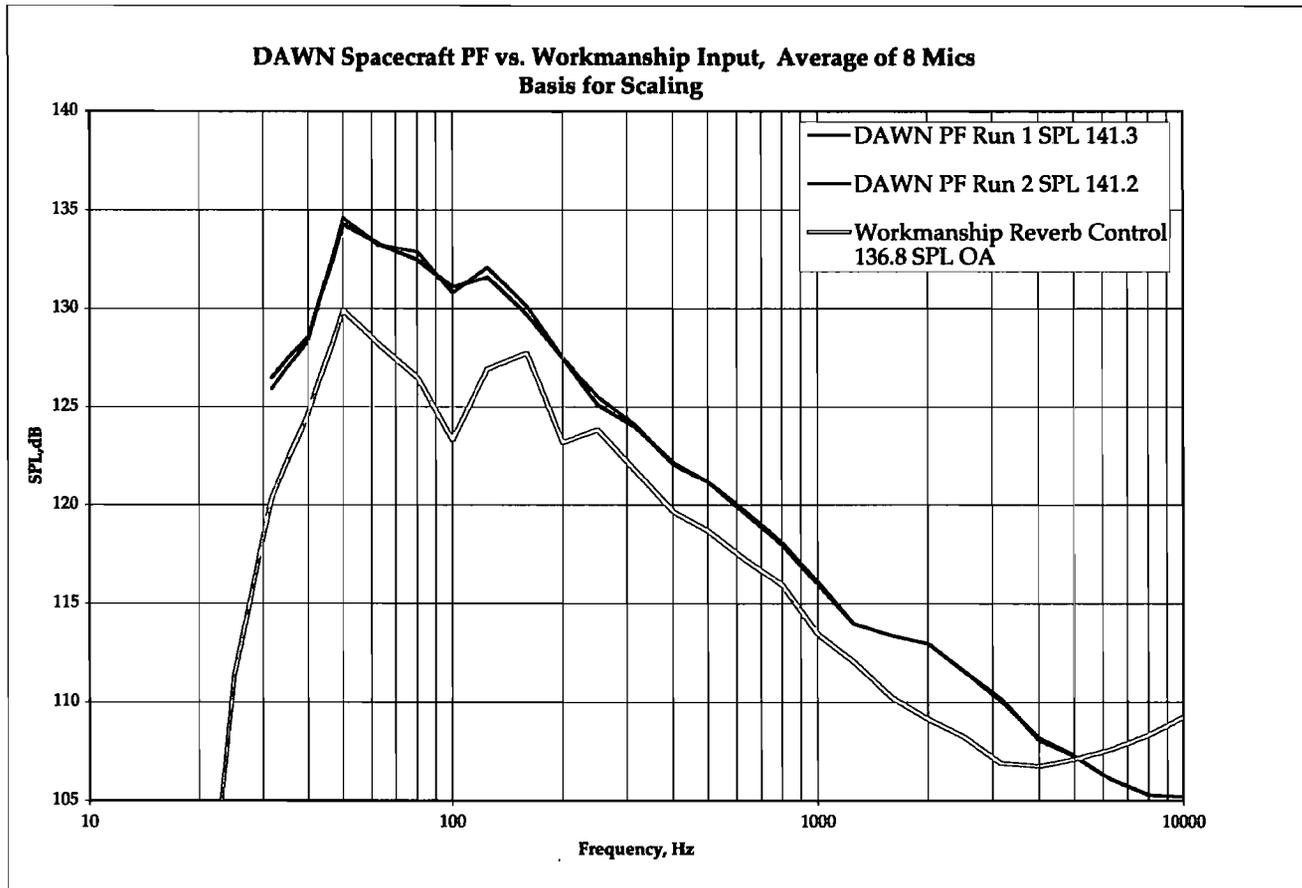


DAWN S/C and Speaker Setup

- Speakers in 300" circle around DAWN spacecraft
- DAWN Mass Mockup in the foreground

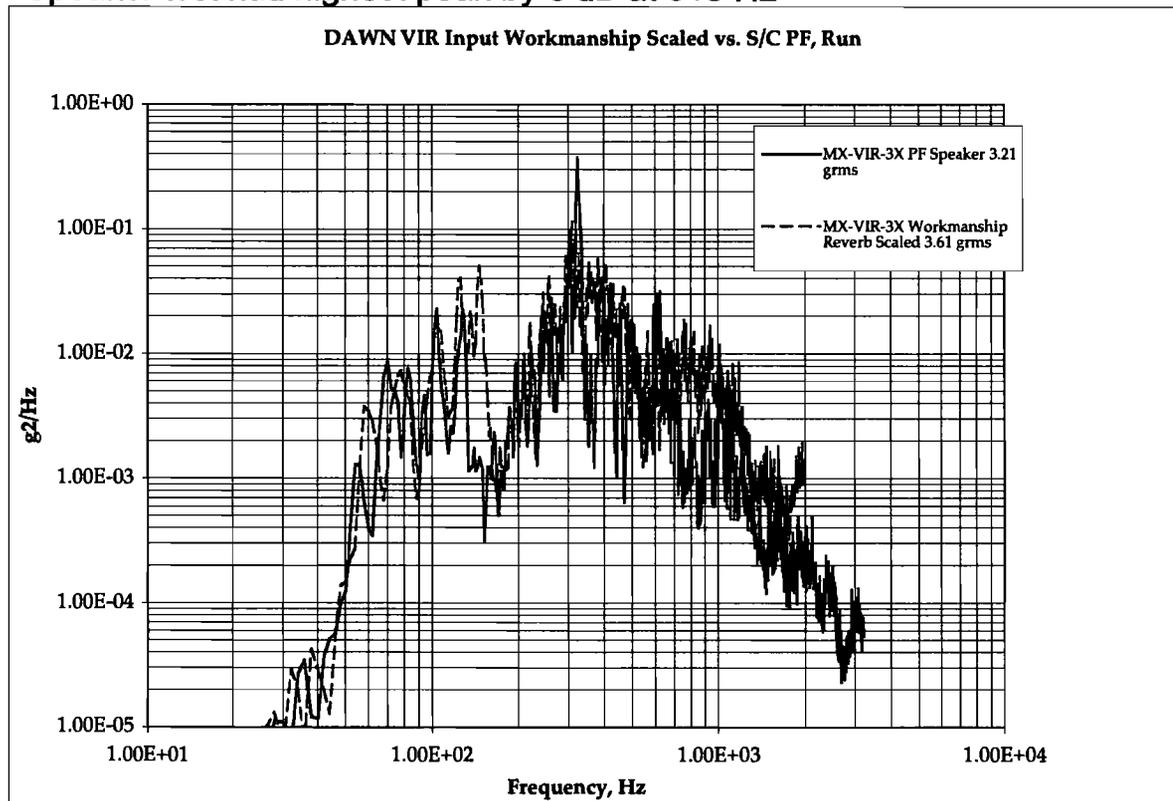


DAWN S/C Acoustics



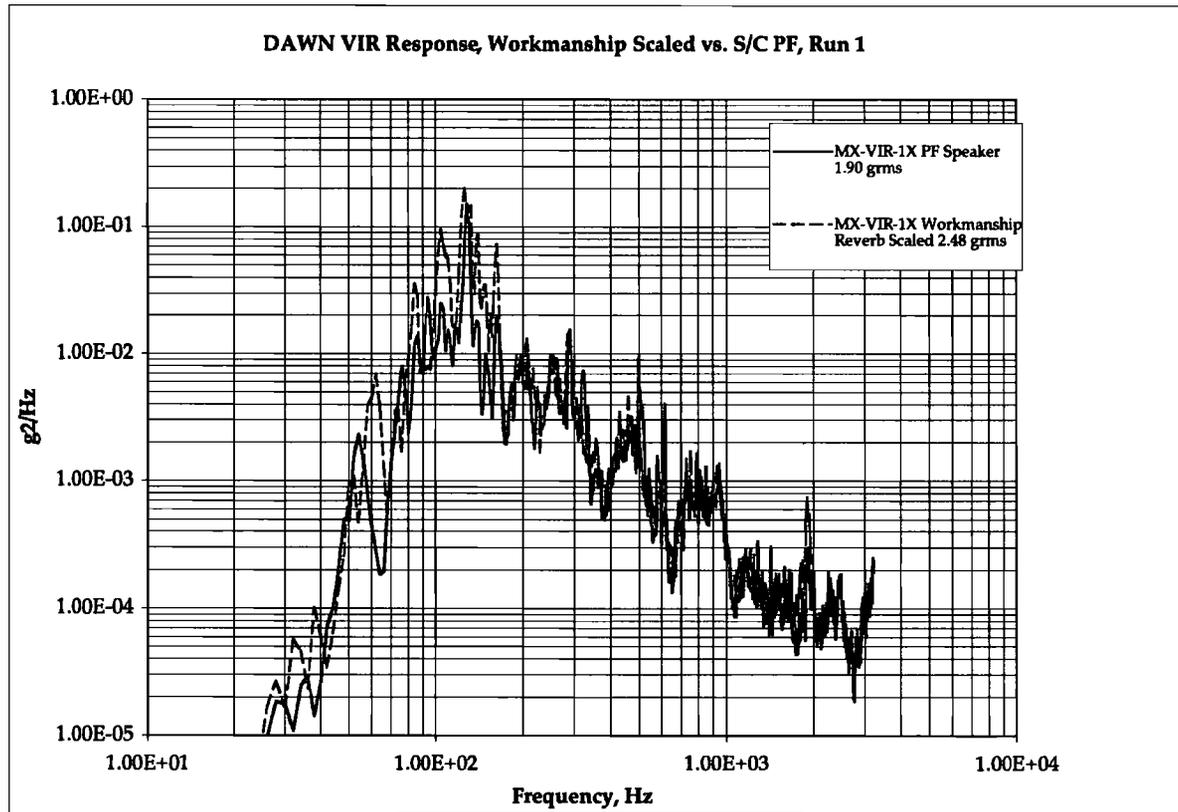
DAWN VIR Input

- VIR input peaks 6 dB - 15 dB higher during DAWN reverberant test 60 Hz to 160 Hz
- Speaker test had highest peak by 6 dB at 315 Hz



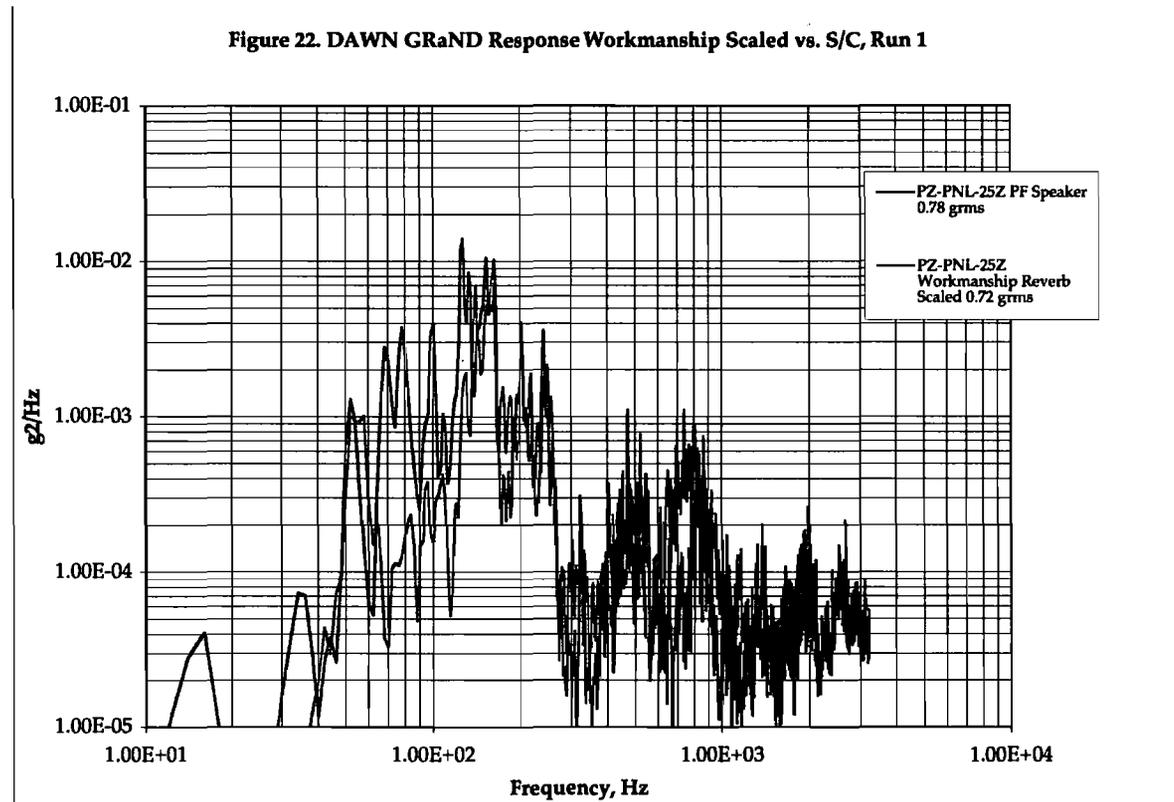
DAWN VIR Response

- VIR frame response similar but peaks 6 dB + higher during DAWN reverberant chamber test 60 Hz to 160 Hz



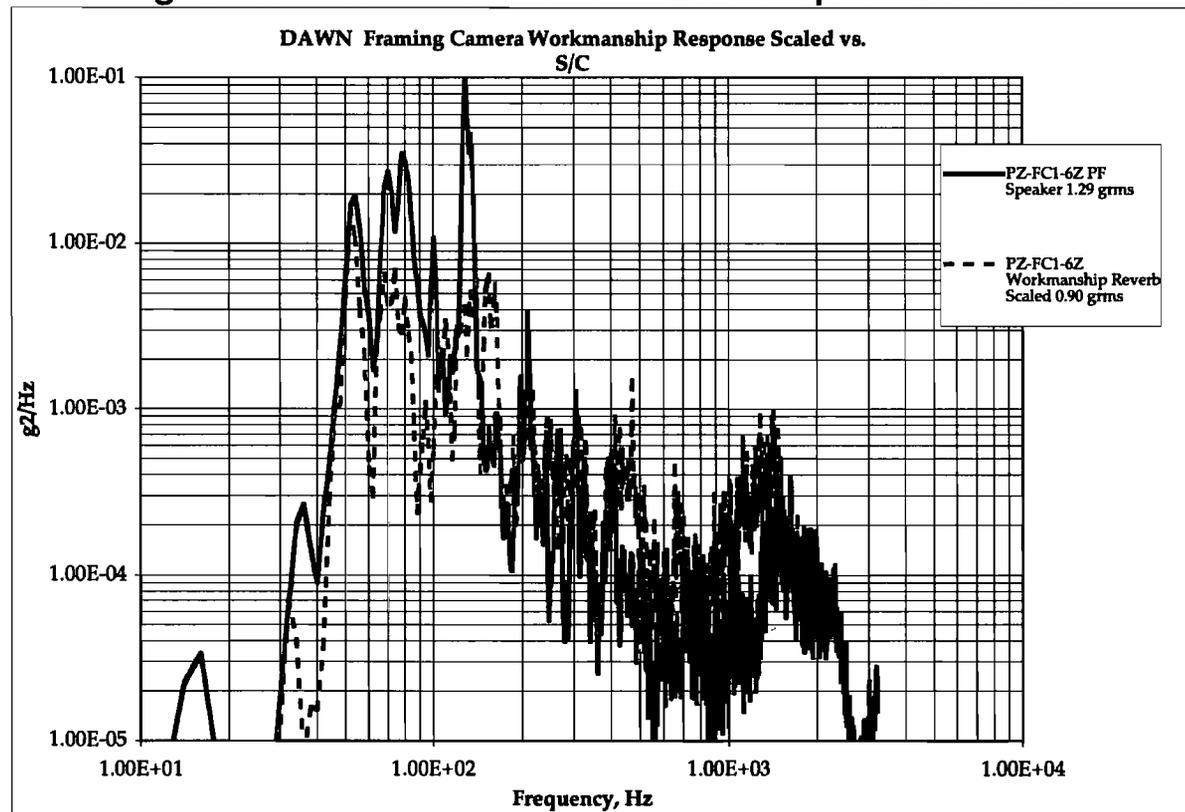
DAWN GRaND Response

- GRaND response peaks to speaker test more than 10 dB higher from 60 Hz to 125 Hz - Z Panel parallel to floor



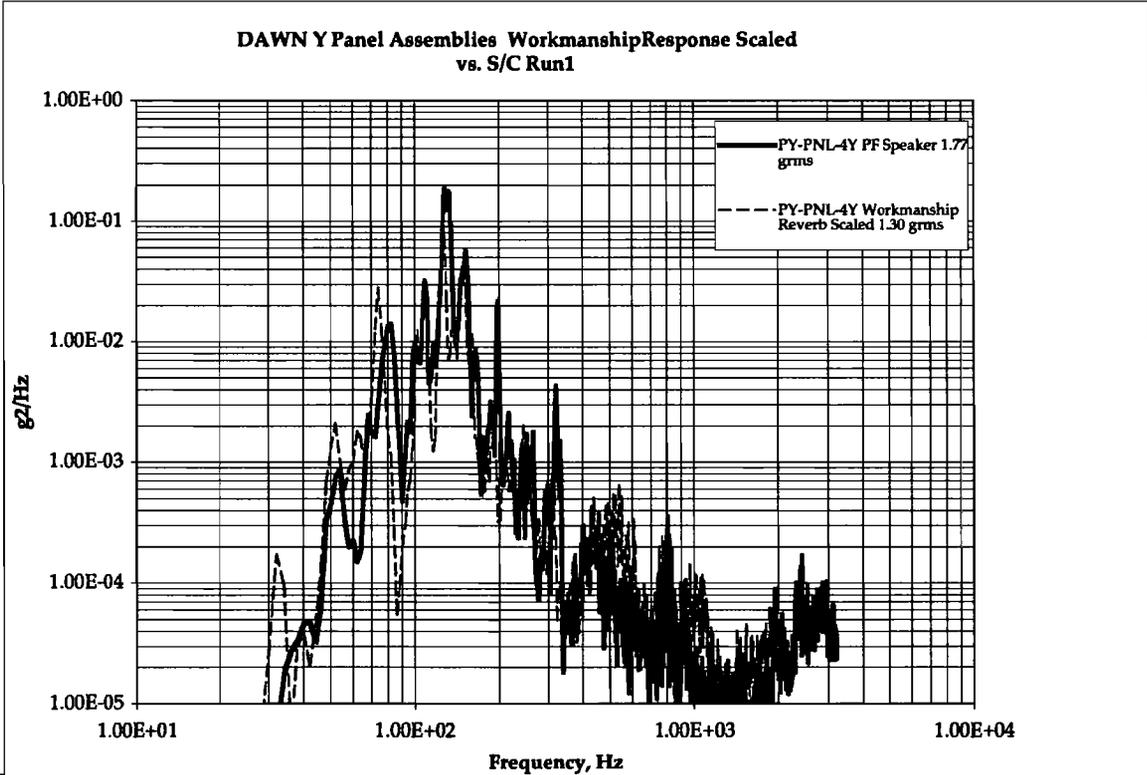
DAWN Framing Camera Response

- Framing Camera speaker testing response peaks 7 dB - 12 dB higher from 60 Hz to 125 Hz - Z Panel parallel to floor



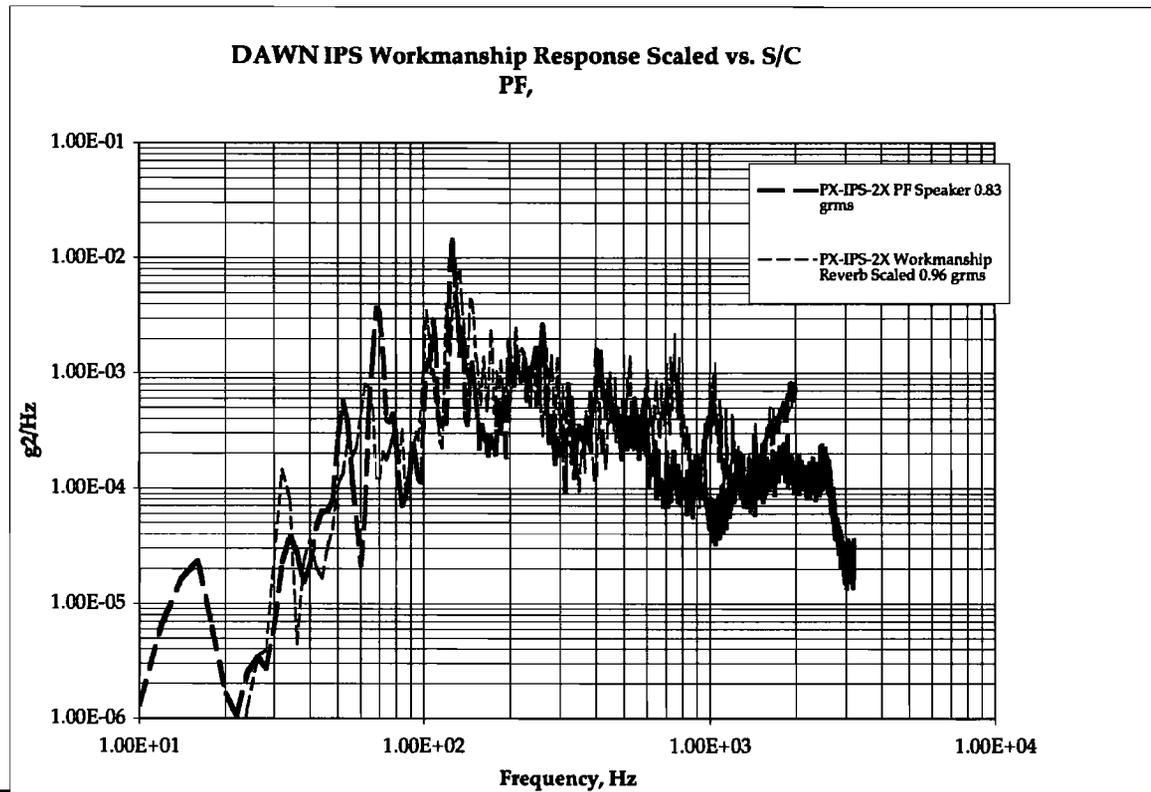
DAWN Y Bus Panel Response

- Y Equipment Panel reverberant test data peaks were higher at low frequencies by 3-7 dB below 80 Hz
- Generally similar response above 100 Hz



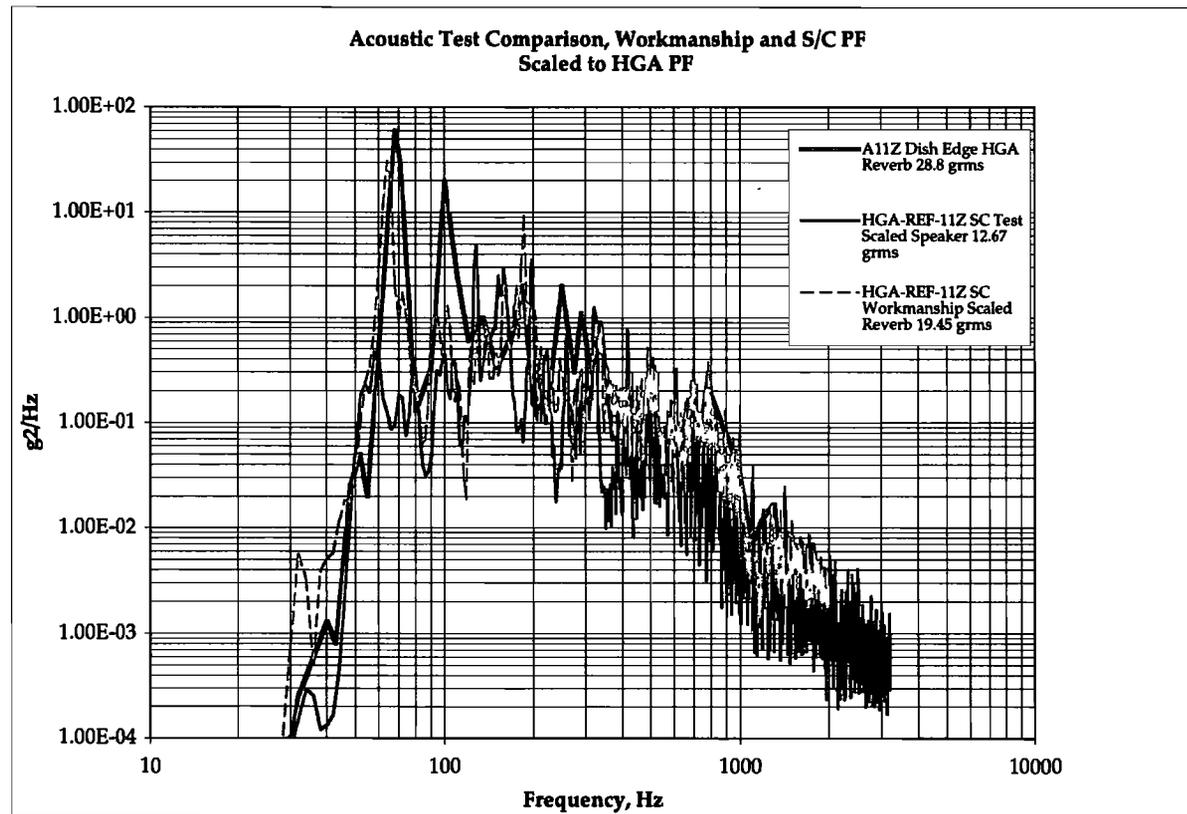
DAWN IPS Response

- IPS speaker response peaks up to 6 dB higher 60 Hz to 160 Hz
- IPS reverb chamber response up to 10 dB higher above 600 Hz



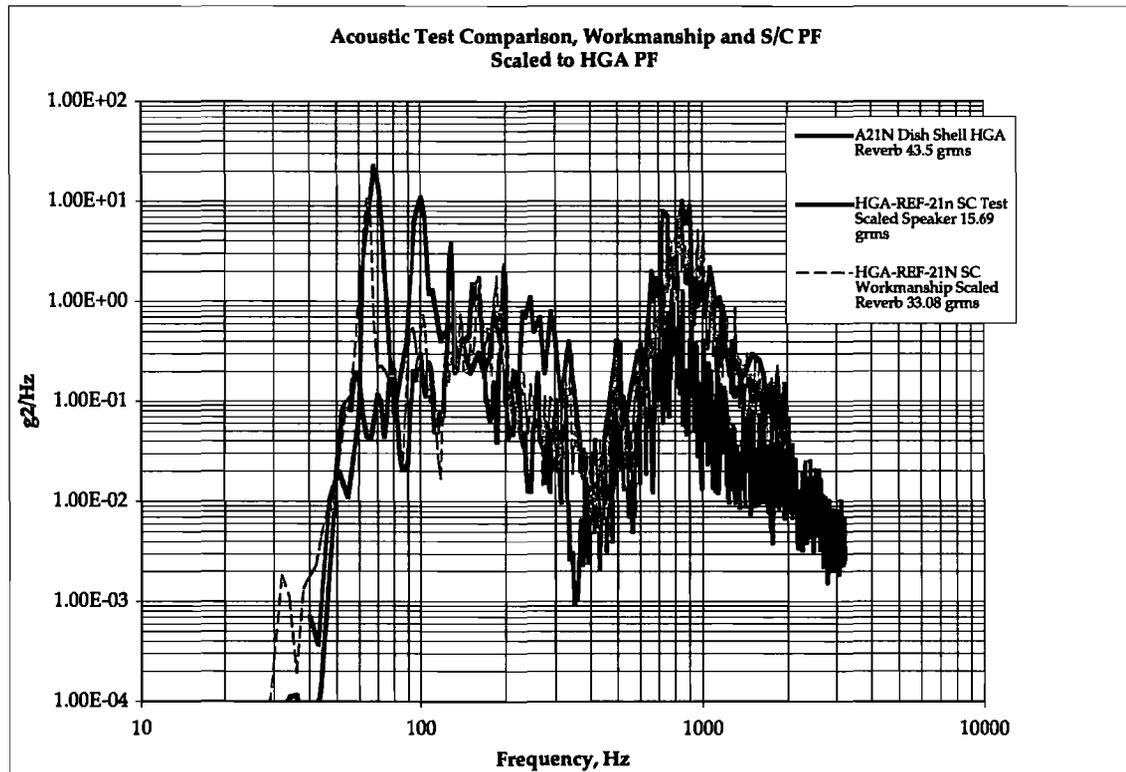
DAWN HGA Response

- HGA dish edge response peaks 15 dB - 22 dB higher during DAWN reverberant chamber test 60 Hz to 125 Hz



DAWN HGA Response

- HGA shell response peaks 15 dB - 20 dB higher during DAWN reverberant chamber test 60 Hz to 125 Hz
- Also higher 225 Hz to 330 Hz and 600 to 2000 Hz



Summary of CloudSat Results

- CPR direct speaker spacecraft and HGA reverberant chamber acoustic test responses were generally similar
- CPR direct speaker acoustic test response peaks 10 dB + higher between 70 Hz and 350 Hz, depending on location
 - Grazing incidence effect possible at CPR main reflector
 - Reflector may have driven entire instrument 70 Hz and 350 Hz

Summary of DAWN Results

- DAWN VIR input 6 dB + higher for reverberant chamber test except at isolated peaks at 315 Hz and 600 Hz
- DAWN VIR responses similar for two test methods with 6 dB (or more) higher reverb chamber peaks below 160 Hz
- GRaND, Framing Camera and IPS responses about 10 dB higher for speaker test 60 Hz - 160 Hz but 10 dB higher for reverb chamber above 600 Hz
 - Z spacecraft panels parallel to floor with grazing incidence to speakers
- DAWN Y panel response (facing speakers) was generally similar for both reverberant chamber test and direct speaker test
 - Some peaks were exceptions
- DAWN HGA response was significantly higher for reverberant testing especially below 125 Hz (20 dB +)



Conclusions

- Reverberant and direct acoustic speaker tests resulted in generally similar vibration responses at common instrumentation locations for CloudSat
 - Speaker acoustic test response peaks 10 dB + higher between 70 Hz and 350 Hz
- Significant response differences occurred over specific frequencies for DAWN testing
 - Up to 22 dB higher during DAWN HGA/ spacecraft reverberant testing
- No clearly dominant test method
 - Response differences seemed to depend on test configuration and orientation of panel relative to speakers
 - Larger speaker circle used for DAWN than CloudSat
 - 300" speaker circle vs. 228"
- Detailed investigation of response differences between test methods and configurations recommended
 - Detailed BEM and/ or SEA analysis
 - Modeling of sound source

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