GBT MEMO 96

WIND VIBRATIONS

Sebastian von Hoerner

December 23, 1992

At the GBT Advisory Meeting the question was discussed whether we might have a problem with wind-induced vibrations or flutter, and I volunteered to write a short note about the different items to be considered. [ ] = my evaluation.

1. Karman Eddies, Fatigue (of single round members). - This has already been checked and taken care of in the structural analysis of the telescope. [OK, sure]

2. Eddies coupling into dynamic modes (of whole telescope). - These eddies and their member vibration have higher frequencies. And higher dynamical telescope modes will have strong damping. [OK, rather sure]

3. Wind Tunnel Test showed "flutter lines" behind the telescope rim, at one critical elevation. - To be done: do not use this elevation for stow position. But keep in mind: Wind tunnel tests can not be done at the proper Reynold number (of the actual telescope conditions). The Reynold number R is proportional to the product DV, and if the diameter D is scaled down by a factor 20, say, then the velocity in the tunnel should be 20 times the survival wind speed, to give the same value of R! But usually, once R is above 50,000 or so, it is not very important how much R is above it. Thus: avoid for stow the critical elevation plus minus 5 degrees, say. [Then probably OK]

4. Deformation of the Geometry (of the whole structure), changing the air flow pattern, which may cause flutter (wings of light airplanes). - This should be completely negligible. The telescope deformations, even in survival wind, are very small as compared to the telescope size (not so for light-weight planes). [OK, sure]

5. Dynamical modes in Resonance with Gusts. - Probably no problem, since dynamical modes have sharp frequency values, while wind gusts are smoothly distributed (Kolmogorov spectrum). [Probably OK]

6. Just in case, **To Be Done:** Any kind of flutter will show up strongly at the autocollimator outputs, thus we should have in the software a permanent "Flutter Watch". Measuring the rms deviation from average, of each autocollimation output, per half a minute, say, and sounding an alarm if too high. (Inclinometers could be used as well, if they are not too much damped.) In case of alarm:

   During observation: change program, go to different pointing.

   In stow: pray and cross fingers on first occurrence. Then, from the measured autocollimator frequency, find the culprit mode. Add strong damping or bracing in the structure, where it matters for this mode.