MODIS Team Meeting Minutes

Minutes of the MODIS Team Meeting held on Tuesday March 28, 1995.

Action Items:

82. Work with the MODIS team to obtain a consensus on a revised MODIS crosstalk specification and provide inputs for a Configuration Change Request. Assigned to Ed Knight 12/14/93. Due 1/11/94 **Tabled on 2/ 1/94 until 8/ 1/94 Tabled on 8/ 2/94 until 2/ 2/95**

94. Provide a detailed (high fidelity) analysis of scatter in the scan cavity. The results would determine the need for PF near field scatter measurements vs scan angle. Assigned to Guenther 8/23/94 Preliminary results due 10/15/94. Final due 2/28/95. New due date 4/28/95

108. Prepare a report addressing the status of the MODIS Reliability Program. Reliability elements will include: FMEA, Worst Case, CIL, Reliability Assessment and Parts Device Stress Analysis and Trend Analysis. Assigned to Silva 1/ 3/94. Due 1/17/95

111. Recommend an optical design for the diffuser screen. Assigned to Waluschka 1/31/95. Due 2/28/95

112. Analyze the ScMA optical design. Assigned to Waluschka 1/31/95. Due 2/ 7/95

Attendees:

✓ Richard Weber	Bruce Guenther	✓ Larissa Graziani
✓ John Bauernschub	George Daelemans	✓ Bob Martineau
✓ Rosemary Vail	Patricia Weir	✓ Bob Silva
Lisa Shears	✓ Mitch Davis	✓ Robert Kiwak
✓ Mike Roberto	✓ Ken Anderson	Harvey Safren
Nelson Ferragut	✓ Rick Sabatino	✓ Ed Knight
✓ Gene Waluschka	Cherie Congedo	Harry Montgomery
✓ Bill Barnes	Jose Florez	✓ Marvin Maxwell
✓ Les Thompson	✓ Gerry Godden	✓ Bill Mocarsky
✓ John Bolton	✓ Sal Cicchelli	Helen Phillips
Pat Delosa		

The following items were distributed:

1) Weekly Status Report #182
2) SBRC Memos submission from week #174
3) Minutes of the previous team meeting

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MODIS Technical Weekly March 31, 1995

Sent out 3/30/95 at about 3:00 PM to MODIS.REVIEW

1. Summary

Any team member going to SBRC is required to submit a written trip report. I recommend the report be sent via email to Ken and me. You need to include any recommendation or suggestion made regarding MODIS, and if it was proposed by you or SBRC. The Engineering model is SBRC's call regarding testing and performance.

Remember, only Ken Anderson can give technical direction.

Larissa Graziani will be going to SBRC the middle of next week for MODIS Calibration Chamber (MCC) certification. One important item to be addressed is the criterion for passing certification. George Daelemans will be going to SBRC next week for preparations for the EM thermal vacuum test.

Gerry Godden presented results showing the components which contribute the most to in-field scatter (very small angles) based on a Breault analysis using BRDF data from OCLI on a dichroic witness sample. Dichroic 1 was the largest contributor for in-field scatter. Reflected light scatter from dichroic 1 is estimated by SBRC to have an equivalent RMS surface roughness of about 80 microns. The visible appearance of Dichroic 1 under a microscope indicates many scattering centers/pin holes. Dichroic 1 is regarded as by far the most complex optical element in MODIS.

This report includes comments from Tom Kampe on the following:

a) Filters 29 through 31 transmission 20 to 30 percent low. Cathy Peterson of Focal Plane Parts Division (FPPD) believes cleaning solution may have etched away germanium. Will try depositing germanium on several reject filters. Also will use MSAP to check effects of low transmission on system performance.

b) The issue of the consistent 10-20 nm shift in the MWIR filters center wavelengths is realistic.

c) Thick stack of IR materials make dichroic #1 the worst scatterer in the system. Possibly could use another material to reduce scatter.

May look into tradeoffs such as fewer layers at the expense of some reflectance and/or polarization in the VIS/NIR bands.

d) There is the question about what to do about the PFM dichroic assembly which is already mounted in the AOB.

Gerry Godden informed Breault Research Organization regarding SBRC BRDF Measurements of BS1/SN#2. Tom Pagano wrote up notes on the systems telecon. In a memo, Mitch Davis summarized the SAM grounding problems, and Bob Martineau provided focal plane assembly status. Bruce Guenther provided his MODIS Characterization Support Team (MCST) weekly.

2. Gene Waluschka (Message from Tom Kampe on MODIS Filters)

forward from Gene 3/29/95 at 12:49 PM of email from Tom Kampe 3/29/95 at 12:44 PM:

Tom Kampe's message:

Got your message yesterday. There are a number of issues surrounding MODIS filters. I'll give you a brief (maybe not so brief) rundown here:

1. LWIR filters, bands 27-31: these filters were procured from SBRC FPPD. Originally, the data provided with the filters indicated that transmissions were within specification. However, these measurements were done on witness coupons, not the actual filters. When we (Optics, Systems Division) made measurements on the filters themselves at 80K, we found the transmissions to be some 20-30% low. This didn't make sense and was the impetus to evaluate our test methodology, etc. (See PL3095-Q04751). The outcome is that the filters are measuring low in transmission and this is, most probably, due to processing differences between the filters and the witness samples.

The filters go through a dicing operation, photolithography, and Dark Mirror deposition while the witness samples do not. Cathy Petersen from the FPPD Coating Lab feels that she has identified the problem. The filters are placed in a cleaning solution after photolithography, prior to dark mirror coating. If the filters are

in this solution too long, germanium in the top coating layer will etch off. Validating this using the Coating design software indicates that etching around 200 angstroms from the top layer will cause the problem (drop in transmission) we are seeing. The obvious question is "Why were they left in solution too long!". I'll get back to you on this. This discovery took place yesterday, so its still a little premature to assume all questions have been answered.

Today, Cathy will be putting several reject filters into the coating chamber and redepositing 200 angstroms of germanium. The transmission of these filters will then be remeasured to see if there is a significant improvement. I'll keep you posted. If we can correct the problem, one option will be to return the delivered filters and have a thin layer of Ge deposited on them. I still need to look at yield issues, long-term survivability issues, etc.

At the same time, we are folding in all the measured and predicted transmission data for PFM filters and lens and doing an end-to-end transmission and SNR evaluation of the MODIS system using MSAP. Possibly, we can live with the current transmissions - we'll see. This should be done by the end of the week.

2.) SW/MWIR filters: All filters are now in house. The band 5-6 filters look very good, both spectrally and physically. The issue of the consistent 10-20 nm shift in the MWIR filters center wavelengths is realistic. We have validated our test setup and are confident that the filters are being measured at the correct temperature. The waiver submitted should be evaluated as it stands.

My feeling is that the filters in hand should be used for PFM - any consideration for replacing the filters should be deferred to FM1 and beyond (assuming the science community can live with this). I plan to build the PFM SW/MWIR filter Assembly as it now stands.

3.) Dichroic Beamsplitter #1 (BS1): the BRDF measurements on this part indicate that the scatter is quite high (~80 angstroms RMS). Breault's analysis tends to confirm that this component is the most significant contributor to scatter in the system. Representatives from OCLI were in yesterday and we discussed the possible root cause for the scatter. No unexpected information here. Basically, they confirm our feelings that the scatter is due to thick stack of IR materials (ThF4 and ZnS) used for the IR regions. Ion Assisted Deposition (IAD) is not a viable option to improve the packing density for IR materials - in fact, OCLI's experience is that coatings deposited with IAD exhibit higher scatter and absorption than conventionally deposited coatings (A good point to remember). They do not feel that the scatter can be traced to the surface roughness of the substrate.

What can be done to improve the situation?

o One thing OCLI will do is to measure BRDF on IR coatings (another dichroic) in which an alternate material was used in place of the ThF4. Bill Kastanis, IR Products Product Manager, felt that some improvement may be possible with this alternate material. I'll let you know where this goes.

o An interesting point that I want to get to the bottom of is the fact that the scatter off Dichroic #3 is significantly less than that from BS1. BS3 uses far fewer layers (~17 vs. maybe 70 for BS1), however the layers are much thicker. The total thickness of the layers may be almost equivalent. BS1 does have many more interfaces, and this may be the root of the problem. One thing I need to confirm is whether the same materials were used for both coatings - Bill was unclear whether Ge was used for the high index material on BS3 in place of ZnS. This could also be significant. We'll do a visual inspection of BS3 (if we can't see through the coating and it looks metallic, it would imply that Ge was used) - OCLI will also provides feedback. We'll keep you posted.

o My feeling is that we'll need to start looking at performance tradeoffs soon - can we sacrifice some polarization and/or reflectance in the VIS/NIR bands at the expense of reducing the number of layers used in BS1? I am also proposing that near-field response tests be done at the sub-system level. I want to

measure the VIS objective as a stand-alone assembly and then place the BS1 in front of it and measure the difference. I want experimental verification that this is the source of the problem. I'll do my best to push this through.

o Finally, I have the issue of where to go with PFM. Realize that the Dichroic Assembly for PFM is already complete and mounted on the AOB. Do we move forward with this or hold things back until all issues are resolved with the dichroic scatter. Assumably, if we continue on our present course, PFM will exhibit the same level of near-field scatter as observed on EM. This is something we will be discussing with the Program Office and Systems Engineering early next week.

Obviously, there's plenty to keep us occupied out here. Disseminate this information as you see fit - most of it will be covered in "official" memo to be published soon. Call if you have any questions or concerns...

3. Gerry Godden (Copy of Message to Breault Research Organization regarding SBRC BRDF Measurements of BS1/SN#2)

Email from Gerry Godden on 3/29/95 at 2:52 PM. Excerpt from message from Gerry to Danny Milsom at Breault on 3/29/95 at 14:45:

I just heard from Jim Young at SBRC regarding their recent BRDF measurement of BS1/SN#2. This is a flight-like element, not a witness sample. As a matter of fact it was probably intended for the Protoflight Model which will become Flight Model #1 (aka AM-1). Jim said there was no significant difference in the magnitude of the scatter compared with the witness sample measurement data you already have. He did indicate that there were differences between the two sides of normal scans, but not a serious difference. His H.S. fit to these data results in ~18 (amplitude), -2.2 (slope). After their discussions with OCLI yesterday regarding improvement strategies, he offered that they might be able to improve the amplitude.

4. Systems Telecon on March 27, 1995

Email from Tom Pagano on 3/27/95 at 11:31 PM:

Tom: Performed SIS tests with preset gains. Data looks good. We've recalculated the gains and have uploaded them and are taking data now. BCS data acquired and looks good for the PC bands, but not much signal in the MWIR. We are reloading C-sub and will re-take the data. Spatial data being acquired. Working well. We will acquire a complete set over the next couple nights.

Neil. Took out-of-band on all bands in ambient. Also acquired normalization set. Normalization set being reduced today. We learned that the IR data was not acquired with the chopper on. We will repeat the IR bands probably tonight.

Barnes: Read that you were getting low SNRs on the reference detector. Was this true?

Jim. Believe Sam was referring to in-band measurements.

Ed. Believe out-of-band depended on getting the c-sub working.

Neil. Yes; its working, we are learning more about it every day. We're starting to print out the radiative cooler stages which are instrument with temperature sensors. We believe the ambient room temperature is affecting our background. The room is warmer in the MCC area than the Hi-bay. We're now getting the room to run colder. Some of the bands we couldn't even bring out of saturation. Plan is to get the room temperature down and monitor the stage temperatures. We'd like to look into instrumenting the stages on PFM at some cooler temperature.

Barnes. A thermoelectric type cooler?

Neil. Yes

Koch. Also determining the detector stability has a high effect.

Neil. Another variable is the leakage current in the detector which is a function of the FPA. Data at 85K not an optimum situation primarily in the LWIR bands.

Tom. Taking some ambient acceptance testing at 82K. The BTC has good stability.

Barnes. What is the lowest temperature you could achieve?

Neil.. About 82K. We achieved 81K in the hi-bay.

Barnes. It sounds like C-sub not working effectively.

Tom. C-sub working, but the some bands have just too much backgrounds.

Koch. We're taking spatial, spectral and radiometric data this week. We install windows in the chamber and take data next week.

Ed. When do we perform T/V tests?

Koch. Some time around the 8th or 9th of April.

Young. Last week we said it looked as if the data implicated the dichroic number 1. I think that still remains the case. Subsequently we looked at some of the data outside of the intermediate field baffle and we do have a scattering level there also. That level is an order of 10 to 20 times less than within the confines of the field baffle.

Young. We've also looked at the IR data. We should have had a radiation chopper in between the ScMA and the source so we could modulate the energy to reduce the effects of temperature gradients in the structure. What we are seeing is in the near field (0 pixels to 60 pixels) there is a temperature gradient of the order of 3 to 7 degrees. That makes the data non-usable.

Barnes. Can you retrofit the ScMA?

Young. Yes we will for PFM. We are also looking at using the IAC for EM T/V measurements. I would expect we will be able to get some of that kind of data.

Young. Measurements of dichroic 1 match the data results we're seeing. Went out 7 km from the peak and pulled off the response value for all VIS and NIR. Appears to drop off with wavelength in both regions. Each FPA starts at about the same level.

Barnes. Both FPAs start at the same level is strange?

Young. Getting much better data than we ever thought we would from the ScMA tests.

Godden. One FPA is transmission, the other reflection; there may be some compensation.

Roberto. Thermistor for the solar diffuser. I read Al's comments that the thermistor was removed.

Tom. I didn't sign the specification.

Roberto. We got the spec today and I talked with Daelemans today. He will check to see if the thermistors he has have similar specifications. We should known soon. It looks like the specification is standard. We can see if we can get some shipped out right away?

Tom. Please do that.

Roberto. QMR went well. Comments will be sent soon.

Barnes. Lee did so good we're going to let him do it every time.

Godden. Scan mirror witness samples received today. Sending them out to Lincoln labs for measurement. Got the disk from T. Kampe on the recently measured scatter data. Used the scatter data for dichroic 1 and asked Breault to run the APART model for the dichroic 1 scatter model. Asked him to reduce it by a factor of 4 and a factor of 2.

First number is amplitude, second is slope. 1st Run . 24, -2.5 Contribution. 91% at 0.61#161#, 84% at 0.4#161#, 2.1e3 power at 0.16#161# 2nd Run 6, -2.5, 0.61#161# 72%, 0.4#161# 67%, 6.6e2 at 0.16#161# 3rd Run 1, -2.5, 0.16#161# BS1 30%, NIR element 2 surface 1 34%, NIR element 2 surface 2 38.1%. Total power 2.1e2

Barnes. We're running as measured, and trying to determine what the scatter would look like if we had a better dichroic.

Godden: Outside the field stop we have 56% SMA, 22% fold 21% pri 0.15% BS. Dichroic worst. The next worst element in the IR channels is element number 2. Our guess is you could improve by a factor of two, and that decrease correlates approximately to the amplitude decreasing by a factor of 4.

Young. We are meeting with OCLI tomorrow to discuss how they could manufacture dichroic 1 a little better.

Godden. Suggest you explore making the transition less sharp.

Young. We are trying to get a feel at what king of parameters we can trade off.

Tim. Could you send the update on the plot vs scan angle. Can't get it to plot.

Tom. Try deleting additional tabs.

Tim .Do you know why the data didn't roll off beyond 60#161#?

Tom. We'd have to look at the geometry.

Tim. Not a critical item. If you have any data we don't have I'd like to see it.

Neil. I'll look.

Ed. If you have band 32 we'd like to get a copy of it.

Ed. In February you had risk reduction review.

Jim. I wrote up a memo on how to spectrally calibrate the SRCA using method of least squares. I have not seen any other formal documentation.

Tom. Do you have the view graphs from the review.

Ed. No

Tom. I'll see if we can get a PL number put on that.

Ed. Calibrating the fire bands. We will use the IAC bb?

Jim. Yes

Ed. I was unable to find the memo where you define how you're planning on doing that.

Jim. I have a matched model and have put the measurement methodology in words. This one would be earlier than that. Cross calibrate the IAC at 350K.

Ed. Do you have an error estimate for the IAC?

Jim. Yes we have not written it up.

Bruce. Yoram wants to know if the IAC is any good for calibrating the fire band.

Jim. I thought we should meet that.

Ed. We're looking at changing the start stop sectors.

Tom. Probably should talk to Weber about having our electronics folks look at it. There is scientific basis for wanting this and it requires software modifications.

Neil. If you significantly alter the start stop values in the tables, you

start running into flight software modifications.

Ed. MWIR filters. We did not get any progress on the deviation waiver.

Jim. There is a memo that summarizes the waiver. It had bands 27-36.

Barnes. What about 20 - 25?

Tom. I believe they were measured at the right temperature.

Tom. It is extremely exciting to look at the instrument and collect quality data.

Jim. There is progress.

Koch. We're processing about a gigabyte of data per day.

5. Mitch Davis (Summary of SAM Grounding Problems)

In a memo with the above title and dated March 27, Mitch Davis has summarized the grounding problems and solutions with the Space view Analog Module (SAM) in the MODIS Engineering Model (EM) instrument. The two main problems were coherent noise and the "missing codes" problem. The following contains excerpts and summarizes Mitch's memo:

a) Coherent Noise

The inductor/capacitor combination of the six SAM cards created an oscillator which required more than one card to oscillate. For the EM, the solution was to an a 6.8 ohm damping resistor across the inductor. For the PFM, it will be determined if the inductor is necessary. It was there to limit in rush current.

b) "Missing Codes"

For the "missing codes" problem, certain digital codes never occur when the analog input covers the entire span. The cause was digital switching currents offsetting the analog reference at the Analog to Digital Converter (ADC). The missing codes were always the same. Location and magnitude of missing codes depended on how many higher order bits were transitioning.

For the CLK_BIAS/ACE card, the analog ground to digital ground connection was removed at the ADC and reconnected at the card input connector. This got the missing codes down to 1 bit.

The same correction was applied to the ACE/ACE card, but the missing codes were still far from specification. Digital +5 volt power and ground of the ADC were replaced with analog +5 volt power and ground, reducing the missing ACE/ACE codes to an occasional 1 bit.

Analog ground impedance on the ACE/ACE board was measured and found to be very high (several milliohms). The ground plane is actually a ground grid. A heavy wire was run in parallel to the ground plane from the input connector to the ADC (ADC digital input power and ground may have been reconnected to digital supply) and the missing code remained an occasional 1 bit.

The missing codes problem was not found at card level since card test unit does not accurately simulate instrument cable impedance. Test procedures should be changed to test for missing codes on the PFM SAM box assembly. It is very important to verify the new SAM layout in the instrument. One possibility, as mentioned by an SBRC design engineer, would be to install one copy of the PFM layouts (CLK_BIAS/ACE and ACE/ACE cards) in the EM instrument after thermal vacuum testing and before the instrument is disassembled.

6. Bob Martineau (Latest Telecon Info on Filter/Bezel Asys and FPA Deliveries)

Email from Bob on 3/28/95 at 3:17 PM:

1) Delivery date of the PF LWIR FPA has slipped from April 24 to April 29, if the LWIR filter assembly is received by April 14. The filters have trouble with filter transmission which is too low in all bands, particularly Band 27, band widths which are off, and center wavelengths which are off. I had been told of a filter mask problem before, which doesn't seem to be a problem now, but this is the first I hear of problems with the spectral quality of the filter.

2) Delivery date of the PF SMWIR FPA has slipped from April 7 to April 21, if the SMWIR filter assembly is received by April 7. I do not know what the problem is with these filter. I was directed to Gene Waluschka for information since he was tracking this problem. Joe Banach said there was a memo #PF 3095-Q04751 that Gene would have describing the problem.

3) These two FPAs are on the critical path for building the Rad cooler. SBRC expects the filter issue to be resolved with GSFC concurrence on use.

7. Bruce Guenther (MCST Weekly Newsletter)

Email from Bruce Guenther on 3/30/95 at 10:00 AM:

ALGORITHM

Marghi Hopkins, the MCST Level 1B Systems Engineer, conducted the Level 1B System Requirements Review on 23 March. It was attended by 25 people, including representatives of the land, oceans, atmosphere and cryosphere teams of the MODIS Science Team. The Review progressed well, and a number of very useful comments were provided to us. There were no "show-stoppers" in the questions and comments. Thank you for your participation in this Review.

A final draft Algorithm Theoretical Basis Document ('94) is in circulation internally to MCST for final-final comments. These comments will be incorporated into the prose version of the document which will be released on Friday, April 7. This draft has been delivered electronically to David Herring, and he has rehosted it onto the "stealth" WWW, and recovered it. We now know it can be easily put onto the Web when we release it. Bill Barnes, the VIRS sensor scientist, has been using this ATBD to assist him in developing the calibration algorithms for the VIRS sensor.

SENSOR

We have forwarded two witness samples from the scan mirror to Lincoln Labs for their measurements of the IR reflectance as a function of scan angle.

Our Breault computer analysis of the MODIS near-field scatter has been temporally halted while we await another SBRC measurement of the dichroic #1, probably from the article slated to be flown on PFM.

FLIGHT OPERATIONS

On 3/23/95, Ed Knight and Kirsten Parker met with Jeff Kronenwetter, Debbie Ramey, Dave Folta, and representatives of the Flight Dynamics Facility to review the MODIS Planning Aid Requirements. Accuracies were clarified and some minor aids dropped. Requirements for access to the Engineering Data and subsequent processing in the TLCF were reviewed later.

ADMINISTRATIVE

The MCST is under going a Program Review by the Laboratory for Terrestrial Physics on Tuesday and Wednesday next week.. The Team has been involved in extensive preparations this week for the Review. The Tuesday Meeting is an open meeting, and will take place at the GSC MODIS Support Office beginning at 8:30. This Office is located at 7501 Forbes Blvd., GREENBELT.

Mike Roberto

March 31, 1995