Alcator C-Mod Trip Report (March 9-12, 2011)

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I visited Alcator C-Mod for 3 days last week, following the FESAC meeting in DC. The purpose of the visit was to get re-integrated into the experiments, renew my computer and facility access, look at C-Mod data during the run, prepare FWP's, and discuss plans with my colleague Jim Terry for IR measurements, both at C-Mod, and someday at W7X.

The present IR system consists of a FLIR Titanium 550M camera with fiber-optic gigabit Ethernet interface, a cooled magnetically shielded housing, a custom 5-meter long IR periscope firmly attached to the C-Mod concrete shielding igloo, and a stainless steel viewing mirror inside of the vessel. In addition, the area viewed around the divertor has specially instrumented tiles (embedded thermocouples) to allow calibration of the images. One set of tiles is specially tilted, to intercept un-shadowed incident plasma fluxes. This system has proven invaluable in the recent study of scrape-off layer scaling with plasma current (B. LaBombard, et al, "Scaling of the power exhaust channel in Alcator C-Mod, PSFC/JA-10-56).

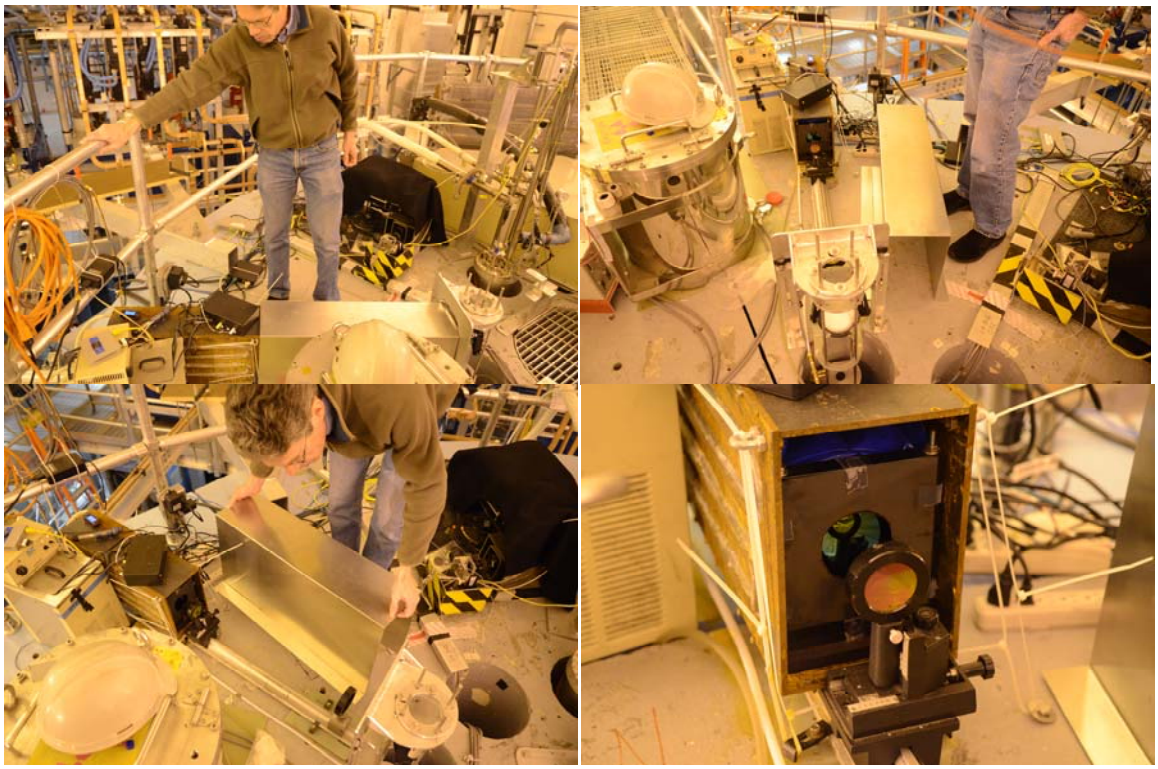

Fig. 1 Jim Terry on top of Alcator C-Mod, removing the protective cover in front of the IR camera. The IR periscope is largely hidden, diving down into the igloo. The iron shielding is cooled with a chiller, and blue freezer packs conduct heat away from the camera body itself.

Because the divertor tiles are viewed at different angles, and because of coatings that can develop on the tiles (from boronization, for example), the emissivity of the tiles is not constant. Hence, to calculate

the actual tile temperatures, it is useful to monitor the temperatures late in time with thermocouples, thereby allowing regular cross-checking of the “IR surface temperature” to the bulk tile temperature.

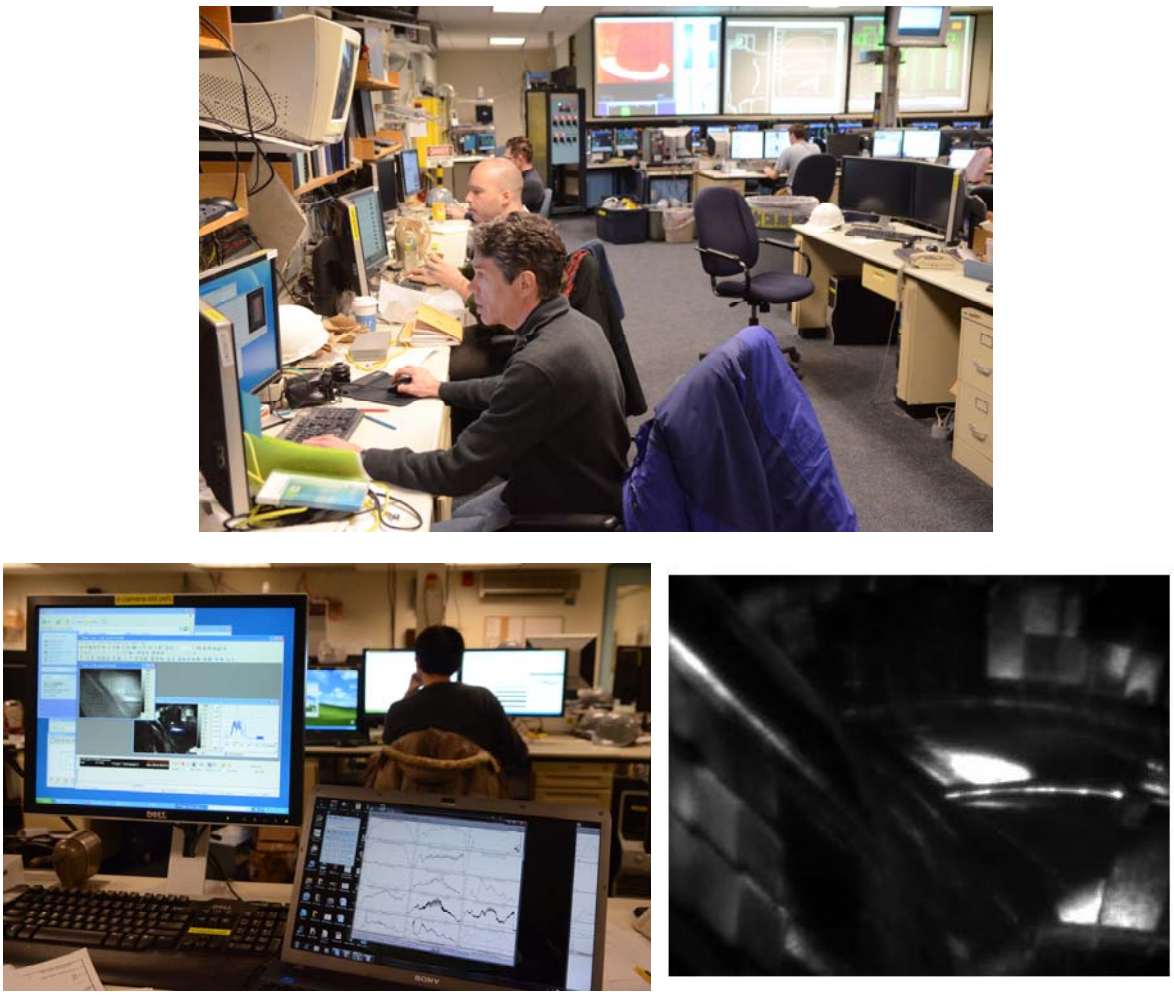

Figure 2. Looking at IR data and shots in the C-Mod control room.

Presently, about 185Mb of 12-bit image data is obtained per shot. We post-shot process (up to 10 minutes worth) the data to remove frame-to-frame shaking from the images (the vessel moves with respect to the igloo), and then apply calibrations, and then generate time-history temperature plots of interesting features. The raised tile routinely experiences ~1000 ˚C temperature increases.

Our challenge in the near future is to be able to process real-time video data streams fast enough to be able to make rapid decisions for machine protection, in eventual long pulse superconducting experiments.