Ultracam Optics

- The design of the optics for Ultracam were driven by the following requirements:

    - The instrument is to be used on the WHT, Aristarchos and the Liverpool telescope, and any other broadly similar telescope, with only a change of collimator.
    - The field is to be at least 5 arc minutes square.
    - There are to be three colour bands in use at any one time with as high a throughput in each band as possible. The bands being the following pass bands of the SDSS filter set: u', g', r' and i'. The last two filters are to be interchanged in the red arm camera.
    - The pixel scale is to be matched to the seeing of 0.35''.

Basic camera design

- The three cameras are based upon a four element double Gauss type lens, with two glass types per camera to keep the cost within bounds. The performance of the cameras is quite typical of their type.

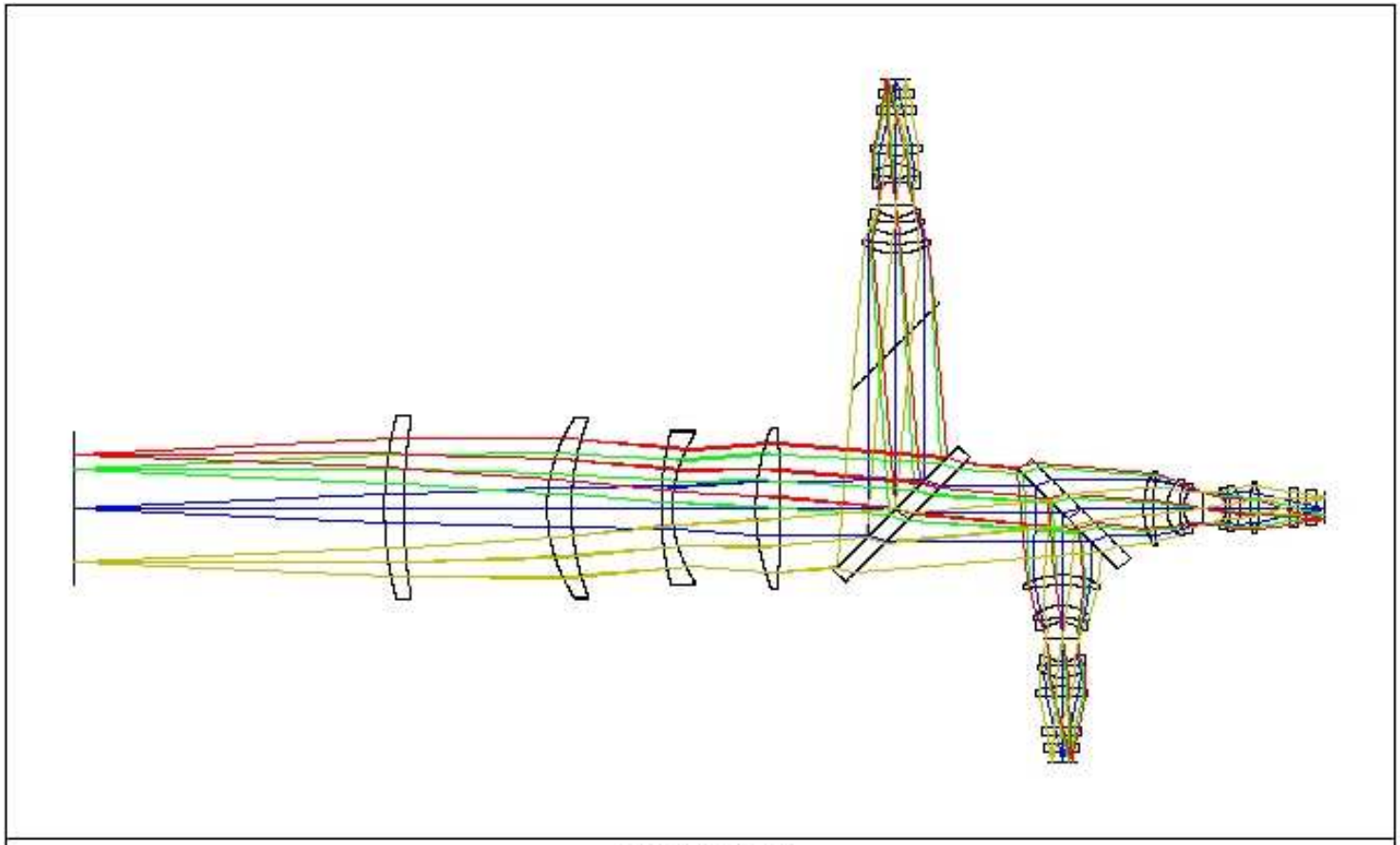
- The glass thickness has had to be kept to a minimum, particularly within the u' camera, to keep the throughput as high as possible.

- The cameras were optimised for an infinite object distance with a field angle dictated by the required field size on the WHT and the need for the telescope pupil to be re-imaged onto the camera 'stop' by the collimator at sufficient distance from the last surface of the collimator that the dichroics could be placed between collimator and camera.

- Filters are placed between the last surface of the camera lens and the window into the evacuated enclosure of the CCD.

The collimator

- The preliminary design of the collimator was a Petzval lens with the very remote re-imaged pupil.
- This preliminary design was optimised between the telescope and the three cameras simultaneously. The resulting lens was a compromise between the requirements for imaging quality, through put and the manufacturers requirements.
- It has to attempt to keep the effects of chromatic aberration between 320nm and 900nm within reasonable bounds whilst transmitting well in the u' band. This restricts the available glasses considerably and only N-PSK3, LLF1 and CaF2 were used in the four element design.



3D LAYOUT

ULTRACAM SYSTEM.
TUE MAY 15 2001

UK ASTRONOMY TECHNOLOGY CENTRE
THE ROYAL OBSERVATORY
EDINBURGH EH9 3HJ

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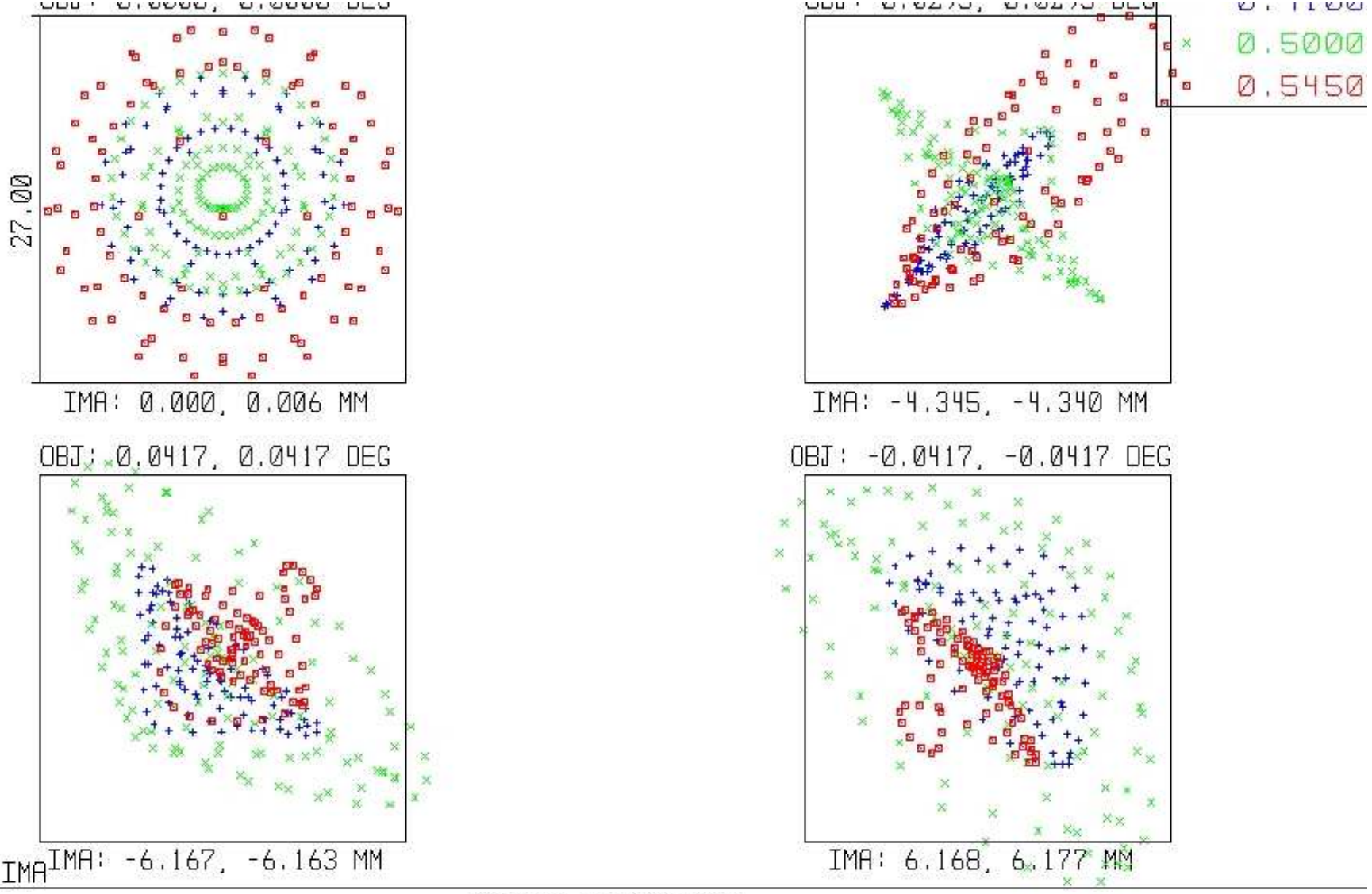
CONFIGURATION: ALL 4



SURFACE: IMA

SPOT DIAGRAM

ULTRACAM ON THE WHT
TUE MAY 15 2001 UNITS ARE MICRONS.

FIELD	:	1	2	3	4
RMS RADIUS	:	7.876	6.323	7.396	8.150
GEO RADIUS	:	13.133	17.601	17.512	18.489
BOX WIDTH	:	27		REFERENCE	: CENTROID

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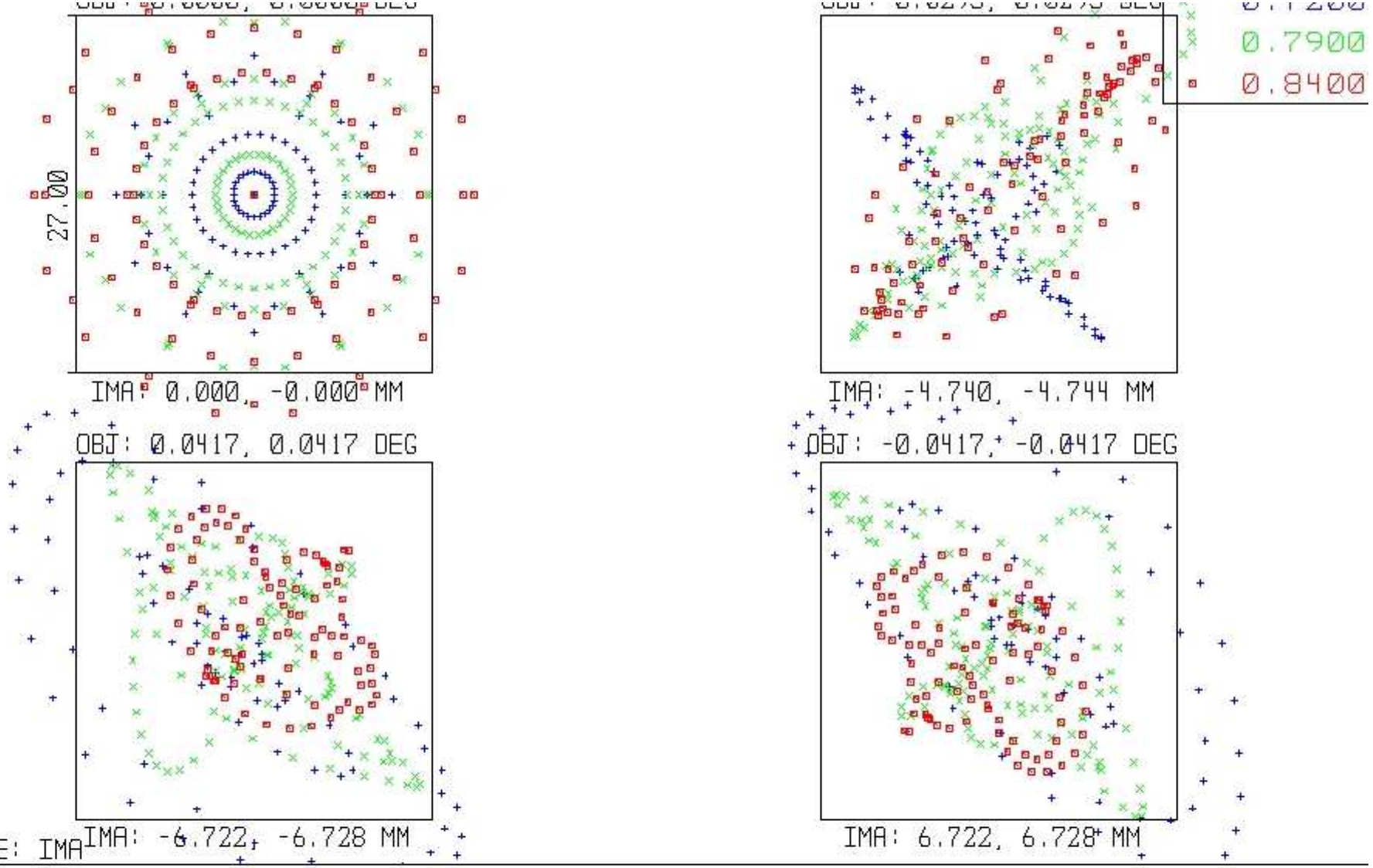
CONFIGURATION 1 OF 4



SPOT DIAGRAM

ULTRACAM ON THE WHT
TUE MAY 15 2001 UNITS ARE MICRONS.

FIELD	:	1	2	3	4
RMS RADIUS	:	9.498	8.804	10.054	10.054
GEO RADIUS	:	16.732	20.178	23.539	23.539

BOX WIDTH : 27 REFERENCE : CENTROID

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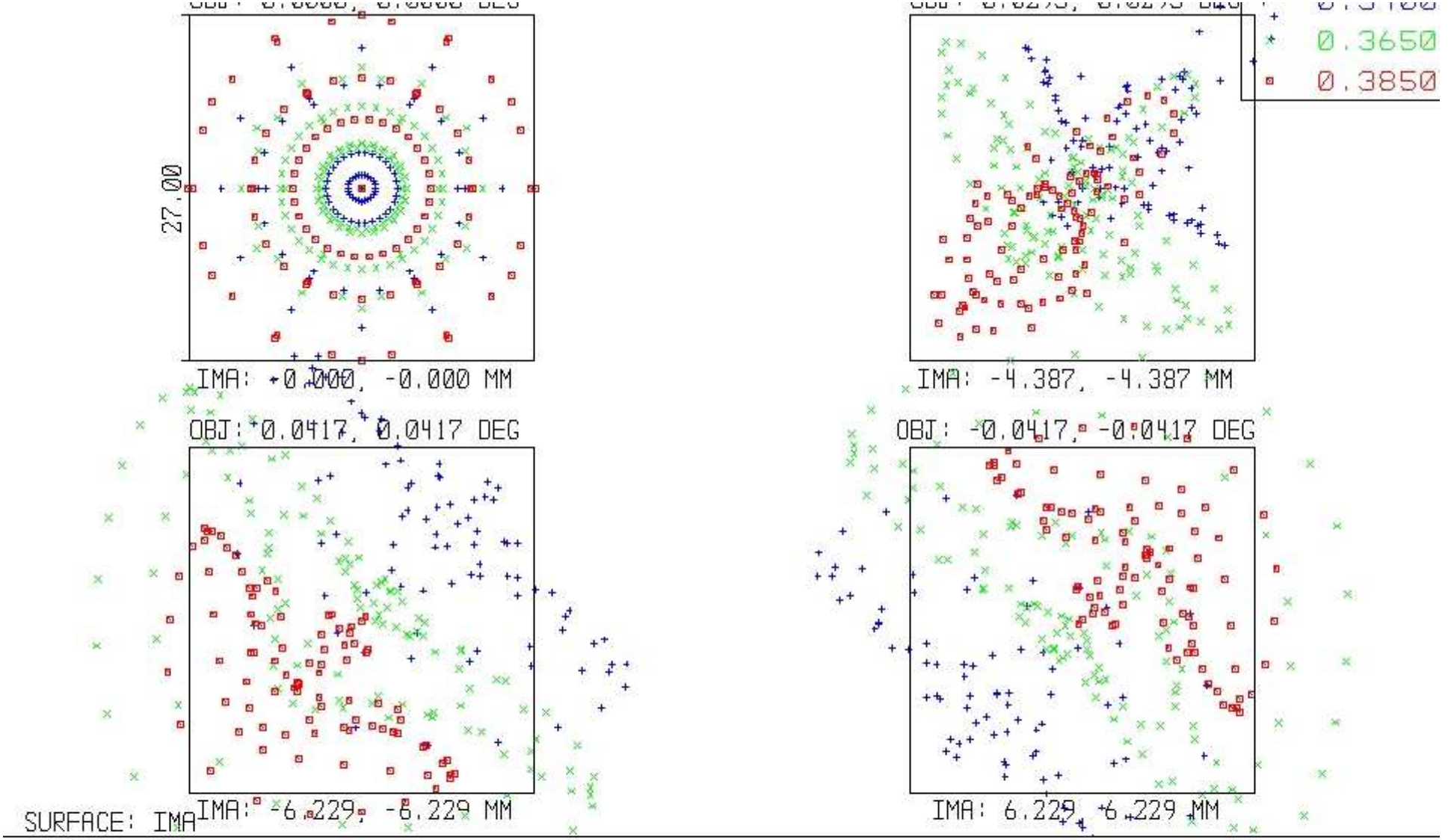
CONFIGURATION 4 OF 4



SPOT DIAGRAM

ULTRACAM ON THE WHT
TUE MAY 15 2001 UNITS ARE MICRONS.

FIELD	:	1	2	3	4
RMS RADIUS	:	7.271	8.272	12.752	12.752
GEO RADIUS	:	13.532	20.330	23.318	23.318

BOX WIDTH : 27 REFERENCE : CENTROID

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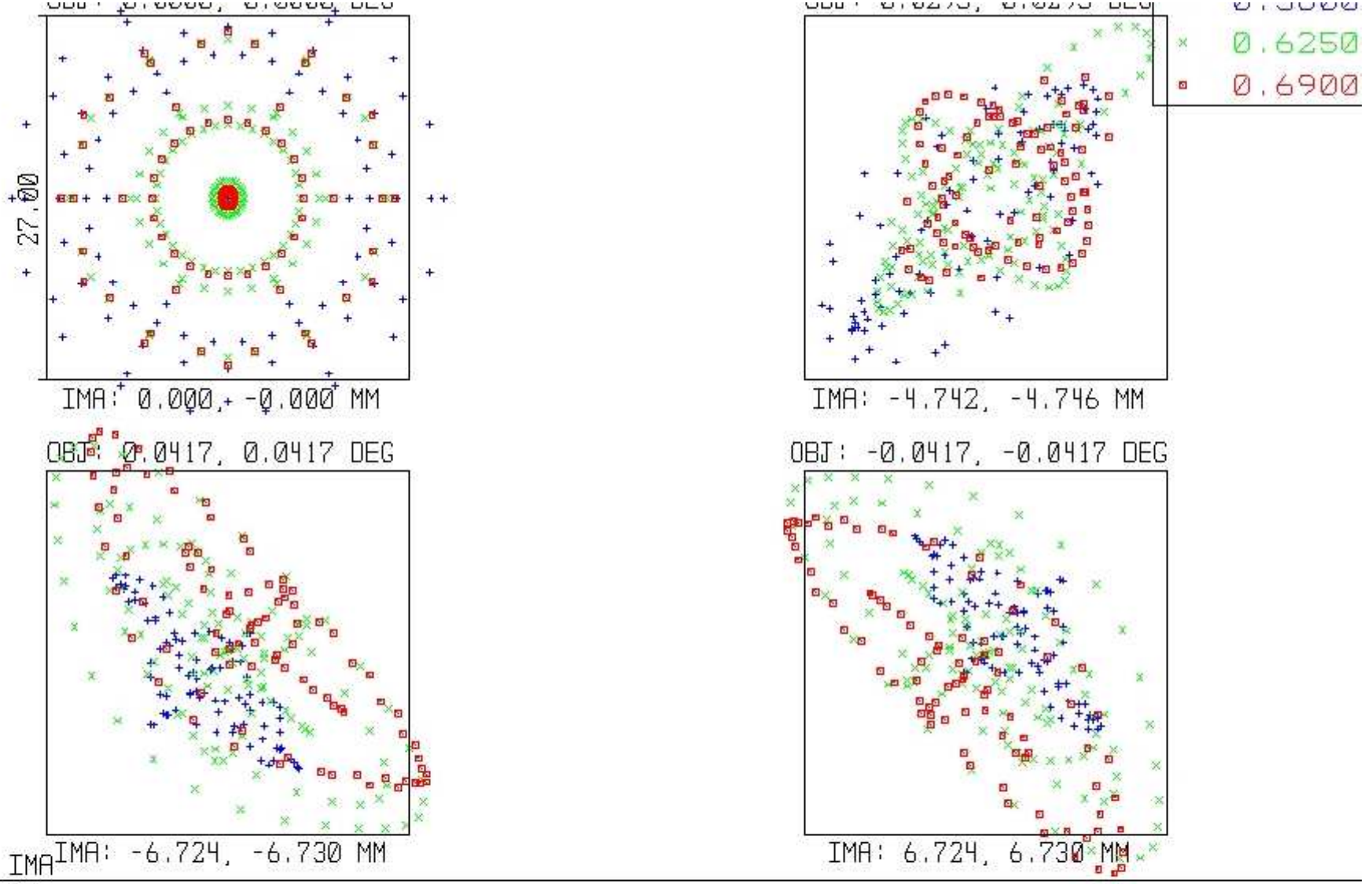
CONFIGURATION 3 OF 4



SURFACE: IMA

SPOT DIAGRAM

ULTRACAM ON THE WHT
TUE MAY 15 2001 UNITS ARE MICRONS.

FIELD	:	1	2	3	4
RMS RADIUS	:	9.363	7.751	9.006	9.006
GEO RADIUS	:	16.070	17.076	19.059	19.059
BOX WIDTH	:	27		REFERENCE	: CENTROID

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CONFIGURATION 2 OF 4