RVS Consortium Review

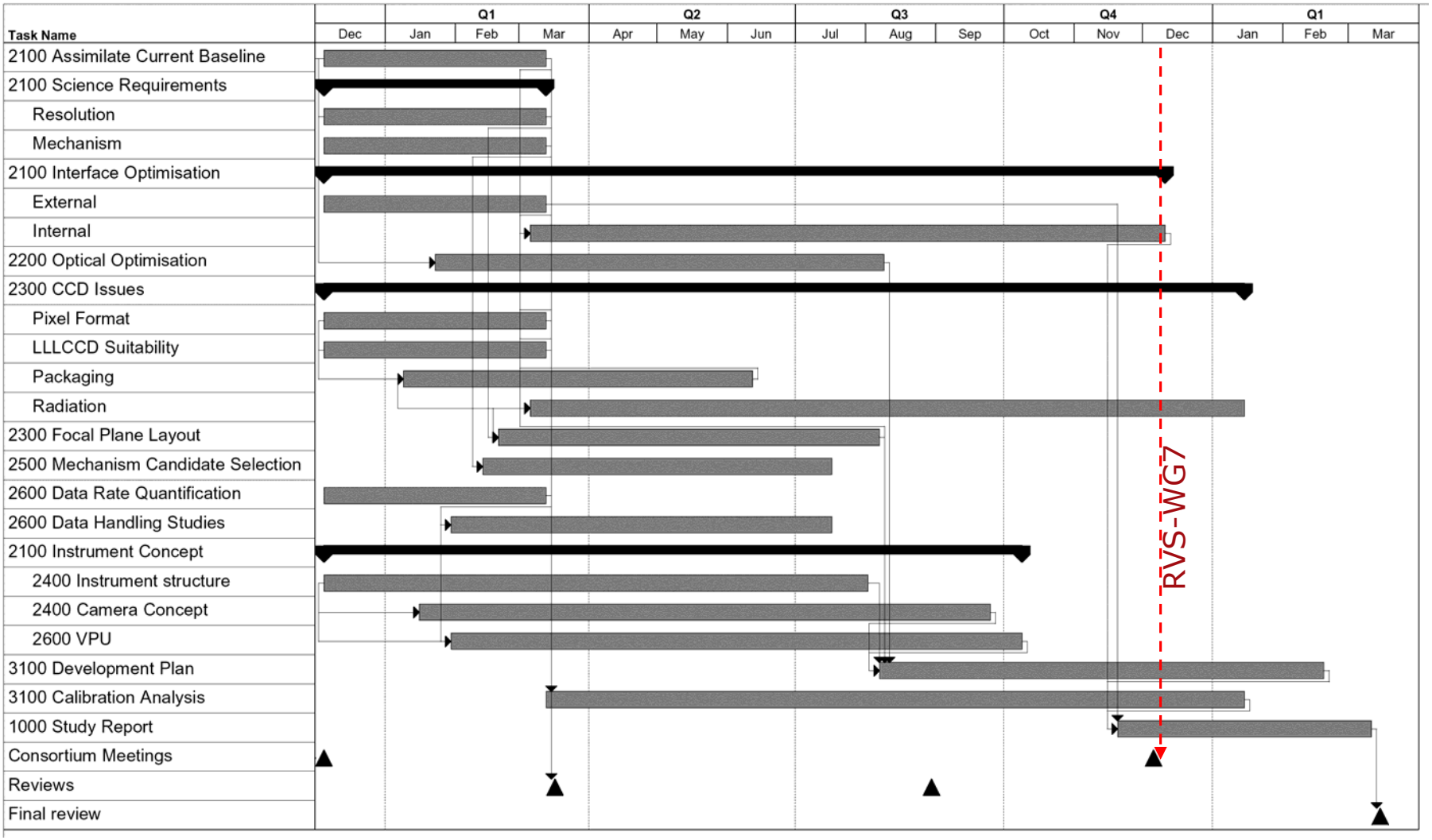
RVS-WG 8, Padua

Mark Cropper & RVS Consortium

Main milestones since RVS-WG7 (December 2003)

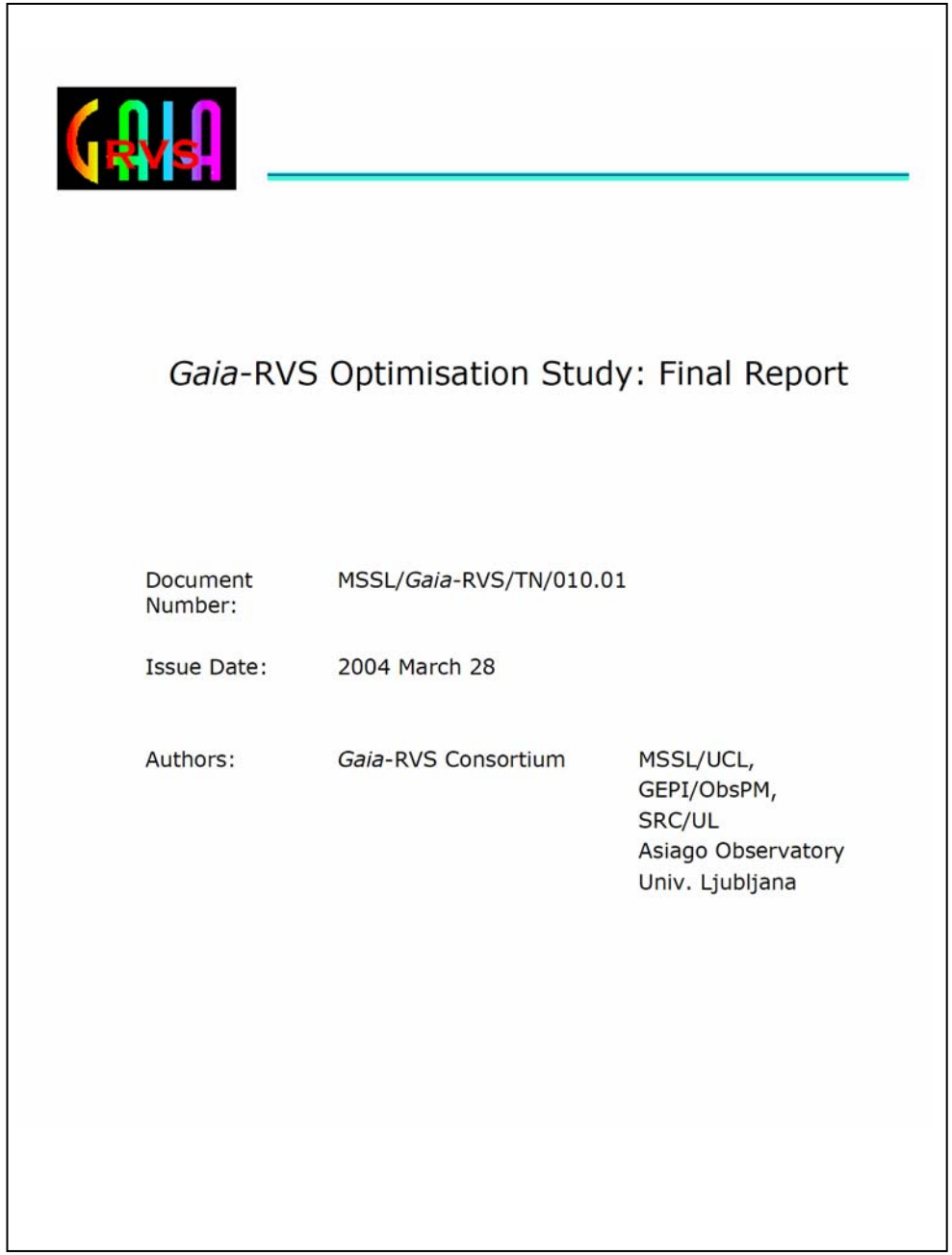
- Changes to both Alenia/Alcatel and Astrium payloads at end of 2003 allowed adoption of Offner relay design suggested by RVS Consortium
- Q1 2004 concerned with adjusting to new baseline
- March: ESA revises MBP layout with implications for RVS focal plane
- March 2004: final report and final review for Technical Assistance Phase (=Phase A).
- Discussions with ESA for continuing Consortium activities during Definition Phase (=Phase B1); funding agreed
- Proposal to UK funding agencies; funding approved
- Activities addressing Final Report actions
- February: meeting with Astrium to discuss their new spectro layout
- February and April: meetings with Alenia/Alcatel to discuss their new spectro layout.

TA Study schedule



RVS TA Phase Final Report

- final report encapsulated all of the TA phase work
- substantial body of work ~150 pages
- Presentation given on 31 March to ESA at ESTEC.
- Reduced final reports sent to industry teams (issues of confidentiality)



Gaia-RVS Optimisation Study: Final Report

Document Number:	MSSL/*Gaia*-RVS/TN/010.01	
Issue Date:	2004 March 28	
Authors:	*Gaia*-RVS Consortium	MSSL/UCL, GEPI/ObsPM, SRC/UL Asiago Observatory Univ. Ljubljana

ESA Contractural Situation

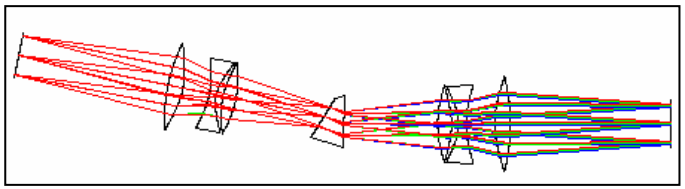
- Funding offered from ESA to continue RVS Consortium role during Development Phase
- Full study – main workpackages:
  1. overall system-level definition
  2. Proximity electronics development
  3. Data handling algorithms
  4. L3CCD proving
  5. Interfaces/budgets
- Consortium structure to continue as before except that Leicester University participation (Andrew Holland) moved to Brunel University (CCD workpackages)
- Some commonality sought for proximity electronics with *Eddington* electronics chain studies at MSSL
- Proposal to be submitted to ESA shortly

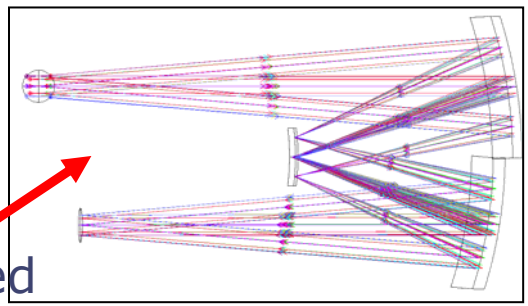
UK Funding Status

- Resources required to support the Definition Study exceed that available in ESA contract (as with TA-phase work)
- Underpinning resources bid for through UK research council (PPARC) for work at MSSL/UCL and Brunel
- Funding recently approved (~550kE) subject to formal notification
- Workpackages include all aspects of system development
    1. management
    2. system engineering
    3. optical engineering
    4. detector engineering
    5. mechanical and thermal system engineering
    6. data handling system
    7. AIV and calibration
- Funding formally commences 1 July for 18 months.

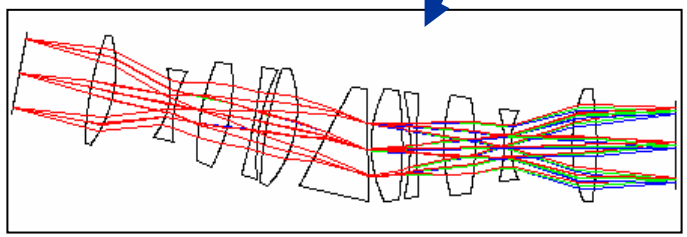
Optics (ObsPM)

- Four systems were studied





selected



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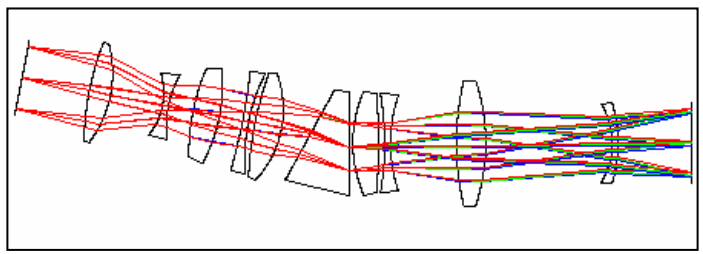
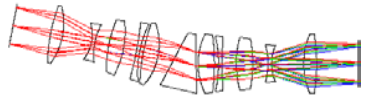


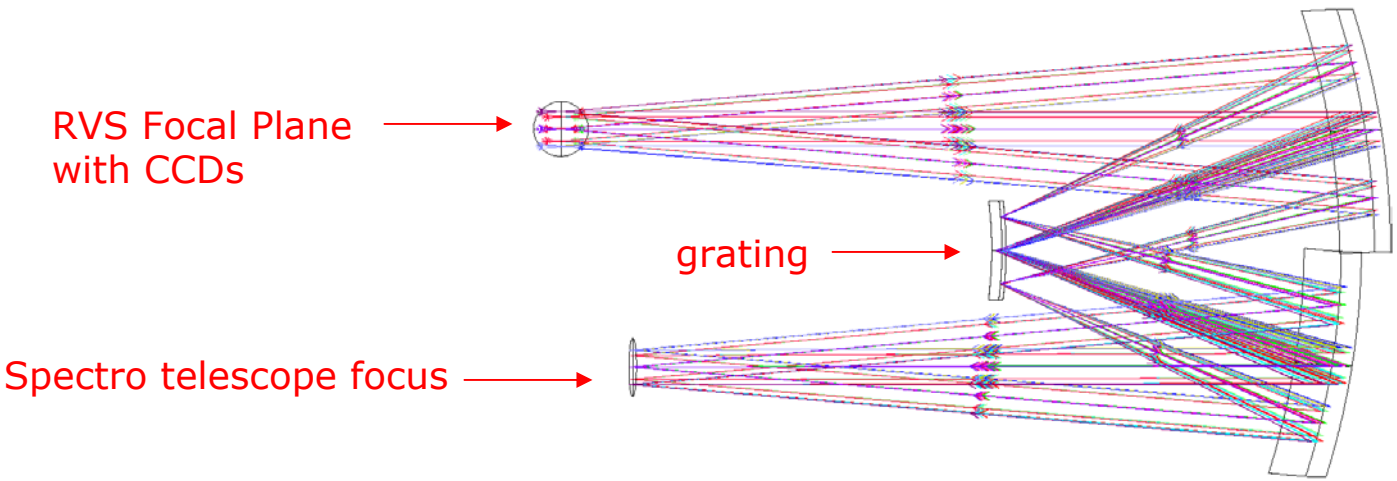
- They were compared in terms of
  - Optical quality
  - Feasibility
  - Volume and mass
  - Ease of alignment

Optics (ObsPM)

- Tolerancing completed on dioptric system



- Offner advantages:
  throughput, simplicity, all-reflecting, materials selection

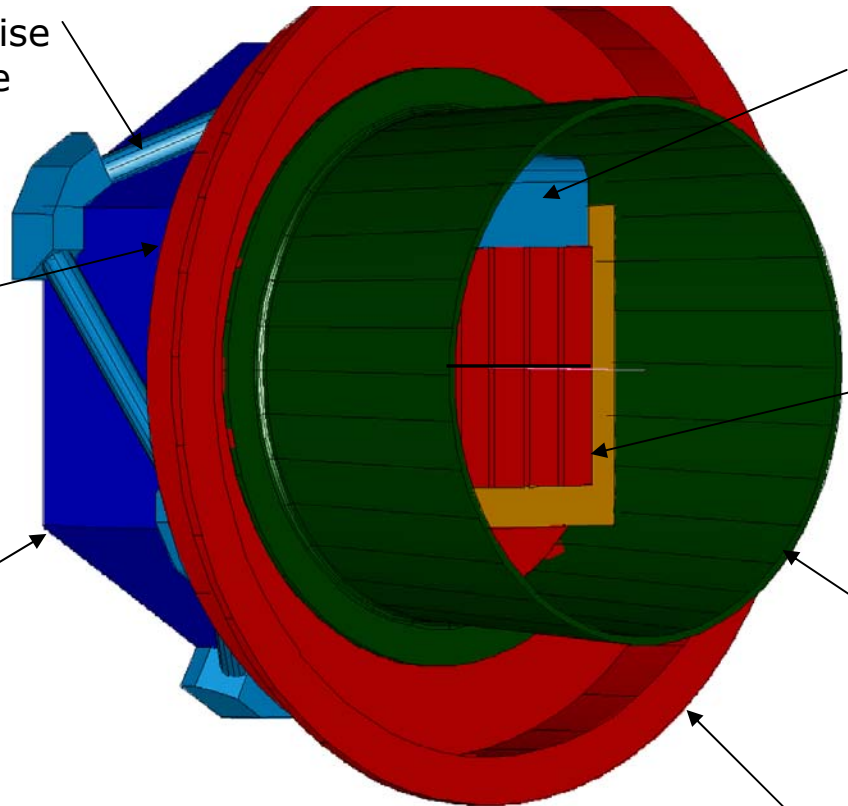


- Optical performance of Offner system investigated – good
- Optimisation and tolerancing for Astrium layout in progress
- Optimisation for Alenia/Alcatel system soon to start

Focal Plane and Proximity Electronics

Thin wall tubular struts supporting PE/REU electronics to minimise thermal conductance

Flex circuit from CCDs to connectors to PE electronics (connectors mounted on Detector mounting can).



MLI positioned between Detector mounting can and PE/REU electronics

CCD assy.

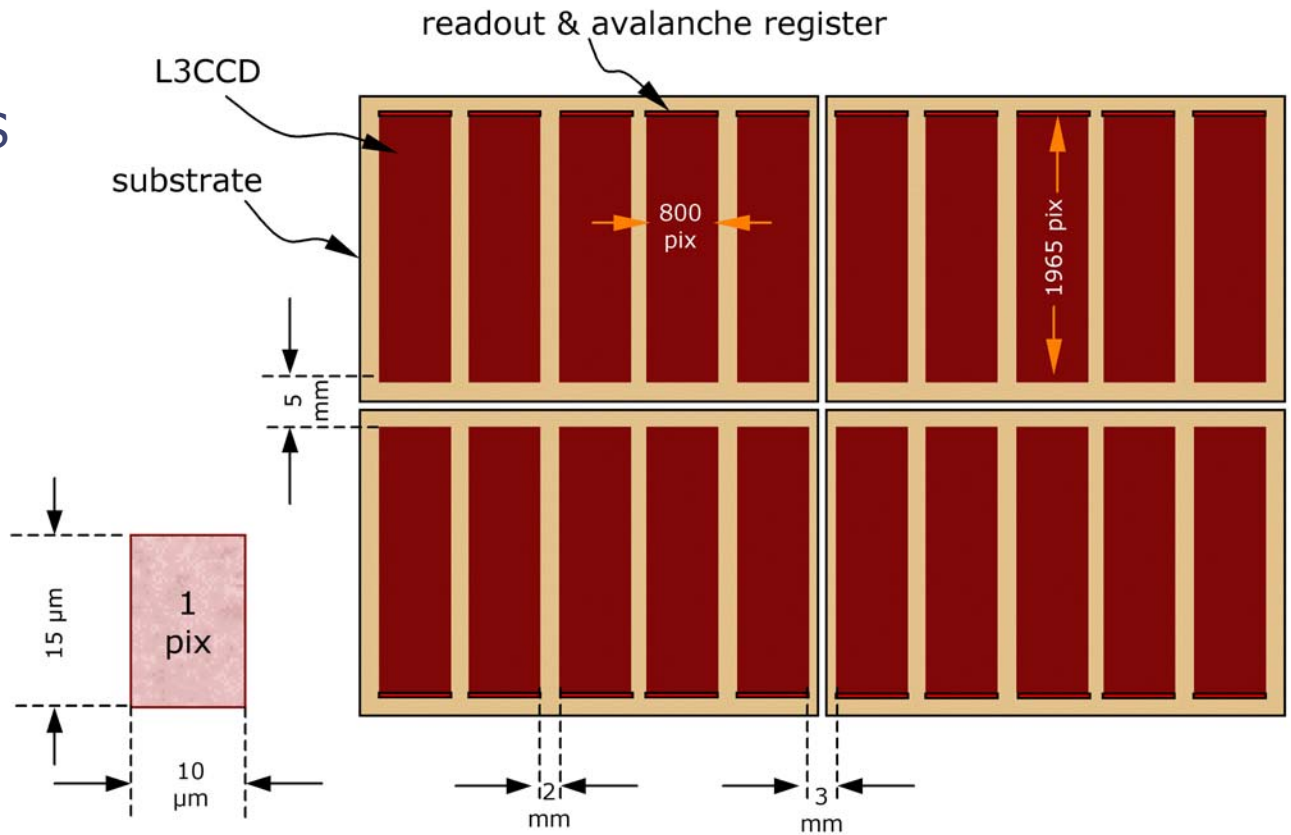
PE/REU electronics box. (spaced off Detector mounting can)

Radiation screen

Detector mounting can

Focal Plane Assembly

- Commonality sought between MBP and RVS CCDs
- Baseline continues to adopt L3CCDs
- Pending final performance assessment RVS focal plane now 20 CCDs each 800x1965
- Filling factor 75%
- Redundancy through vertical splitting (half height CCDs)



L3CCD Issues

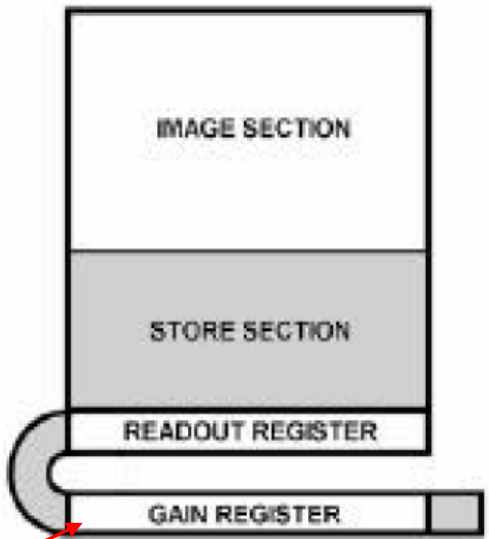
- Several differences between MBP and RVS CCDs which require development and proving in order to ensure suitability

	Currently covered by ESA development funding	*Not covered by ESA development funding*
pixel size		
rectangular pixel		
device size		
back-illumination		
2D clocking option		
high resistivity material		
L3 operation		
AR coating		
Radiation effects in L3		

- Main issues are:
  1. Radiation tolerance
  2. Gain in high resistivity material

L3CCD Issues – radiation

- Radiation tests (representative proton dose) at Paul Scherrer Institute (Switzerland) on 20 L3CCD65 from e2v



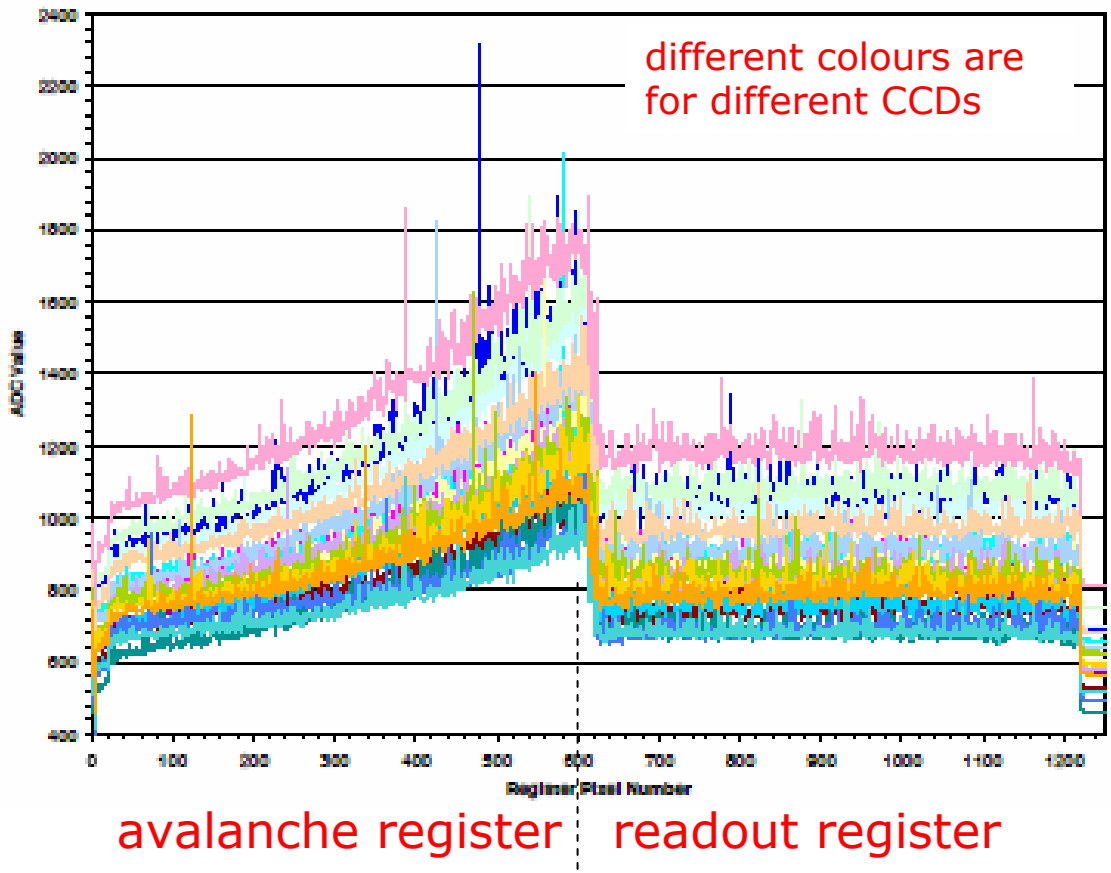
- Radiation performance expected to be the same as normal CCDs except in the avalanche gain register
- Damage in gain register could cause amplification of dark noise to level at which the CCD would be unusable.

L3CCD Issues – radiation

- Measurements made at ambient temperature of the dark noise generated in the avalanche gain register and readout register to examine any evidence for radiation damage

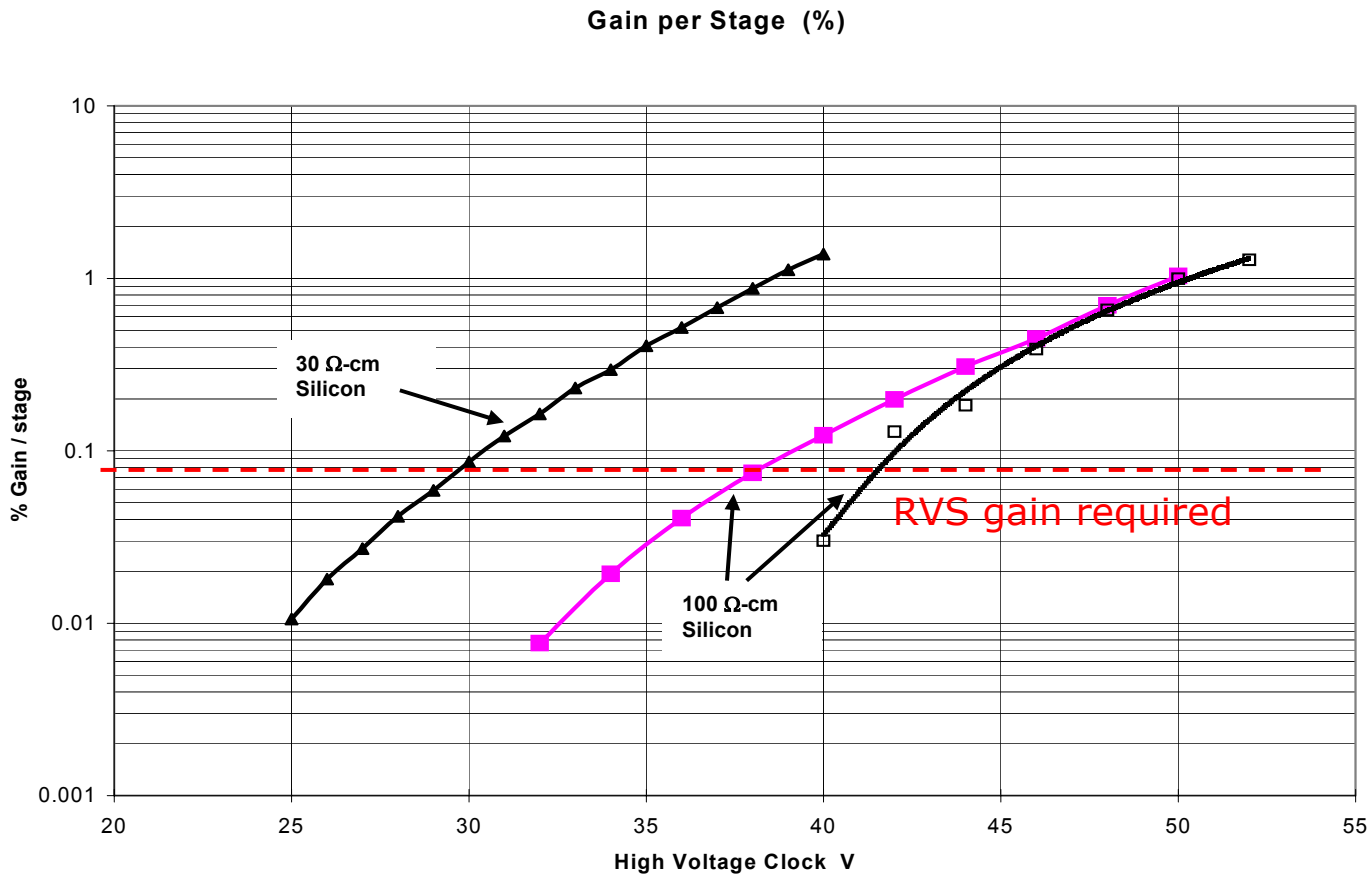
- Some small increase (x2) in one device mainly.

- At operating temperature the dark noise is much reduced ⇒ *no damage expected in context of RVS*



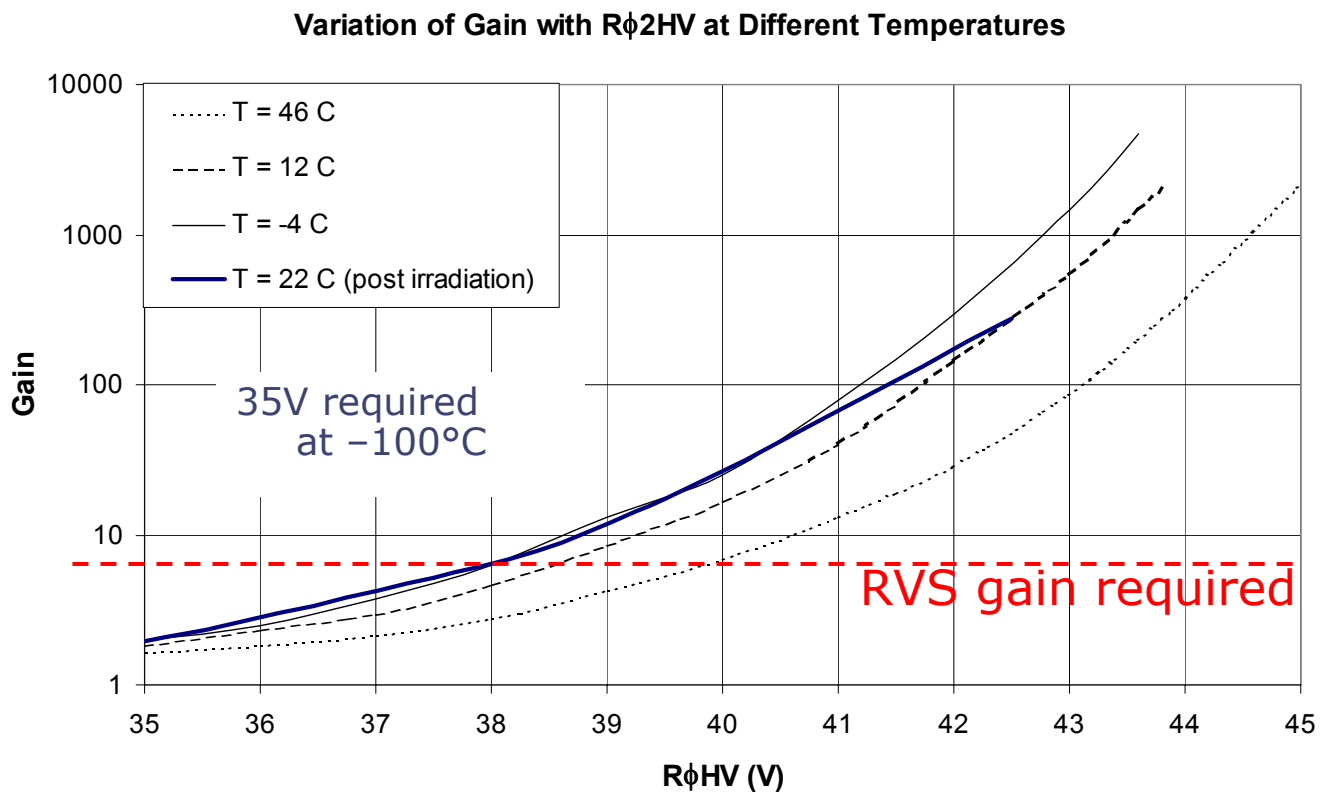
L3CCD Issues – resistivity

- In order to have *both* high senstivity (QE) *and* good spatial definition/resolution (MTF) the RVS CCDs need to be made of high resitivity material, optimally 1000 Ω-cm
- However, need to qualify the L3 operation on this material: indications are that high voltages are required in the avalanche register
- High resistivity material also slightly poorer cosmetically.



L3CCD Issues – resistivity

- Some benefit derived from temperature dependence: gain is higher at operating temperature than ambient

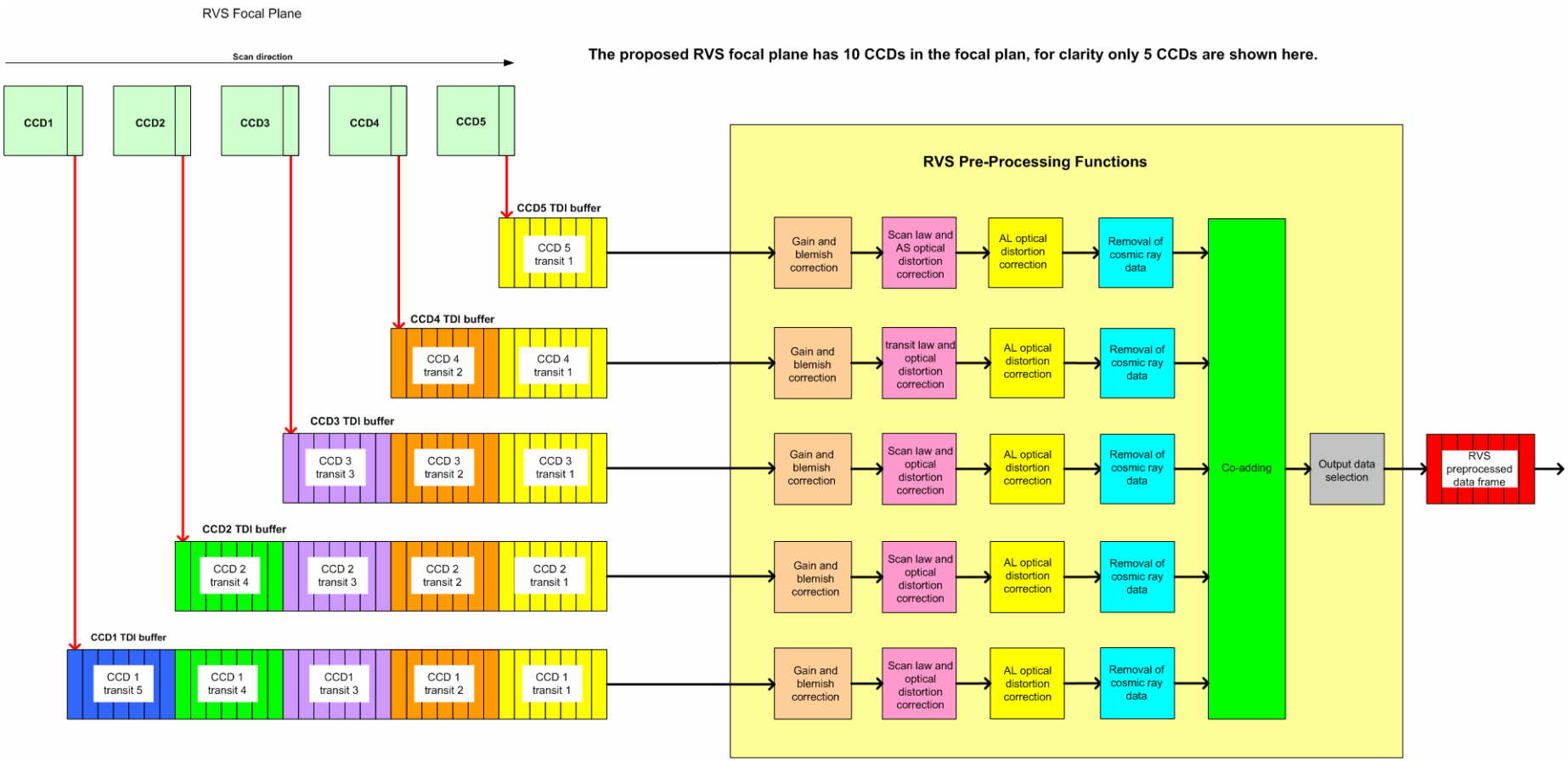


- Issues of voltage and temperature stability on avalanche clock to ensure gain stability

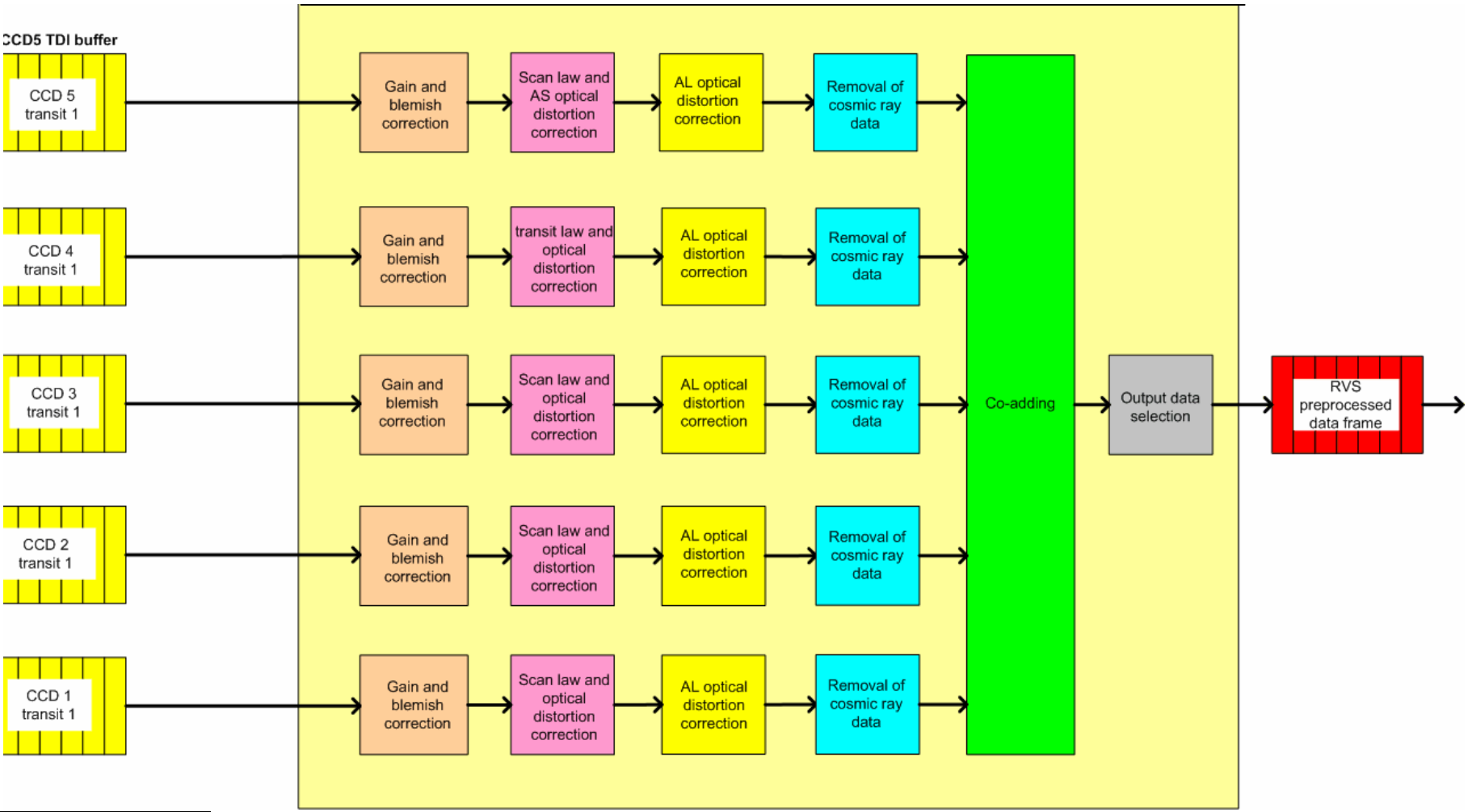
RVS On-board Processing

- RVS data processing is necessary to reduce the data rate, principally by combining the data from different CCDs
- The processing tasks in sequence are as follows:
    1. CCD gain correction
    2. Blemish reduction
    3. Scan law and AC optical distortion correction
    4. AC optical distortion correction
    5. Cosmic ray removal
    6. Co-adding
    7. Output data selection
- Tasks have been isolated to show the tasks more clearly. In a realistic implementation each task may not exist as discrete function.
- Algorithms specified in RVS Processing Tasks document (updated) MSSL/GAIA-RVS/TN/005.02

RVS Processing Scheme (5 CCDs only)



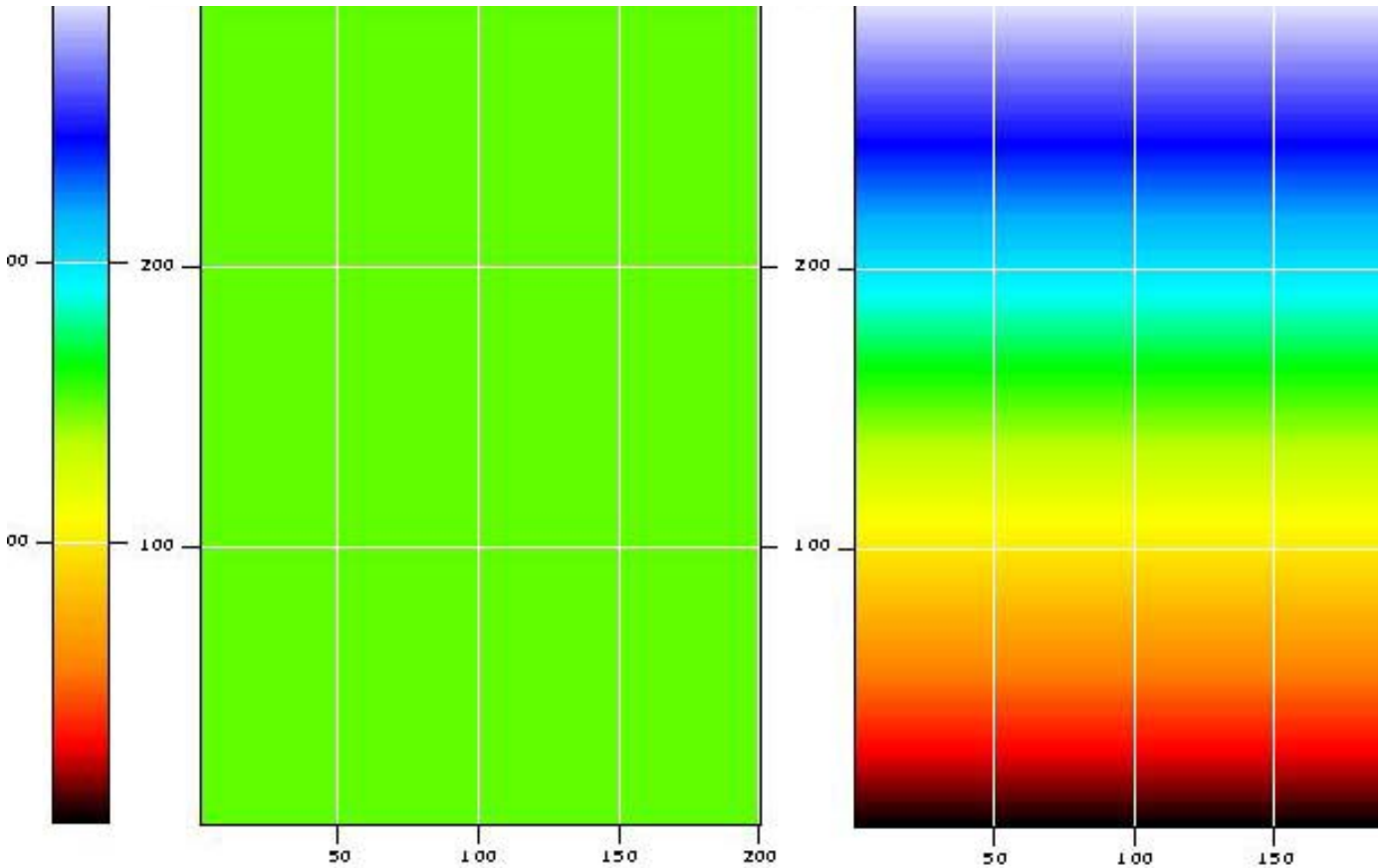
RVS Processing Scheme (5 CCDs only)



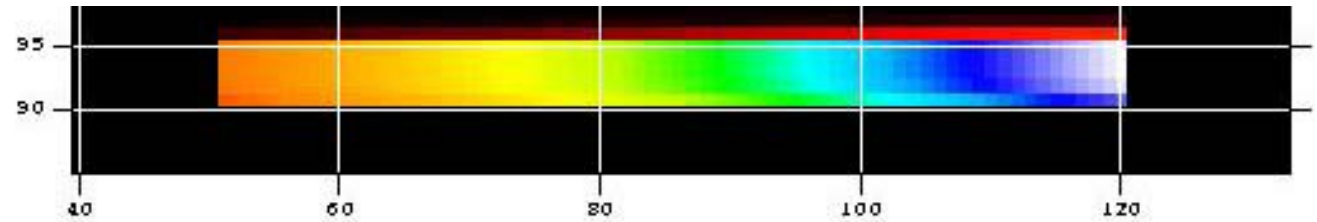
Processing: Initial Prototyping

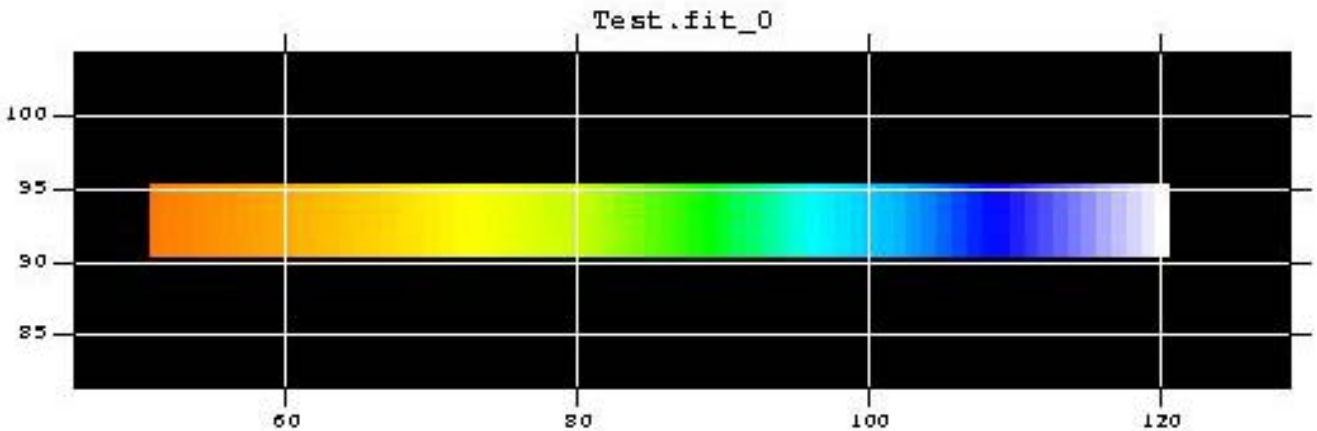
- Initial prototyping of the on-board processing has begun
- Code written in C compiled on PC – later will be ported to VXWorks real time operating system on PowerPC 750fx development board
- Works on FITS files generated by specific routines as a test set, or data from MSSL RVS Simulator
- Currently initial routines implemented for:
  - CCD gain correction
  - AC scan resampling/scan law
  - image selection (of only star area)
- Pipeline to be implemented next
- RVS Simulator needs to be modified to incorporate optical distortion effects and cosmic ray
- Initial results (still some way to go) …

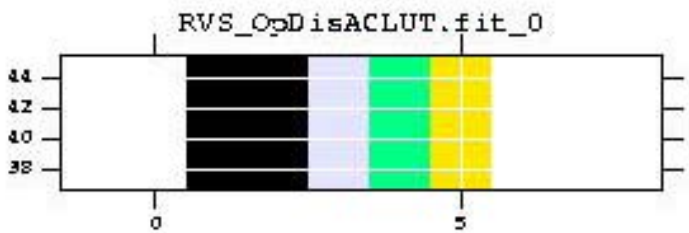
Gain correction using lookup table



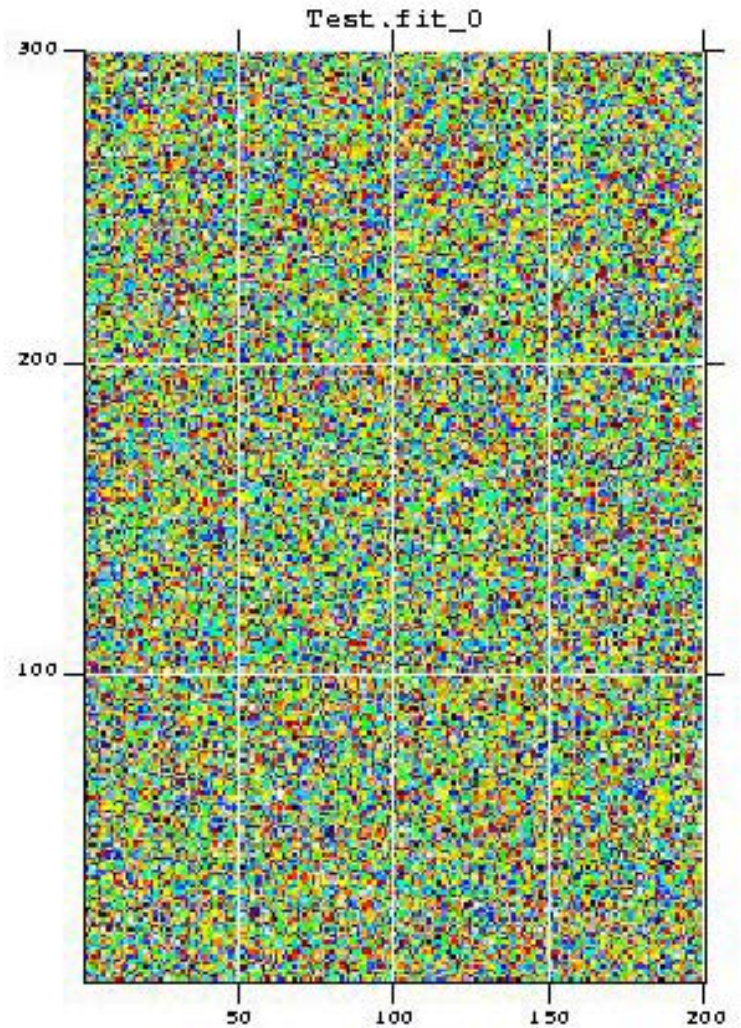
Across-Scan Resampling

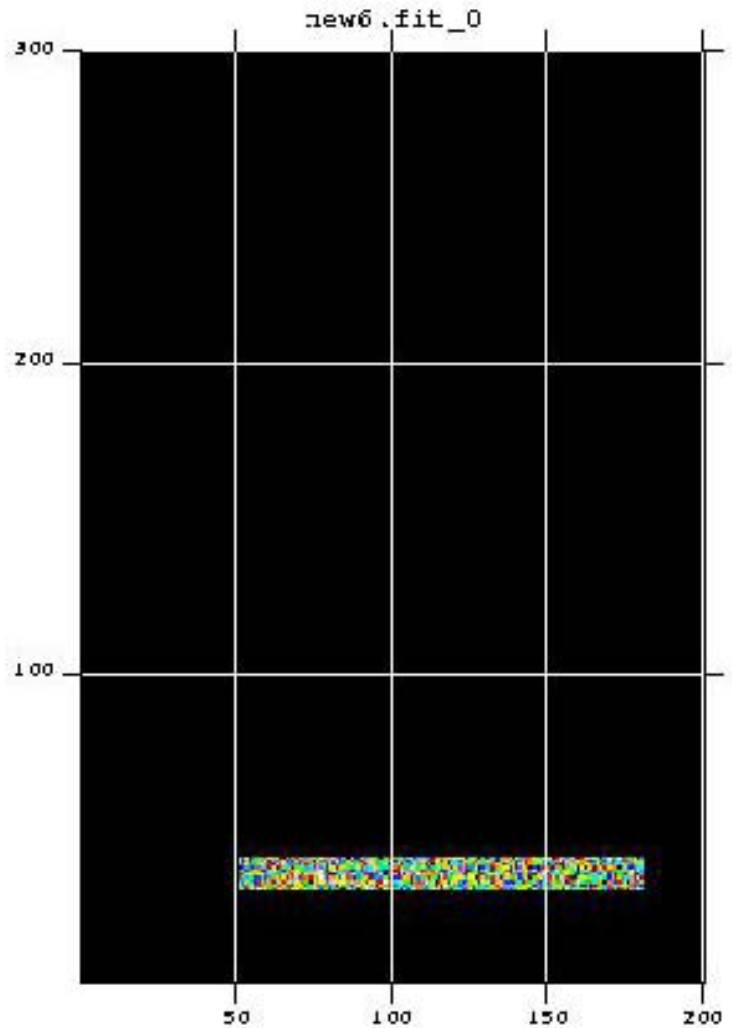






Data Selection





RVS: Upcoming Priorities

- Describe radiation performance in RVS context in more detail
- Pursue L3CCD on high resistivity gain issues
- Characterise L3CCD performance in more detail
- develop processing algorithms as rapidly as possible; provide software specification to Dornier
- converge on RVS accommodation issues with both primes
- develop RVS opto-mechanical layout using SiC/CeSiC materials in more detail
- develop detection chain based on RAL ADC/video ASIC