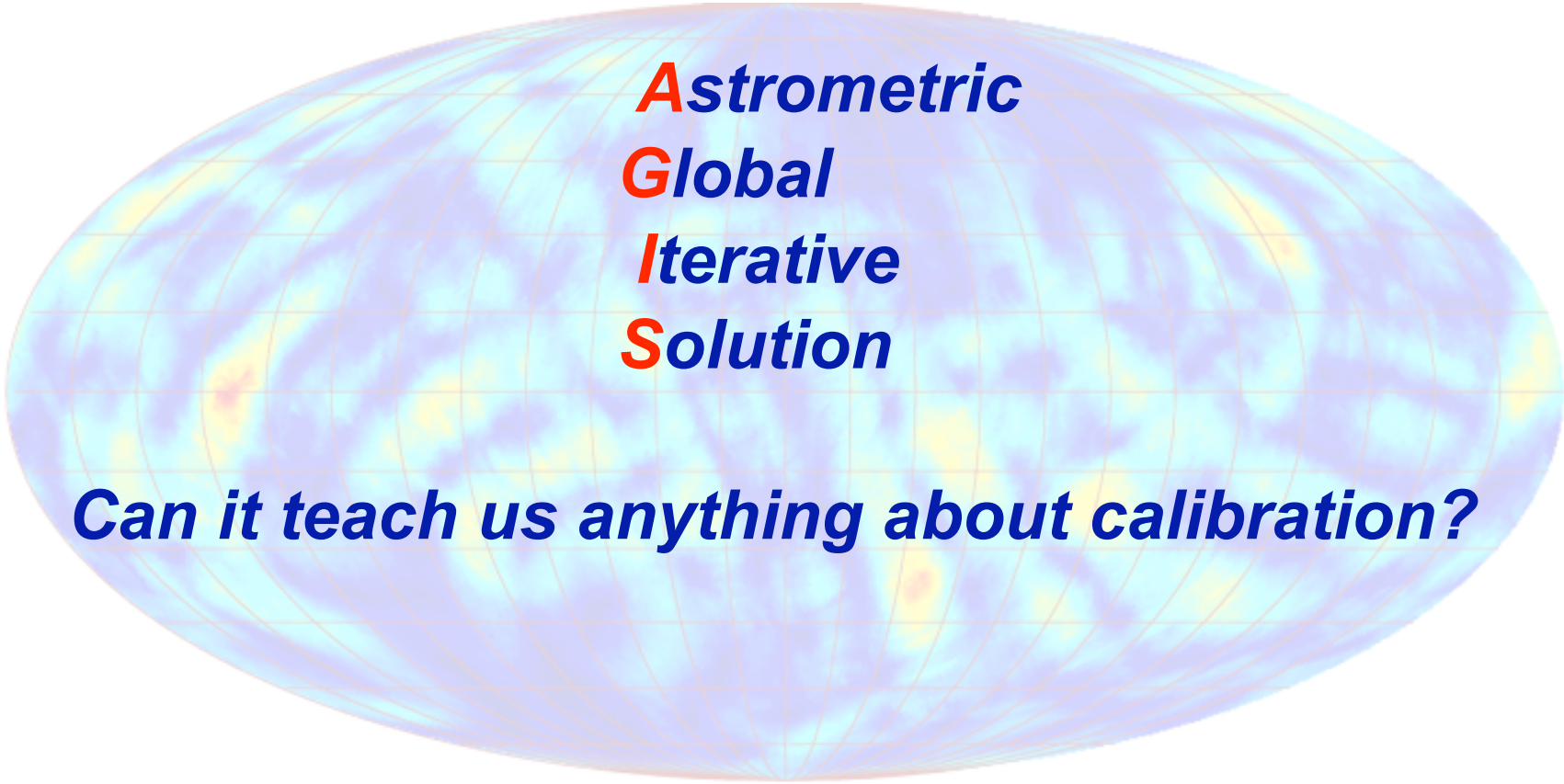
What is the Gaia AGIS ?



Astrometric
Global
Iterative
Solution

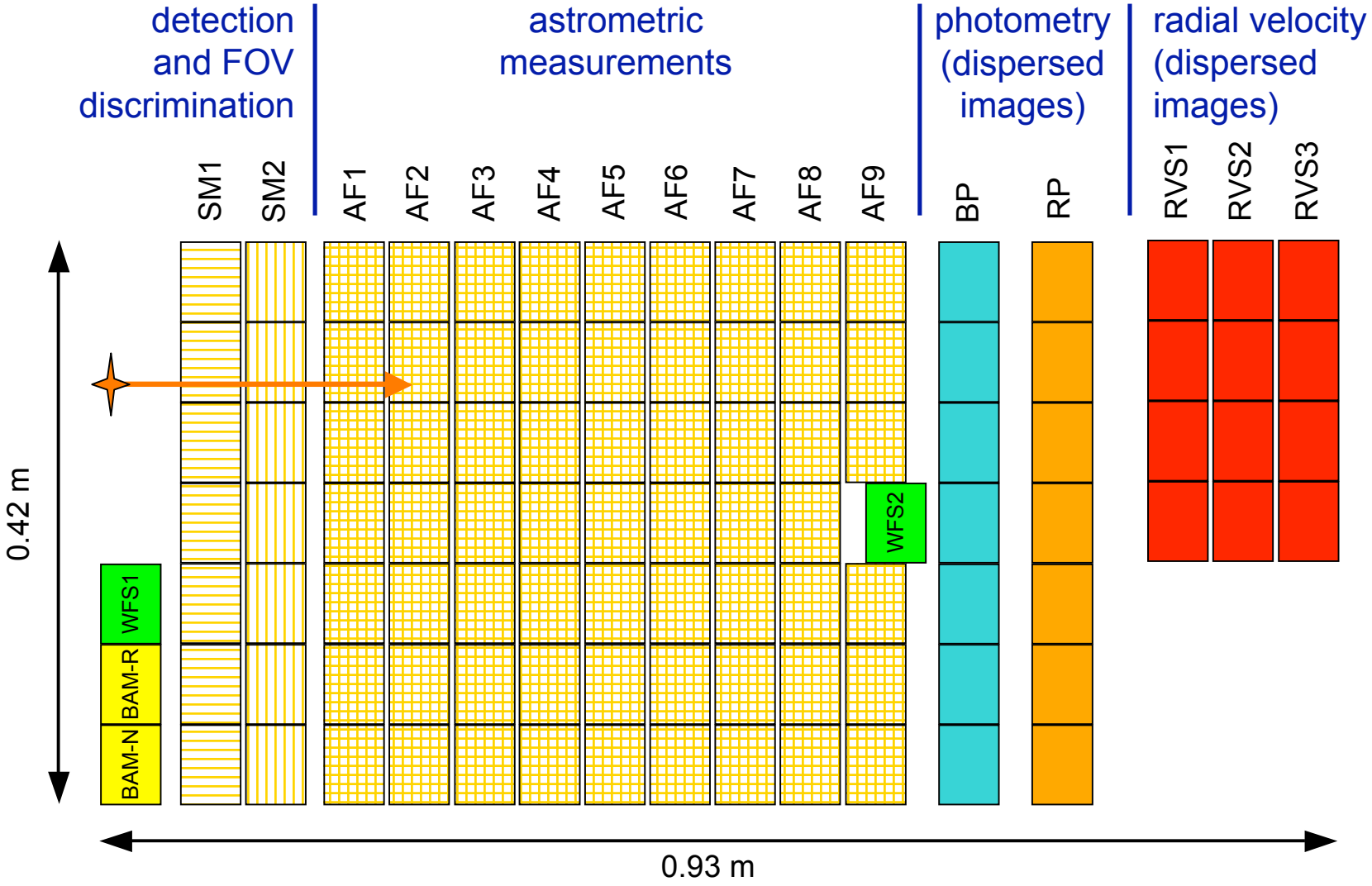
Can it teach us anything about calibration?

Thanks to Uwe Lammers

What are they after with AGIS?

- For all 10^9 observed celestial objects they want to determine six astrometric parameters:
  - Position on celestial sphere: α,δ
  - Parallax (distance): π
  - Proper motion: μ_α, μ_δ
  - Radial velocity: v_R (of a subset)
- at the μas level (π: <25μas@V=15, <7μas@V<10)
- using (in theory) no *a priori* knowledge of these quantities but deriving them from observation data alone in a self-consistent manner

Gaia focal plane (106 CCDs)



BAM = basic angle monitor, WFS = wavefront sensor

The problem

- Need to determine

  5 x 1000 Million unknown source parameters (S)

  from all (>1 trillion) measurements using an observation model that incorporates
  - Satellite attitude (A)
  - Calibration parameters (C)
  - Global physical parameters (G)
- Could set up a system of equations that solves directly for the unknowns – system is manifold over-determined
- Problems:
  - Computationally intractable
  - Calibration/Attitude parameters are not known accuratly enough

The solution

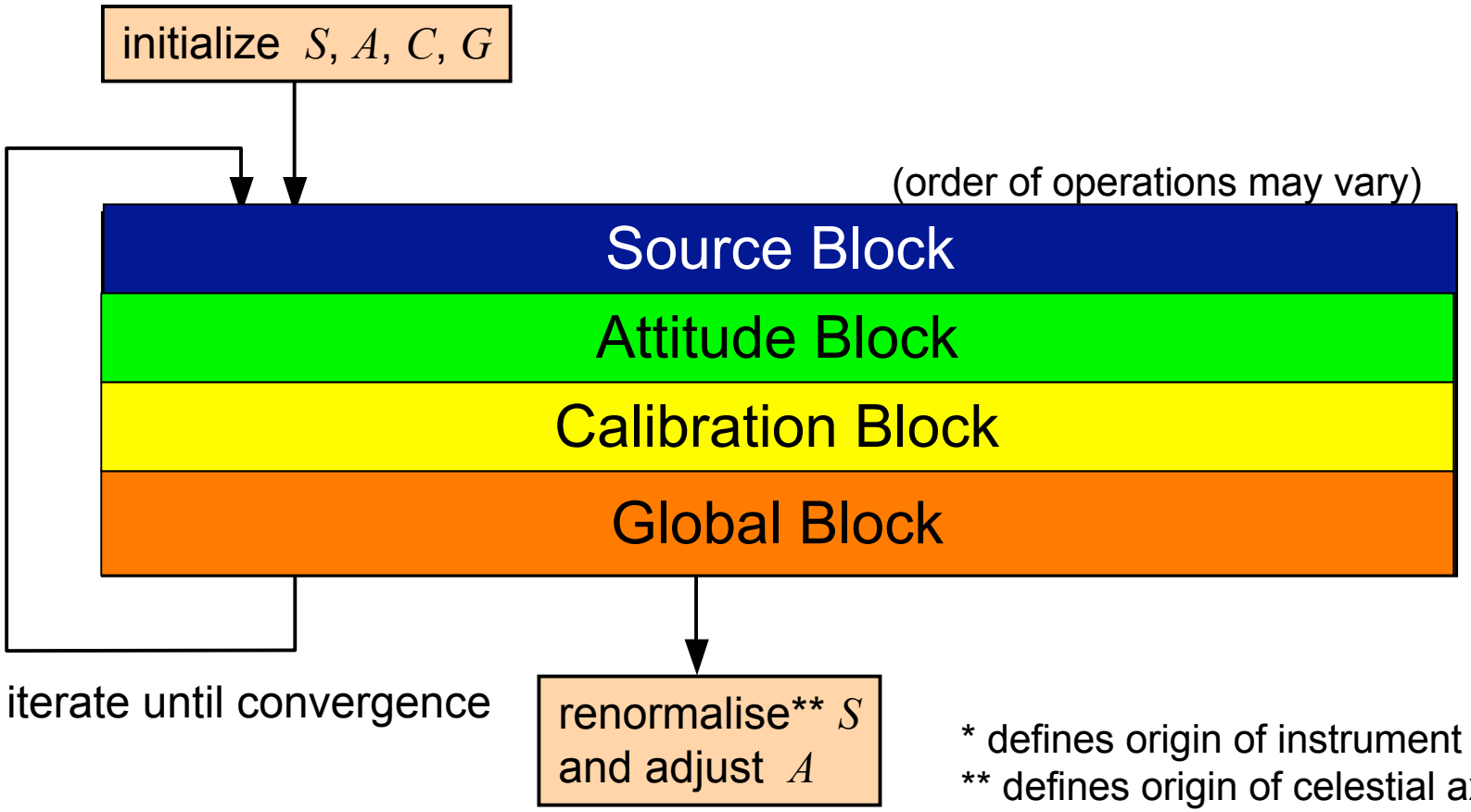
- "Primary AGIS": For about 10% of all sources "Primaries") treat **all** parameters entering the observational model (S, A, C, G) as unknown. Solve globally as a least-square minimisation task

  $$\Sigma_{observations} |observed\text{-}calculated(S,A,C,G)|^2 = min$$

  in a block-iterative manner.
- This yields
  - Reference attitude
  - Reference calibration
  - (Rotated) Global reference frame
  - Source parameters for 100 Million objects
- "Secondary AGIS": Solve for the remaining 5x900 Million unknown source parameters also with least-squares but use A+C+G from previous "Primary AGIS" solution

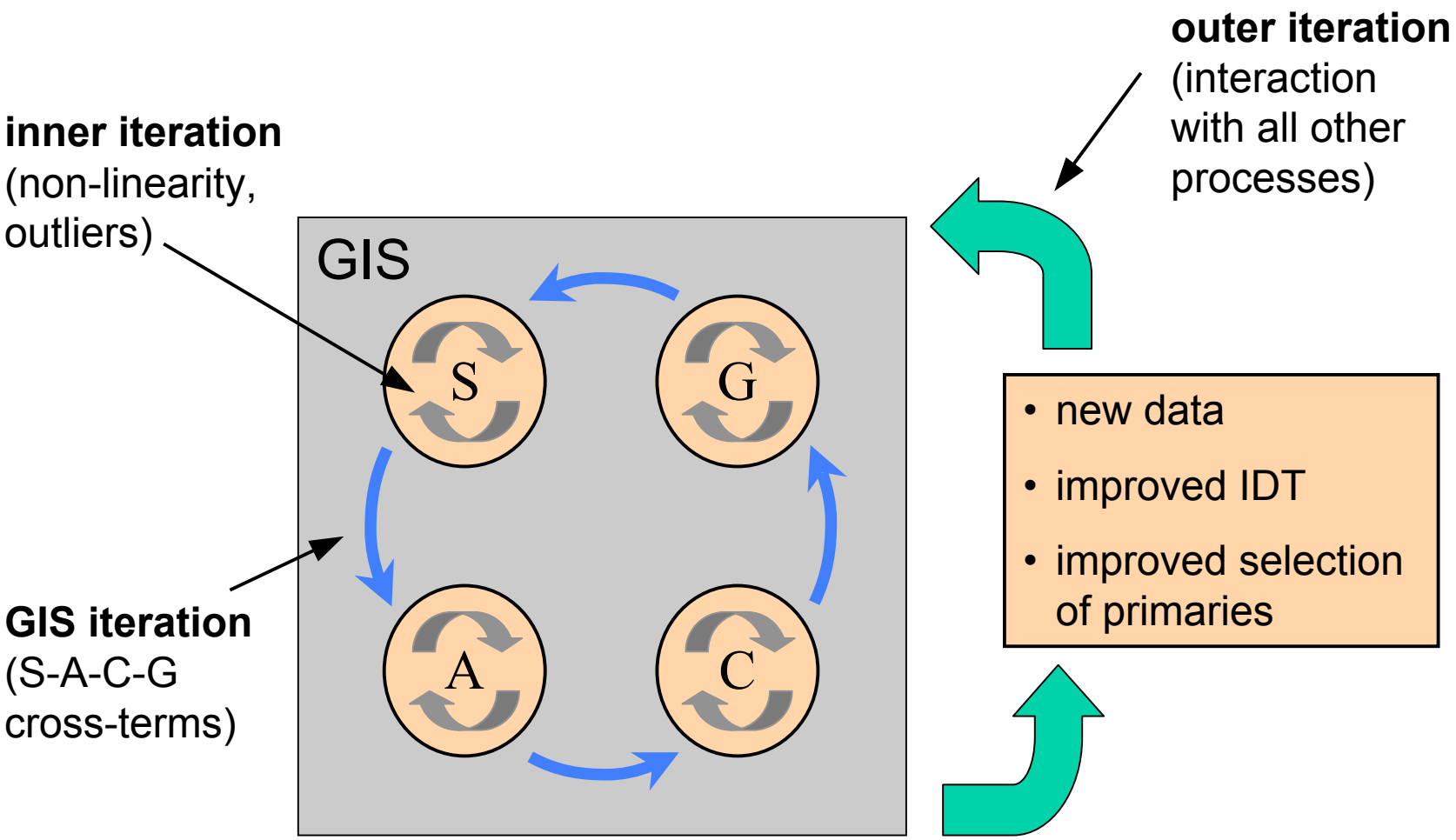
What does "block-iterative" mean?

GIS: Global Iterative Solution (block-iterative least-squares solution) of the over-determined system of equations $O = G + S + A + C + n$



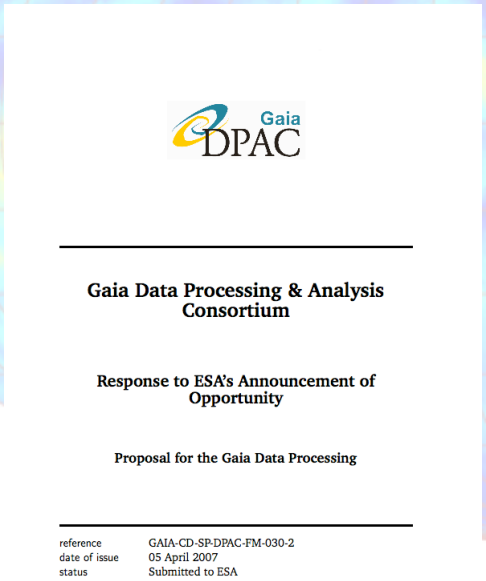
* defines origin of instrument axes
** defines origin of celestial axes

Another view of the same …



The amazing thing is…

it works !



Gaia DPAC

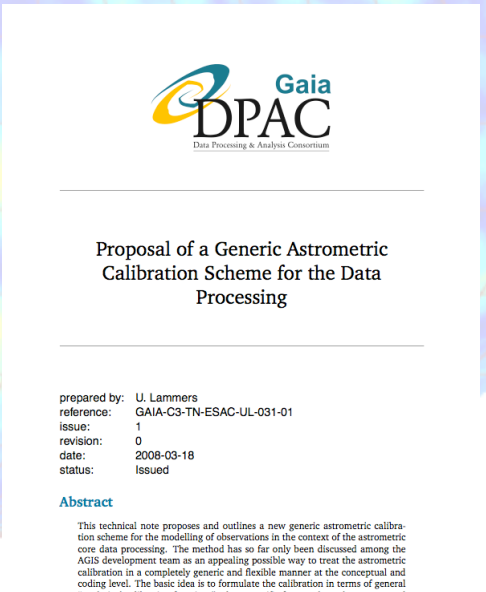
Gaia Data Processing & Analysis Consortium

Response to ESA's Announcement of Opportunity

Proposal for the Gaia Data Processing

reference	GAIA-CD-SP-DPAC-FM-030-2
date of issue	05 April 2007
status	Submitted to ESA

680pp



Gaia DPAC

Data Processing & Analysis Consortium

Proposal of a Generic Astrometric Calibration Scheme for the Data Processing

prepared by:	U. Lammers
reference:	GAIA-C3-TN-ESAC-UL-031-01
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Abstract

This technical note proposes and outlines a new generic astrometric calibration scheme for the modelling of observations in the context of the astrometric core data processing. The method has so far only been discussed among the AGIS development team as an appealing possible way to treat the astrometric calibration in a completely generic and flexible manner at the conceptual and coding level. The basic idea is to formulate the calibration in terms of general "analytical calibration functions" whose specific form and number are treated as variable in the coding phase.
Note: The method is of no relevance for any onboard or pre-launch on-ground calibration activities.

27pp

Thanks to Uwe Lammers