Closing remarks
ELSA and the frontiers of astrometry

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- What was gained from the ELSA network?
- Some thoughts on the data processing and data publication
- A future ELSA?
Scientific research conducted in support of Gaia mission and data processing
  - including preparations for the science exploitation
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  ► Mathematical, engineering, IT
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  - *I’m convinced I came to the right conference!*  
    *(Chiappini)*
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- **Trained next generation space astrometry experts**
Astrometry

Did I tell you about my adventure with the covariances?

Conjugate gradients, my good man, of course!

Hmm, better verify what these guys are producing...

My attitude is a nuisance?!
Radiation damage mitigation

I can simulate every pixel!

Okay, but real men simulate electrons.
Sorry gentlemen, we own the Galaxy now.

And the Magellanic clouds!
I want my parallaxes spotless!

Don’t forget theory!

CCD-resolved photometry or bust!

10 000 templates? 20% discount, that’s the best I can do!
IDU-schmIDU, just parallelize it!

I was this close to catching that stream.

What to invert today...
Future proofing the Gaia data

- Gaia will provide an unprecedented stereoscopic map of our Milky Way and the nearby universe
  - 1 billion stars, 300,000 solar system objects, millions of galaxies, 500,000 quasars, 10,000 exo-planets, ...
  - catalogue ‘finished’ in 2020

- It will be *the* astronomical data archive for decades to come
  - tremendous discovery potential when combined with other archives
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● Let’s therefore seriously explore the following:
  ► publish early and often
  ► keep raw data, calibration data, and processing software available
  ► facilitate reprocessing
  ► make the archive ‘live’
  ► consider the catalogue as the best explanation of the data at a given moment
Publish early and often

- Early Gaia data will still be fantastic resource
  - e.g., volume around the sun
- Provides early experience with catalogue publishing and use
- Feedback from users will be invaluable
- Keep in mind SDSS experience

First publications?
- positions
- $G$-band and $G_{BP} - G_{RP}$ colour
- rejuvenation Hipparcos proper motions

Simulated Gaia sky
Facilitating reprocessing

Data curation

- All raw data
  - $\sim 60$ TB uncompressed
- Calibration data and models
- Intermediate data products
- All processing software
- Implement data lineage concept
  - ‘no hard decisions’

Science goals

- Raw data reprocessing based on better algorithms, better calibration models etc
- Alternative processing of specific stars, groups of stars, or even entire catalogue
- Reprocessing data based on new and independent information
Gaia catalogue and archive released in \(\sim 2020\) should not be ‘final’

- Updates should be allowed so as to incorporate:
  - updated classification or parametrization of stars
  - better distance estimates for faint stars
  - ground-based follow-up observations
  - independent information on, e.g., double stars

- Implications for maintenance, quality, security, keeping mirrors in sync
Bring the processing to the data

- Szalay (Sloan Digital Sky Survey) has advocated this for large archives
  - allows arbitrarily complex processing of archive data
  - example: dynamical model of the Milky Way that best explains the catalogue

- Virtualisation (O’Mullane, ESAC) could allow users a virtual machine in the Data Centre with the Archive
  - code what you want and specify how you want run it

Gaia cloud …
Hogg (NYU): the catalogue is a probabilistic model of the data

- Single frozen catalogue contains all our knowledge about the data but it may not necessarily be the best description of the data

- Provide ‘catalogue’ as a model incorporating all our knowledge of the data
  - explains the observed data
  - predicts unobserved, new, or different kinds of data
  - adjustable through likelihood re-evaluation

- Include ambiguities in the catalogue as likelihood of certain parameters to explain observed data
  - makes priors in catalogue construction more visible
  - allows injection of new information
Innovative exploitation existing data in 2020

- How do we implement the advanced ideas on catalogue publication?
- Is an ‘explanation of every pixel’ feasible? Necessary? How?
- Combination with other data archives

Future astrometric surveys

- Where can we gain the most in terms of science?
- Develop breakthrough technology or measurement principles to circumvent current accuracy barriers

See brainstorming session at Heidelberg ELSA school in 2009 (DPAC-SVN)
The next generation