50. The German DIVA project

BY AROUND 1995, before the Hipparcos catalogue release, it was in the minds of various groups around the world to propose a follow-on astrometric mission.

In the US, various ideas were put forward between around 1995–2005. Amongst these were a 'point-and-stare' mission, POINTS, aiming at sub-microarcsec astrometry on a number of objects, one objective being planet detection. By early 1999, scientists at the US Naval Observatory in Washington had advanced a scanning concept, FAME, to the level of a Phase A study. And the ambitious long-baseline interferometer, SIM (part of the NASA Origins programme, and later descoped to SIM-LITE), targeted its original launch in 2005. All eventually fell by the wayside for technological or financial reasons, or through lack of wider scientific support.

In Russia, scientists were suggesting a Hipparcos clone (AIST), and there was talk of studies of other astrometric concepts (Lomonosov and Regatta–Astron). But by 1999, these ideas had also dispersed, presumably due to the country's economic situation at that time.

In Japan, scientists began to look at a series of missions – Nano-Jasmine, Small-Jasmine, and Jasmine – which would yield progress in technology and scope.

In a historical context, these various astrometry mission ideas undoubtedly merit their own more detailed consideration. But here, I will focus only on a European idea which gained more traction, DIVA, and summarise how its development and eventual demise was entwined with the progress of the ESA juggernaut, Gaia.

IN RESPONSE TO THE ESA CALL for an M3 (medium mission) proposal in 1993, Erik Høg (Copenhagen) and Lennart Lindegren (Lund) led a proposal for a European follow-on to the Hipparcos mission, which they called Roemer – along the lines of Hipparcos, but using CCDs as detector. We had looked at CCDs for use in Hipparcos in about 1982, but the suggestion (by Delft engineer M. Hammerschlag) was rejected then as being technologically immature. But by 1993, in contrast, CCDs were being used widely in astronomy, and had become the natural, if still complex and challenging, choice.

Roemer aimed at sub-milliarcsec astrometry. While of scientific value, this was not in reality a transformative advance. Roemer was rated highly by ESA's Astronomy Working Group (AWG), but eventually rejected by its more senior advisory groups in favour of Cobras/Samba (subsequently Planck) for a Phase A study in 1999.

Out of these early ideas the much more ambitious Gaia was proposed by Lennart Lindegren and Michael Perryman. It engaged much wider support, and it was eventually accepted by ESA's advisory groups in 2000.

IN 1995 Siegfried Röser, of the Astronomischen Rechen-Institut Heidelberg (ARI, now ZAH), Germany's leading institute for astrometry, began to coordinate the preparation of a mission concept, DIVA (Deutsches Interferometer für Vielkanalphotometrie und Astrometrie; viz. German interferometer for multicolour photometry and astrometry) for submission to the German Space Agency, DARA (DARA merged with the research and development activities of DLR to form the German Space Agency, DLR, in 1997).

The expectation was that DLR would issue a call for new missions before the end of 1997. The successful outcome of their Phase A study could lead to the start of Phase C/D in 1999, and a launch of DIVA in 2004.

DIVA WAS DESIGNED to fill the gap in observations between Hipparcos (100 000 stars at 1 milliarcsec accuracies at 9 mag) and Gaia (a billion stars to 20 mag, with accuracies of 10 microarcsec at 15 mag).

In a 24-month mission DIVA would measure positions, proper motions and parallaxes of all 30 million stars down to 15 mag, with accuracies at $V = 9$ mag of around 0.2 milliarcsec in positions, parallaxes, and annual proper motions, along with accurate broad-band photometry (Röser et al. 1999).

A key idea was that, due to the progress in technology since the time that Hipparcos was designed, DIVA would be able to surpass its performance at a fraction of its cost. Like Gaia, it started as an interferometer, with dispersed fringes providing multi-colour information.

As both mission concepts progressed over the next few years, affordability, politics, and national priorities, all played their parts in their destinies.

In addition to its near-term scientific harvest, the proponents of DIVA saw it as a guarantee of Europe's leading role in space astrometry should Gaia not be selected as a future mission by ESA, and as of great value in maintaining scientific expertise and continuity in the years leading up to launch if Gaia were selected.

Representatives of the Gaia effort saw DIVA as a confirmation of the importance of astrometry in Europe, but at the same time as a competitor both for finite financial resources (in DLR and ESA) and, as importantly, for the critical knowledge and expertise available within the European astrometry community.

In 1998, as the German delegation to ESA lobbied the ESA Director of Science, Roger-Maurice Bonnet, for assistance in funding, Bonnet expressed his view that it did not sit comfortably with him that a national programme should benefit from ESA's technical expertise, using it as a means of supporting a national programme which, they could then claim, could be developed at significantly lower cost. Bonnet countered by inviting the German delegation to instead contribute more to Gaia, with a view to facilitating an earlier launch date.

Also in the back of Bonnet's political mind was that bringing Gaia forward from its target launch of 2012, would take more wind from the sails of the ongoing US studies on FAME (itself based on many of the ideas from Hipparcos and Gaia), and on a possible linkup between FAME and DIVA which had also been mooted.

By late 1998, DLR had completed their feasibility study on DIVA, conducted by the industrial consortium Dornier/DASA. Though confident of its technical feasibility, they did not yet have a firm commitment on funds. With the constraints on Germany's funding for space science, the accepted wisdom was that if FAME were to be funded, then DIVA would be consigned to history.

A NASA press release, and an email from the FAME principal investigator Ken Seidelmann on 15 October 1999, brought the news that FAME had been approved for further study – a new entrant representing a serious threat for both DIVA and Gaia. In the fierce competition for future missions in ESA, such news was ammunition for those pursuing other priorities.

The following weeks and months were punctuated by much discussion, negotiation, rumour, and declarations of personal priorities. The Gaia Scientific Advisory Group, which I chaired, met to discuss the project's position: FAME targeted a significant advance which could weaken the political support for Gaia. And there was little enthusiasm for a trans-Atlantic collaboration. Of course if Gaia were to be approved for an early 2009 launch, FAME itself would no longer make much sense.

In this confusing atmosphere, DIVA continued its onward progress. In January 2000, Germany's DLR laid its cards on the table, favouring DIVA over Gaia from both an industrial and a science policy point of view. Influential Danish astrometrist Erik Høg stated that Gaia would be his priority, and that he could not spare effort to work on DIVA as well. The Gaia Scientific Advisory Group was also concerned by the 11 August 2000 selection data for DIVA targeted by DLR, just in advance of the planned selection date for the next ESA round.

In February 2000, ESA science programme coordinator Sergio Volonté announced that Oxford Galactic dynamicist James Binney had agreed to serve as assessor of DIVA and Gaia, as well as FAME and SIM, for the next Astronomy Working Group meeting on 9 May. Siegfried Röser informed us that the DIVA selection would be postponed until after that for Gaia. By April, the emerging wisdom was that DIVA would be too unsettling to a coordinated Gaia approach in Europe, while the FAME mission would perhaps keep the discipline vibrant without detracting European effort from Gaia.

On 22 September 2000, DLR recommended DIVA as the next space mission within the German national programme. But a financial caveat soon became known: 50% of the needed funding would have to come from other sources, for example from the federal states.

Shortly afterwards, on 12 October 2000, Gaia was in turn selected by ESA's Science Programme Committee.

For the next few months, DIVA marched on in parallel with Gaia. A major scientific workshop devoted to DIVA was held at the Max-Planck Institute for Astronomy, Heidelberg, in April 2001, and attended by about 60 scientists from the DIVA and Gaia teams. Detailed discussions examined the optical design, attitude control, radiation environment, operations and data processing. Launch was still targeted for mid-2004.

Ultimately, the survival of DIVA hinged on obtaining 15 M€ in funding from ESA. But as this request made its way through the ESA committees, the AWG on 15 November 2001 and the SSAC on 19 November, it became clear that this support would not be forthcoming.

On 11 March 2002, DLR's executive committee decided that for financial reasons the next German mission would not be carried through in the years 2003–05. Formally, this was considered as just a delay for DIVA, rather than as a cancellation.

A final high-level petition from German industry for ESA contributory funding was made at a meeting in ESTEC on 1 October 2002. But the AWG maintained its negative stance, and the rejection of ESA funding by the SPC on 5 November 2002 marked the end of DIVA.

This was a bitter blow for the DIVA team, who had made great efforts to advance space astrometry. But by pooling all European expertise, Gaia would benefit.