systems with separations smaller than 4 au. The estimated merger rate is therefore more than enough to explain all observed Type Ia supernovae.

Moving further up in mass, Nial Tanvir discussed gamma-ray bursts (GRBs). It has long been known that the short GRBs originate from merging neutron stars, but evidence is now also mounting that even for long GRBs, binaries may be needed!

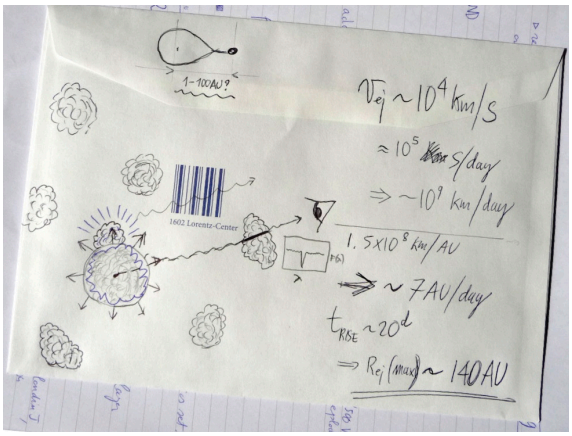

Figure 3. Nando Patat's "back of the envelope" calculation for the double degenerate model, showing how the merging of two WDs can lead to a Type Ia supernova.

A legacy

Else Starkenburg opened the last session of the conference, pointing to the fact that the lowest-metallicity stars that still exist today probably carry the imprint of very few supernovae in the early Universe. This turns out to be one of the key science goals of Pristine, a survey at the Canada-France-Hawaii telescope devoted to the search for the most metal-poor stars. Along the same lines, Sara Lucatello reviewed the present-day results on binary fractions at low metallicity. Evidence seems to suggest that CEMP stars likely originate from binaries. Moreover, preliminary data from the Lick Extremely Metal Poor (EMP) binary survey indicate a higher binary fraction at higher ([Fe/H] ≈ –2) metallicity. Putting it all together, Rob Izzard reviewed why we need to perform binary population synthesis, and how it is currently done. There are now more and more sophisticated codes that address many problems, although one needs to be sure that the correct physics is used. JJ Eldridge showed also how stellar models may be used in population and spectral analysis, while Laurent Eyer and Nami Mowlavi highlighted the observational side, stressing the fact that, with Gaia and the future Large Synoptic Survey Telescope (LSST), we are now entering a data-driven era and we need to prepare for it. Gaia will find and characterise tens of millions of binaries of various sorts, and is therefore bound to revolutionise the field – if we are ready to address the data flow.

We hope that this workshop will have a strong legacy and we have therefore assembled PDF files of most presentations via the programme webpage[1], as well as many of the posters[2]. We also prepared videos of the presentations that are also linked from this page. However, perhaps the most obvious outcome of the meeting is that textbooks need to be rewritten to take into account the importance of binarity in stellar evolution. We have therefore also embarked on producing a textbook that will comprise edited versions of most of the invited talks at the workshop. The book will be published by Cambridge University Press next year.

Acknowledgements

We would like to thank the members of the SOC for their hard work in putting together a very interesting and diverse scientific programme. It is a pleasure to thank Stella-Maria Chasiotis-Klingner for her dedicated support with all the logistics, as well as Tereza Jerabkova, Viktor Zivkov, Na'ama Hallakoun, Fabio Herz, Anna Vucovic, Jürgen Riesel and the ESO logistics staff for their invaluable help in making the workshop run smoothly. Many thanks also to Ed van den Heuvel for providing an enlightening summary talk of this very dense workshop.

Links

[1] Programme with links to presentations: http://www.eso.org/sci/meetings/2017/lmbase2017/program.html
[2] List of poster PDFs as well as poster abstract booklet: http://www.eso.org/sci/meetings/2017/lmbase2017/posters.html

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Forty Years at ESO — Bernard Delabre and Optical Designs

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[1] ESO

The optical designer Bernard Delabre has retired from ESO after 40 years at the forefront of telescope and instrument optics. A short overview of his achievements and his legacy of astronomical telescopes and instrumentation is presented. Bernard Delabre was

awarded the 2017 Tycho Brahe Prize by the European Astronomical Society.

Bernard-Alexis Delabre received his diploma in optics in 1974 at the École d'Optique de Morez in France. He worked for a few years at the Société SEIMA (now Valeo) designing car headlights before joining ESO, then in Geneva, in 1977 and he has been at ESO ever since.

During his 40 years of service, Bernard has made profound contributions to optical and infrared ground-based astronomy, which have benefited the entire astronomical community. His genius has been in the optimisation of instrument designs. He brought a clear vision of what astronomers need and how the details of an optical design can be merged with the mechanical constraints to provide optimal performance. It was normal to find astronomers, mechanical engineers, control engineers and system analysts all sitting with Bernard in his office discussing, negotiating and evolving designs.

Bernard was the chief optical designer of a number of telescopes, including the New Technology Telescope (NTT) on La Silla and the Extremely Large Telescope (ELT). While the NTT and the Very Large Telescope (VLT) are classical Ritchey-Chrétien designs, for the ELT Bernard invented a beautiful five-mirror design that provides an aberration-free field, telecentric without a corrector, with an adaptive mirror conjugated close to the ground and an intermediate focus (Delabre, 2008). Recently Bernard has worked on a novel design for a telescope 12–15 metres in diameter suitable for massively multiplexed spectroscopy (Ellis et al., 2016; Pasquini et al., 2016).

Bernard designed the optics of nearly all ESO instruments built in the past 35 years. He was a true innovator in optical design for instrumentation during the fundamental transition to large-format two-dimensional digital detectors. As the telescopes and detectors increased in size and improved in performance, the challenge was for the optical design to ensure that the best image quality was delivered with the fewest elements.

Bernard exemplifies the ESO tradition of working at the forefront of technological evolution, applying novel technologies to enable new capabilities for astronomy.

Instrumentation developments

The ESO Faint Object Spectrograph and Camera (EFOSC) was the first focal reducer and spectrograph combination (Buzzoni et al., 1984). The innovative optical design included the creation of a parallel beam space between the collimator and the camera, which allowed for the insertion of a multitude of different optical elements, such as filters, grisms and Wollaston prisms for polarimetry. EFOSC was made possible thanks to a new glass, FK54, and flexible cements that enabled an efficient and broad-band achromatisation. It was one of a series of optical developments made by Bernard, working closely with optical manufacturers to broaden the scope of instrumentation for astronomy.

Many copies of EFOSC are in operation at observatories around the world, including the ARIES Devasthal Faint Object Spectrograph Camera (ADFOSC) at the Aryabhatta Research Institute of Observational Sciences (ARIES) telescope in India, the Danish Faint Object Spectrograph and Camera (DFOSC) at the 1.5-metre Danish telescope on La Silla, the AndaLucia Faint Object Spectrograph and Camera (ALFOSC) at the Nordic Optical Telescope on La Palma, and the Asiago Faint Object Spectrograph and Camera (AFOSC) at the 1.82-metre telescope on Mount Ekar, to name but a few. Derivatives of the design were the Low Dispersion Survey Spectrograph (LDSS) at the Australian Astronomical Observatory, the William Herschel Telescope and the Magellan telescopes, the Faint Object Camera And Spectrograph (FOCAS) at Subaru, the Gemini Multi Object Spectrograph (GMOS), and, last but not least, the FOcal Reducer and low dispersion Spectrograph (FORS1 and 2) at the VLT.

With the ESO Multi-Mode Instrument (EMMI) on the NTT, Bernard designed the first truly multimode instrument to combine low and intermediate resolution and cross-dispersed echelle spectroscopy

Bernard Delabre

with imaging. As with EFOSC the incoming wide-field focal plane could be combined with a slit mask that provided multi-object spectroscopy using grisms. Using the same camera to image, take grism spectra and deliver the cross dispersion for the echelle grating is quite remarkable.

The next step in Bernard's use of evolving technology to improve optical performance came with the Infrared Spectrometer And Array Camera (ISAAC), the first-generation infrared camera spectrograph for the VLT. Diamond turning to generate optical surfaces was becoming viable in the 1990s. Bernard realised that this created an absolute mechanical reference for the optical surface. Three-mirror anastigmats, which previously had been considered too difficult to align and keep aligned, could now be employed. They provided a wide corrected field of view, free from bulky transmission optics which are temperamental and difficult to model for a cryogenic instrument. Three-mirror anastigmats are now very popular for instrumentation, and also for some telescopes.

The white pupil concept introduced by André Baranne in 1972 was further developed by Bernard for the UV-Visual Echelle Spectrograph (UVES) for the VLT. This new configuration eliminates vignetting and aberrations by delivering a sec-

ond white-light pupil, where the cross disperser and the camera are located. With a few added optical elements, resulting in the loss of only a few percent of the light, the vignetting typical of traditional designs is removed and the image quality and overall luminosity substantially enhanced. This new design was again adopted by several instrument builders in Europe and overseas.

Bernard also developed the 4C concept, which enables camera chromaticism to be compensated through the chromatic effect introduced by the collimator. It was used in several VLT instruments including X-shooter and the VIsible Multi Object Spectrograph (VIMOS) and inspired the design of instrument concepts overseas, such as the Gemini Montreal-Ohio-VIctoria Echelle Spectrograph (MOVIES; Delabre et al., 1989). Bernard also developed a new "pupil slicing" technique for one of the early instrument concepts for the ELT and worked on the optical design of the Echelle SPectrograph for Rocky Exoplanet and Stable Spectroscopic Observations (ESPRESSO). This instrument combines pupil slicing with anamorphism and slanted volume phase holographic (VPH) gratings to achieve high resolving power.

Recently, Bernard also took a leading role in the development of optical designs for instruments using curved detectors, where no optical design with an affordable number of lenses can be found with identical transmission and identical field of view. This work is paving the way for future massively multiplexed spectrographs (Iwert & Delabre, 2010). All the ESO spectrographs under construction — the near-infrared Enhanced Resolution Imager and Spectrograph (ERIS) and the Multi-Object Optical and Near-infrared Spectrograph (MOONS) on the VLT, and the 4-metre Multi-Object Spectrograph Telescope (4MOST) on VISTA — are also benefitting from Bernard's incomparable expertise.

Award and retirement

Nearly all astronomers in Europe, and many outside, have used or will use a Delabre optical system for their science, be it at ESO or elsewhere. Three of the ten pioneering spectrographs of the twentieth century are attributed to Bernard (Hearnshaw, 2009). His genius and dedication were acknowledged in the award of the Tycho Brahe Prize for 2017 by the European Astronomical Society which was presented to Bernard at the meeting in Prague in July[1,2].

A retirement party was held in Bernard's honour on 28 July 2017 at ESO Headquarters and was attended by many friends and colleagues who have worked closely with him. Speeches were given by the ESO Director General Tim de Zeeuw, Gerald Hechenblaikner of the Directorate of Engineering and his colleagues Samuel Lévêque and Jason Spyromilio. At the party, it was announced that Bernard was to be made Emeritus Engineer at ESO in appreciation of his many achievements, and in anticipation of many more ingenious optical designs.

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Links

[1] Tycho Brahe Prize award 2017: http://eas.unige.ch/tycho_brahe_prize.jsp
[2] ESO Announcement of Tycho Brahe Prize: http://www.eso.org/public/announcements/ann17018/

Departure of Patrick Geeraert, Director of Administration

Tim de Zeeuw[1]

[1] ESO

Patrick Geeraert was appointed Head of Administration at ESO in 2008, initially on a one-year secondment from the European Organization for Nuclear Research (CERN) in Geneva. One year became three, three became five, five became seven, and seven became nine. He has now returned to CERN.

When he arrived at ESO the then Administration division consisted of two nearly independent units, one in Chile and the other in Garching, and the Human Resources (HR) department also needed to return to Administration. In the context of the unification of ESO's structures, and in order to increase the links between the sites in Chile and Germany, Patrick oversaw the evolution of Administration towards a much more inte-grated structure. After a while it became clear that HR also needed to be inside the Administration division and the title was changed to the Directorate of Administration, with Patrick as its Director.

Patrick played a key role in leading the last two collective bargaining rounds in Chile. The recent one in 2016 was particularly challenging as it involved the