

A Sneak Preview of the E-ELT Design Reference Science Plan Questionnaire Results

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The European Extremely Large Telescope is in its detailed design phase until the end of 2010. During this period, the telescope design is being consolidated and instrument and operation concepts are being studied. The scientific users are feeding back requirements into the project in numerous ways. One of them, the Design Reference Science Plan, was an opportunity for the entire community to provide direct feedback to the project. Here, we summarise the first results from this study. The full report will appear in the first half of 2010.

As the detailed design phase of the European Extremely Large Telescope (E-ELT) progresses at a rapid pace, the scientific users are continuously injecting requirements into the project. The E-ELT Project includes a science office staffed by around ten researchers (the majority being post-docs, i.e. young future users of the facility), and it is continuously assisted on scientific issues by an external Science Working Group (SWG), established in early 2006, and comprising about 20 senior researchers from the community. A Design Reference Mission (DRM) was set up by the SWG and served as reference for about 20 high priority science cases that have been simulated in detail (the first reports are available on the project web pages¹). The outcome of these science cases is being used to drive the telescope and instrument requirements.

However, a very broad, direct input from the community was missing until a year ago. This was the reason for launching the E-ELT Design Reference Science Plan (DRSP) at JENAM 2008 in Vienna. The DRSP is meant to be a large collection of science cases provided directly by the future users of the E-ELT. The DRSP aims at exploring the full range of science cases for which the E-ELT will be used. Ultimately, it will help to define the boundaries of the parameter space over which

the E-ELT will operate. It will be used to guide the performance optimisation of the telescope, the prioritisation of the instruments, as well as to plan the science operations modes.

In order to collect input from the community efficiently, the DRSP was set up as a web questionnaire, guiding the users through the submission of a dummy proposal for the E-ELT. The questionnaire prompted for the science case (title, abstract, category, ...), the identity of the authors (institute, stage of career, ...) before going into the details of the targets, spatial requirements, spectral requirements, type of instrumentation required, operations requirements, synergies, etc. A detailed presentation of the questionnaire can be found in the contribution of Aybüke Küpcü Yoldaş to the Design Reference Mission Workshop 2009 (see Hook et al., 2009) and available on the E-ELT science web pages².

The questionnaire was available to the community from September 2008 until June 2009. During that period, 188 science cases were submitted by 157 principal investigators from 105 institutes across Europe. This well exceeded our goal of collecting at least 100 cases. The entries have been collected in a large database and are being analysed statistically. A report, with the analysis, as well as the entries for all those cases that agreed to publication, will be produced and published in the first half of 2010. Here, we provide a sneak preview of the first statistics.

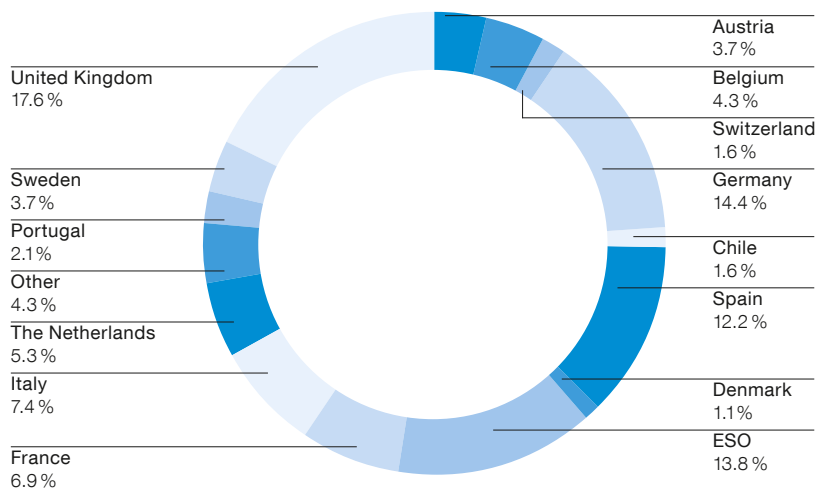
Synopsis of questionnaire results

Proposals were received from all ESO member states. The UK, Germany and Spain feature prominently, followed by Italy and France. The distribution of questionnaire returns by ESO member state is detailed in Figure 1. The number of returns for ESO is partly inflated by the E-ELT Science Office, which, in addition, "submitted" all those DRM cases not already covered by the community. About two thirds of the PIs were faculty members, the other third being made up of postdoctoral researchers (see Figure 2 for the breakdown).

The proposals were classified in the four categories established for the ASTRO-NET Roadmap³. Three quarters of the proposals were shared between the categories, "How do galaxies form and evolve?" and "What is the origin and evolution of stars and planetary systems?" (see Figure 3 for the project categories and the distribution of the returns).

On the technical side, all instruments that are being currently studied in Phase A have been requested and almost all equally, with a slightly higher number of proposals for the only mid-infrared instrument (METIS), and a slightly lower one for the most specialised instrument: the planet-finder. The full breakdown by re-

Figure 1. Pie chart showing the E-ELT DRSP questionnaire responses divided by ESO member state of the respondees.



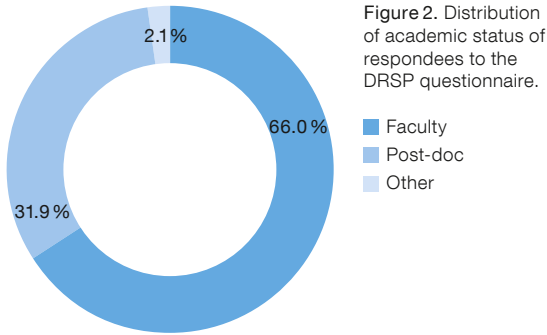


Figure 2. Distribution of academic status of respondents to the DRSP questionnaire.

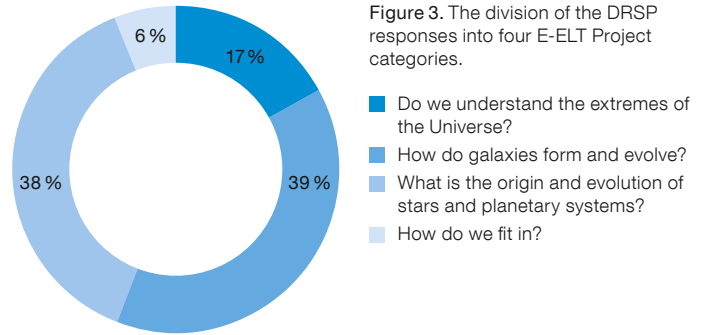


Figure 3. The division of the DRSP responses into four E-ELT Project categories.

requested instrument is given in Figure 4 and a list of the E-ELT instruments can be found in Spyromilio et al. (2008). Only a very few proposals requested capabilities not included in the current studies, confirming that the suite of instruments presently under investigation covers the entire needs of the community. In terms of spatial resolution, the largest share goes to diffraction-limited imaging.

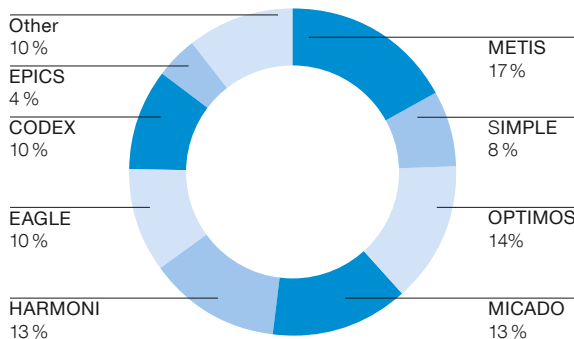


Figure 4. Breakdown of responses to the DRSP questionnaire by the eight E-ELT proposed instruments and an "other" instrumentation category.

Not surprisingly, given that the spatial resolution of the E-ELT exceeds that of the James Webb Space Telescope (JWST) by a factor of seven at infrared wavelengths, some ambitious science ideas were unleashed. However a quarter of the proposals requested seeing-limited image quality (see the summary of proposals by spatial resolution in Figure 5). This trend is to be expected, partly because, towards the blue end of the wavelength range, much better spatial resolution will not be available (at least in the first few years of operation), and partly because some high resolution spectroscopy cases did not require high spatial resolution, but rather are intending to use the E-ELT as a giant light-collecting bucket (its 1200 m² far exceeds the ~ 50 m² of a single VLT Unit Telescope). The field of view selectable in the questionnaire ranged from 1 × 1 arcseconds to 10 × 10 arcminutes and the distribution of the requests is shown in Figure 6, with 85% requesting 1 arcminute or less, and 60% requesting a field of view of 1 arcminute or less.

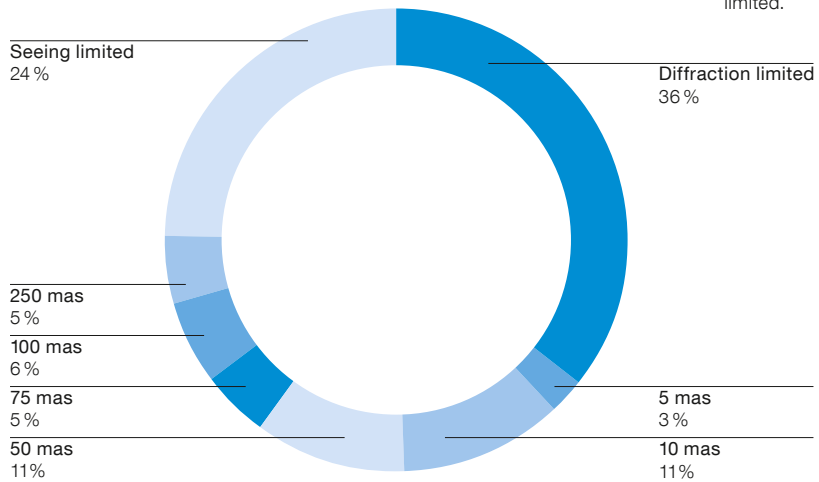


Figure 5 (below). The spatial resolution in milliarcseconds (mas) of the proposed DRSP projects broken down into diffraction-limited, six size bins and seeing-limited.

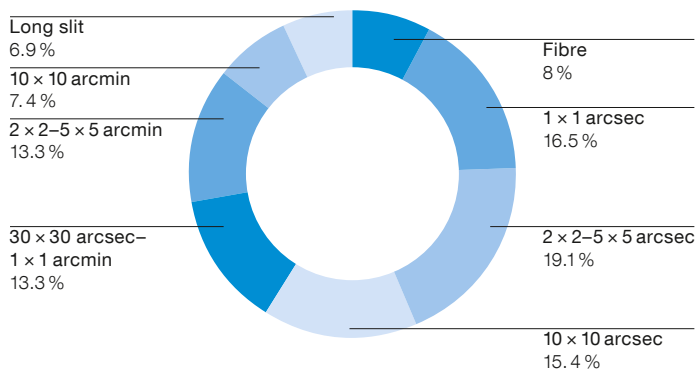


Figure 6. Distribution of proposed E-ELT observations by field of view (six categories) and including fibre and long slit.

The range of requested spectral resolutions is very wide, covering from $R \sim 100$ to $R > 100\,000$. About a quarter of the proposals requested broad- or narrow-band imaging. Peaks are seen in the requested spectral resolution near the "standard" near-infrared resolutions

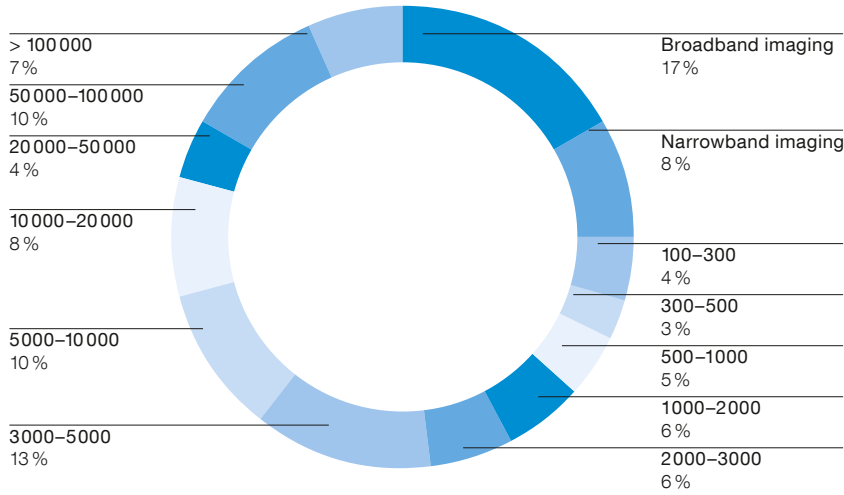


Figure 7. Pie chart of the requested spectral resolution for E-ELT DRSP proposals divided into broadband imaging, narrowband imaging and eleven ranges.

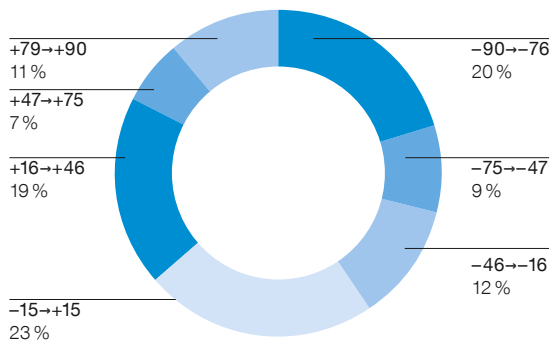


Figure 8. Distribution of requested declinations for the targets from the E-ELT DRSP questionnaires.

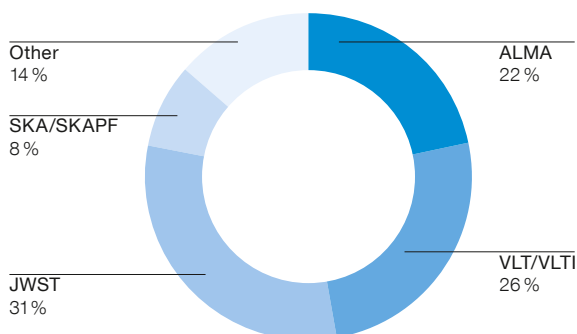


Figure 9. The current and future facilities with which the proposed E-ELT DRSP observations have a synergy.

(3000–10 000) and above $R \sim 50\,000$ (see Figure 7).

The targets of the proposals have a very uniform distribution in right ascension. In terms of declination, targets in the southern hemisphere (declination < 15 degrees) prevail over the targets in the northern hemisphere (declination > -15 degrees), as is clear from Figure 8.

Finally, the authors were asked to indicate whether their proposal would work in synergy with another facility (Figure 9). More than a third of the proposals mentioned JWST, about a third mentioned the Atacama Large Millimeter/submillimeter Array (ALMA), and the next most mentioned facilities are the VLT/VLTI and the Square Kilometre Array (SKA) (incidentally all located in the southern hemisphere).

So far, the proposals have provided valuable feedback, strengthened some of the project requirements and guided the project on scientific issues. The project is extremely grateful to the community for their numerous inputs to the DRSP and thanks all those potential future users who have taken time to support the project through the DRSP.

References

- Hook, I. et al. 2009, *The Messenger*, 137, 51
- Spyromilio, J. et al. 2008, *The Messenger*, 133, 1

Links

- ¹ E-ELT DRM Science Cases: <http://www.eso.org/sci/facilities/eelt/science/drm/cases.htm>
- ² E-ELT Design Reference Missions and Science Plan workshop proceedings: <http://www.eso.org/sci/facilities/eelt/science/drm/workshop09/>
- ³ ASTRONET Roadmap: <http://www.astronet-eu.org>