Council
154th Meeting (remote)
9 and 10 June 2020

For Information

REPORT FROM SCIENTIFIC TECHNICAL COMMITTEE
95th Meeting (remote)
16 and 17 April 2020

This document is PUBLIC

Council is invited to note this document
Report and Recommendations from the 95th STC Meeting


Excused: G. Pietrzynski

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I Introduction

The STC takes note of the difficult situation generated by the conjunction of the Chile crisis and the consequences of the Covid-19 pandemic. The STC expresses its support to all ESO staff and thanks ESO for their rapid safety management. The STC is encouraged to see early action from ESO on controlling the spread of the virus, a realistic appreciation of the impact of the virus on future operations and a balanced approach to early conversations about a future gradual and staged re-opening of ESO facilities.

The STC is again impressed by the great successes of the organization over the recent period and is very pleased to see the consideration given to the recommendations of the previous STC meeting.

The STC has taken note of the Conflicts of Interest, as presented at the end of the document. The VLT2030 discussion has been chaired by the vice-chair. The reports from the sub-committees (ESC, LSP, and ESAC) are presented in the annexes: they contain additional comments and recommendations that are important for the activities on the three main programmes.

II ELT Programme

The progress with ELT construction and all the associated developments in the companies or institutes is very impressive. The team should be commended for this. Despite the many complications generated by the DMS contract, the Chile Crisis, and now Covid19, the STC continues to be highly appreciative of all the efforts being made to maintain progress on the ELT programme. The STC would also like to express its great satisfaction with respect to the level of the cross-consortium activities and note that MICADO is now on track to FDR.

The STC thanks ESO for the presentation of the situation of the ELT Total Cost Exercise and is looking forward to the Council actions in June. The STC wishes however to emphasize that the plan does not permit the recovery of the full instrumentation programme as it was initially envisioned.

The STC was informed about the growing delays on intermediate milestones, which has eaten into the initial time buffer before first light. The STC is sensitive to the fact that the ELT project is being impacted by the third force-majeure event. These new delays on the programme are unavoidable and it is close to impossible to have a proper evaluation at this stage. The STC is aware that a new analysis will be necessary when the situation permits and that the delay on instruments/telescope projects will have to be re-analysed. The STC looks forward to an update at the appropriate time.

The STC acknowledges the progress on the MAORY consolidation phase that has led to the lifting of the yellow flag. The STC however points out that there is still no consolidated schedule to PDR of MAORY, and the mismatch of the schedules between MAORY and MICADO induce risks in many areas of the projects, not only the interface. A consolidated schedule is urgently needed, and ESO should continue closely monitoring the situation to keep the delays of MAORY to a minimum. In particular, the impact of the delay of the integration and commissioning plans for MAORY, at a time when MICADO will be operating, needs to be re-assessed. The STC notes that the optical interface
between MAORY and MICADO is now defined and under configuration control, and the STC encourages ESO to continue closely monitoring this critical interface.

The STC thanks ESO for the presentation on the activities regarding the pre-phases B of HIRES and MOSAIC. Considering the current overall situation of the ELT programme, and of ESO in general, the STC strongly recommends the continuation of the activity towards the optimization of the best MOS for the ELT, serving the largest possible community. Whereas the timeline for HIRES now seems clear, the STC recommends that ESO clarifies the timeline for completing the trade-off activity on MOSAIC, with clear TLRs. The STC and the ESC continue to be ready to assist ESO in this task.

The STC acknowledges ESO for following and recognizing the outcome of the many sub-system Critical Design Reviews (CDR) for HARMONI. The STC recommends that the issues resulting from the HARMONI CDR continue to be followed-up, and that everything possible is done to minimize the growing delays for this instrument. The STC therefore supports ESO in seeking a reasonable schedule for the HARMONI FDR.

The STC highlights the positive progress towards PDR closure for METIS. The STC notes four change requests (CRE) impacting the science performance. Following comments from ESC, the STC recommends the acceptance of these CRE. In addition to the CRE, the STC endorses the change to a GeoSnap detector, and expects a recommendation to be sought from the STC once the official CRE is filed, with appropriate documentation.

### III LSP Programme and APEX

The STC is encouraged to see the smooth commissioning of CRIRES+, the success of the NEAR science demonstration and the largely completed commissioning of Gra4MAT, which will greatly increase the scientific reach of MATISSE.

The STC congratulates the FORS upgrade team for a successful and well prepared Phase A and endorses the conclusion of the review board. STC is pleased to see no significant increase in the estimated level of resources required with respect to the plan presented in STC#93.

The STC was concerned about the delays and significant issues in the ERIS project with both NIX opto-mechanics and the Spiffier H2RG detector. STC recommends that ESO prioritises allocating the resources to oversee and assist the consortium in fixing these issues, given that neither NACO nor SINFONI are currently operational.

The STC is pleased to see the progress of MAVIS towards Phase A and is looking forward to the report of the Phase A review. The STC also acknowledges the outcome of the CfP for a UV spectrograph and is looking forward to following the Phase A process and taking part in its final review.

Unlike previous Paranal Instrumentation Plans, the **Cou-1889** document briefly discusses the long term status of VISIR. In light of the imminent removal of the Q-band from the METIS instrument for the ELT, and given that even MIRI/JWST has very limited capabilities beyond 12 microns, VISIR
may have unique capabilities for a significant period. The STC expects that ESO will carefully include the future of VISIR in the roadmap for the Paranal Instrumentation Programme when we are updated on the roadmap in upcoming meetings.

The STC takes note of the document describing the ESO position on APEX. The STC reiterates its concern that the recent large investment in APEX will not provide much benefit to the ESO community, given the short time frame from implementation to the end of 2022. The STC asks ESO to inform the community of the limited remaining availability of APEX, which will have an important impact on the recent instrument upgrades, some of which have not yet been implemented.

[VLT2030] In view of the material submitted in the White papers and ESO’s analysis, the STC endorses the instrument proposals as outlined in the Gravity+ and BlueMUSE white papers.

SCT strongly encourages ESO to proceed immediately to Phase A studies of Gravity+, followed by BlueMUSE no later than 2022. This Phase A for Gravity+ needs to include a thorough analysis of the ESO resources needed to complete the project. The extra time allocated to the BlueMUSE programme should be used to evaluate the technological feasibility of the curved CCD detectors, which will have an important bearing on the proposed 2 square arcminute field of view, and significant cost implications even for a 1 square arcminute field of view option. STC notes that this technology will have importance well beyond its implementation in BlueMUSE. Note, however that even with a 1 square arcminute field of view, the STC still assesses the science case of BlueMUSE as outstanding.

The STC is concerned about the very significant burden Gravity+ will place on ESO resources, and expects ESO to ensure that appropriate resources will also be made available to BlueMUSE, once it starts Phase A.

The STC finds that the White Paper for Sphere+ is less compelling and detailed than the other two (for example in relation to the community engagement and the limited maturity of the cost analysis). The STC asks ESO to investigate the possibility of targeted Sphere upgrades instead, as part of the PCS technology development roadmap.

The STC encourages ESO to continue the development of the roadmap for the Paranal Instrumentation Programme, with participation by the STC and input from the scientific prioritisation working group. This roadmap should give due consideration to SPHERE+ and the HR-MOS concept that emerged from the June 2019 workshop, as well as potential upgrades of current instruments and new ideas.

IV ALMA Programme

The STC wishes to underline the essential disappearance of the data processing/delivery backlog and congratulates the entire observatory on this achievement. The STC also congratulates ALMA on the most recent publications statistics, showing that ALMA is among the most productive observatories worldwide, with an increasing user community. The STC appreciates the recent progress for the development of Band 2.
The STC remains worried about the situation regarding the unilateral cancellation of the correlator upgrade project (CUP), as the CUP is an essential part of the roadmap towards 2030. The STC appreciates that a workshop has been held in February and recommends ESO to actively encourage European participation or contributions to a new CUP-project.

The STC remains worried that the continued use of the off-site budget to pay for in-kind contributions to on-site activities might have a negative impact on regular activity in the near to long-term future.

The STC agrees with the arguments presented in document \textbf{STC-648} for why a new ALMA OT is required and is impressed by the preliminary work that was presented. The STC is therefore happy to recommend the approval of the project to develop the new OT.

The STC supports the possibility of offering ALMA-VLT/I joint programmes. The scientific cases presented are very interesting and such joint programmes will be very positive for the community. It is clear that such a joint opportunity will be beneficial to several scientific areas. In particular, one can see a clear advantage for early career scientists that often have less time to complete their projects. Moreover, joint programmes can improve the completion efficiency of multi-wavelength studies.

The STC recognizes the importance of Guaranteed Time Observations (GTO) as a concept for increasing the interest and motivation of institutes and the ALMA community to contribute time and resources to the ALMA development roadmap. This possibility was not previously implemented. The STC appreciated receiving the presentation, as well as the updates given by the DG, and looks forward to seeing a fully detailed proposal of this concept in order to be able to issue a recommendation. The STC fully agrees that the reimbursement in the form of GTO time should be done on the basis of the science that can be executed with the GTO time.

\textbf{V General Business}

The STC is very supportive of every effort to intensify the scientific cooperation between ESA and ESO and is pleased to be consulted in the matter of the PLATO Ground-based Observation Programme (GOP) at this time. However, the STC feels unable to comment on the specific modus operandi in which the GOP could be implemented. To be able to do so the STC would require more detailed information regarding the GOP, such as its scientific goals, the details of its target sample selection, proprietary data rights requirements and ESA’s plans for how to constitute the GOP team in order to build this ESA-ESO coordination.

The STC is very supportive of the efforts to implement the Double Anonymous Peer Review and commends OPO for using the experience of other organisations where this has already been implemented and giving detailed consideration to how the reviews can be performed in practice at ESO. The overall proposed implementation closely follows what has been successfully implemented by STScI for the Hubble Space Telescope and this seems sensible. At present OPO is planning to have a ‘dry run’ in P106 where proposers are encouraged to write the proposals anonymously, but no requirement is made and the review will be performed as in P105. The STC has a slight concern that the planned execution of the ‘dry run' in P106 may in fact create an uneven playing field for proposers.
and spark unconscious biases with reviewers. The STC encourages OPO to consider how the review process itself can also undergo a dry run in P106. Also, the details of how the review will be handled were not communicated as clearly to the community, as they were to the STC. The STC therefore recommends that for P107, the details of how the review will be handled are communicated more clearly to the community.
Annex I: Report from the ESC Meeting April 3rd 2020

Attendance: (all remote)
ESC: B. Carry; R. Chini; A. Fontana; U. Heiter; V. Hill (chair); J. Liske; S. Longmore; F. Rigaut; S. Sousa.
ESO: Adrian Russel, Bernard Koehler, Fabio Biachat Marchet, Florian Kerber, Frederic Gonté, Juan Carlos Gonzales Herrera, Michele Cirasuolo, Oliver Pfuhl, Paola Amico, Paolo Padovani, Patrick Cailler, Roberto Tamai, Suzy Ramsay, Vincenzo Mainieri, Xavier Barcons, Joel Vernet, Frédéric Dérie , Ralf Siebenmorgen, Sebastian Egner

Conflicts of Interest: B. Carry: HIRES (inst), MICADO (pers); A. Fontana: MAORY, HIRES, MICADO, MOSAIC. (INAF supervision); U. Heiter: HIRES (pers+inst); V. Hill: HIRES (inst), all instr (French follow-up committee); J. Liske: HIRES (phase A study, WG leader); S. Longmore: (UK E-ELT oversight committee, close interaction with HARMONI); S. Sousa: HIRES (inst. + pers)

The ESC took place on April 3rd, remotely via Teams, given the covid-19 lock-down of most European countries. Fact sheets about the telescope, the four construction-budget instruments and AO modules, as well as fact sheets for MOSAIC and HIRES were provided by ESO 2 weeks beforehand. The ESC was also given access to the slides for all presentations 3 working days in advance of the meeting. The ESC also received documentation about the scientific analysis of MOSAIC’s observing modes in view of optimising the scope of the instrument (MOSAIC Overview, E_MOS-SCI-ANR-HMMOPT, E-MOS-SCI-ANR-IFUCOMP and questions_referees.tar). ESO staff presented telescope and instrument progress. Discussion took place with the ESO staff in open sessions and within the ESC in closed sessions.

The ESC would like to acknowledge that despite the complications that the covid-19 lockdown induced, the ESC meeting took place in very good conditions: documentation was available in due time (including the presentations) despite the high pressure by the lock-down; presentations were at the usual very high standards; and discussions took place in an open and constructive spirit. The ESC wants to give special thanks to ESO for this. The ESC also appreciated that its recommendations and requests for information were almost all systematically addressed in presentations/documentation.

The ESC would like to stress that items for which ESO seeks specific comments or recommendation, should be accompanied by relevant documentation. Changes to instrument TLRs clearly belong in this category, since it changes significantly the science opportunities opened by an instrument.

ELT programme status:

The ESC wishes to congratulate the ELT team for the excellent work and progress of the project in the last period, despite the added complications and associated extra work, first with the civil unrest in Chile, and then the covid-19 situation. The ESC recognises the huge efforts involved in following all aspects of the project already in normal conditions, and the additional work implied by both these situations, including the monitoring and analysis of Force Majeure invoked by many contractors. The ESC acknowledges ESO’s efforts in staffing the ELT programme, and continues to support the ELT programme towards filling in the shortfall in FTEs.

On the programmatic side, the approval of the second Pre-Focal Station B Phase 2 item is a major success that will allow the full deployment of the ELT instrumentation (including HIRES and MOSAIC) as well as flexibility for commissioning a delayed MAORY while maintaining MICADO in
operation, and finally, a general versatility/flexibility for the ELT instrument suite.

The ESC notes the growing delays on intermediate milestones in many different areas, so that all the slack for the scheduled first light is now gone. In this respect, the ESC takes note that both M4 and M5 are on the critical path. The current lock-down situation will undoubtedly induce further delays on top of these growing intermediate milestone delays. *It is therefore clear that a new analysis of the ELT schedule will be needed, once the impact of the current crisis can be analysed in sufficient detail.* Once this new schedule analysis is performed, both for the telescope and infrastructure on the one side, as well as for the first light instruments on the other side, there is a risk that a lack of synchronization is uncovered. *The ESC would like to be kept informed of any backup plans, should this analysis reveal a serious delay between the first light of the telescope and the readiness of the first light instruments.*

**ELT Instruments:**

The ESC would like to commend ESO for the cross-consortium activities that are taking place (workshops on dedicated topics, working groups on science and technical topics, regular topical telecons ...). The community working groups were due to meet face to face in May, which is clearly impossible, but the ESC was informed that the meeting will take place (plenary in video-conferencing, followed by separate meetings for the splinters).

**MICADO:** [This part of the report was drafted by the non-conflicted members of the ESC]

*The ESC was very happy to hear that the interface between MICADO and MAORY is now agreed upon by all parties, under configuration-control, and that ESO continues to own the interface. The ESC commends all people involved, at ESO and in the consortia, for handling the issue very well, despite the two projects being out of phase in their development (MICADO working towards FDR while MAORY is still working towards PDR). The ESC recommends that ESO continues monitoring closely this interface, and continues to organise close-contact between the two consortia.*

The path to FDR for MICADO looks sound. The ESC however recognises, as for the ELT telescope, infrastructure, and all the other instruments, that the current uncertainties with the lockdown in Europe and elsewhere currently prevents a full analysis of the impact on the MICADO schedule.

**MAORY:** [This part of the report was drafted by the non-conflicted members of the ESC]

The ESC salutes the progress of the MAORY consolidation phase that has allowed to reach consensus on a new design for the instrument that meets its performance requirements (including a gravity invariant second port), and the lifting of the yellow flag status. *The ESC looks forward to a consolidated schedule for PDR in the very near future.*

*The ESC would also like to encourage the MAORY consortium to produce simulations of the final expected performance, now that the design of the instrument, the number of actuators of the deformable mirrors (DM), and the number of Laser Guide Stars (6, with a risk that operations might start with only 4), are fixed, focussing the discussion on the impact of a second DM.*

As noted above in the MICADO section, *the ESC recommends that ESO continues to organise close-contact between the MAORY and MICADO consortia as part of the configuration control of the interface between the two instruments.*
In the context of the risks generated by the fact that MAORY and MICADO are out of sync, and with the availability of PFS-B, the ESC would like to understand what the integration and commissioning plans are for MAORY and the likely impact of this on MICADO operations.

**HARMONI:** [This part of the report was drafted by the non-conflicted members of the ESC]

The ESC commends ESO for following up and recognizing the outcome of the many sub-system CDRs of HARMONI, recommends to continue following up the issues that came out of the CDR, and do everything to minimize the growing of delays for the instrument. The ESC also supports ESO in seeking a reasonable schedule for FDR.

**METIS:** [This part of the report was drafted by the whole ESC as no ESC members present are conflicted]

The ESC would like to congratulate the METIS team for nearing a successful PDR closure.

Following the PDR, METIS submitted to ESO four change-requests (CRE), some of which alter significantly the science performance of the instrument. In addition to these CREs, the case was also made for changing the baseline detector (Aquarius) to a Geosnap detector. The ESC was presented briefly with these CRE and the case for a detector change, while more thorough discussions took place during the PST meeting on March 19th, during a METIS-dedicated session where a member of the ESC was invited (R. Chini).

The ESC felt the degree of information received concerning the CREs of METIS was not sufficient to allow for solid recommendations to be made on the topic during the meeting. The ESC therefore chose to hold a separate close session by telecon the following week, after receiving and studying the documents (same documents that were available to the PST), to formulate the recommendations below.

Changing the baseline detector (Aquarius) to a Geosnap detector improves significantly the sensitivity in L, M and N bands, at the cost of losing the Q-band for METIS. The science impact of these sensitivity aspects was thoroughly investigated. The gain in L, M and N bands has a significantly larger positive impact on the primary science cases than the loss of Q-band imaging capabilities, which is only marginally more efficient than VISIR@VLT. Regarding the Q-band comparison with VISIR, the ESC would have appreciated an analysis of the scientific impact due to the reduced spatial resolution aspect of the loss of the Q-band. The ESC agrees with the trade-off presented to the PST, and expects that a formal change request is made to ESO for using a Geosnap detector, where the impact of the detector change on the instrumental WP should also be considered.

*In the view of the arguments presented, the ESC recommends that the CRE R-MET-89 (dropping the simultaneous L+M band slit spectroscopy), R-MET-90 (dropping the medium resolution N-band slit spectroscopy), R-MET-99 (reformulation of the instantaneous wavelength coverage of the IFU spectroscopy), and R-MET-110 (changing the Laser Tomography AO into a Laser Assisted AO) are accepted.*

The ESC however notes that the METIS science team was not as unanimous concerning the loss of the medium-resolution N-band spectroscopy as for other CREs. *It would have certainly been useful that simulations (or experiments based on VISIR@VLT observations) were shown to demonstrate the minimum resolution needed to attempt atmosphere correction in the wavelength range relevant to the science case(s) concerned.*
The ESC also notes that the CRE to change AO mode from LTAO to Laser Assisted AO was essentially driven by technical considerations (mass/volume, cost). Given that the high spatial and spectral resolutions are indeed key to METIS breakthrough science, the ESC would have expected an analysis of the science impact of the CRE, in particular on the high-contrast science.

**HIRES and MOSAIC:** [Note that a majority of ESC members are conflicted with HIRES – albeit institutional conflict in a majority of cases]

The ESC salutes the efforts by the consortia and ESO follow-up teams of HIRES and MOSAIC for keeping up momentum in this period pre-phase B.

MOSAIC is undergoing a competitiveness analysis of each observing mode, followed by re-designing activities, that were presented at the March 19th PST meeting, where expert referees were invited, as well as J. Liske and V. Hill as observers for the STC/ESC. The ESC also received the associated documentation for information. The lengthy discussions of the PST session showed that the HMM (visible and near-IR) and HDM modes have strong science cases, although the HDM appears less competitive. Moreover, the combination of all modes might compromise the optimization of any given mode in the technical solutions for a common design. There are still a few options that should be investigated to come to the final scope for the instrument, including the type of AO needed with the current HDM design, and the potential improvements that could stem from optimizing an instrument with HMM mode only. The next step in the process is a technical meeting in June, but the ESC was not presented with a clear timeline for the full process up to defining the final scope of the instrument.

*The ESC recommends that ESO defines, as soon as possible, a route and associated timeline for converging on the instrument scope, consolidated by science as well as technical aspects. The ESC looks forward to the final outcome of this analysis, and reaffirms that it stands ready to assist ESO in preparing any follow-up decision for defining the MOS that would be most competitive for the community.*
Annex II: LSP Report, 16 April 2020

Attendance and Conflicts
Anja C. Andersen, Paul Callanan (Chair during VLT2030 discussion), Gael Chauvin, Michael Ireland (Chair), Stefan Kraus, Marcella Marconi, Dimitri Mawet, Laura Pentericci, Hugues Sana
Apologies: Grzegorz Pietzynski

The conflicts are given in the following table, with “P” for personal “I” for institutional, and “p” for potential conflicts. Hughes Sana declared a conflict for 4MOST community surveys (a current topic) but was not conflicted about the instrument itself.

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Introduction

The LSP acknowledges the very difficult times at the moment due to the Covid-19 situation in Europe, Chile and the world. We were encouraged to see early action from ESO on controlling the spread of the virus, a realistic appreciation of the impact of the virus on future operations and a balanced approach to early conversations about a future gradual and staged re-opening of ESO facilities.

The LSP was excited to see smooth commissioning of CRIRES+ so far, and encouraged that no significant issues are foreseen at this stage in completing the commissioning. The LSP was also encouraged by the success of the NEAR science demonstration and the largely complete commissioning of Gra4MAT, which will greatly increase the scientific reach of MATISSE.
Remarks on VLT2030 White Papers
(NB Gael Chauvin was project scientist for Sphere+, so was not associated with drafting this text and was not present for the ESO presentation and subsequent discussion session)

The quality of the VLT2030 white papers was generally high, and when taken together with plans for a high-resolution multi-object spectrograph, represent a broad set of exciting instrumentation that would maintain ESO’s world leading status in ground-based astronomy in 2030 even without considering the ELT.

**Sphere+**

Sphere+’s exoplanet science case builds on the success of Sphere and proposes to push the limits to smaller inner working angles, better contrast, and higher spectral resolutions. The Sphere+ white paper was assessed as the least mature of the three white papers, and importantly did not address the requested Community Engagement strategy. Realistic simulations of yield are needed with a range of assumptions based on data, including long-term RV monitoring and a defined sample (e.g. SHINE once published). If the consortium is to re-propose for a future instrument slot, they should address the overlap with Gravity (and Gravity+), ERIS, HARMONI and MICADO. There was also not enough technical detail in the white paper to warrant proceeding to Phase A, given the required resources from ESO. Because of this lack of detail, the likely cost of the programme is also too uncertain. The issue of the DM also has to be addressed. ESO should investigate the possibility of targeted Sphere upgrades, e.g. as part of the PCS technology development roadmap.

**BlueMUSE**

The BlueMUSE white paper presented a broad set of science topics and questions. Some of these were assessed as strong and unique to BlueMUSE, in particular constraining models of gas flow in and around galaxies, understanding Lyman continuum emitters at z~3-5, and the investigation of a variety of sources at “Cosmic Noon” through cluster lensing. We noted that the key science questions became a factor of ~2 more efficient with a 2 rather than 1 square arcmin field of view - critical for an instrument anticipated to use much more than 1000 nights of UT time. However, the technological and cost difference between pre-phase A designs based on curved and flat detectors was too great to recommend a Phase A for the full instrument starting this year. We recommend that ESO should work with the consortium to assess the feasibility of curved detectors and any alternative optical designs as part of continued pre-phase A discussions with the consortium, with an anticipated Phase A start of 2021 or 2022.

**Gravity+**

Many of the science cases presented in the Gravity+ white paper are clearly unique internationally in the ELT era (this cannot be overstated - Gravity is an asset to ESO and the European community with little to no competition overseas) - especially masses of high redshift AGN and resolving the Einstein radius of gravitational microlenses including stellar mass black holes. The LSP notes that the exoplanet science case seems most useful for planets with <10 year Gaia orbits or planets already detected with other instruments. As with the SPHERE+ criticism, the exoplanet case needs to be addressed in more detail with realistic simulations. There are several issues of cost and risk still to be worked out, including the number of ESO FTE required and an achievable timescale for providing these FTEs. We argue that these issues are best worked out as part of a formal phase A process starting this year. Because of the very limited de-scoping opportunities for Gravity+, it is
important that the consortium members fulfil their funding obligations at the end of Phase A. Depending on the result of this phase A process, we recommend the STC considers whether to move to subsequent phases. The community engagement section of the white paper was reasonable, but should be expanded in Phase A, for example with a plan that involves more than one community workshop.

**Additional Recommendations/Comments to STC**

**Dual Anonymous Peer Review**

The LSP was pleased to see that a clear plan of implementation for the Dual Anonymous Peer Review process was presented by ESO with the goal of implementing it for period P107 considering the ESO’s specificities. This plan has been a gradual evolution over the past periods to bring ESO submission and peer review process to the most advanced international standards.

**FORS-Up**

The LSP congratulates the FORS upgrade team for a successful and well prepared Phase A and endorses the conclusion of the review board. We were pleased to see no significant increase in the estimated level of resources required.

**UV-Spectrograph**

The LSP was encouraged that the UV-Spectrograph renewed proposal appeared at this early stage to be scientifically compelling and only require a small amount of ESO resources. As stated in STC-639, the LSP looks forward to being able to critically analyse the result of the Phase A review.

**ERIS**

LSP was concerned about the delays and significant issues with both NIX opto-mechanics and the Spiffier H2RG detector. We recommend that ESO prioritises allocating the resources to oversee and assist the consortium in fixing these issues, given that neither NACO nor SINFONI are currently operational.

**Lessons Learned**

As several instruments draw to a close from a technical perspective, both formal and informal lessons-learned processes will be needed. The NEAR experience, in particular with data reduction and the influence of water vapour, has particular relevance to METIS. We encourage both a technical paper as planned, and direct communication with the METIS team. After commissioning for CRiRES+ is completed, we note that the recommendation from STC 632 still stands, and a lessons learned process is needed.

**CIAO**

We thank ESO for an honest report on why CIAO is not yet offered in an on-axis mode, and hope that technical issues can be resolved and that the mode can be offered for P107.
Follow-up of Previous Recommendations

We note that ESO did not report on any considerations they may have had for offering the NEAR mode during 2020 (Annex C of STC 639).

Although we were encouraged to see Gra4MAT, we understand that the MATISSE pipeline progress is still ongoing and we would like to be informed about progress to a resolution to this as part of PAC.

We note that installation of the front end lenses for ESPRESSO (to recover blue throughput) and VLTI delay line doubling are ongoing, and anticipate hearing about these upgrades in a future meeting.
Annex III ESAC Report

Report of the February 2020 ESAC F2F Meeting
ESO Garching, February 20, 2020


ESAC members: Anne Dutrey (via videocon), Maryvonne Gérin, Josep Miquel Girart, Talvikki Hovatta (via videocon), Pavel Jáchym, Kirsten Kraiberg Knudsen, Mario Tafalla, Paul van der Werf (chair), Sven Wedemeyer, Eva Schinnerer (Observer)

ESO participants Carlos de Breuck (via videocon), Evanthia Hatziminaoglou, Rob Ivison, Cisca Kemper, Tony Mroczkowski, Neil Phillips, Erich Schmid, Felix Stoehr (via videocon), Leonardo Testi, Pavel Yagoubov, Martin Zwaan (via videocon)

1. Summary

- ESAC appreciates how difficult the circumstances created by the Covid19 situation are, with impact on all aspects of ALMA. ESAC is positive about the clear and quick communication concerning the ALMA deadline, compliments the entire observatory on the way the present difficult and unpredictable situation is handled, and wishes the entire staff success and good health going forward.
- ESAC is very positive about the essential disappearance of the data processing/delivery backlog, and congratulates the entire observatory on this achievement. ESAC also congratulates ALMA on the most recent publications statistics, showing that ALMA is among the most productive observatories worldwide, with an increasing user community.
- ESAC appreciates the efforts going into monitoring the political situation in Chile and how this affects the ALMA and APEX operations.
- ESAC remains worried that the continued use of the off-site budget to pay for in-kind contributions to on-site activities might have a negative impact on regular activity in the near- to long-term future.
- ESAC is satisfied by the successful implementation of the Distributed Peer Review process during the past Cycle 7 Supplemental Call for proposals.
- ESAC supports the principle of double anonymous refereeing of observing proposals, as proposed, as the way forward. ESAC supports the introduction of a new medium category for proposals. ESAC also supports promoting high-risk/high-gain science for a limited time share and encourages the observatory to find suitable ways to increase the share of corresponding projects. These changes must be thoroughly evaluated once some experience has been gained.
- There is unanimous support within ESAC of the necessity of the OT upgrade.
- ESAC has expressed concern on the CUP cancelation (issue raised in the previous meeting). It is essential for the observatory that the schedule for a correlator upgrade is confirmed and known to the community.
- ESAC appreciates the progress of band 2 developments and supports the new design with 2SB and a wide IF.
- ESAC was positive about the results of the completed development studies.

2. ESAC composition and meeting process

- There has been a change in ESAC membership since the last meeting. Franz Kerschbaum (previous ESAC chair) and Jes Jørgensen (observer) ended their terms and we thank them for their commitment and valuable contributions. New ESAC members are Maryvonne Gérin, Pavel Jáchym and Paul van der Werf. Paul van der Werf will also be a member of the STC starting 2020, and is the new ESAC chair.
ESAC met at ESO Headquarters in Garching on February 20, 2020, two weeks before the ASAC meeting and eight weeks before the STC meeting (on April 16-17, 2020). The European ASAC members are Anne Dutrey, Maryvonne Gérin, Kirsten Kraiberg Knudsen, Eva Schinnerer, and Mario Tafalla. Talvikki Hovatta, Pavel Jáchym, Kirsten Kraiberg Knudsen, and Paul van der Werf are also STC members.

The ESAC meeting has been decoupled from the STC schedule to ensure informed and timely input to the ASAC meeting. The documentation for the ESAC face-to-face meeting was for the most part available well before the ESAC meeting. The information given during presentations by ESO staff was well prepared to allow for informed discussions. The EOC document was not available during the face-to-face meeting and was discussed separately during a telecon on March 3.

An additional telecon was held on March 20, to discuss the implications of Covid19 and related measures on ALMA proposal deadline, operations and users.

ESAC would like to thank Ciska Kemper for organizing the ESAC meeting and telecons and all of the ESO ALMA staff for a very productive face-to-face meeting.

The agenda for the ESAC February 2020 meeting is included as Appendix 1. The permanent and ad-hoc ASAC charges are listed in Appendix 2.

3. ESAC assessments and concerns for STC regarding ALMA

The Covid19 crisis has had important effects on ALMA operations in the broadest sense. The ESAC wishes to compliment the entire observatory with the way these difficult and unpredictable circumstances are handled. Here we first list the points related to Covid19.

Covid19-related points

- Due to the Covid19, ALMA operations were suspended, and the ALMA proposal deadline was pushed back. These developments were discussed by ESAC in a telecon on March 20, 2020, with Ciska Kemper, Evanthia Hatziminaoglou and Martin Zwaan present to describe and comment on the current situation and answer questions.
- ESAC is very positive about the swift action taken by the observatory, in a situation of rapidly changing conditions. The decision to suspend operation and to push back the proposal deadline was taken based on a thorough analysis of the situation, risks, implications and developments. As such, ESAC was happy about the quick decision to push back the proposal deadline (only about a week after the release of the Call for Proposals). Quick and clear communication is far preferable over a situation of “waiting it out”. ESAC is also positive about the decision to extend proprietary time on data sets that were not yet public by the time operations were suspended.
- With operations suspended, there is an inevitable effect on the observations that were to be scheduled in the period from March 19 onwards, which includes the long baseline configuration. ESAC would like to stay informed about developments in the decision process on how to deal with this, in particular for A-rated programs, and on further effects on operations.

Other points

- Several new observing modes will be offered in Cycle 8. ESAC notes that in the Cycle 8 differentiation of standard and non-standard modes will be removed but users should be aware of limitations that remain. ESAC notes that removing the term "non-standard mode" may have a positive effect on the number of proposals for, for example, high-frequency proposals.
- ESAC is impressed that the data processing/delivery backlog has essentially disappeared. Also, the fraction of QA2 failures due to “beam” has been brought down to 1%. The entire observatory is to be congratulated on these achievements. Efficiency of observations has increased and was in fact so high that a brief scheduling gap occurred. This was dealt with in a logical and satisfactory way, but ESAC points out that if this occurs more often, a structural solution must be found.
- ESAC congratulates ALMA on the most recent publications statistics, showing that ALMA is
among the most productive observatories worldwide, with an increasing user community. This underlines that the observatory is successful in being a facility for the entire astronomical community, not just for specialists, in line with the goals of the observatory.

- With data processing now done primarily at JAO, ESAC is concerned about this becoming a one-point failure risk in the long term. ESAC also remains worried that the continued use of the off-site budget to pay for in-kind contributions to on-site activities might have a negative impact on regular activity in the near-to-long-term future. ESAC received reports that power at the ALMA site is less reliable than before, and in positive about the use of Paranal expertise or synergy to mitigate risks.

- ESAC is satisfied by the successful implementation of the Distributed Peer Review process during the past Cycle 7 Supplemental Call for proposals. ESO was responsible for technical implementation that ran mostly in a smooth way. There is clearly some more work to do to further improve the process. ESAC was informed that a non-negligible fraction of reviewers failed to understand the proposal rating scale correctly. Hopefully even clearer instructions will prevent this in the future. The ESAC was pleased that the Cycle 7 supplemental call attracted a high fraction of new proposals.

- One of the most significant changes in the proposal system will be the double anonymous refereeing system. ESAC supports this new process as the way forward. ESAC also supports the introduction of a new medium category for proposals. This may encourage more ambitious programs, without having to go into the somewhat intimidating “large programme” category, thus addressing a recommendation from the IVC. These are important changes, affecting directly how observers use ALMA, and ESAC therefore emphasizes the importance of properly evaluating the new system. The evaluation must include the refereeing process, the division of proposals into large, medium and normal, the choices on how to referee these three categories, how the aim of promoting a certain amount of high risk/high gain science is folded into this, and how successful the new system is in addressing recommendation by the IVC, where applicable. ESAC also supports promoting high risk-high gain science for a limited time share and encourages the observatory to find suitable ways to increase the share of corresponding projects.

- There is unanimous support within ESAC of the necessity of the OT upgrade. The project is well prepared, through a pre-study, which gives confidence in the project outcome.

- ESAC has expressed concern on the CUP cancelation (issue raised in the previous meeting). It is essential for the observatory that the schedule for a correlator upgrade is confirmed and known to the community.

- ESAC appreciates the progress of band 2 developments and supports the new design with 2SB and a wide IF. A small concern about the risk of the availability of LNAs with the required performance remains.

- ESAC was very happy to see the results of the completed development studies, with very positive outcomes for the observatory, for instance improvement of Rx tuning leading to improved performance.

- ESAC discussed the EOC document in a separate telecon and is pleased to see the new capabilities offered. ESAC also discussed the capabilities prioritized for cycle 9, and for cycle 10 and later, and broadly supports the choices made. However, ESAC was surprised that high frequency polarization capabilities were not included in the document, and would like to understand what the priority of that capability is in the current planning.

- Finally, ESAC appreciates the efforts going into monitoring the political situation in Chile and how this affects operations.

4. ESAC assessments and concerns for STC on other items

- ESAC is positive about the continued upgrade of APEX, in particular the continued surface improvements and upgrades to heterodyne receivers, despite the limited future of the telescope as an ESO facility.

- An important future development for APEX will be the CONCERTO instrument. ESAC is disappointed that, as a consequence of the limited lifetime of APEX as an ESO facility, the CONCERTO instrument will only be available for a very limited time to the ESO community.
It is important that the community is made sufficiently aware of the limited remaining availability of APEX.

5. ESAC responses to ad-hoc charges

ESAC addressed the following ad-hoc charges that it received from the European ALMA Support Center (EASC):

Ad hoc charge #1. ASAC/ESAC should consider means by which ALMA could both solicit and identify high risk/high reward proposals as part of the future calls for proposals and the ensuing proposal evaluation process.

ESAC supports promoting high risk-high gain science for a limited time share and encourages the observatory to find suitable ways to increase the share of corresponding projects. Among the possibilities are instructing the review panels to select (a limited number) of high risk-high gain proposals on the one hand, or creating a separate channel for such proposals on the other hand. The ESAC was of the opinion that it would be best to place the onus of arguing/demonstrating that a proposal is of “high-risk/high-gain” nature on the proposers; of course the reviewers may be of a different opinion. Examples of “high risk” proposals include the usage of experimental (i.e., not fully commissioned) observing modes, proposals using commissioned observing modes with potentially zero scientific outcome but potential high impact results, and demonstration of to-be-developed capabilities. The ESAC was of the opinion that the use of experimental observing modes or to-be-developed capabilities may be better realized via DDT. ESAC recognized that the observatory would make the final choice given the risks involved. ESAC further suggests to consider the medium project category for high risk proposals as the larger amount of observing time intrinsically poses a risk. Such projects could be subject to an intermediate decision point at which it is decided if it is worth continuing the project or not.

Ad hoc charge #2. ASAC/ESAC should list the science questions they would like to see addressed by publication statistics.

ESAC agrees with the science questions that ASAC would like to see addressed by the publication statistics (see ASAC report to the ALMA Board from October 31, 2019). Central questions include how ALMA’s scientific output has evolved over time and how it compares to other major observatories. More detailed information on the cycle-to-cycle evolution and distribution of peer refereed publications and average time from data delivery to publication split by region, science category, receiver band, configuration can be essential in identifying potential areas of improvement with the aim of a further increase of ALMA’s scientific impact across fields. ESAC recognizes the difficulties in adequately accounting for publications that use data from multiple bands and configurations, possibly spread over several projects. Assigning such a paper to only the first band being mentioned, as the current procedure seems to be, would result in biased (and thus potentially misleading) statistics with limited value. ESAC is aware of the very considerable effort it takes to compile such comprehensive statistics but would like to emphasize the high value of detailed publication statistics for a meaningful evaluation of ALMA’s scientific impact.

Ad hoc charge #3. ASAC/ESAC should comment on the draft revised Principles of the ALMA Proposal Review Process, especially on the concept and the extension of medium and large programs.

ESAC discussed the document on Principles of the ALMA Proposal Review Process. ESAC is aware of the large amount of hard work that went into producing and implementing such a new method of review and congratulates the whole ALMA staff for this fundamental work. ESAC supports the new double anonymous refereeing process. ESAC also supports the introduction of a new medium category for proposals. This may encourage more ambitious programs, without
having to go into the somewhat intimidating “large programme” category, thus addressing a recommendation from the IVC. These are important changes, affecting directly how observers use ALMA, and ESAC therefore emphasizes the importance of properly evaluating the new system. The evaluation must include the refereeing process, the division of proposals into large, medium and normal, the choices on how to referee these three categories, how the aim of promoting a certain amount of high risk/high gain science is folded into this, and how successful the new system is in addressing recommendation by the IVC, where applicable.

**Ad hoc charge #4.** ASAC/ESAC should summarize the feasible science observations with the Total Power Array given its expected sensitivities in this mode.

Solar observations were identified as the most important driver for continuum on the TP Array. This does not put strong constraints on sensitivity, but stability is important. No other pressing science cases were identified for this mode.

6. **ESAC responses to permanent charges**

In the following ESAC’s responses regarding the ASAC permanent charges are summarized and its recommendations to the ALMA Observatory (through the European ASAC members) and/or ESO are provided.

**Permanent Charge #1 – Performance of ALMA Scientific Capabilities**

ALMA continues to gradually expand its scientific capabilities. The following Cycle 8 capabilities will be offered: solar observations in band 5, pulsar mode (.P), Bands 9 and 10 ACA stand-alone observations, mosaicking of continuum linear polarisation observations (Bands 3 to 7), ACA spectral scans, and VLBI observations of faint targets (<500 mJy) in passive phasing mode. ESAC understands that in the Cycle 8 differentiation on standard and non-standard modes will be removed but users should be aware of limitations that remain. ESAC notes that removing the term "non-standard mode" may have a positive effect on the number of proposals for, for example, high-frequency proposals.

**Permanent Charge #2 – Technical Aspects of ALMA performance**

ESAC has been very impressed to hear that data delivery is now stabilized and that the delivery time goals are met. It congratulates all parties involved on the success of the concerted efforts. Further, we would like to note that in Cycle 7 QA0-failures have been very low and that the failure rate of QA2 due to beam has become basically negligible due to improved scheduling.

With data processing now done primarily at JAO, ESAC would like to learn which measures are in place to avoid that this is potentially becoming a one-point failure risk in the long-term future when the current resources in the EU-ARC might have been re-allocated to other tasks. ESAC learned that maintenance of the transporters and the power system is ongoing with the aim to increase their reliability. ESAC remains worried that the continued use of the off-site budget to pay for in-kind contributions to on-site activities might have a negative impact on regular activity in the near- to long-term future.

ESAC notes the good progress on the "Extension of the control room", which is an important move towards remote observing.

ESAC appreciates that the actions and development done for recovery after bad weather have improved the situation, leading to a faster recovery.

ESAC was informed that the contract for the current helpdesk tool, which is run by the NRAO, will end at the end of 2020 (after having been previously extended). A new vendor needs to be identified, and ESAC highly recommends that the ARC/JAO/ALMA and ESO investigate potential synergy with existing ESO tools and efforts.

ESAC is happy to learn that staging of calibrated (archive) data is available in all regions, and that it is popular. ESAC notes that this appears to be implemented in an automatic manner that does not introduce excess workload to the European ARC.
ESAC notes that raw data access has been implemented with low priority in support.

**Permanent Charge #3 – Assessment of Science Outcome**

ESAC is very impressed by the continued increase in ALMA publications that are now surpassing the VLT output. This is partly driven by publications with first authors from ESO member states and shows that the ESO ALMA community is continuing to grow. This is a major success, showing that the goal of ALMA to be an observatory for all astronomers, not for specialists only, is being achieved, and this is to the credit of the entire observatory. The apparently slow increase of papers using high frequency (Band 8, 9, and/or 10) data could be caused by the current accounting of multi-band projects, where the band that is mentioned first (which is typically the band with the lowest number) is the only band that gets counted.

ESAC raised a couple of questions it was interested in seeing answered by publications statistics. For these, see Ad-hoc charge no. 2.

**Permanent Charge #4 Maximizing Science Impact**

ESAC is satisfied by the successful implementation of the Distributed Peer Review process during the past Cycle 7 Supplemental Call for proposals. ESO was responsible for technical implementation that ran mostly in a smooth way. There is clearly some more work to do to further improve the process. ESAC was informed that a non-negligible fraction of reviewers failed to understand the proposal rating scale correctly. Hopefully even clearer instructions will prevent this in the future. Overall, PIs were mostly satisfied with the DPR system. About 85% of PIs considered that the comments were clear, and 75% rated the comments as very or somewhat useful. More PIs indicate that panels are more robust against biases (29%) than DPR (22%), 50% feel that the biases are similar in the two processes or have no strong opinion. There was some concern about confidentiality in the DPR. Since the DPR system is still very new, ESAC recommends ALMA to educate the community on the new DPR system.

ESAC noted the occurrence of a scheduling gap in 12m array compact configuration, which resulted in the resurrection of 6 projects (3 from EU). The gap arose due to less weather and/or engineering down-time. Should this be a trend, a measure to prevent this in future should be taken.

The ESAC was pleased that the Cycle 7 supplemental call attracted a high fraction of new proposals.

**Permanent Charge #5 – Operational or Scientific Issues Raised by (Regional) Communities**

No specific EU-related issues were raised by ESAC at the meeting.

**Permanent Charge #6 – ALMA Development**

There is unanimous support within ESAC of the necessity of the OT upgrade. The project is well prepared, through a pre-study, which gives confidence into the project outcome. Therefore, ESAC recommends that the project starts as requested. It is reassuring that any issues that may delay the project will not have an impact on the OT, since the present java-based OT can still be issued if such a delay happens. We recommend that some people in charge of the OT are present through teleconference in the next ASAC meeting. This is necessary in order to address previous concerns of how web-based OT works in certain conditions.

ESAC has expressed concern on the CUP cancelation (issue raised in the previous meeting). It is essential for the observatory that the schedule for a correlator upgrade is confirmed and known to the community.

ESAC appreciates the progress of band 2 developments and supports the new design with 2SB and a wide IF. A small concern about the risk of the availability of LNAs with the required performance remains.

Excellent progress was made with ARI-L. A discussion arose on where the ROBUST parameter used in the imaging should be stored (in the FITS header, readme or log), but ESAC does not want to micromanage this point, as long as the information is available and can be found in a simple way.
ESAC was very happy to see the results of the completed development studies, with very positive outcomes for the observatory, for instance improvement of Rx tuning leading to improved performance. New development 2019 studies are scheduled to start soon.

ESAC discussed the EOC document in a separate telecon and is pleased to see the new capabilities offered for cycle 8. ESAC also discussed the capabilities prioritized for cycle 9, and for cycle 10 and later, and broadly supports the choices made. However, ESAC was surprised that high frequency polarization capabilities were not included in the document, and would like to understand what the priority of that capability is in the current planning.
Appendix 1: Agenda STC-ESAC Meeting Garching, 20 February 2020

08:30  Closed session
09:00  Opening, adopt agenda
09:05  ALMA and EASC update (L. Testi), including feedback from the IVC
09:20  Programme Scientist report (F. Kemper)
       Ad hoc charge 3: Principles of proposal review
       Publication statistics
       Ad hoc charge 2: Questions to be answered with publication data
       News from the IST
09:35  APEX report (C. De Breuck)
09:45  Development studies (C. De Breuck)
       2016 studies
       2019 studies
10:05  Discussion on APEX/ESO only studies
10:20  Coffee break
10:35  Science operations update (E. Hatziminaoglou)
       Status update
       Experience peer distributed review ACA supplemental call
       EOC status and plan for the next five years (deferred to later telecon)
11:10  Discussion on ASAC charges 1, 2, 3, 4 & Ad-hoc charges 2, 3
11:40  ALMA Development: general and EU overview (F. Kemper)
       Roadmap and implementation
       Correlator, digitizers and front-end development workshops
       ARI-L
       Band 2
       OT upgrade
       ALMA science Archive v1.0
       Sumitomo Helium Compressor Analysis
12:00  Closed session
12:30  Lunch
13:15  OT upgrade proposal (A. Biggs/M. Nicol/E. Schmid)
13:45  ARI-L status update (M. Massardi)
14:05  Band 2 update and plan (P. Yagoubov/L. Testi/T. Mroczkowski)
       Band 2 science case background (T. Mroczkowski)
14:20  Discussion on ASAC Charge 6 (ALMA development)
14:30  ASAC Ad hoc Charge 1: High risk/high reward science
15:00  Coffee break
15:15  ASAC Ad hoc Charge 4: Science cases for the total power array
       Sensitivity estimation for Total Power Array continuum mapping
       Single-Dish continuum observations at ALMA (draft report)
15:45  Discussion on ASAC Charge 5 (Community issues)
16:00  Closed session
17:00  Exit Report
17:30  End of meeting
Appendix 2: ASAC Charges

**Permanent Charge #1.** Assessment of the performance of ALMA scientific capabilities: The ASAC shall indicate what information is required from the Joint ALMA Observatory (JAO) to perform this assessment.

**Permanent Charge #2.** Assessment of the technical aspects of the ALMA system performance: The ASAC shall indicate what information is required from the JAO to perform this assessment.

**Permanent Charge #3.** Assessment of the science outcomes from ALMA: Statistics on publications, citations, press releases, web sites, etc. collected by the Executives shall be collated by the JAO, and analyzed by the ASAC.

**Permanent Charge #4.** Recommendations of ways to maximize ALMA’s scientific impact: This includes review of the scientific effectiveness of the Proposal Review Process after each Proposal cycle.

**Permanent Charge #5.** Reporting on operational or scientific issues raised by the wider community as communicated by the three regional Science Advisory Committees (ANASAC, ESAC and EASAC).

**Permanent Charge #6.** Assessment of the scientific impacts of the ALMA Development Program, and particularly of new projects that are proposed.

**Ad-hoc Charge #1.** In the context of the feedback received from the 2019 ALMA International Visiting Committee, stating that is important for the Observatory not to lose sight of the importance of delivering datasets that facilitate transformational scientific discoveries, ASAC should consider means by which ALMA could both solicit and identify high risk/high reward proposals as part of future calls for proposals and the ensuing proposal evaluation process.

**Ad-hoc Charge #2.** ASAC should list the science questions they would like to see addressed by publication statistics.

**Ad-hoc Charge #3.** ASAC should comment on the draft revised Principles of the ALMA Proposal Review Process, especially on the concept and the extension of medium and large programs.

**Ad-hoc Charge #4.** ASAC should summarize the feasible science observations with the Total Power Array given its expected sensitivities in this mode.
### Annex IV: Conflicts of interest for STC#95

#### STC#95 Apr 2020 Conflicts of Interest

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**P:** Personal Conflict of Interest  
**I:** Institutional Conflict of Interest  
**Prefix p** for potential Conflict
Annex V STC #95 in "closed" session