Summary of the ATLAST-French days
12-14 May 2025, Paris -- Summary
https://atlast-fr-days.sciencesconf.org/

The Atacama Large Aperture Submillimeter Telescope (AtLAST) is a concept for a wide-field of view (1-2 square degrees) 50-meter telescope working in the sub/millimeter at 5000m. With strong synergies with IRAM, SKA, and ALMA, and much to learn from these facilities, AtLAST will also revolutionize astronomy by providing deep and wide field-of-view observations of the millimeter and sub-millimeter sky.

Following the recommendations of the A&A prospective, we organised a 3-day workshop gathering 85 participants to discuss the current status of the AtLAST project, its scientific potential, gauge France's potential interest and role in joining/supporting AtLAST, leverage on the french know-how in instrumentation and data reduction/analysis, and take into account the environmental and societal considerations.

The meeting fostered extensive discussion. We summarise hereafter some points that were identified as important for the French community and make a list of future actions.

Science with AtLAST

The AtLAST consortium has published eight refereed white papers. Scientific presentations at the meeting, across a wide thematic spectrum, reinforced the project's unique objectives presented in these white papers and their utmost importance to the French community. On top of these, a few gaps were identified that hold significant value for France:

- Wide-field observations (including polarization) of protoplanetary disks to probe their environment.
- Cosmic rays in evolved super-nova remnants.
- Mapping the gas content of cosmic filaments.
- Precising the properties of the first galaxies during cosmic dawn and reionisation.

AtLAST should also be incorporated in the Einstein Telescope blue book.

Beyond the cases that cover all the science that can be done by a general observatory, it is also important to extract the 3-4 main science goals. The French community would favor the use of AtLAST in a set of large key projects that would structure the international community.

Environmental considerations

Environmental impact and sustainability have been thoroughly addressed in the AtLAST project since 2021 with significant resource allocation. This is an impressive effort and an important point for the French community. In this domain, synergies with SKA have been identified, and exchanges of expertise are expected to follow.

Funding scheme:

The ESO "Expanding Horizons" call (Letter Of Intent due end of 2026, and proposal due mid 2027) is currently the best opportunity to obtain a participation of France in AtLAST. France is at the forefront of developing critical instrumental technologies, but sustained progress in these areas requires dedicated human and investment resources. CNRS/INSU that has always been a main actor in funding R&D could help here.

Precursors:

The IRAM-30m and APEX are natural precursors of the AtLAST project in the mm and submm domain. The IRAM/ALHAMBRA multi-beam camera of 25 beams at 3mm and 49 beams at 1mm, as well as the NIKA3 project that would fill a 11.5' field-of-view in multi bands will bring much expertise on the possibility to develop instruments that will eventually fill 1 to 2 square degrees. The POLARIS project of a polarized camera for APEX will also bring much information on polarization in the sub-millimeter range.

The French community also has a significant expertise in polarization with the polarized cameras in use or under development. The possibility to have a polarized calibration source on-board of a satellite (eg, the COSMOCAL project) is also a potentially strong asset of the French community.

Instruments by 2035 with significant French expertise

Presentations and discussions have highlighted the instruments that could be developed with the help of the French community by 2035:

- ~ 300 kpixels KID array.
- ~ 200 heterodyne beams of 2 x 16 GHz[1] at 0.1 km/s.
- Low-resolution KID spectrometer (1000 KIDS?).
- Polarized continuum camera.

Instrumental, observing, and data frontiers

To achieve these potentialities, several opportunities where France could contribute, have been identified.

- Instrumental:
    - For a KID camera, the focal plane will be curved. This implies a specific hardware design and a need to optimize the optics. Such a large KID array also calls for matching read-out electronics.
    - For multi-beam heterodyne receivers, low heat-production per beam is important. Moreover the integration time could be limited by the back-end capability.
- Observing:
    - The optimal scanning strategy for KID cameras to minimize large scale filtering needs to be specified.
    - Strategy to define as much as possible "signal-free" positions to enable clean position-switching observations will have to be thought out and work on potential correction for the cases where such positions do not exist have to be invested.
    - Flat fielding techniques to correct for gain uncertainties will have to be defined.
- Data reduction and analysis:
    - The foreseen data rates will need 1) to identify on-site processing steps to reduce the stored data volume, and 2) to use realistic simulations to study the scalability and optimize the current reduction and analysis software (calibration and map making).
    - Given the data volume, the French community needs to continue to reflect on the numerical infrastructure model and the way to coordinate data centers,

[1] The figure of merit of an heterodyne multi-beam should be the mapping speed to reach a given sensitivity times the bandwidth that can be reached at a given spectral resolution.

computing facilities, and data archives. Given the timeline, this will benefit from the expertise acquired with the SKA SRC network, including the French node.
    - Atmospheric removal will be a major challenge for large camera observations.
    - France will continue to develop visualisation strategies for large data sets (e.g. HiPS3D developed at CDS for large data cubes) with obvious use for AtLAST.
    - A recent component separation technique developed in France (based, e.g., wavelet scattering transforms) could become instrumental to improve the science throughput of AtLAST.
    - In view of the importance of the data reduction to make AtLAST a success, the French community supports the development of an observatory model that includes data reduction and the initial analysis steps from its definition-on.

French organization

A **contact person or a small group of persons should ensure the contact between** the AtLAST consortium and the French community. This role includes ensuring effective information transfer from the project through a regular newsletter, fostering engagement within the French community, participating actively in the AtLAST consortium, identifying the strategic needs of the French community, and promoting France's contributions. **If you are willing to help, please express your interest for this role by email no later than May 30th.**

Contributing to the AtLAST Work Packages (WP) :

The current work packages (WPs) are listed on the site: https://www.atlast.uio.no/atlast2/. People are strongly encouraged to get involved, whether in first-light instruments, scientific research, operations, environmental aspects, or other areas! **To foster a concerted effort, please send us (mailto:atlast-fr-days@sciencesconf.org) your expression of interest to contribute by May 30th, along with a brief description** .

List of preliminary actions

1. A mailing list of all interested french individuals will be created, and a list of laboratories willing to contribute to R&D efforts will be compiled.
2. Another workshop dedicated to the French potential participation in the instrumental (and data reduction?) effort should be hosted in France with a wide attendance of the current AtLAST actor in this domain.

Acknowledgements

The organizers thank CNRS/INSU, the CEA, Université Paris Cité, PNP, and thematic actions (AT CG, PCMI, PEM, PS) for their support in organizing this event. They are also grateful to Matthias Gonzalez for his key role in organizing the workshop. Finally, they warmly thank all the participants for this very enriching meeting and are eager for what comes next.

The AtLAST team acknowledges support from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101188037 (AtLAST2).

Caroline Bot, Guilaine Lagache, Benjamin Magnelli, Jérôme Pety, on behalf of the interested French community