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ACTION SPÉCIFIQUE HAUTE RÉSOLUTION ANGULAIRE

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Abstract. This paper describes the current activities of the french 'Action Spécifique Haute Résolution Angulaire', which is in charge of coordinating and animating the activities around High Angular Resolution in Astronomy in France.

1 Introduction

High angular resolution (HAR) is now a mature technique in the majority of large astronomical facilities. A large number of scientific results in the stellar and extragalactic domain have shown the importance of this observational approach. HAR lies on complex techniques that require an important effort in technological developments as well as a continuous effort for transmitting the knowledges through specific workshops or schools. Since the beginning, HAR is very active in France and the community is structured in the 'Action Spécifique Haute Résolution Angulaire' (ASHRA). ASHRA is an INSU/CNRS structure established in 2000, after the works of the PNHRAA (Programme National Haute Résolution Angulaire en Astronomie) and the GdR AMI (Astrophysique et Méthodes Interférométriques). ASHRA is responsible for the animation of the community, the expertise of the technical developments and the follow-up of projects. The scientific topics covered by ASHRA could be summarized in optical long baseline interferometry, adaptive optics and coronagraphic studies. The HAR politics relies on a Scientific and Strategic Council, in close collaboration with an Instrumental Committee and the Jean-Marie Mariotti Centre, dedicated to the software aspects. The structure of ASHRA is presented in Fig. 1. A. Chelli is director of the JMMC, C. Perrier is chairing the Strategic and Scientific Council and D. Mourard is director of ASHRA.
The Scientific Council of JMMC is composed by the following members: D. Bonneau, A. Chelli, G. Duvert, D. Mourard, C. Perrier, G. Perrin, R. Petrov, I. Tallon-Bosc, E. Thiébaut and G. Zins.
The Strategic and Scientifc Council of ASHRA is composed by the following members: L. Arnold, A. Chelli, M. Ferrari, V. Michau, D. Mourard, M. Ollivier, C. Perrier, G. Perrin, R. Petrov, D. Rouan, M. Tallon.

2 General scientific objectives of the ASHRA

Many technical principles or instruments developed for HAR observations are now mature and every large telescopes in the world are now equipped with adaptive optics devices. The largest ones also include the new possibility of a coherent combination. The new instrumental concepts under developments should now include adaptive optic in their definition and this evolution follows in parallel the necessary increase of the collecting area. This is particularly true for the case of Extremely Large Telescopes, where the capabilities are greatly enhanced by the addition of dedicated adaptive optics systems.

In parallel, High Angular Resolution techniques have started their insertion into the space domain, where complementary approaches in terms of size or wavelength with respect to the ground facilities are now developed. Many projects of very large arrays in space are in study phase and it exists an important effort in simulations and technological developments or test-benches.

After 20 or 30 years of development, this technique relies now on an important effort of precursive technological developments and on dedicated software tools for the modeling of the future instruments. The variety

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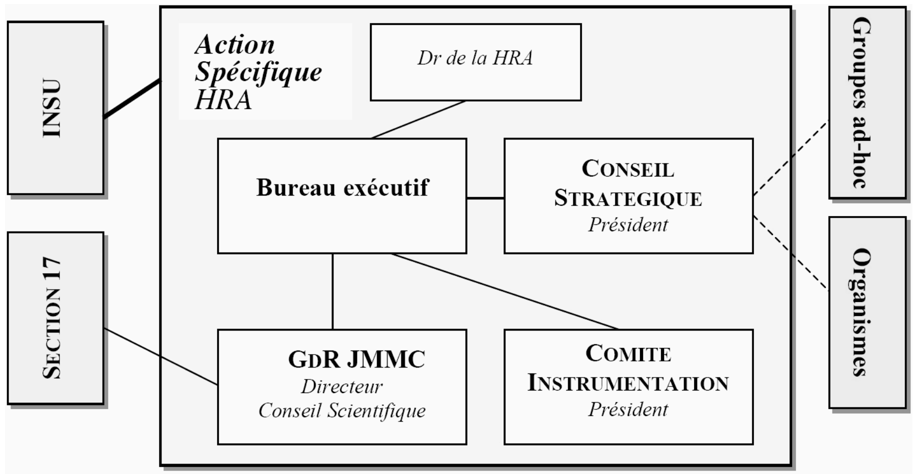

Fig. 1. Organisation of the ASHRA.

and originality of these studies will have great consequences in a large field of astrophysical topics, of course in stellar physics, but clearly also in stellar formation, exoplanetary systems and extragalactic studies, like the very central part of Active Galactic Nuclei.

ASHRA is supporting these developments in close collaboration with the important network of European and international cooperations, but with an very positive position in some key aspects, like coronagraphic devices, system analysis of adaptive optic systems, the use of guided optics in interferometry and the very interesting coupling of high angular and high spectral resolution.

One of the most important role of the High Angular Resolution techniques is in fact to improve the point spread function of light collectors in order to give access to enhanced capabilities of the focal instruments. For example, it is the case for direct imaging with adaptive optics devices. It is also the case when the characteristics of the point spread function is such that there is an important gain for faint object spectroscopy or coronagraphy around bright objects. In all case, the performance of imaging, spectroscopy or coronagraphy are greatly improved by the amelioration of the point spread function. This is clearly understood with single pupil telescopes and adaptive optics but the same physical principle apply in the same way in the case of diluted pupils, also called interferometers. In the optical domain however, the progresses of interferometry are not sufficient enough at that time so that one can really speak of point spread function. But with the great progresses currently made in fringe tracking devices, global co-phasing and imaging principles, it is clear that in the future the same imaging principle could apply to optical interferometry. At that time, interferometers are used as Fourier synthesis machines. The performances of the new generation of interferometers and focal instruments allow now to constrain efficiently complex physical models or even to begin to reconstruct simple images. This is clearly the way for the coming years.

3 Current developments in HAR Astronomy

The main developments could be summarized as:

1. Adaptive Optics
   - Sky coverage: laser guide star
   - Wide field of view: Multi Conjugate Adaptive Optics (Ground Layer AO, Multi Object AO)
   - Very high dynamic range: Extreme AO
   - AO for ELT: from GLAO to XAO
   - Algorithms, components
2. Interferometry

  - Sensitivity: cophasing devices, dual field observations
  - Dynamic range: high precision measurements, spatial filtering
  - Imaging performance: conceptual studies, components

3. Transversal efforts
  - Atmospheric optics and site testing
  - Numerical modeling

All these developments are of course time's and resource's consuming but these efforts are also balanced by the important scientific output of the current generation of HAR instruments. In June 2006, if one consider the VLT/VLTI only, the following number of papers have been published:

- NACO: 84 referee papers
- VINCI: 34 referee papers
- MIDI: 14 referee papers
- AMBER: 2 referee papers (+ 12 in A&A waiting list)

The french community is greatly involved in the following developments:

- Extremely Large Telescope
- Second generation of VLTI: MATISSE, VSI, GRAVITY
- Second generation of VLT: MUSE, SPHERE, KMOS, X-SHOOTER

4 ASHRA Setting

The ASHRA gathers 16 laboratories with three main centers: Grenoble, Nice and Paris. 140 peoples are working in the HAR domain, typically 84 researchers, 42 engineers and 14 peoples belonging to ONERA. Fig. 2 and 3 show the geographical repartition of the interferometric and adaptive optics activities in France.

5 Conclusion

The presentation made during the French meeting "Semaine de l'Astrophysique Française", held in Paris from June 26th to June 30th could be found at the following adress:
`http://www.obs-azur.fr/heberges/ashra/SF2A_2006/ashra.ppt`.

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- First astrophysical results of VLTI/AMBER (ashra_amber.ppt)
- First 'OHANA fringes (ashra_ohana.ppt)
- First results of CARLINA, an hypertelescope prototype (ashra_carlina.ppt)
- A short introduction to the project SPHERE (ashra_sphere.ppt)
- A presentation of the adaptive optics testbench SESAME (ashra_sesame.ppt)
- Some results about the Dôme C characterization (ashra_domeC.ppt)

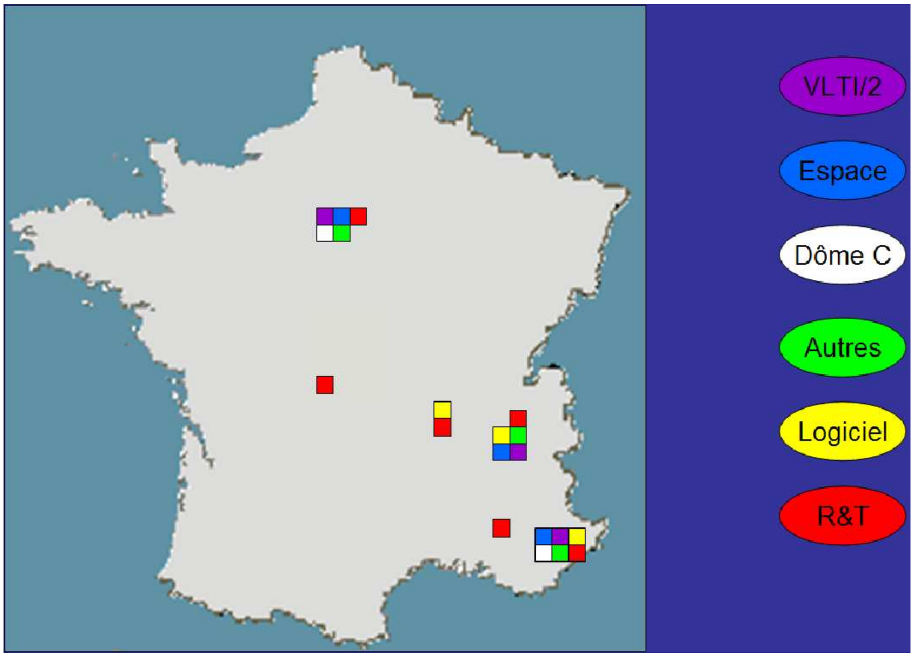

Fig. 2. Geographical repartition of the interferometric activities.

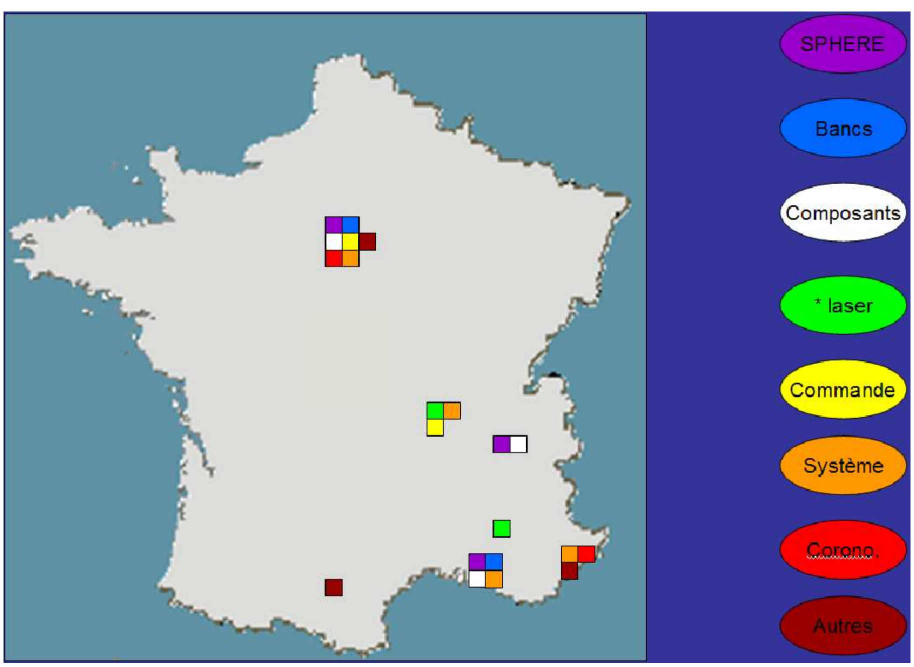

Fig. 3. Geographical repartition of the adaptive optics activities.