Report from the Workshop "Physical and chemical processes of astrophysical interest"

held in Saint Florent, France (Haute-Corse)
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Pressures in the interstellar medium are so low ($P < 10^{-10}$ mbar) that inelastic collisions cannot maintain a local thermodynamic equilibrium (LTE). Molecular populations thus do not, in general, follow a simple Boltzmann distribution and non-LTE spectra are the rule rather than the exception. A detailed knowledge of inelastic state-to-state processes is thus crucial. Non-LTE molecular populations can in turn play an important role in reactive collisions. Now the impact of non-LTE effects on reactivity (and vice-versa) has been largely ignored in the astrophysical literature.

The sixth Workshop "Processus physico-chimiques d'intérêt Astrophysique" was held in St Florent, France (Haute-Corse), June 14-18 2021, and was devoted to *state-to-state chemistry*. Following the success of the previous editions, the aim of this new workshop was once again to bring together experts from both the laboratory astrophysics and observational communities to discuss the current status and the new challenges of interpreting the growing amount of observational data, especially on reactive species. The scientific program has consisted of 29 invited talks (including 6 during one young researcher session) and many informal discussions. The state-resolved spectroscopy, collisional excitation and gas/solid-phase reactivity of interstellar species were discussed together with their current and future observations. We have identified the following (obviously non-exhaustive) list of topics to be addressed in future experimental, theoretical and modelling studies:

- Reactivity of $H_2(v > 0, j)$ with atoms and diatoms
- Chemical pumping processes (e.g. for CH^+, H_2D^+)
- State-resolved inelastic and reactive scattering with classical and statistical approaches
- State-selectivity of ion-neutral reactions, including radiative associations
- State-resolved sticking coefficients for ices
- Ortho-para conversion of molecules in the gas and on grain surfaces
- Product branching ratios in gas-phase reactions
- Primordial chemistry