with the intrinsic properties of the ionized molecular orbital, the PI dynamics at play during the electron-ion scattering process has a major impact on MFPAD. This points to the need for a thorough description of the PI processes, as aimed at by different *ab initio* theoretical approaches.

This direction calls for extensions of the F_{LN} based method for extraction of the MFPADs to a two (multi)-photon PI process (pump-probe) on the one hand, as well as to non-linear small polyatomic molecules, providing then recoil frame photoelectron angular distributions (RFPADs), on the other hand. This type of extension was discussed recently for *e.g.*, the description of DPI of the NO_2 molecule induced by one-photon[73] and multi-photon[74] absorption. The vibrational dynamics at conical intersections, electronic correlations and quantum interferences, or isomerization reactions, are *e.g.*, some of the key processes which can be advantageously studied at the detailed level of time-resolved RFPADs both experimentally and theoretically in small model molecular systems.[43]

In this work, the MP method has been applied to the complete determination of the polarization state of the harmonic comb in APTs generated in SF_6 molecules by an elliptically polarized driving field. We have investigated two other cases where symmetry breaking in the generation process results in the production of elliptically polarized harmonics, well identified in recent literature, namely HHG driven by two color counter rotating circularly polarized fields in Ar atoms, and HHG driven by linearly polarized light in aligned N_2 molecules [in preparation]. One outcome and issue of these first results is the evaluation of depolarization of the generated HHs, in particular in the study of HHG from aligned molecules. It raises interesting questions on the different possible origins of depolarization,[53,54] which will be addressed in future work.

Both above perspectives (i) and (ii) will be pursued, taking advantage of the current development of high repetition rate (>1 kHz) HHG sources for future experiments, such as the 10 kHz FAB10 ATTOLAB source, allowing a significant increase of the statistics.

Finally, the investigation of MFPADs or RFPADs induced by an APT contributes to the ongoing comparison between PI and HHS studies, *i.e.*, the complementary insights on photoinitiated ultrafast electronic and nuclear dynamics in molecules which can be extracted from the two approaches, respectively. In PI, the $I(\theta_e,\phi_e,\chi)$ MFPAD describing photoelectron emission at the microscopic level gives the most complete access to the partial wave resolved complex dipole matrix elements, at each photon energy. On the other hand, in a gas medium HHS observables build up coherently from the microscopic to the macroscopic level, under the condition of phase-matching between the nonlinear polarization and the harmonic field.

Gathering theoretical concepts relevant for HHG and PI, the quantitative rescattering theory (QRS) for linear aligned molecules[75,76] and unaligned polyatomic molecules[66] provides an illustrative theoretical framework for the description of the HHG process, where the photorecombination step is considered as time-reversed PI. Strengthening the fruitful combination of thorough MFPAD-PI and HHS studies, both in experiment and theory, should provide greater insight into the specificities of the strong-field driven dynamics in HHG beyond the QRS theory (see ref. 77 and references therein).

