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The Arxes code suite: high-performance planet formation and astrochemistry

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Thanks to the continuous expansion and improvement of the observational datasets on circumstellar disks, exoplanets and our own Solar System, planet formation and astrochemistry are becoming increasingly interconnected fields of study. The growth and migration processes that shape planet formation in the native circumstellar disks create a bidirectional link between planetary and disk composition. To explore the nature of this link, in the framework of the INAF program Arxes we developed a new suite of simulation and processing codes. The *Arxes* code suite includes:

- *Mercury-Arxes*, a parallel n-body code that simulates the growth and migration of forming planets within circumstellar disks and the interactions between planetary bodies and the disk gas;
- *JADE*, a paralled multi-language code that jointly reproduces the physical and chemical evolution of circumstellar disks setting the initial conditions of planet formation;
- *Hephaestus*, a compositional code that combines the outputs of Mercury-Arxes and JADE to quantify the composition of newly-formed planets from their accretion of gas and solids in the disk;
- *Debris*, a parallel collisional code that estimates from the output of Mercury-Arxes the collisional production of dust from the impacts of planetary bodies and its distribution within the disk.

The simulation and processing capabilities of the Arxes suite of codes are currently supporting the ESA mission Ariel, the ERC Synergy project ECOGAL and the NASA mission Juno, and are being expanded in the framework of the PNRR activities for the National Center for High-Performance Computing, with plans for future applications also in the framework of SKA.

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