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Simulations of image distortion and radiation damage for ESA JUICE mission spacecraft camera

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The JUpiter ICy moons Explorer (JUICE) is an ESA interplanetary spacecraft being developed to perform detailed investigations of the Jupiter system and three of its icy moons: Europa, Callisto and Ganymede. The emphasis will be given on Ganymede as a small planetary body to be studied as a potential habitat. The spacecraft is set for launch in 2022 and would reach Jupiter in 2030. Two identical optical cameras are proposed for the mission to monitor the spacecraft and its surroundings. The sensors of the cameras need to be protected from hazardous radiation levels caused by extremely high fluxes of very energetic electrons. A precise model of the camera was developed to be used for intense Monte Carlo simulations performed to determine the camera performance including its radiation damage and image quality degradation during the mission. Computations were done for several optimized shielding concepts and relied on existing Jupiter radiation models. They included determination of the total ionizing and non-ionizing doses in the sensors and crucial electronic components as well as hot pixels rates in the images due to background events. This paper presents both simulation methods and results together with discussion of the shielding optimization methods and radiation damage minimization.