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Characterization of exorings in the infrared

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After the discovery of more than 700 exoplanets, numerous future instruments are now designed to characterize their atmospheres, surfaces and surroundings. Do they have moons or rings, like the planets of our solar system? In the solar system, all giant planets are surrounded by rings, so that exorings can be expected around giant exoplanets. Their presence around telluric planets, like super Earths is also an exciting possibility. Indeed, some theories of the formation of the Moon (Cameron & Ward, 1976 [1]) assume Earth once had a ring, and super Earths could even support naturally more extended rings because of their greater density. Moreover, the presence of exorings is closely linked to theories of planetary formation. Since the study of extra-solar planetary systems enables to see planets at different moments of their evolution, being able to also observe rings could contribute to the development of formation theories not only of rings themselves, but also of planets.

Different methods can be used to detect and characterize exorings. The transit of an exoplanet similar to Saturn in front of a solar type star could reveal rings like those of Saturn with the Kepler instrument (Barnes and Fortney, 2004[2]). In visible light, a planet with rings would show a lot of signatures when studying the light reflected by the whole system. However, there is no instrument currently capable of seeing them, nor will there be any in the coming years (Arnold and Schneider, 2004 [3]).

We chose to study exorings in the infrared, first because the instrumental context is propitious, with forthcoming instruments expected in the infrared domain like MIRI/JWST and METIS/E-ELT, and second, because of the favorable contrast in the infrared between stars and planets. The effects that rings could produce on the observables have been quantified. In particular, spectral signatures are expected, together with longitudinal effects caused by their variable aspect along the planet orbit as viewed by an observer from Earth. Our simulations are focused on exorings around warm or cold giant planets and super Earths. The first ones constitute most of observable planets with direct imaging in the infrared. Studying exorings around super Earths is interesting because their presence may help to detect these planets which are the only telluric planets detectable with forthcoming instruments.

We simulate the emission of optically thin rings either below the Roche limit of the planet, like the C ring of Saturn or far away from the planet, either produced by outgassing of a satellite like Enceladus and the E ring or by ejecta due to the meteoritic bombardment on their surface. Thermal model as developed from observations of Saturn by C.Ferrari (Ferrari and al, 2005 [4]) are used. In the poster, the preliminary results of this study are presented.

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[2] Barnes, J.W. & Fortney, J. J., 2004, ApJ, 616, 1193-1203
[3] Arnold, L. & Schneider, J. 2004, A&A 420, 1153-1162
[4] Ferrari, C., Galdemard, P., Lagage, P.O., Pantin, E., Quoirin, C., 2005, A&A 441, 379-389