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LITHIUM-ROTATION CONNECTION IN DEBRIS DISK STARS

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This contribution emphasizes the connection between stars with debris disks and stars with extrasolar planets, and how lithium abundances could help us understand this connection taking into account the history of the rotation of the stars.

We present a study of solar-type stars with debris disk, in which we analize the behaviour of the lithium abundances as a function of the stellar parameters, particularly with the age and stellar rotation. For this purpose, we study four different groups of solar-like single field stars: 1) a control group formed by stars containing apparently no disks and no planets (C) ; 2) stars containing only debris disks (DD); 3) stars with debris disks and planets (DDP), and finally, 4) stars containing planets only (CP).

We have found that the atmospheric lithium abundance of a central star decreases as the dust mass of its debris disk increases (see Figure 1). This property, apparently independent of metallicity and age, enable us to infer that the massive dusty debris disks observed today were also massive disks during their first ∼10 Myr, when they were protoplanetary disks.

On the other hand, we confirm the values of the lithium depletions predicted by the model of Eggenberger et al. (2012), which relates the stellar rotation and the braking produced by the protoplanetary disk. We have found that in the two groups presenting planets the metallicity increases as a result that is consistent with a planet- metallicity correlation found in previous studies. Also, these stars appear to have lower lithium abundances and lower rotational velocities. Extremely lithium depletion appears only for the lowest stellar rotators and also, in general, for stellar masses smaller than that of the Sun. We detected a very small group of young very slow rotators debris disks stars, largely lithium depleted, with larger convective zones and having larger dusty debris disks masses. Because there are too young, for any long term main- sequence lithium depletion mechanism would have time to act, we approximately estimate that the action of longer protoplanetary lifetime disk (∼15 Myr) would be necessary to explain the observed low lithium abundances.

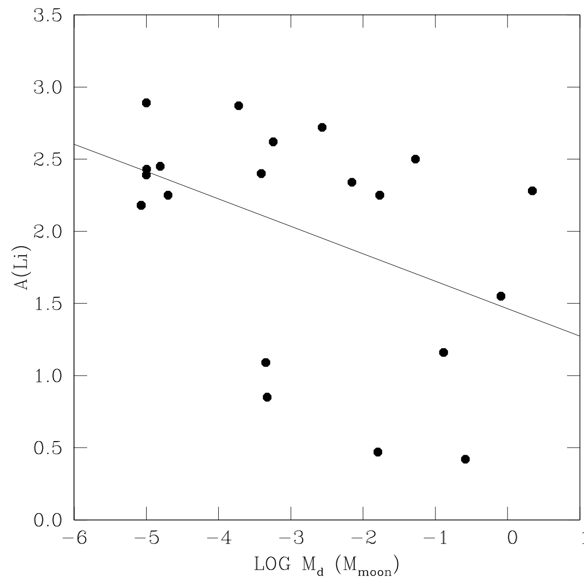

Fig. 1. Lithium abundances of the central stars are shown as a function of the dust mass of their respective debris disks. Here are presented only disks without planets and with small rotational velocities (v sin i < 5 km s^{-1}).

We show that during the the protoplanetary stage, the braking action of a long living disk of ∼ 10 Myr reduces the initial lithium abundance equal to that of the interstellar matter, to abundances near thirteen times less. Further decrease of this abundance to very low abundance values are due to a badly known slow mechanism acting during the whole main sequence. This can be achieved for the lowest stellar masses considered here, if the stellar rotation is very strongly reduced. The lithium abundances observed today in stars with only debris disks, enable us to recover the memory of when these stars were in their protoplanetary stage.

REFERENCES

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