Search for Cold Debris Disks around M-dwarfs

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Summary : Debris disks around main sequence stars are made of left-over planetesimals from the early phase of planet formation and can be studied to advance our knowledge of the origin and evolution of planetary systems around other stars. Searches for debris disks have been conducted mainly around A-type and solar-type stars but M-dwarfs make up to 70% of the stars in the Galaxy, and the census of debris disks is not complete until they have been searched. To this aim, we observed a sample of 50 nearby M-dwarfs with the JCMT/SCUBA and IRAM30m/MAMBO facilities as already reported (Lestrade et al. 2006) and complemented by the new MAMBO observations at $\lambda = 1.2$ mm presented briefly here and in details in a subsequent paper. Only one cold debris disk is detected (GJ842.2) and, hence, the observed fraction of cold debris disks around M-dwarfs is $2^{+4.5}_{-1.5}$ % in our sample. In Fig 1 below, we plot the fractional dust luminosities of our 50 M-dwarfs (mostly 3σ upper limits) derived from these (sub)millimeter observations as a function of disk radii from 1 to 1000 AU since we dont have *a priori* knowledge of the radius of any potential disk. We have added the upper limits of 41 M-dwarfs from the Spitzer 70 μm observations of Gautier et al. (2007) which provide stronger constrains on fractional dust luminosities for the lowest radii. In an attempt to discuss the possible dependence of detectability of cold debris disks on the mass of the central star, we have compared the observed fractions of M-dwarfs in our sample to the ones found in the two submm surveys of A-to-K type stars (Wyatt et al. 2003 and Najita & Williams 2005) which are the closest to ours in term of selection criteria, although not for stellar ages. The apparent higher observed fractions of cold debris disks in these two surveys ($10 - 15\%$) is likely caused by this difference in ages, reducing detectability for our overall older M-dwarfs. Future observations of a larger and better controlled sample of dwarfs of all spectral types with Herschel in the Far-IR and deeper observations in the (sub)mm are needed to clarify this issue.

References :

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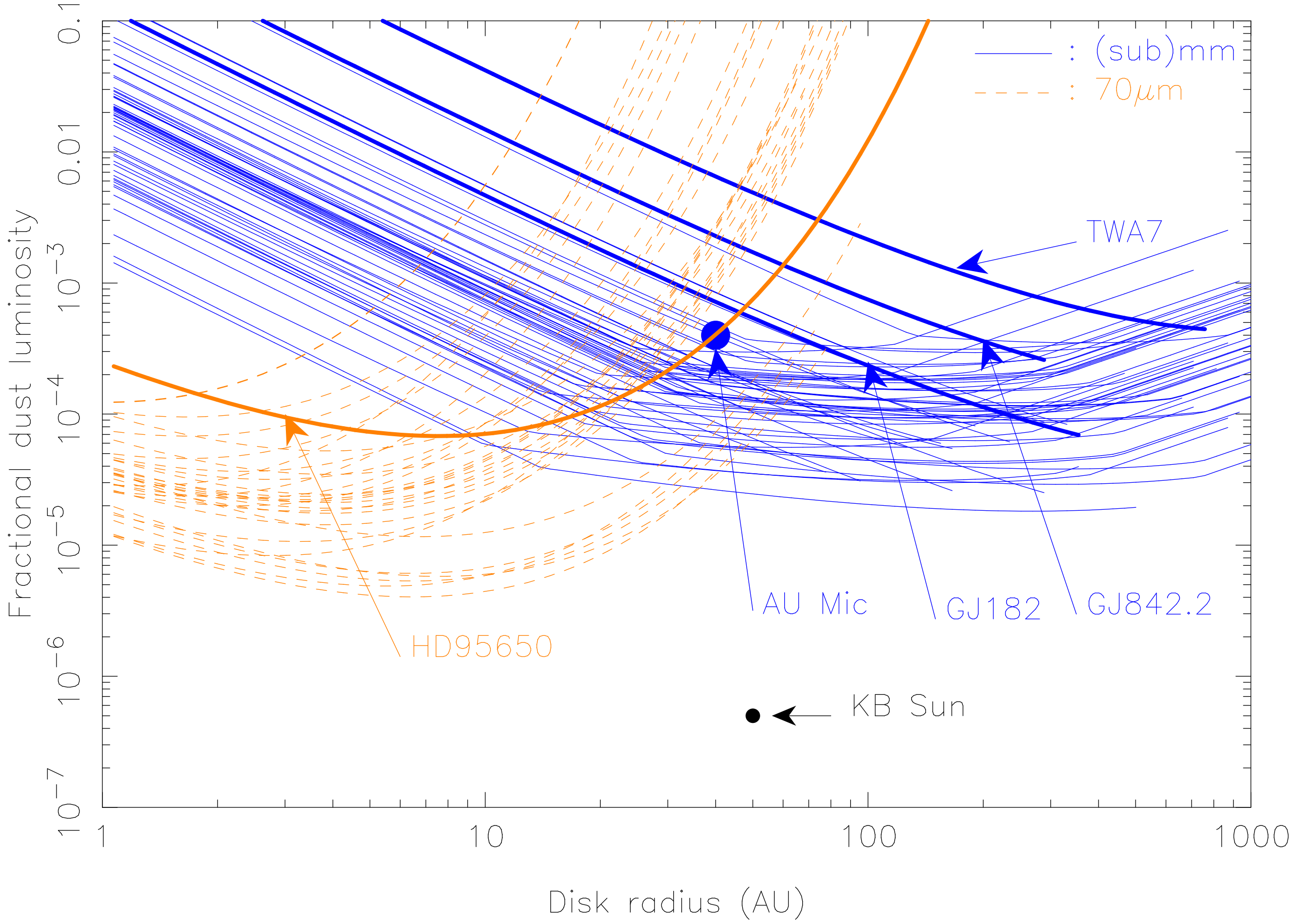

Figure 1: Fractional dust luminosities of the 50 M-dwarfs of our sample as functions of disk radii, *i.e.* temperatures. Most of the curves are upper limits derived from the 3σ flux density limits measured in our MAMBO and SCUBA (sub)millimeter observations (full blue lines). We have added the upper limits of 41 M-dwarfs from the Spitzer 70 μm observations of Gautier et al. (2007) (dashed orange lines). There are 16 M-dwarfs in common between the two samples. These two sets of data are complementary constraining the existence of warm dust at moderate radii and cold dust at large radii. The submm disk detected around AU Mic (Liu et al., 2004) and resolved has been marked by a single dot. Disks detected but not clearly resolved around GJ182 (Liu et al. 2004), around GJ842.2 (Lestrade et al. 2006) and around HD95650 (Smith et al. 2006) have been marked with thick lines. The submm transition disk detected around the pre-main sequence M1 dwarf TWA7 at 55 pc (Matthews, Kalas, & Wyatt, 2007) has been included. Disk diameters probed by the observations are limited by the angular size of 300″ for the MAMBO maps, of 28″ for SCUBA wide photometry and of 38.4″ for Spitzer aperture photometry (Gautier et al. 2007). Some curves are interrupted at $r < 1000$ AU because of these angular limits. Zoom of the electronic version is required for full details.