Peas in a pod?
Similarities between neighbouring protostars

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http://www.jach.hawaii.edu/surveys/GBS_Abstract.html

JCMT Gould Belt Legacy Survey

Abstract Neighbouring SCUBA-2 450 micron cores, within 40" (10,000 AU @ 250pc) of each other, show similarity in their peak fluxes. This suggests that close pairs and small groups form in situ in the same environment through filament fragmentation. It also suggests that these neighbours have not (yet?) competed for mass either from each other or from the wider environment (e.g. through filament flows) as this would lead to mass asymmetries that are not observed.

1. Introduction

Pairs and small groups of neighbouring sources are interesting because they test for dynamic interactions between protostars. If nearby sources compete for mass, either with each other or with their environment, then one of the pair will gain mass at the expense of its companion, leading to mass imbalances. On the other hand, if pair masses are similar, then environment rather than interactions determine their masses. I have been testing this in Serpens South and Serpens Main using submillimetre continuum maps from the JCMT Gould Belt survey.

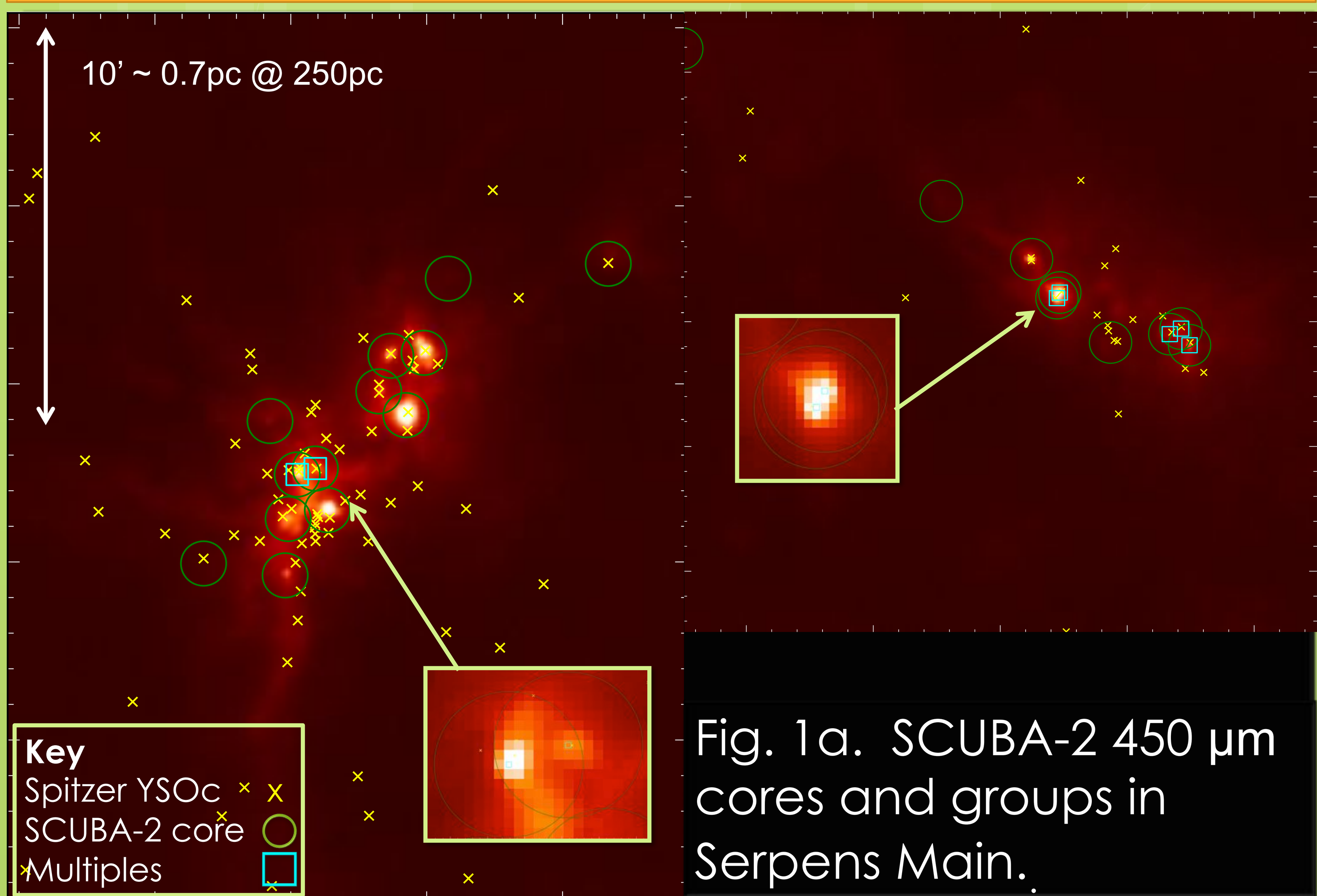


Fig. 1a. SCUBA-2 450 μm cores and groups in Serpens Main.

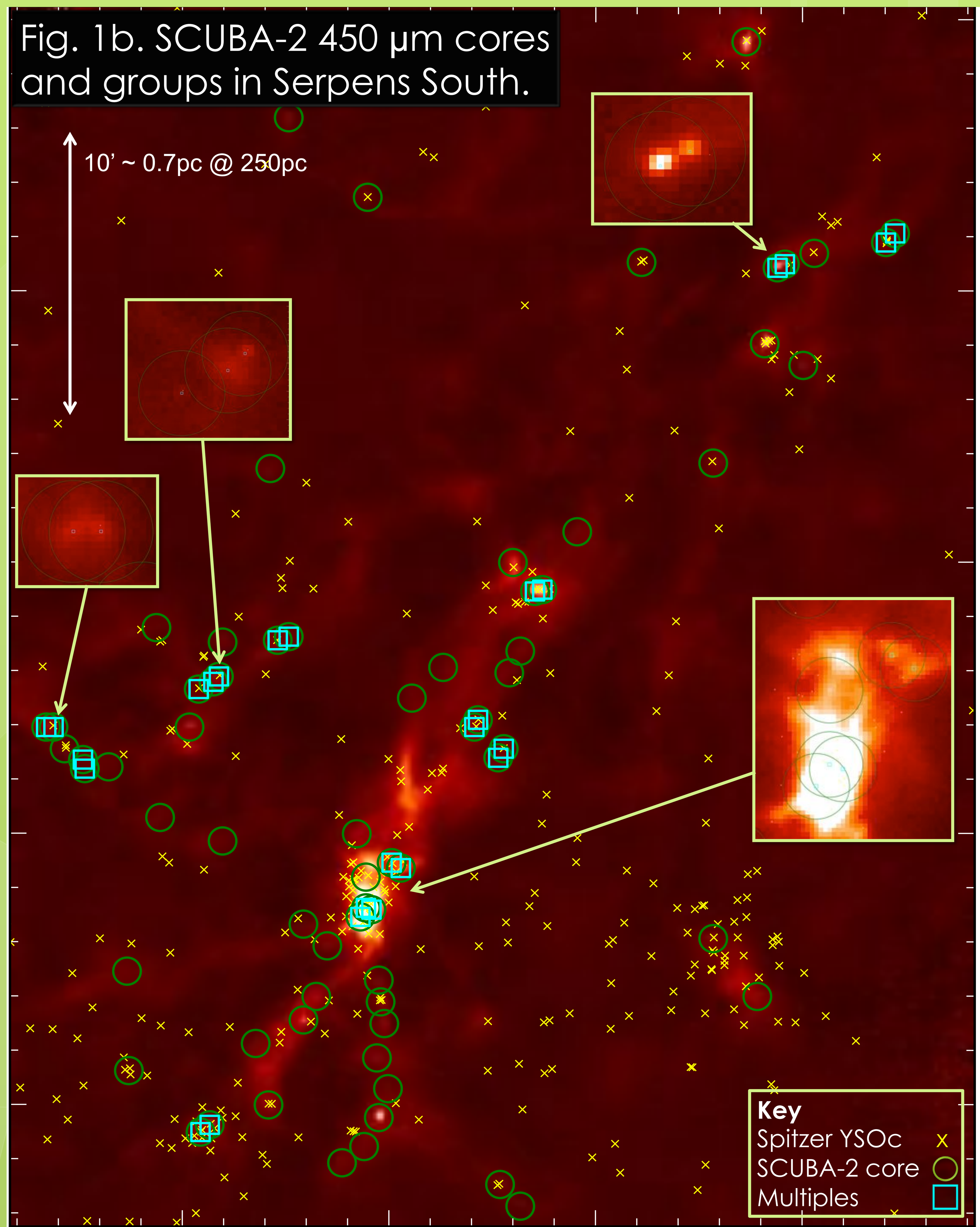


Fig. 1b. SCUBA-2 450 μm cores and groups in Serpens South.

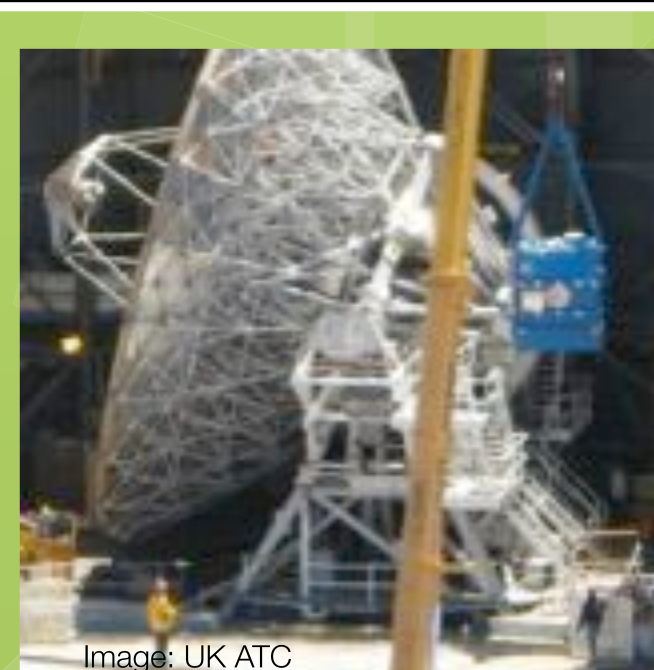
2. Protostellar candidates

The Serpens/Aquila region was mapped using SCUBA-2 on JCMT simultaneously at 850 and 450 microns as part of the JCMT Gould Belt Legacy Survey (GBS). Reduced maps were processed by the GBS team using the Starlink mapmaker SMURF (Chapin et al. 2013). Peaks at 450 microns were identified using the Fellwalker algorithm (Berry et al. in prep.) and peak fluxes and 20" aperture fluxes extracted. Protostellar candidates (see Figs. 1a and 1b) were identified by cross-matching with the Spitzer Gould's Belt survey catalogues of YSO candidates (Harvey et al. 2007, Gutermuth et al. 2008) and/or by 450 micron concentration C (Enoch et al. 2007),

$$C = \frac{\text{peak flux/area} - \text{aperture flux/area}}{\text{peak flux/ area}}$$

3. Multiples

Pairs and groups of near neighbours were identified by position matching within 40" (10,000 AU @250pc). Sources can be separated down to the 8" 450 μm primary beam size (Dempsey et al. 2013). The groups are mainly pairs with some groups of three (see Figs. 1a and 1b).



4. Results and discussion

Multiples are not limited to crowded regions (Fig. 1). Also, the flux distribution for sources in multiples is similar to that of the protostellar population as a whole (Fig. 2). Both of these are consistent with a similar evolution for sources in multiples and single sources.

From Fig. 3, the fluxes of neighbouring sources are strongly correlated (correlation coefficient r=0.94) with the second (and third) sources roughly half the flux of the primary, on average. This suggests that neighbouring sources form in situ from a common environment. With a cloud velocity dispersion of order 1 km/s, YSOcs could potentially travel up to 0.5 pc during the 0.5 Myr embedded phase lifetime and form new pairings. If this happens, it isn't typical among the sources we observe in groups.

To date this comparison is limited to 450 micron fluxes. Comparison of masses (folding in temperature/dust emissiity, e.g. Sadavoy et al. 2013), protostellar classes and other properties will follow.

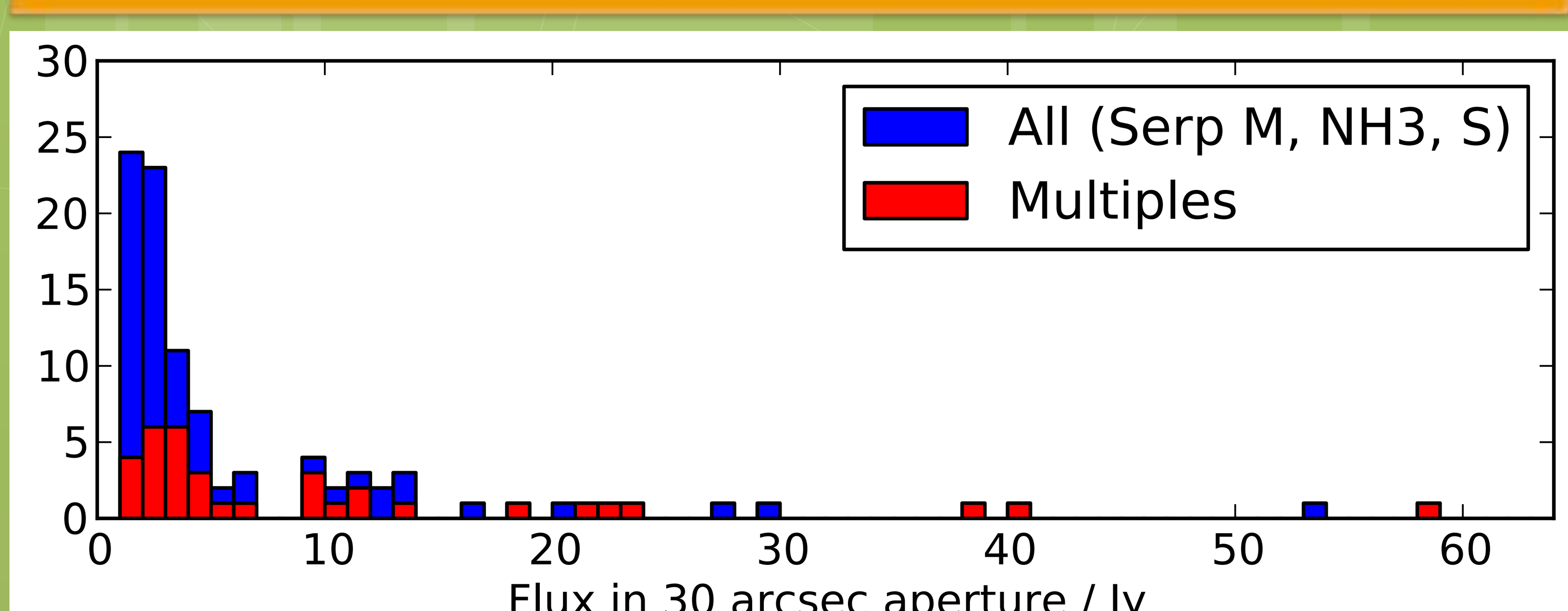


Fig. 2. 450 micron flux distributions.

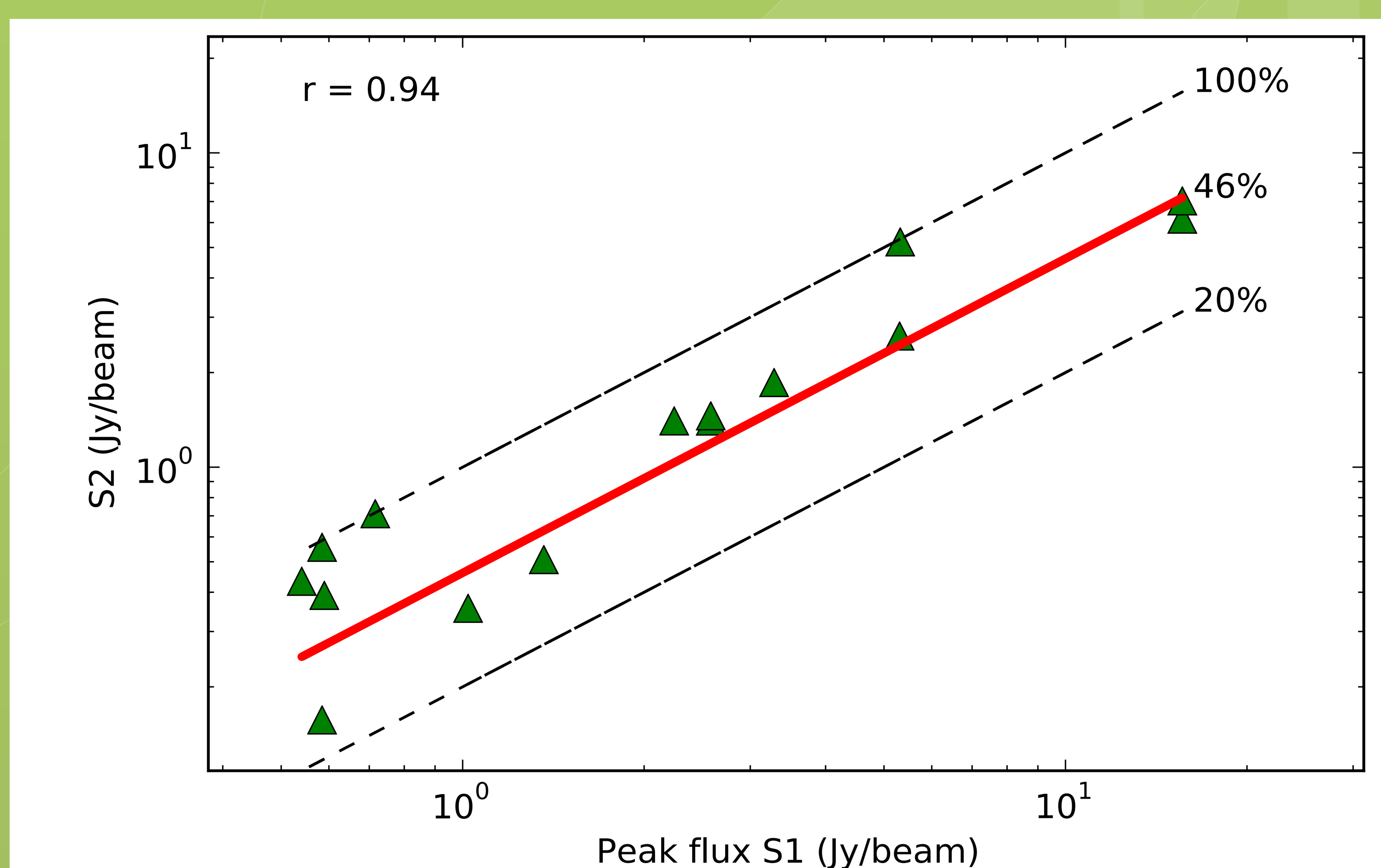


Fig. 3. Flux correlations

Peak 450 micron flux of the 2nd (and 3rd) source(s) in the group vs. the peak flux of the brightest source. The solid red line is the best fit (second/third fluxes on average 46% of primary) and the dashed lines show 100% and 20% levels. The peak fluxes are measured after subtraction of background emission on 2' scales.

References

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