The creation of wide planetesimal belts from migrating pressure traps (No 695)

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S6a : Planetesimal belts: revealing the push and pull within planetary systems

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The question of what determines the width of debris discs is an open one. If solved, this understanding of massive belt structural evolution would provide valuable insights into the architecture, dynamics and formation of exoplanetary systems. Recent observations by ALMA have revealed an apparent paradox in this field, the presence of: radially narrow belts in protoplanetary discs that are likely the birthplaces of planetesimals, and planetesimal belts nearly four times as wide in mature systems (average fractional width ~ 70%). If the parent planetesimals of debris discs indeed form in these narrow protoplanetary rings via streaming instability, we propose that this width dichotomy could naturally arise if these traps form planetesimals whilst migrating radially, e.g. as caused by a migrating planet. Using state-of-the-art dust coagulation software, we investigate the conditions in which migrating pressure traps in protoplanetary discs form wide planetesimal belts over 10 Myr. Consistent with previous results, we find that planetesimal formation is most favourable in low ? discs with strong pressure traps to maximise dust trapping and trigger the streaming instability. As the pressure trap moves, we find that dust can still effectively accumulate and form planetesimals, leading to a positive correlation between the inward radial speed and final planetesimal belt width. The large widths of most observed planetesimal belts constrain ? to values ? 0.001 at tens of au, otherwise the traps cannot migrate far enough. Finally, we find small striations repeating over 10s of au on the surface density profile of the simulated planetesimal belts. The astrophysical origin of this pattern is hypothesised and linked to gaps recently observed in a few wide debris discs.