**Check One: ☑ Project ☐Review ☐Collaboration**

**☐Workshop ☐Other**

| **Descriptive Title** | Stress fingerprint of air-jet entraining particles and resulting impacts, either inter-particle or on surfaces. |
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| **Working Title[[1]](#footnote-0)** | **Stress fingerprint induced by air jets** |
| **Technical Area[[2]](#footnote-1)** | Size Reduction / Dry Systems |
| **Date** | 2025-06-16 |
| **Short Description** | The current cutting edge of milling equipment characterisation lies in matching the stress profile created by that equipment with the “ideal stress” required by a material.  Some recent anecdotal evidence has suggested that particles entering air jets do not achieve anywhere near the peak jet velocity, and that particles may not penetrate very far into the jets.  This throws into doubt the idea that particles in opposed jet mills are really being “bashed into one another”, and raises the possibility that the truly active milling zone is at the jet edges, where the shear rates and turbulence are very high, acceleration may be extreme, and collisions frequent.  If true, it is possible that much jet energy is wasted - could efficiency be improved by understanding and intervening in mill or jet design?  Similar shear also occurs in other processes like air cannons in silos, venturi feeders and spouted bed granulation.  *The exact location of stressing events can probably be determined quite accurately, experimentally and/or via simulation.* |
| **Objectives** | Characterisation of the stress distribution experienced by a particle or group of particles entrained in air jets under varying conditions, e.g. kind of introduction of particles, obstacles in the jet, flow direction of the jet, ….  This could be realized experimentally with high speed tracking (video, PEPT,?) and/or via 3-D simulation. |
| **Scope** | Starting with a simple system, could be a single jet, opposed jets, or spiral, depending on what is practical & available.  ===  Another option proposed for exploration would be the use of tracer particles with known strength which may either break or be deformed by known stress levels, e.g. metal sensor particles.  Ultimately, the methodology (and concept of a mill “stress fingerprint”) would ideally be extendable to other mill types (impact, media, etc.) as well as other particle processing equipment (fluid beds, pneumatic conveyors, etc.)  Notes:   1. It is noted that the stress experienced by a particle may also depend on the particle itself (size, shape, roughness, etc.) and so this can be studied as an extension if possible. 2. The stress fingerprint of a machine may be considered as the *location*, *frequency* and *energy* of impact/stress events. 3. The stress fingerprint of a milling machine can be affected/controlled/optimised by design choices. In the case of a jet mill these would include:    * jet speed (i..e pressure and temperature of compressed gas)    * gas type (air, steam, other?)    * nozzle type (De Laval, straight, flat jets, compound jets ala Hosokawa megajet)    * jet arrangement (single jet in open space, jet against plate, opposed jets, spiral jets, etc.)    * method of particle entrainment/impingement 4. Could entrainment be improved?    1. could particles be deliberately placed inside the jet?    2. pulsed jets? |

| **Recommended Contractors (2 or 3)** | | |
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1. Title used in meeting agendas and file archives [↑](#footnote-ref-0)
2. One or more from the following list: W = wet systems; D = dry systems; F = particle formation; SR = size reduction; M = modeling; SE = systems engineering [↑](#footnote-ref-1)