

en's Function Measurements

Wide-open

Math/Model
Issues

Microscopic
role of

models:
order/disorder

Continuum limit:

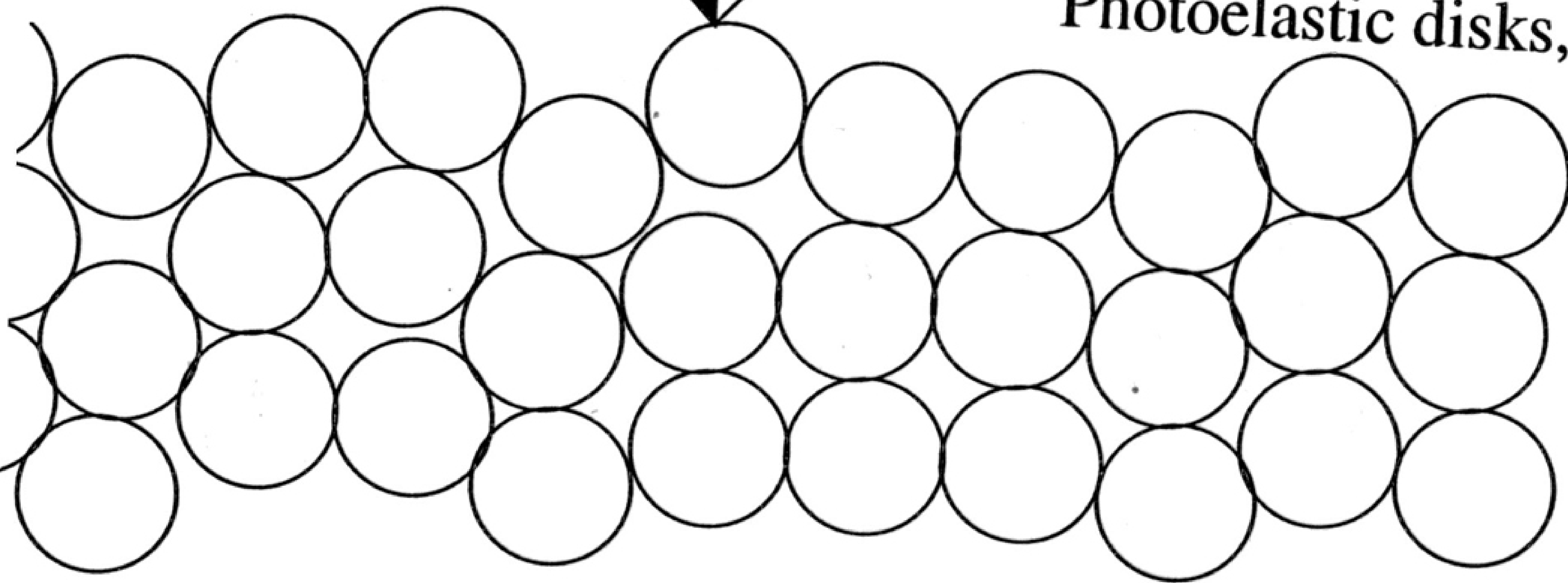
parabolic, hyperbolic
+ elliptic types proposed

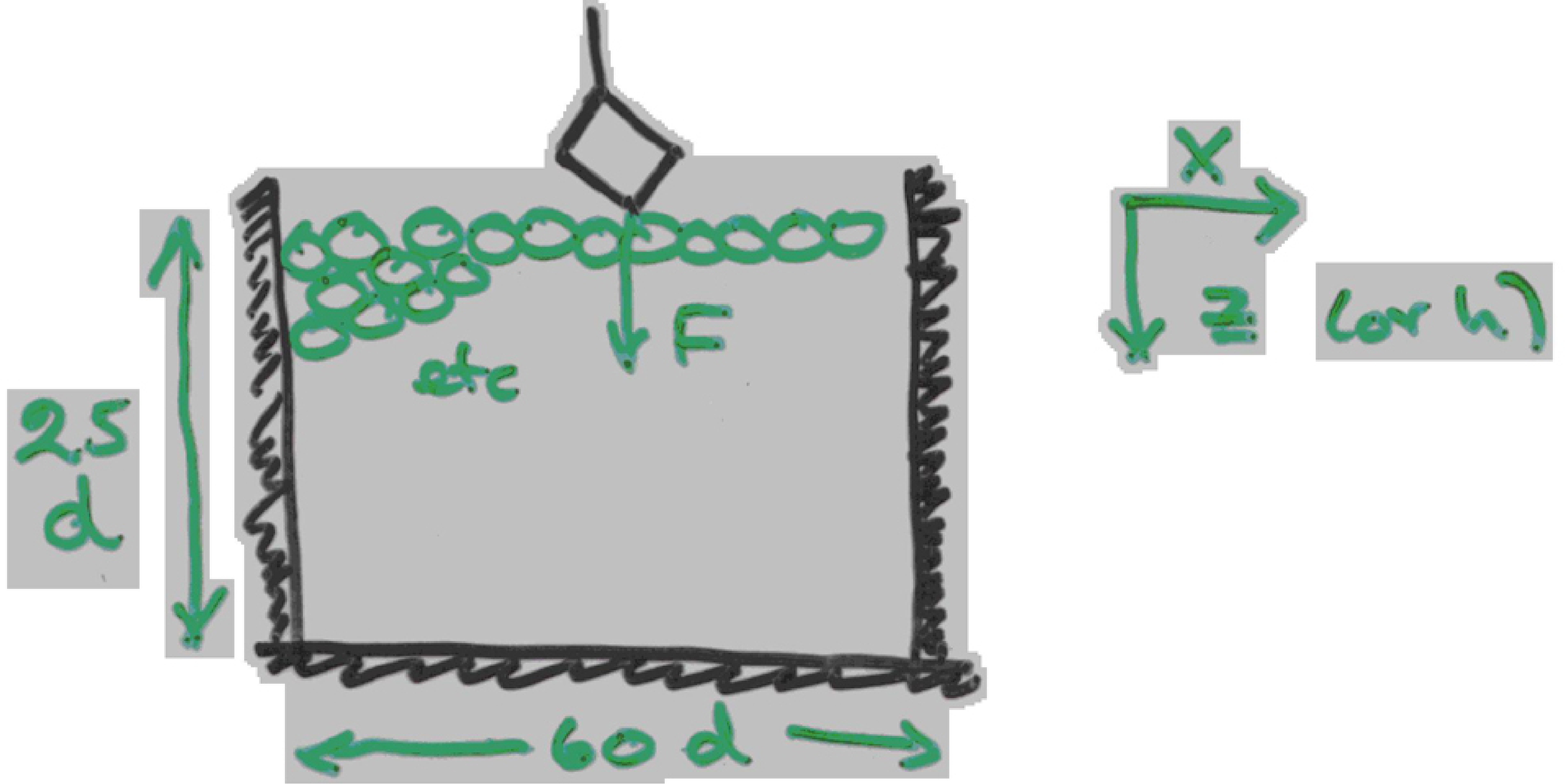
Perhaps none of these
are right

Force Gauge

Weight

Photoelastic disks, pentagons..





$d =$ grain size

2D grain types:

1) Monodisperse disks (spatially ordered)

2) Bidisperse disks (weakly disordered)

- pentagons (disordered)

1. Different Construction Methods: (Fig. 3)

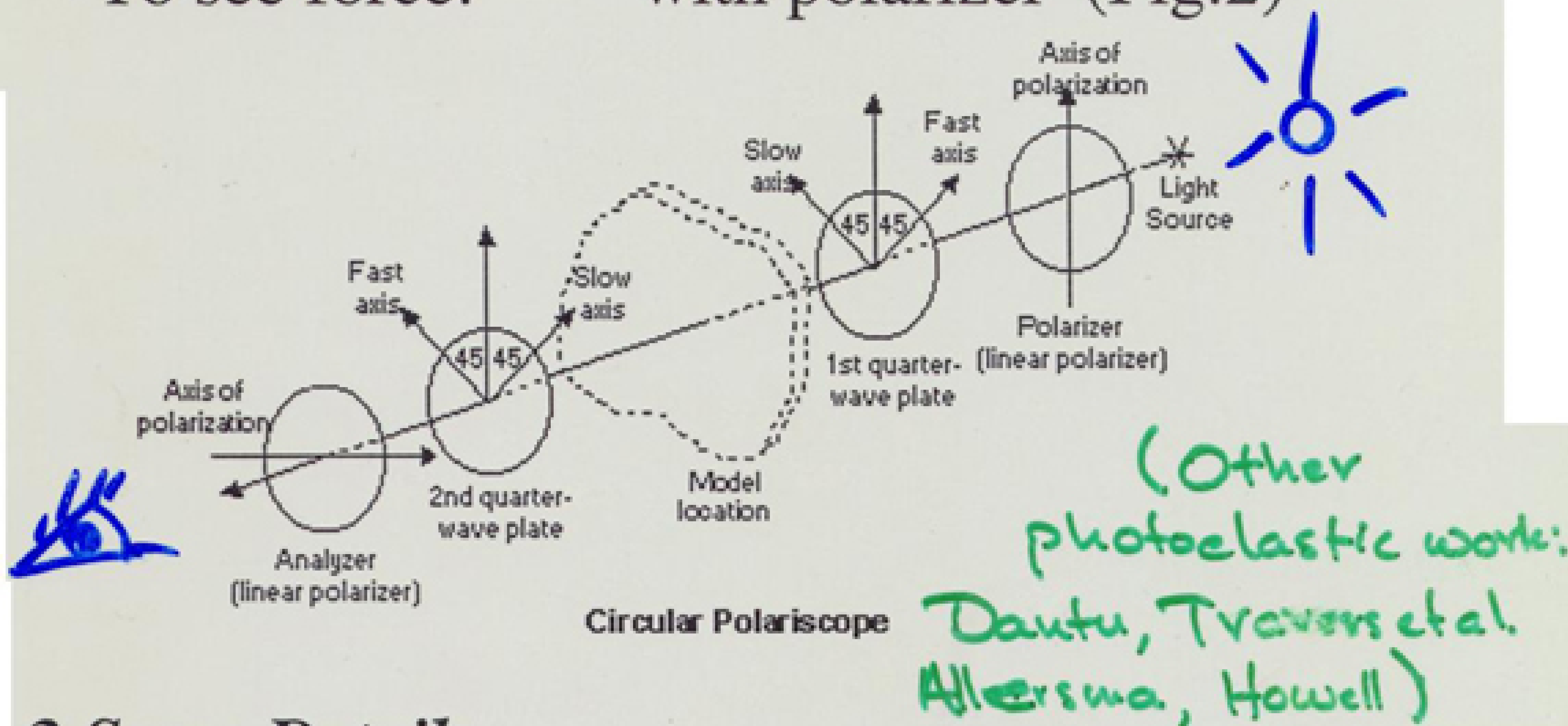
* Raining Procedure : More Uniform Formation

* Localized Procedure: Formation by Avalanches

2. Circular Polariscopes: --> Digitalized Image

* To see structure: without polarizer

* To see force: with polarizer (Fig.2)



3. Some Details:

* # of Disks: 2500 small (d=0.74 cm),
400 large (d=0.9 cm)

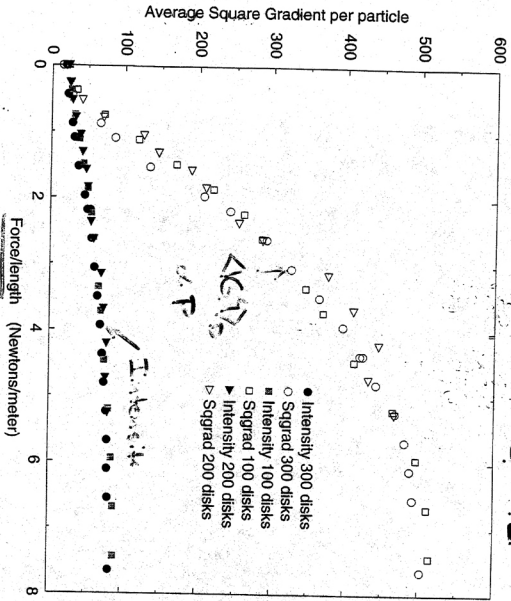
(To avoid hexagonal packing)

* Dimension of Pile: height ~30cm,
length of base ~130cm

* Force Calibration: $F \sim G^2 = |\nabla I|^2$... (Dan Howell)



G:VI

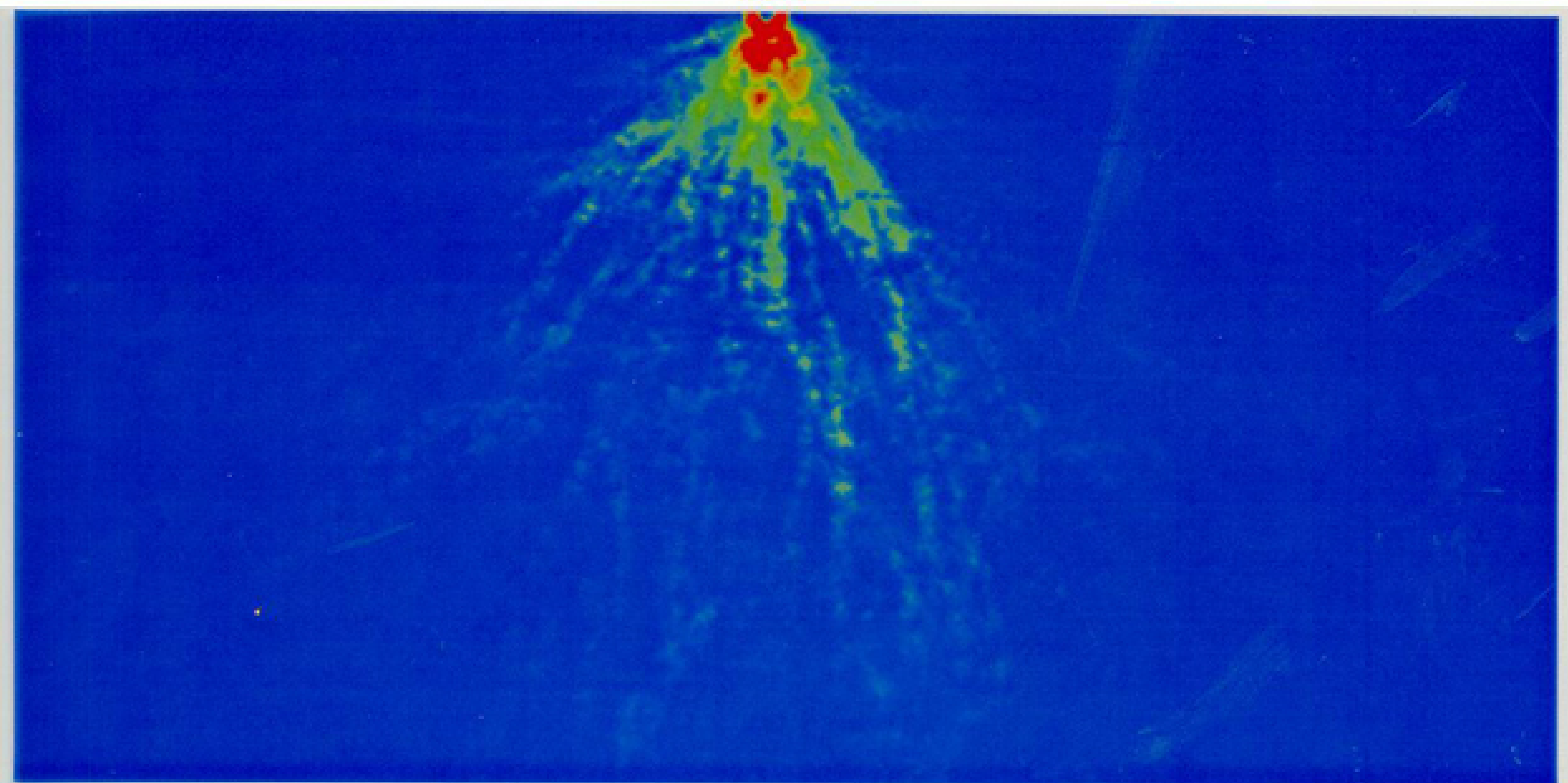
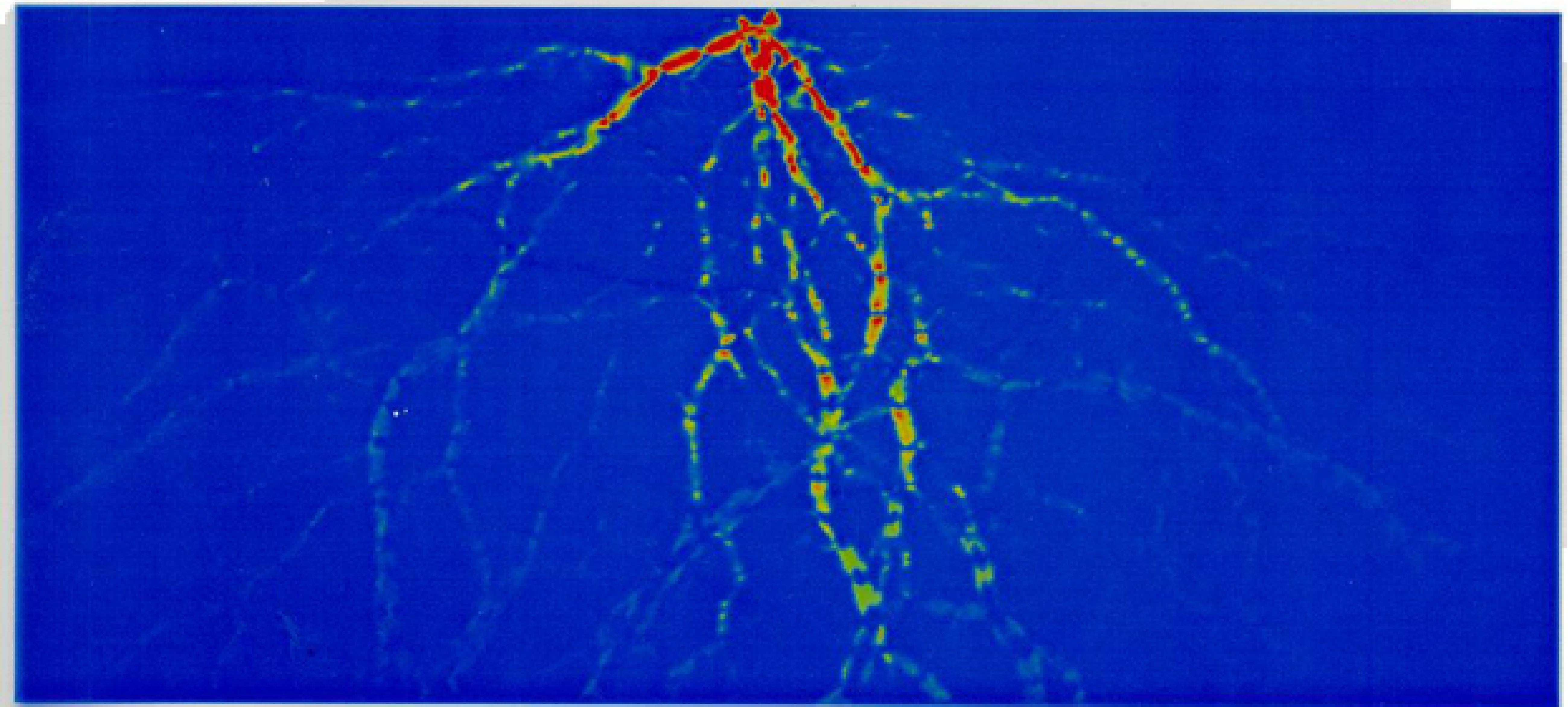


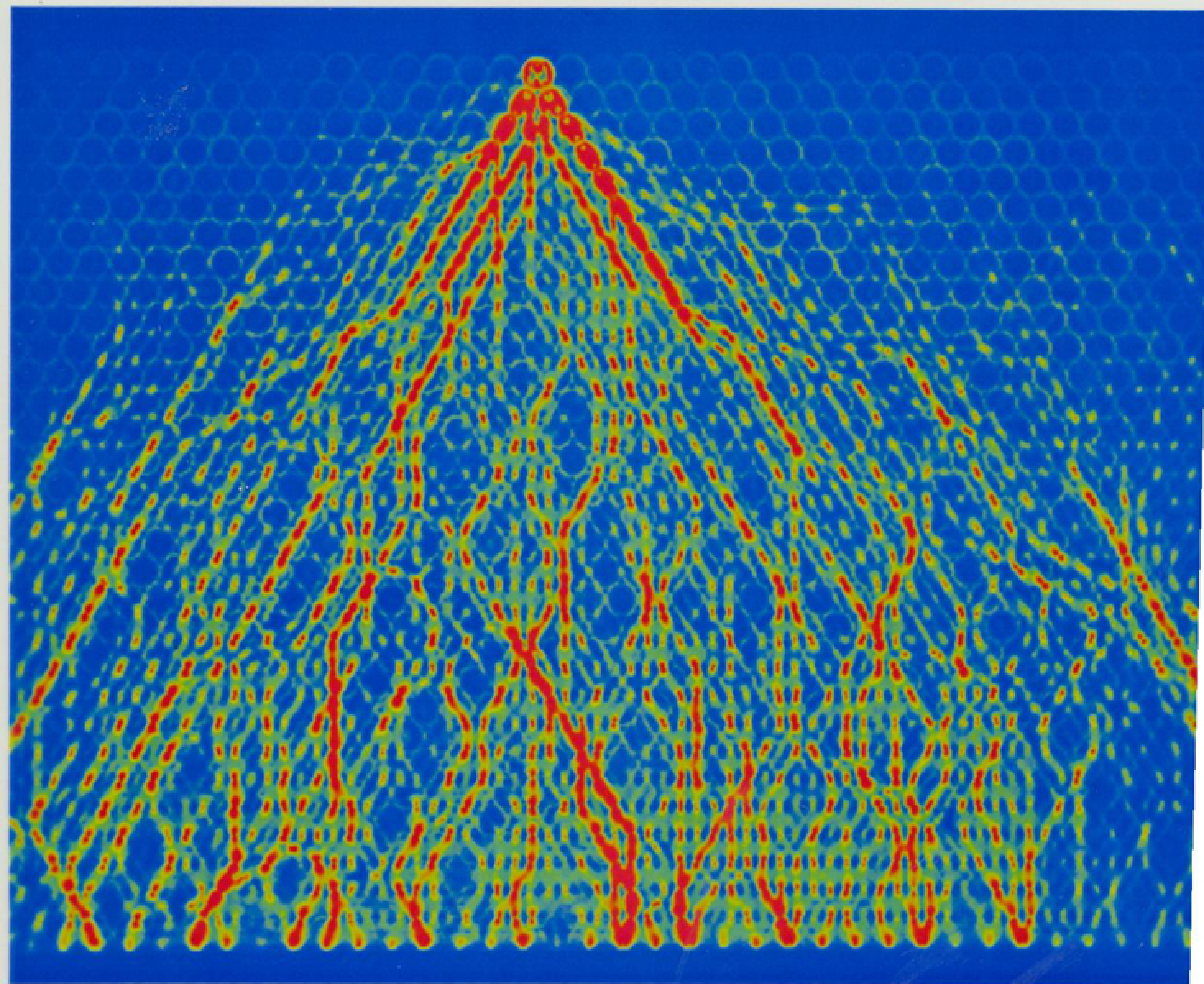


Now with point of ice

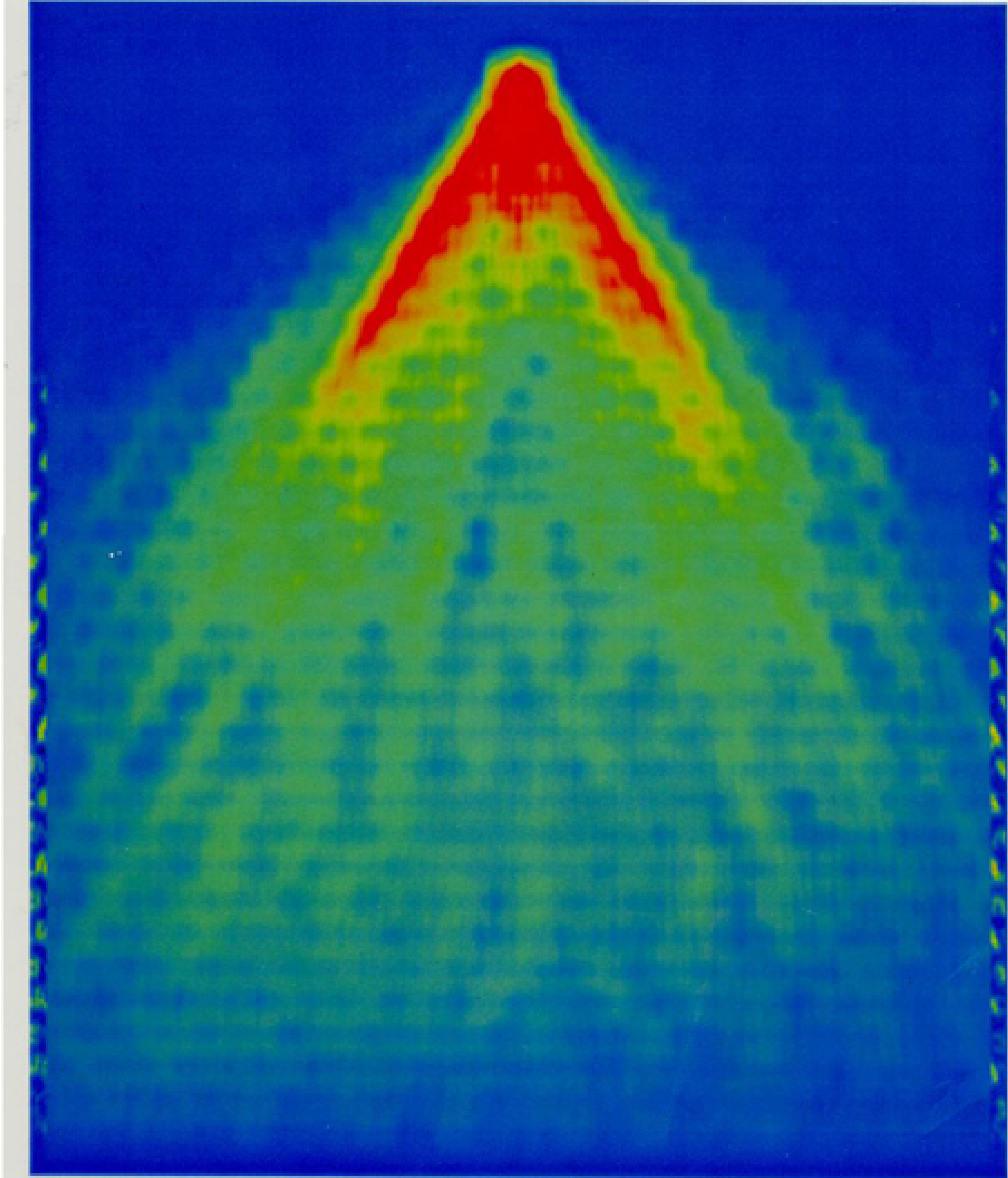
Pentagons

Pentagons Difference Image



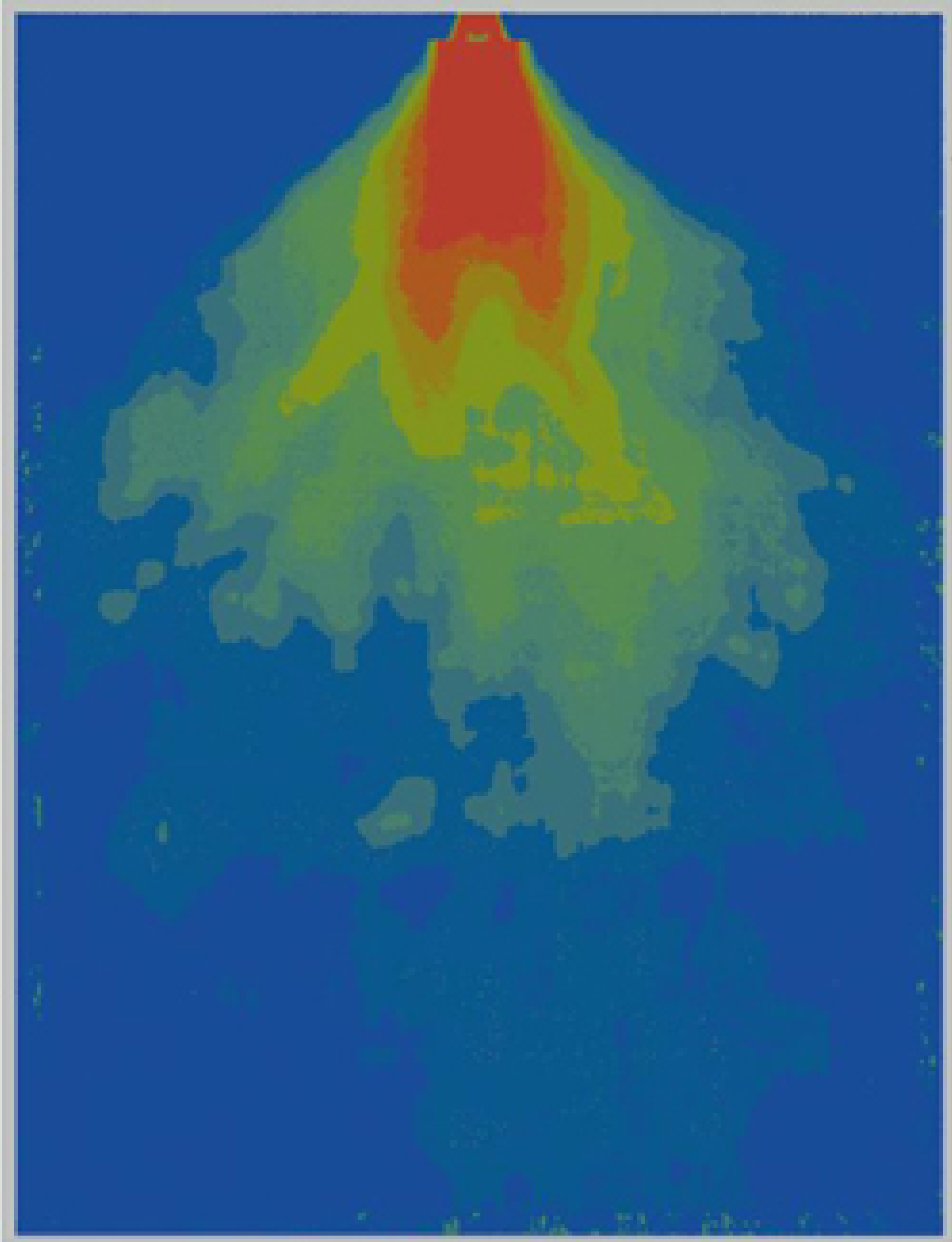


Disks (monodisperse)
with point force

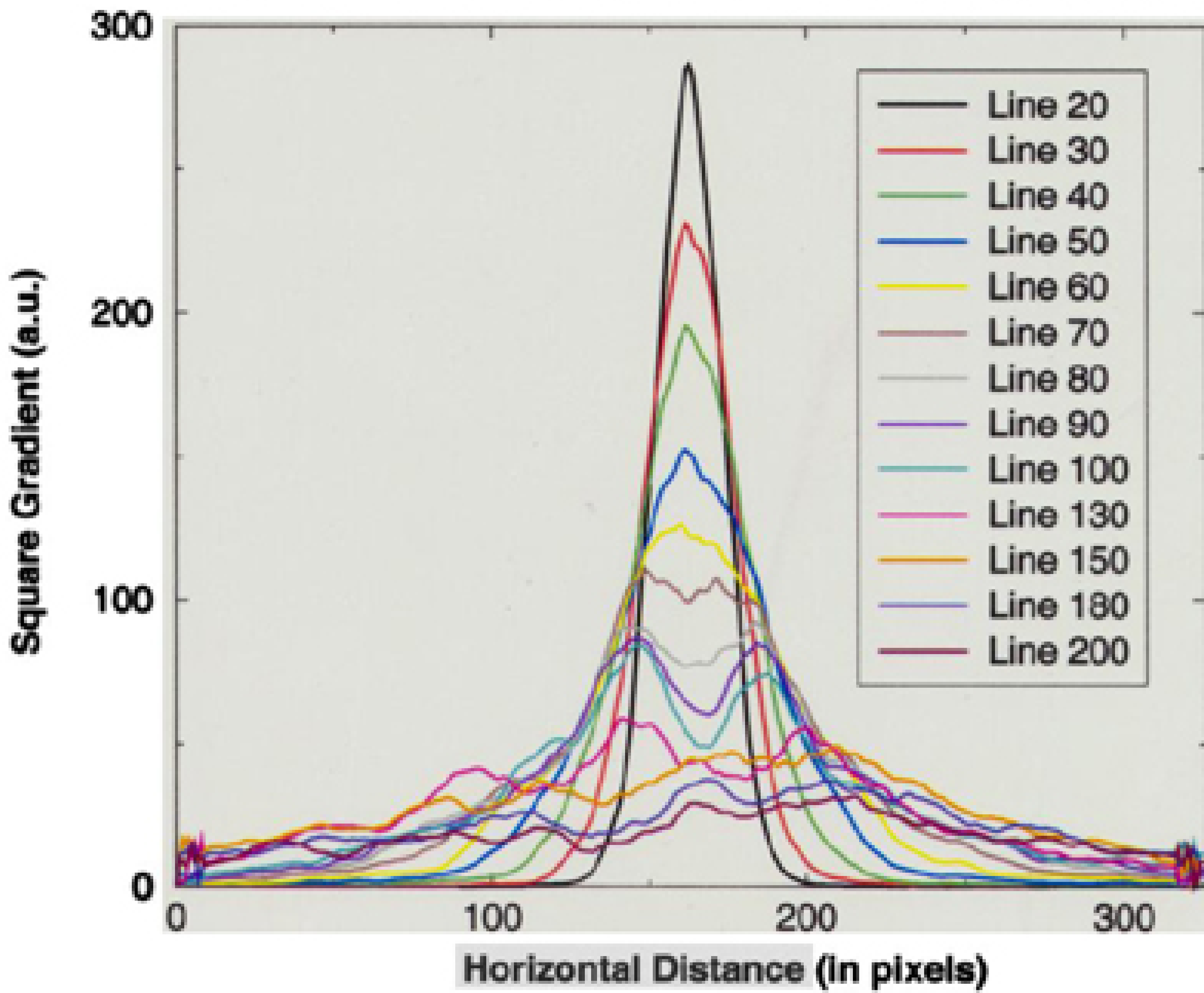


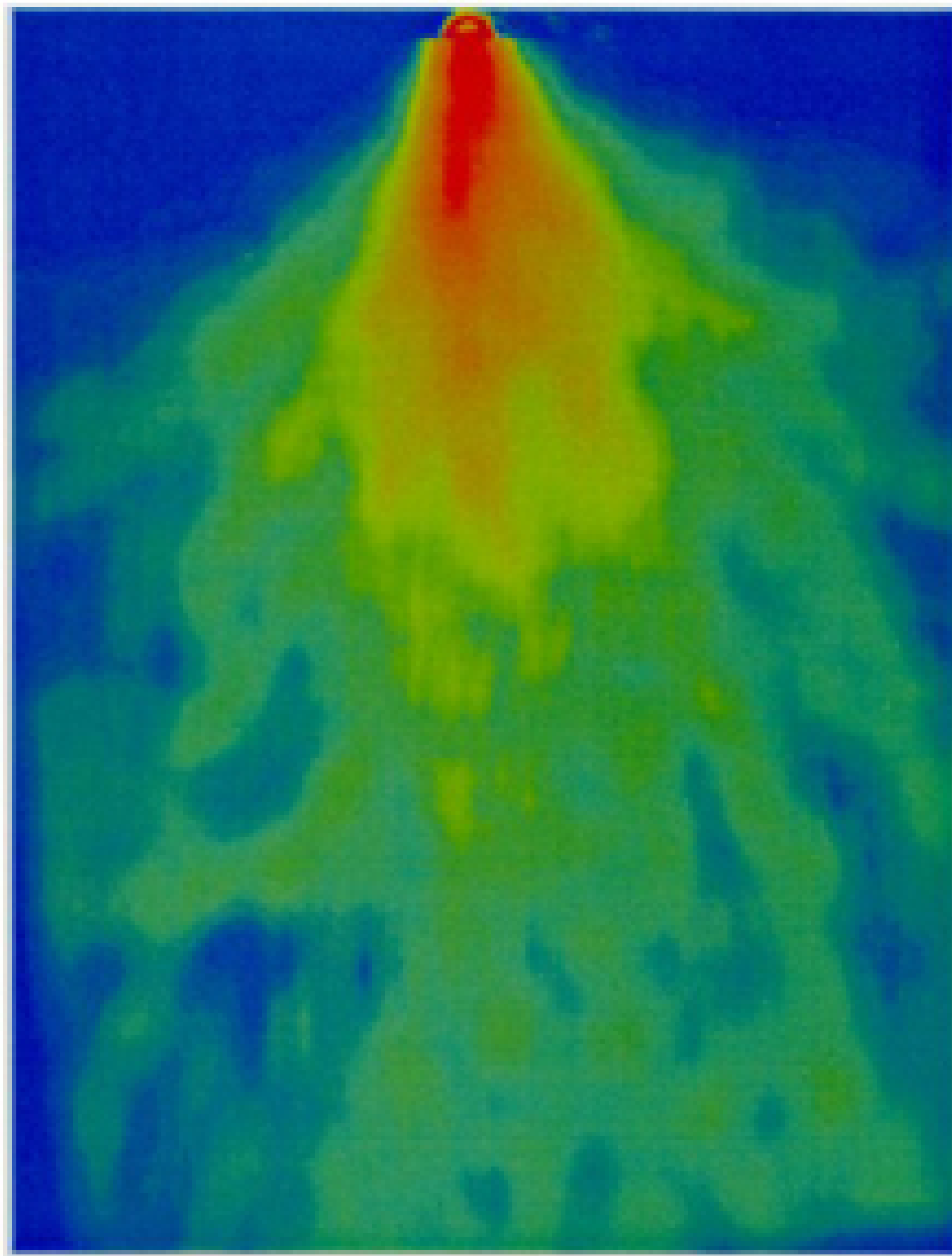
Monodisperse Disks
hydrostatic head removed

Average of 50 trials



Pressure Profiles At Different Depths (Disk Bimode, 50g)





Diffusive

or
elastic?

—————

Diffusive

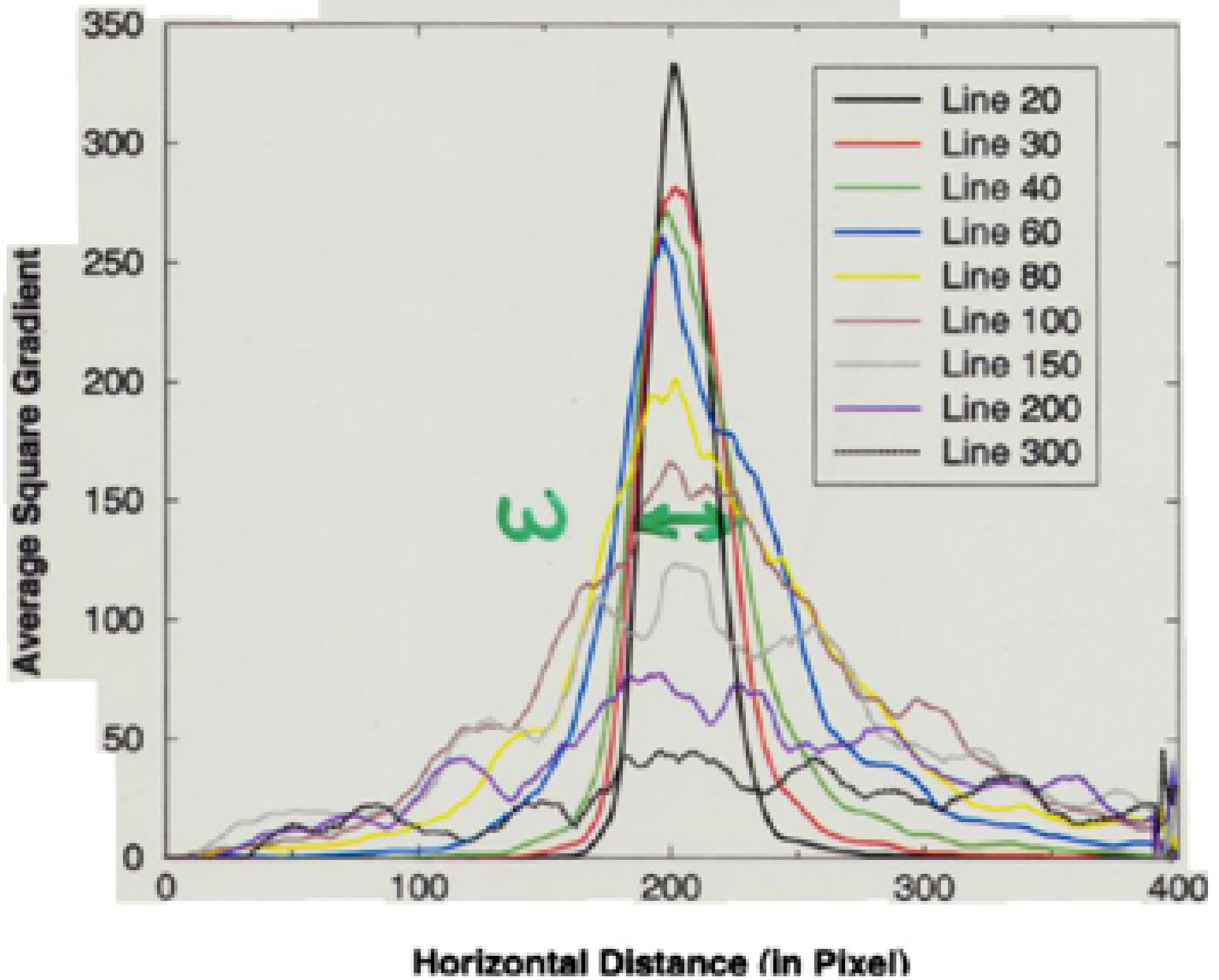
$\omega \propto z^{1/2}$

—————

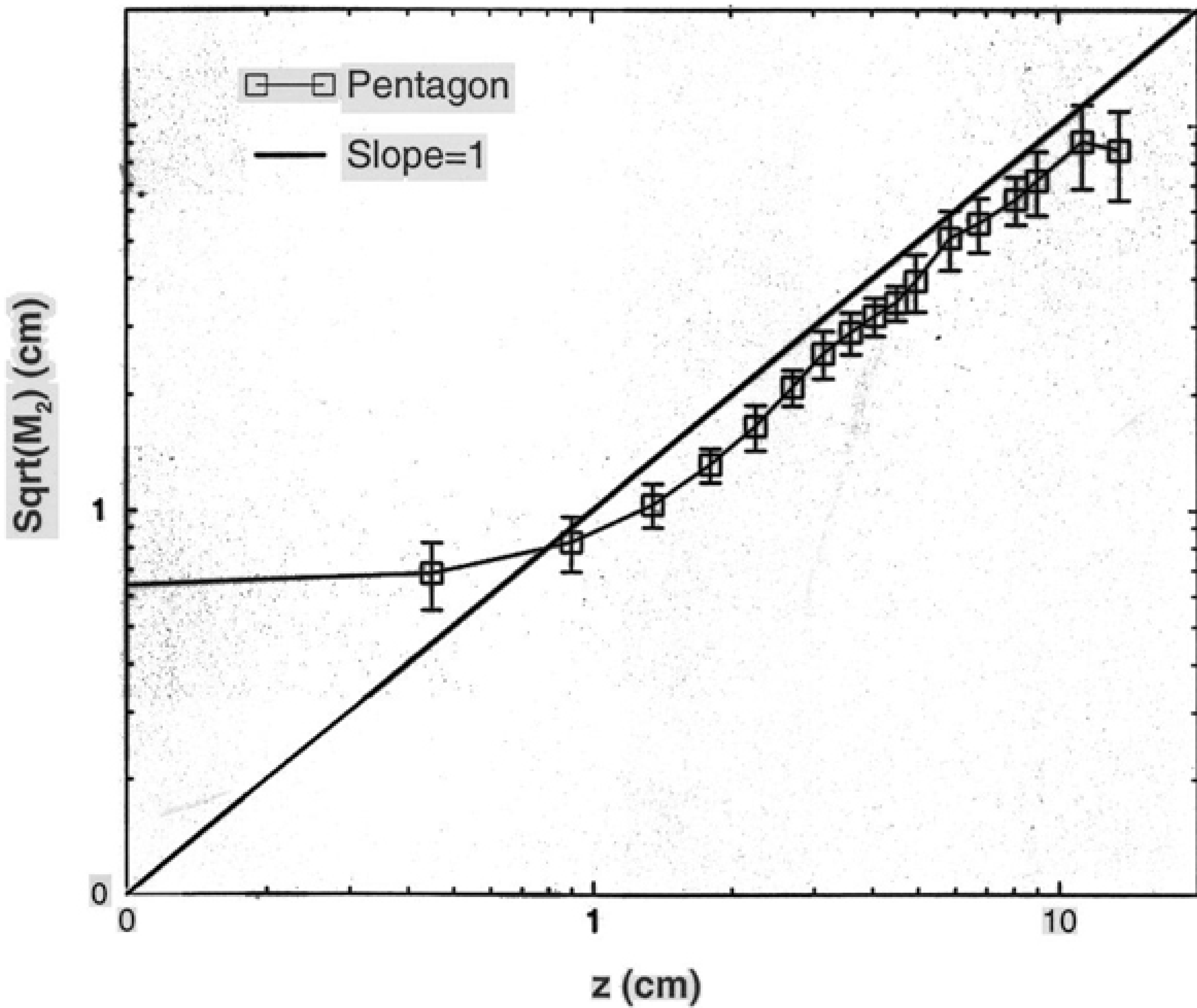
Elastic

$\omega \propto z^1$

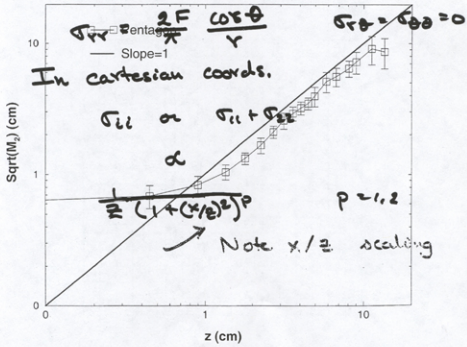
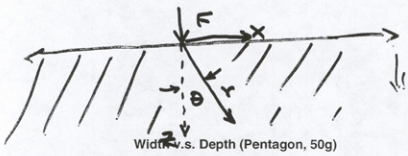
Pressure Profiles (Pentagon, 75g)

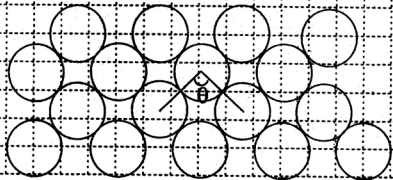
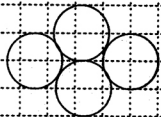
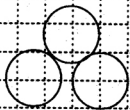
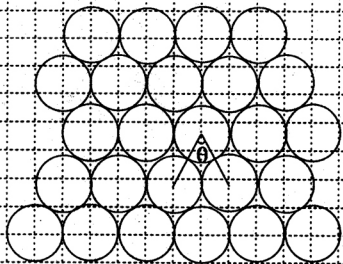


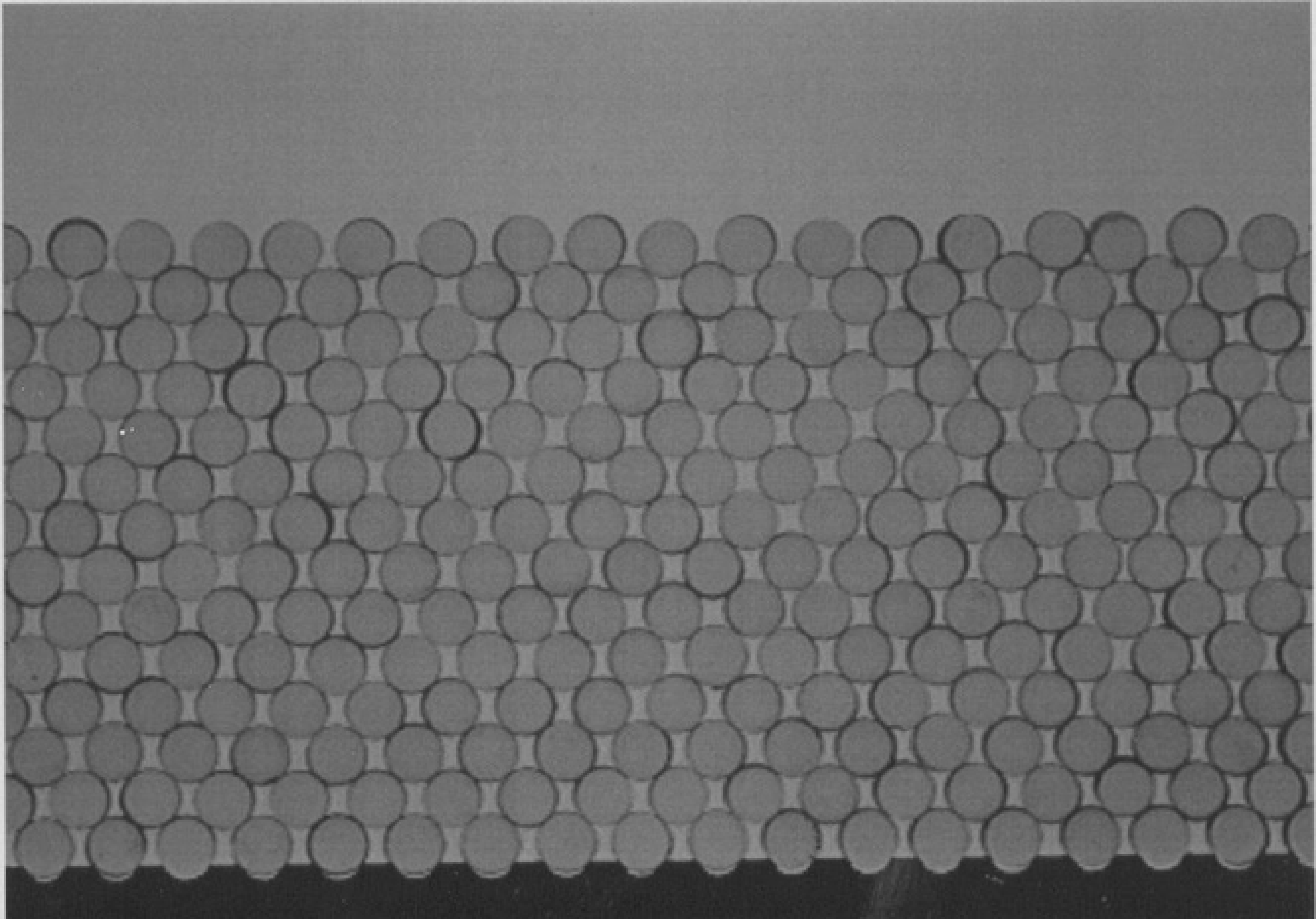
Width v.s. Depth (Pentagon, 50g)

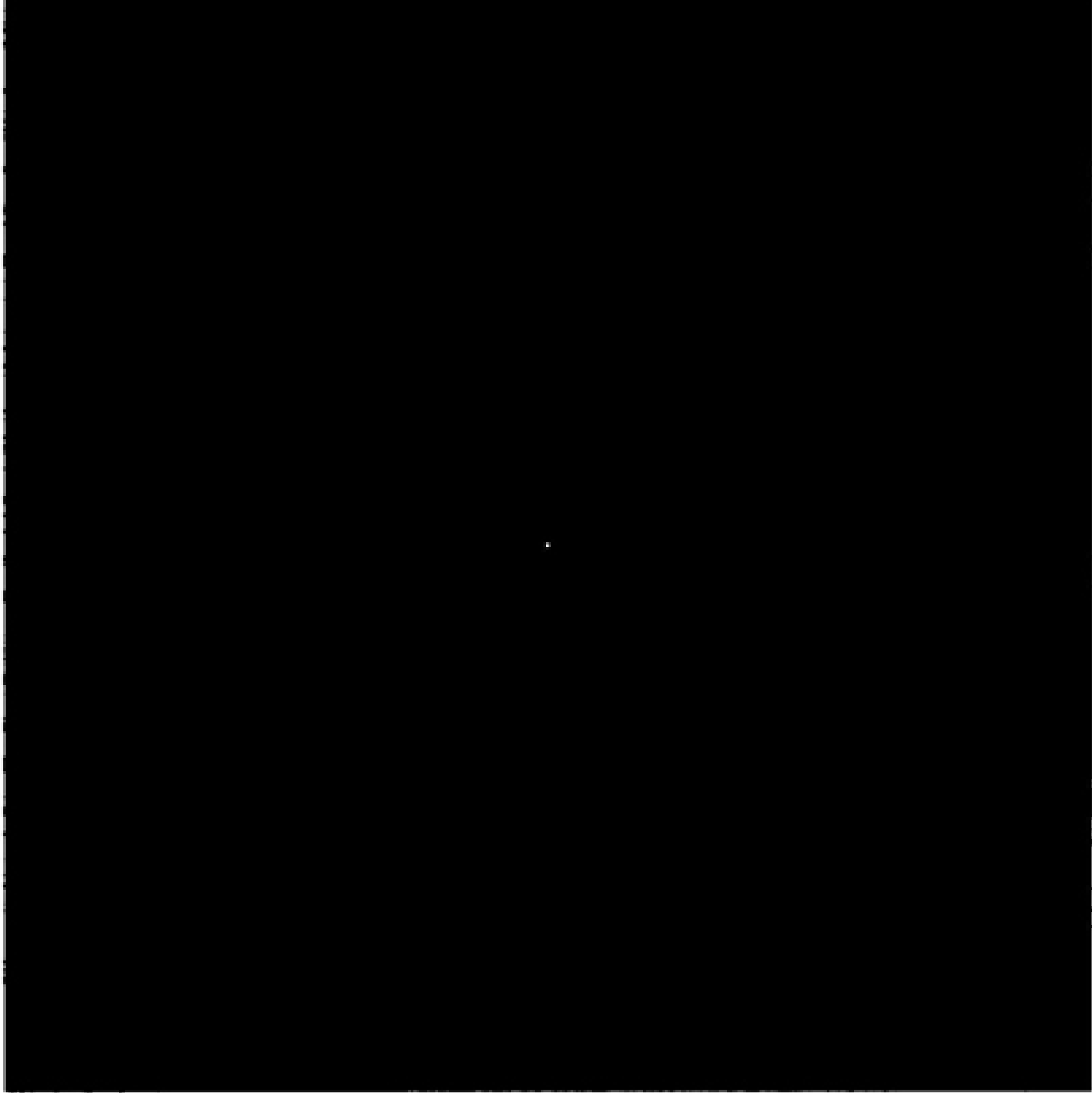


Elastic Response to a Point Force

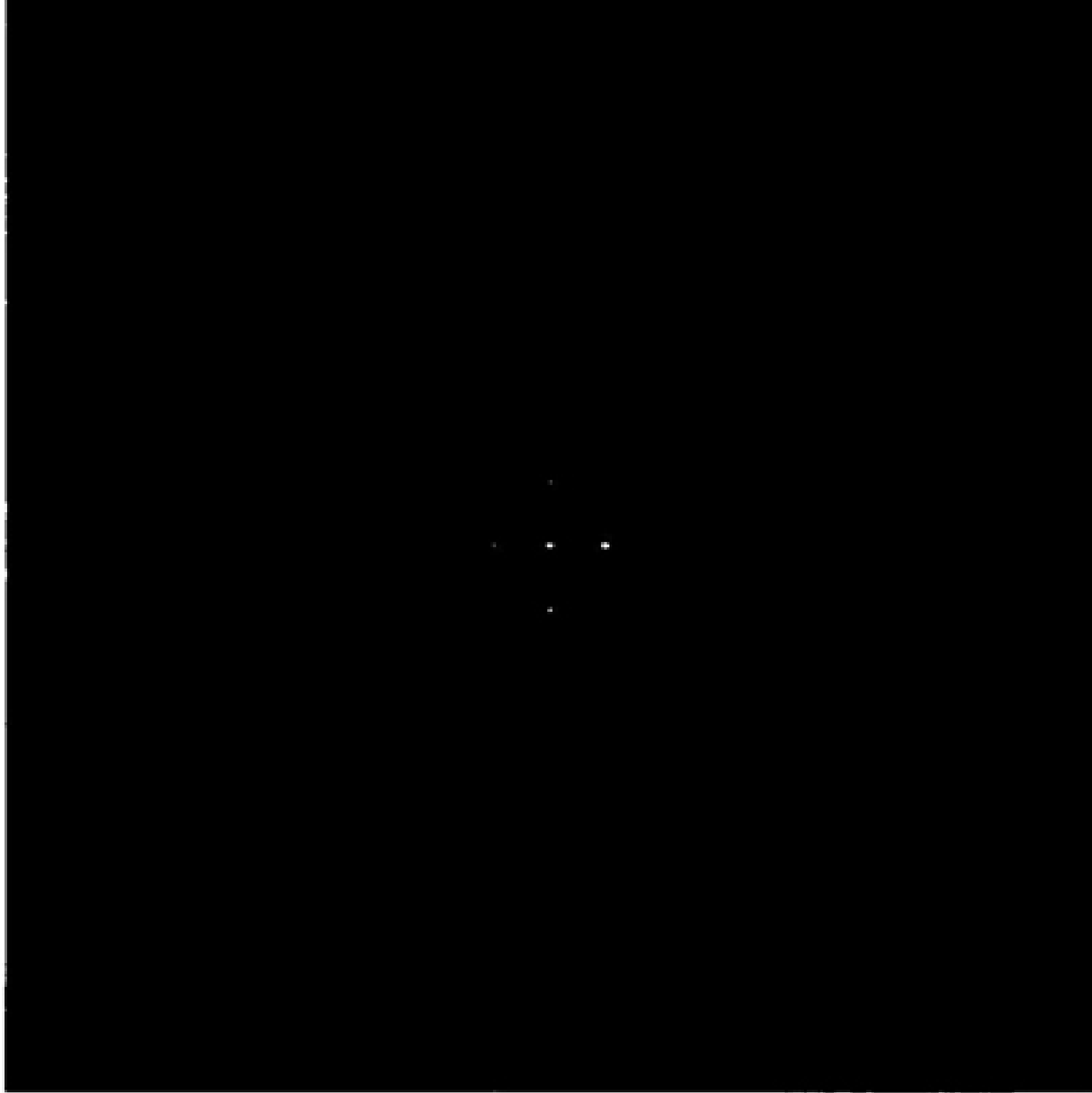




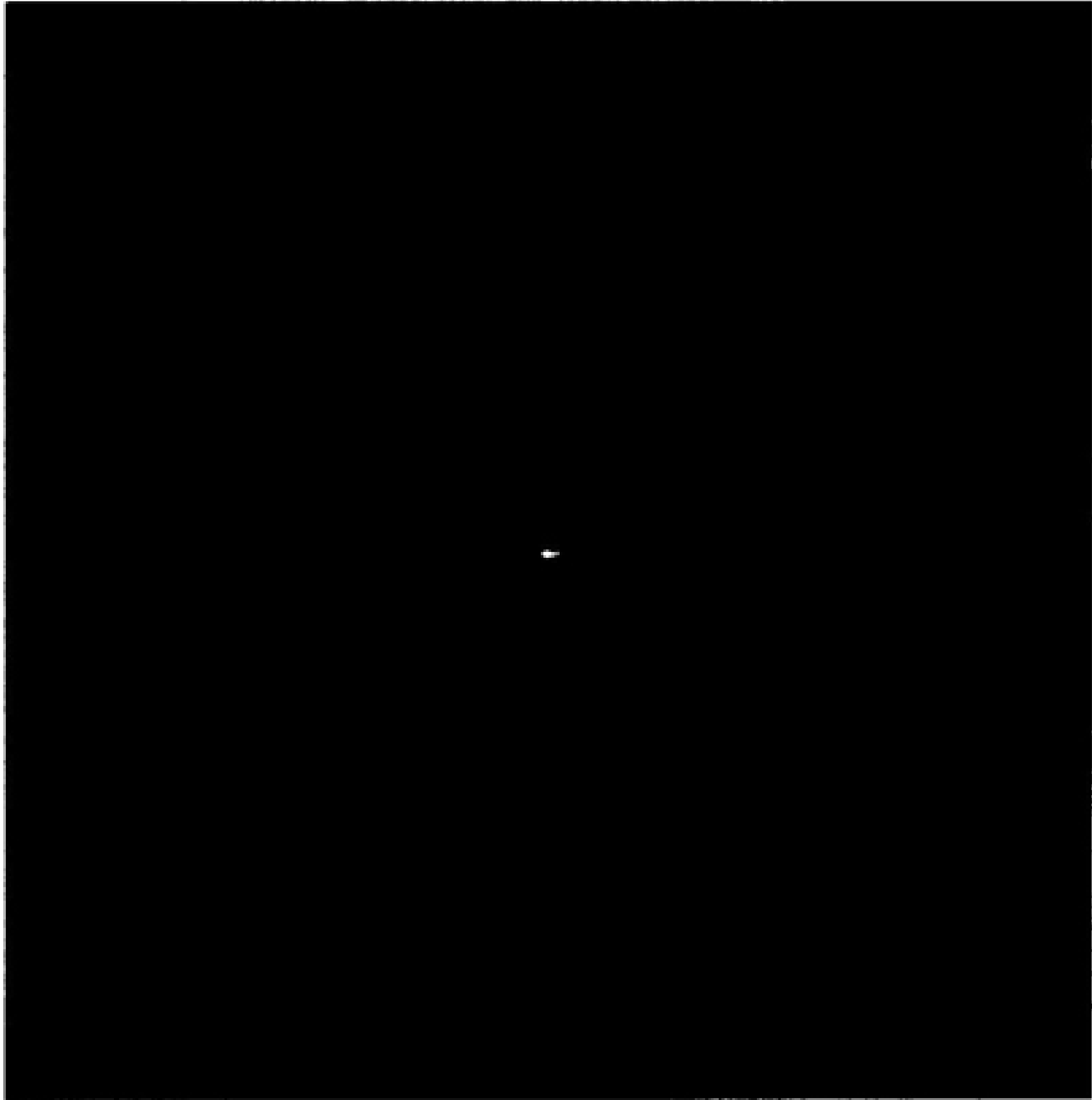




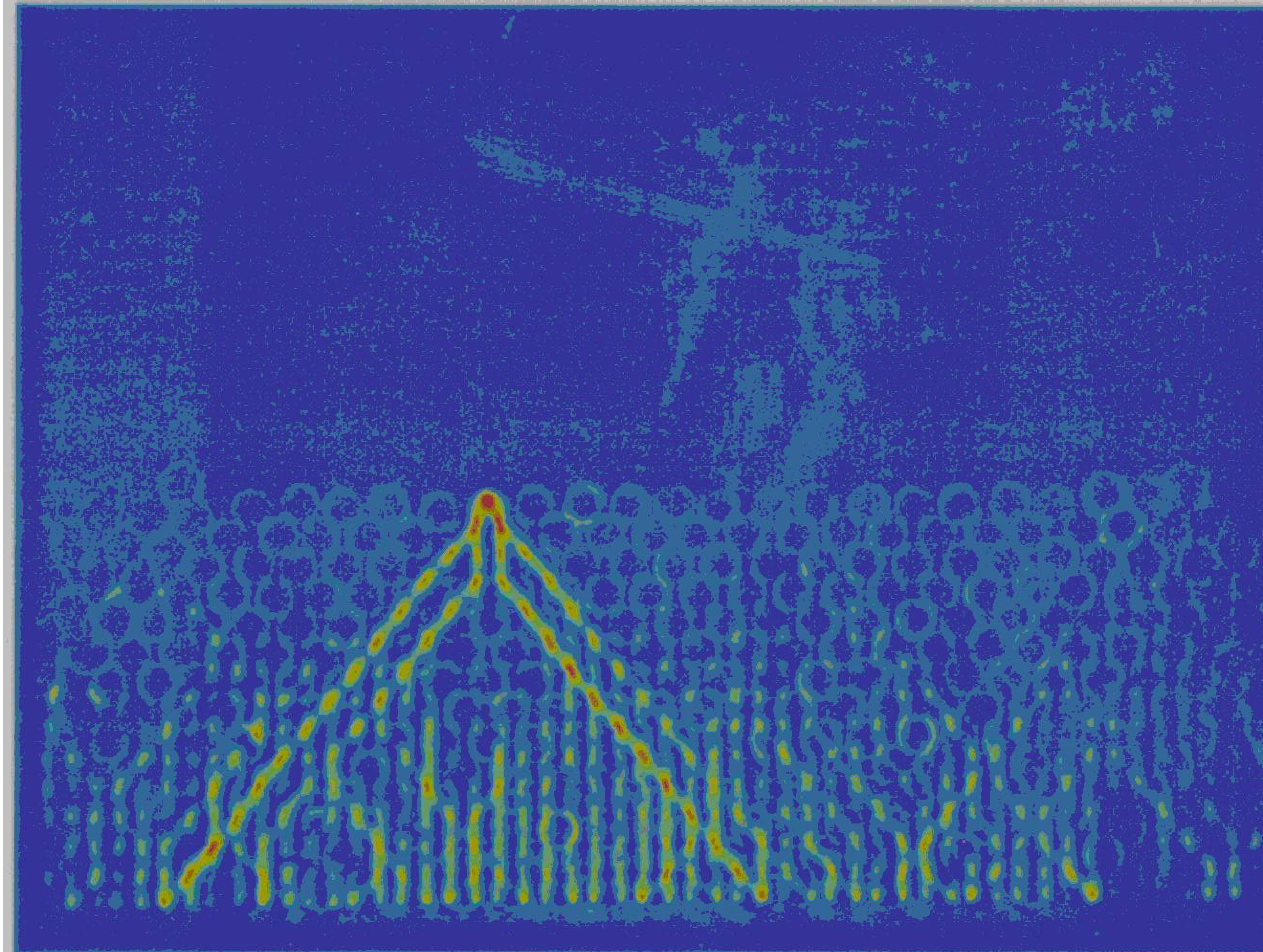
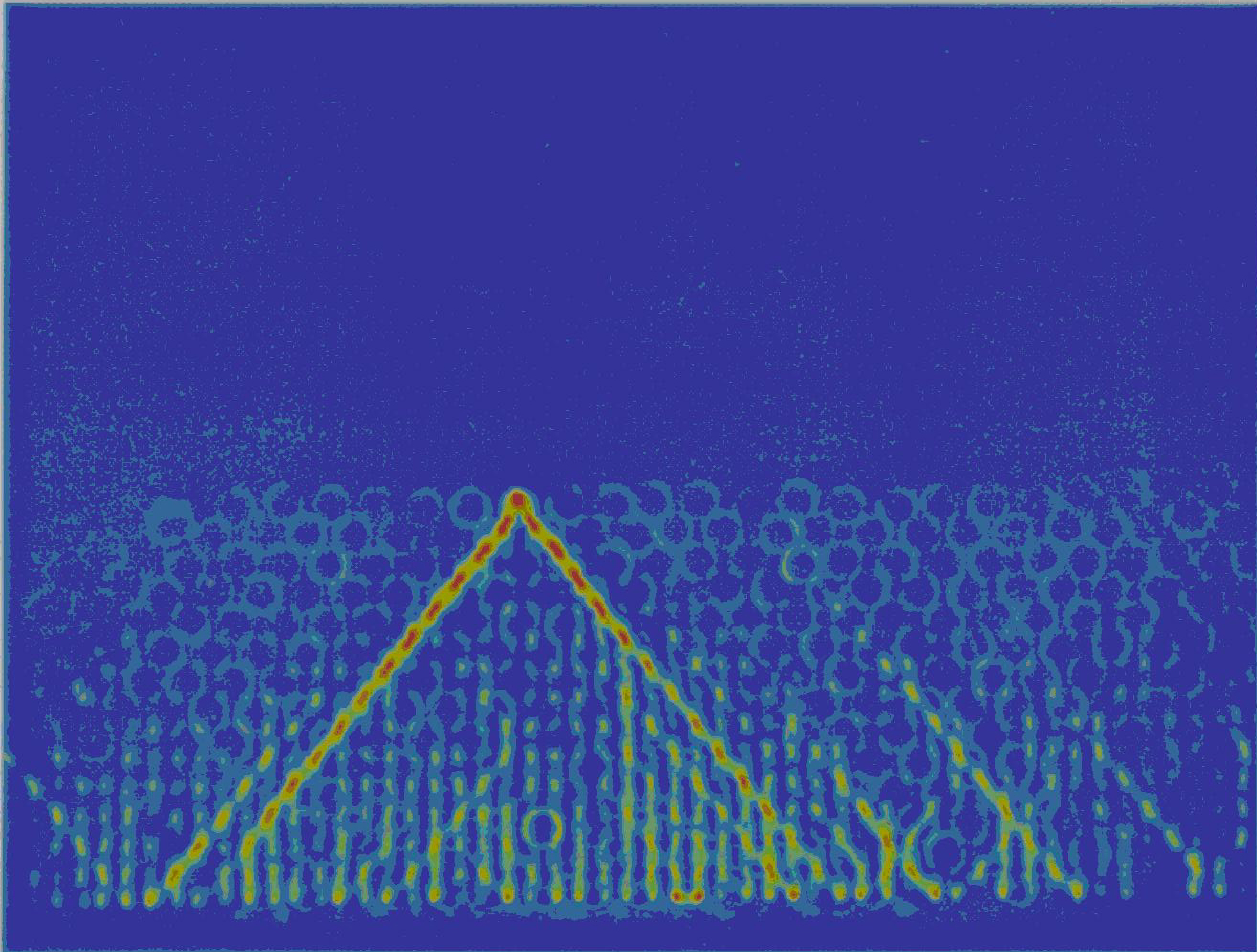
Hexagonal Packing

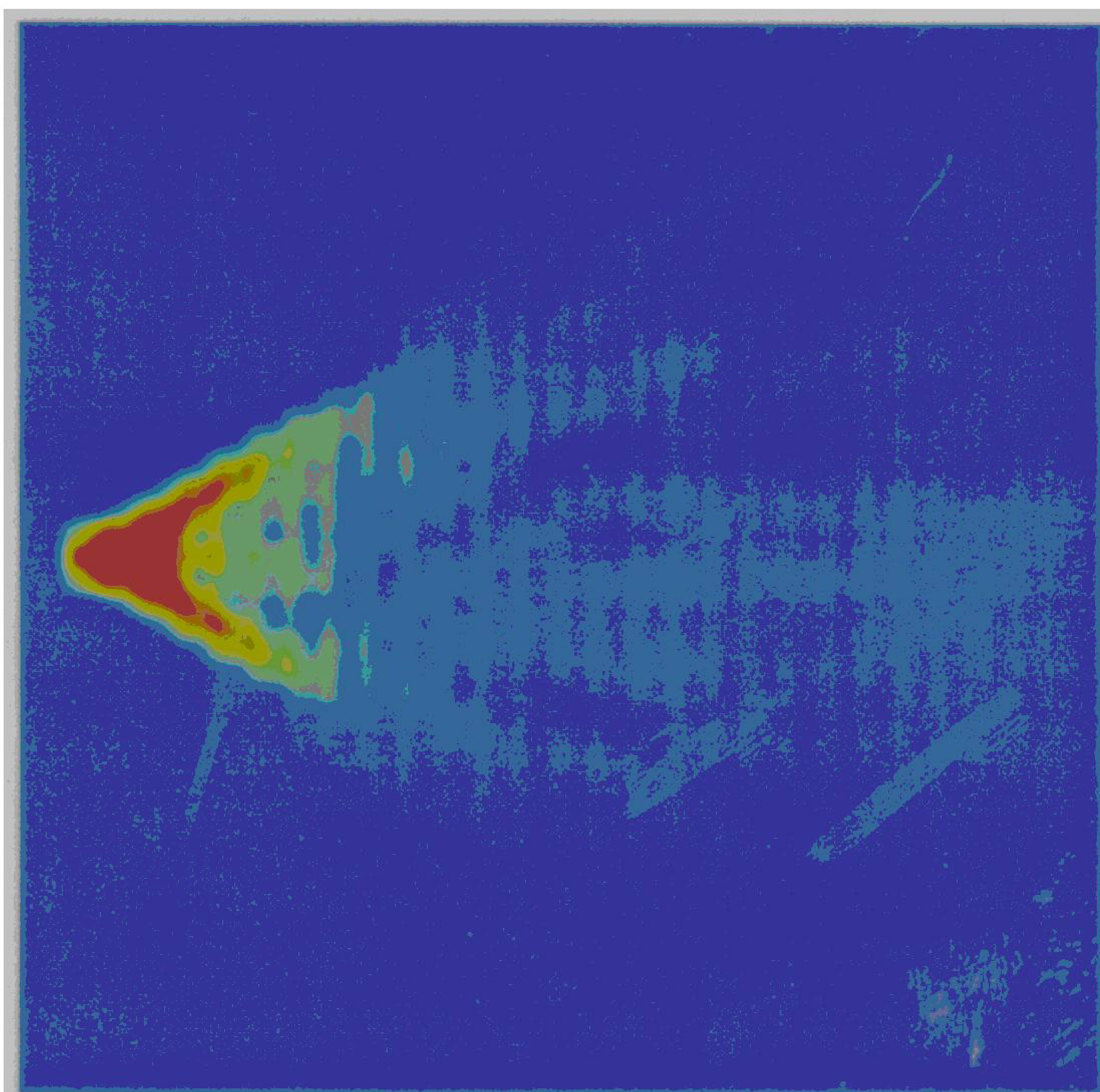
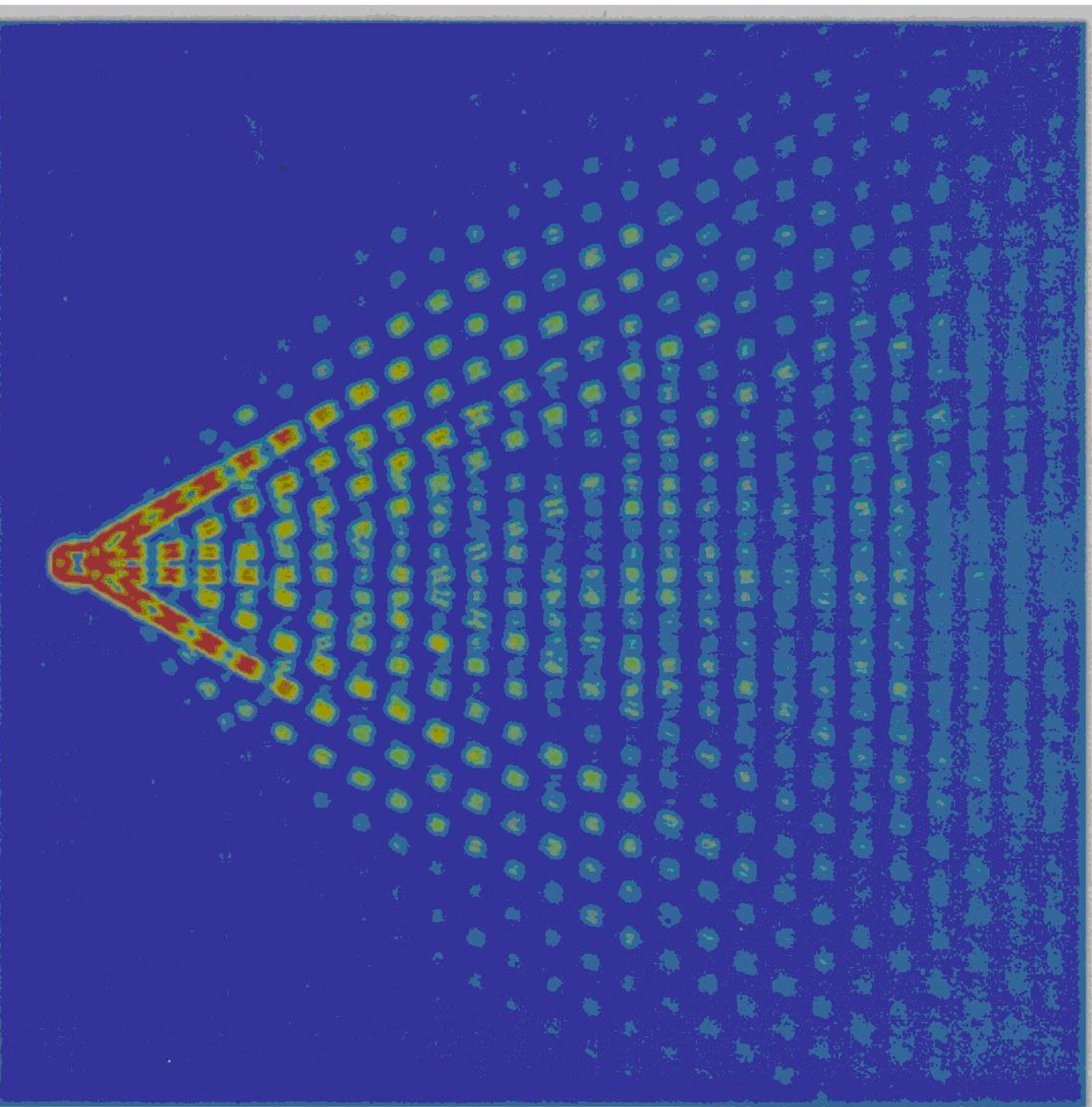
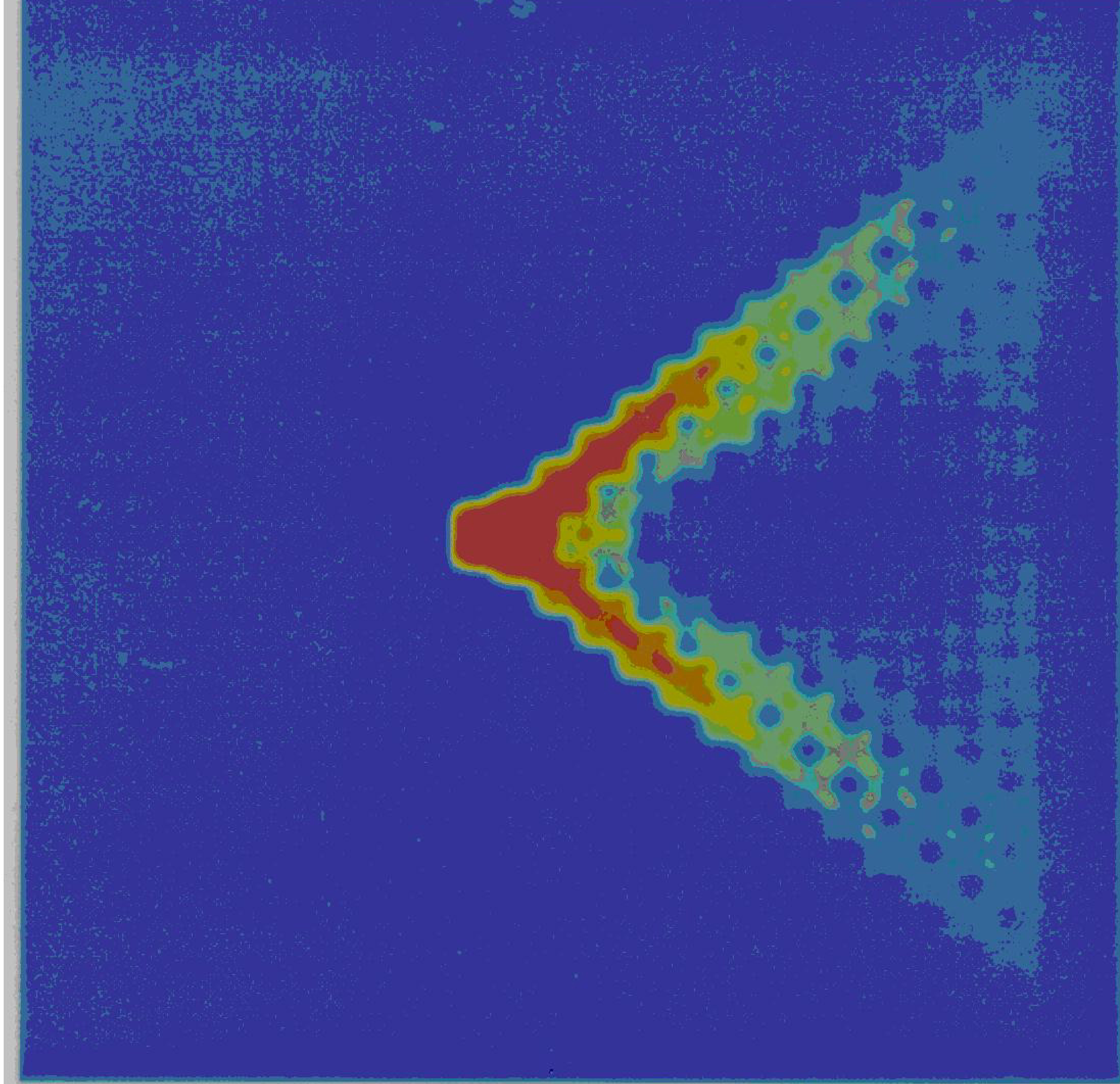
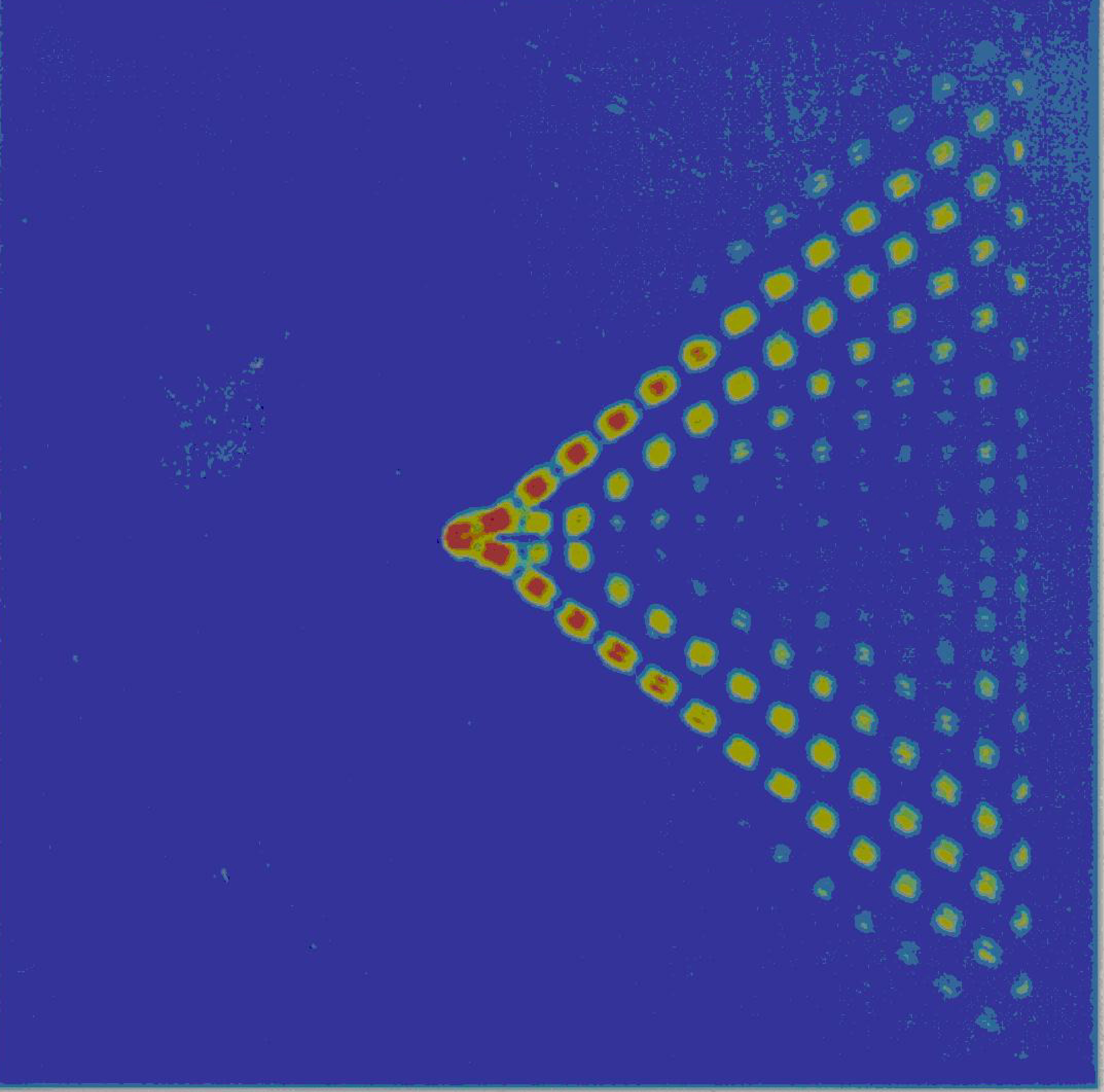


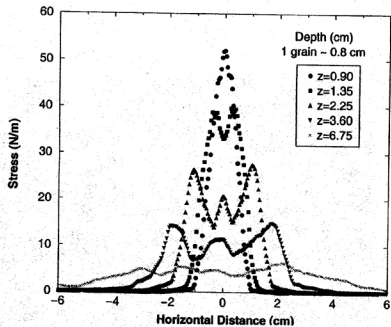
Square-lattice Packing



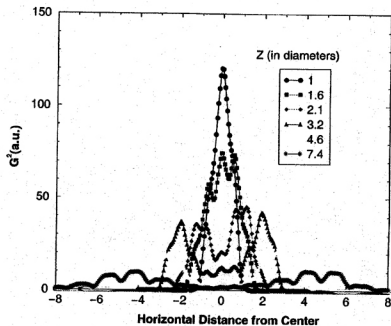
Pentagonal Packing



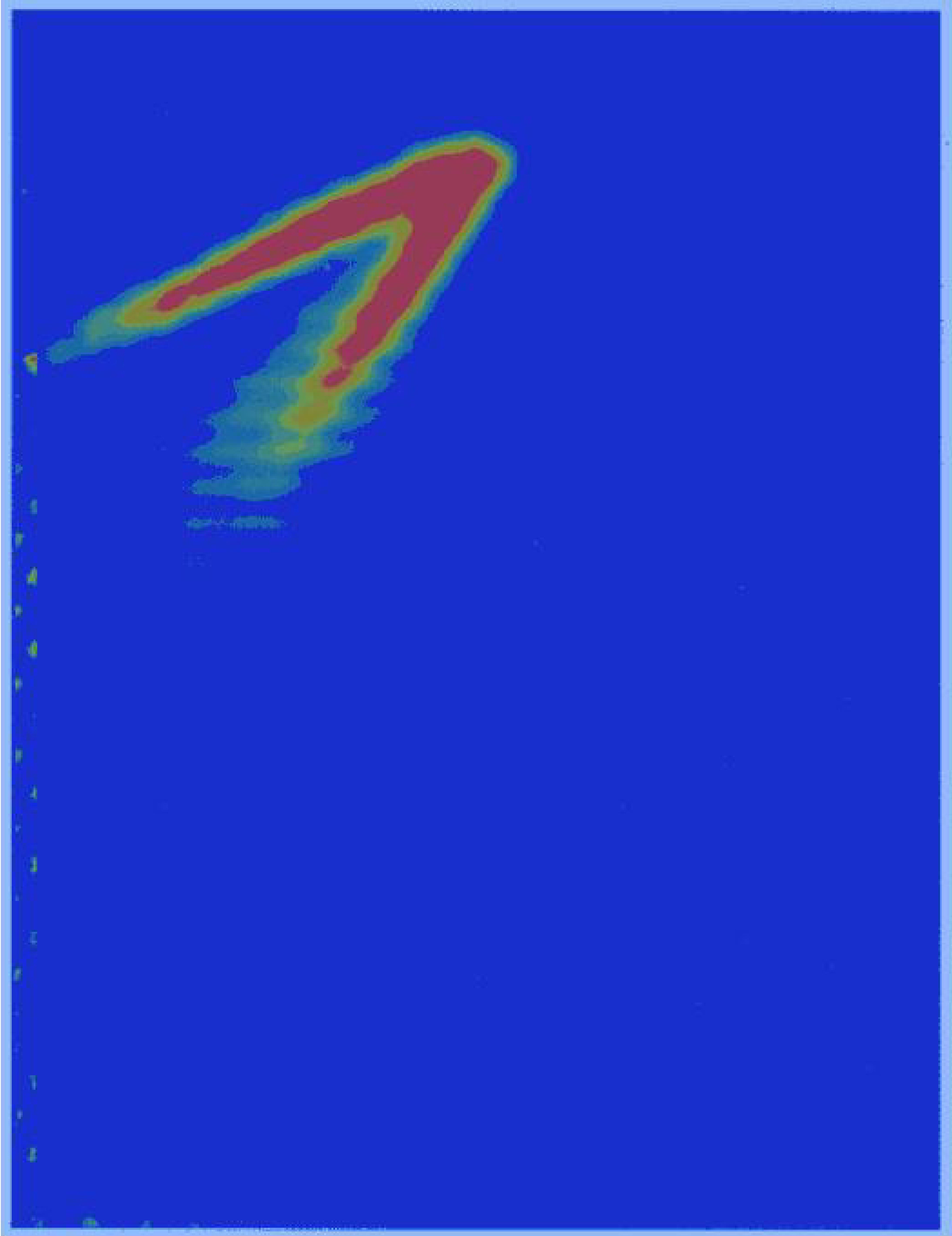




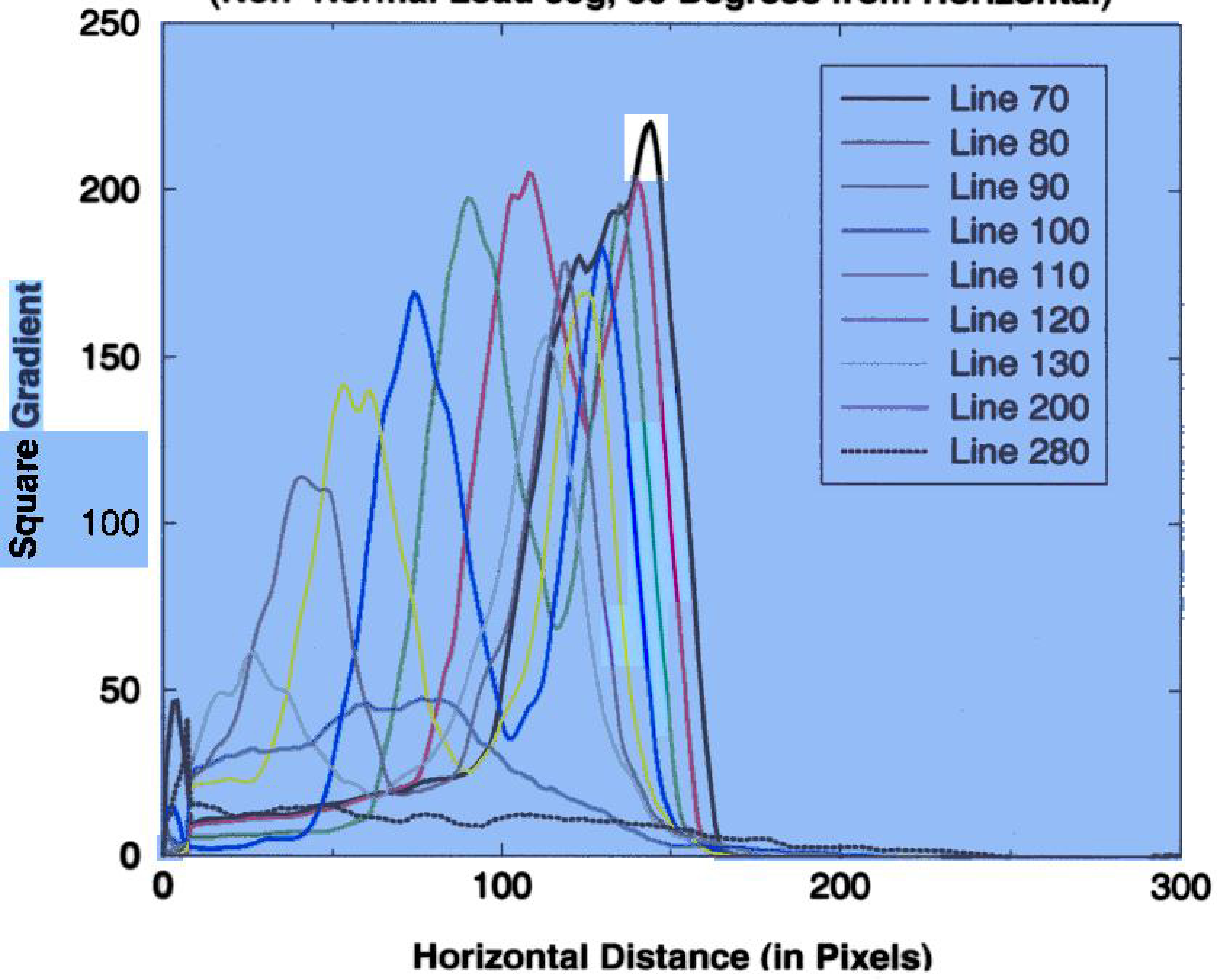
Hexagonal Packing

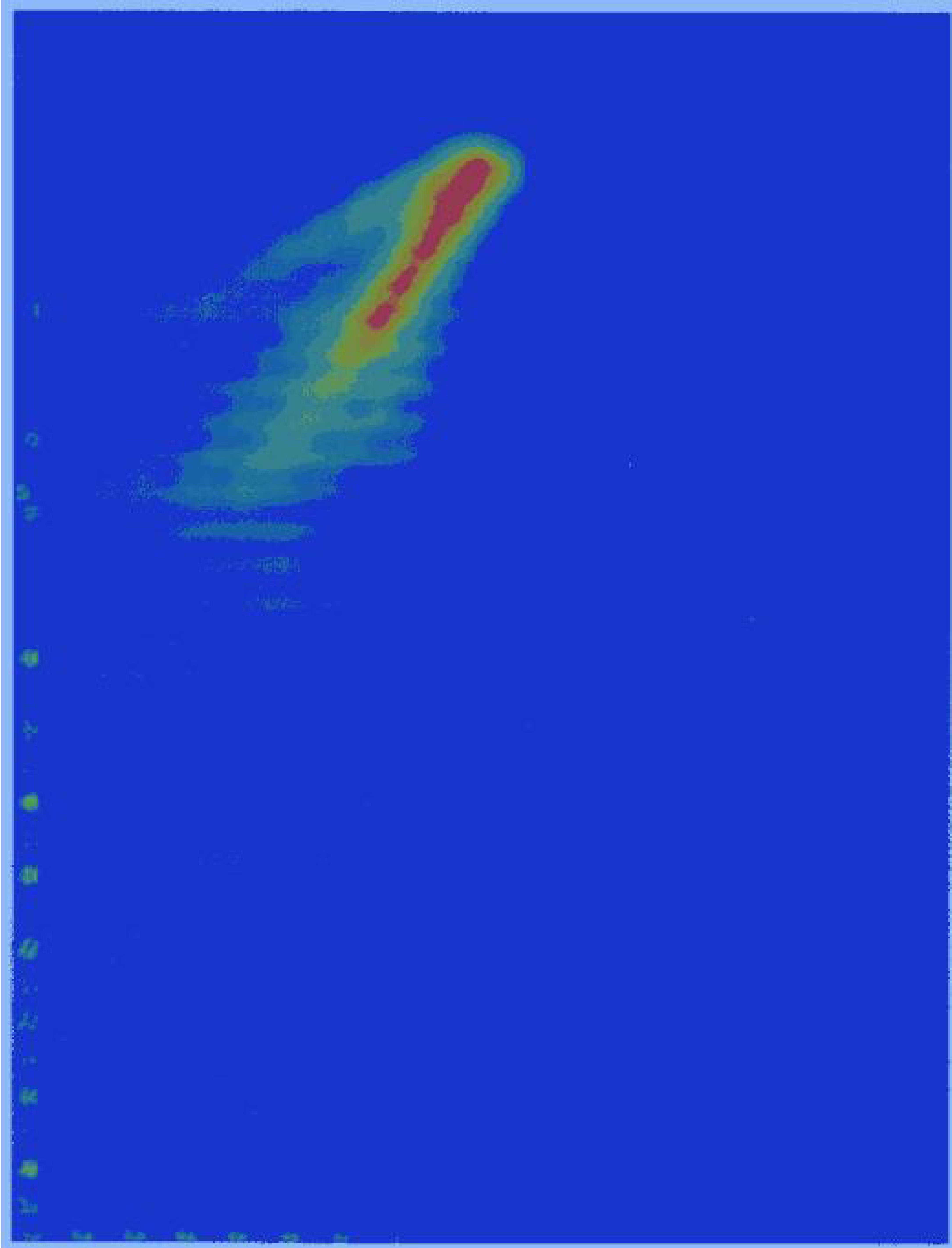


Square-lattice Packing

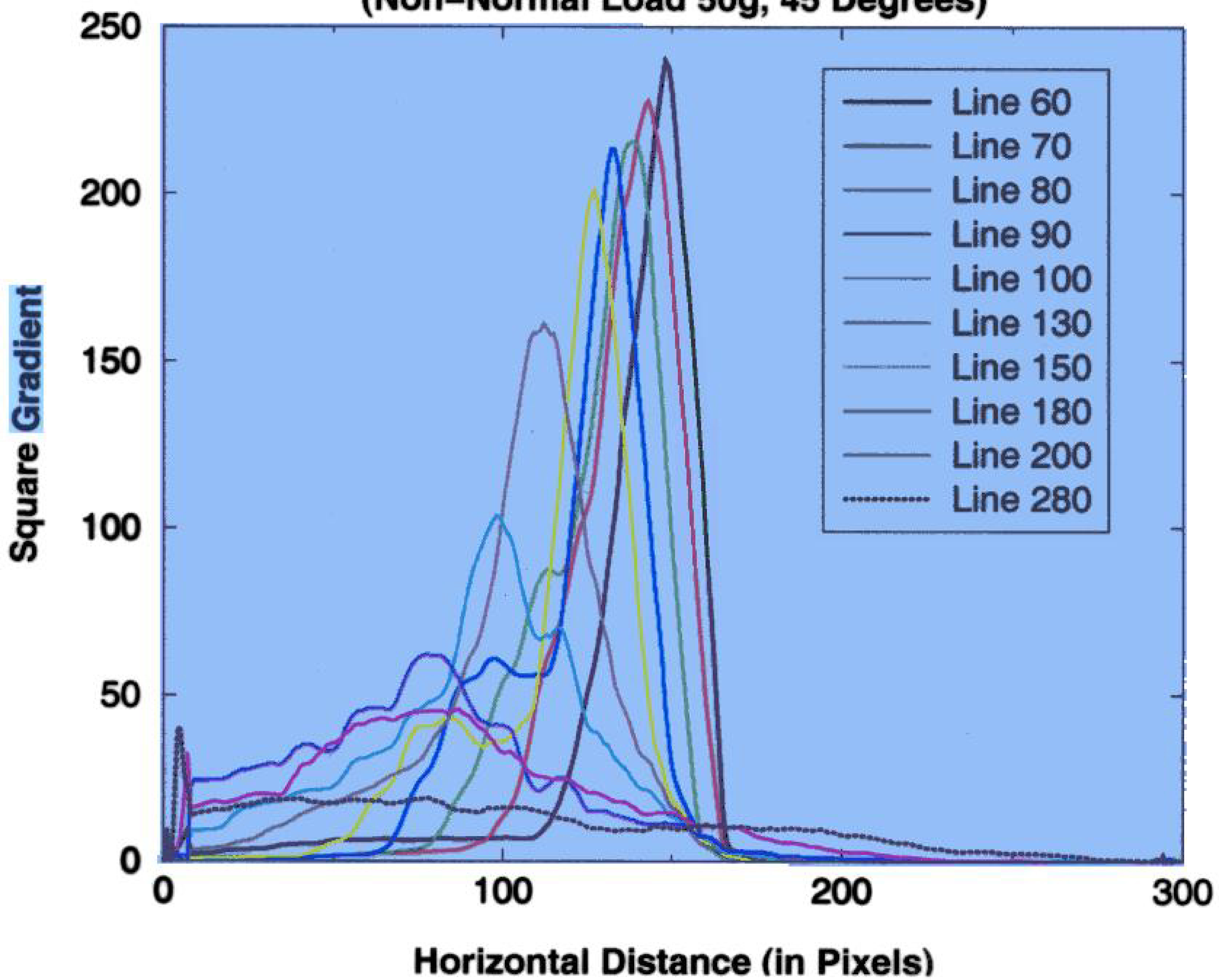


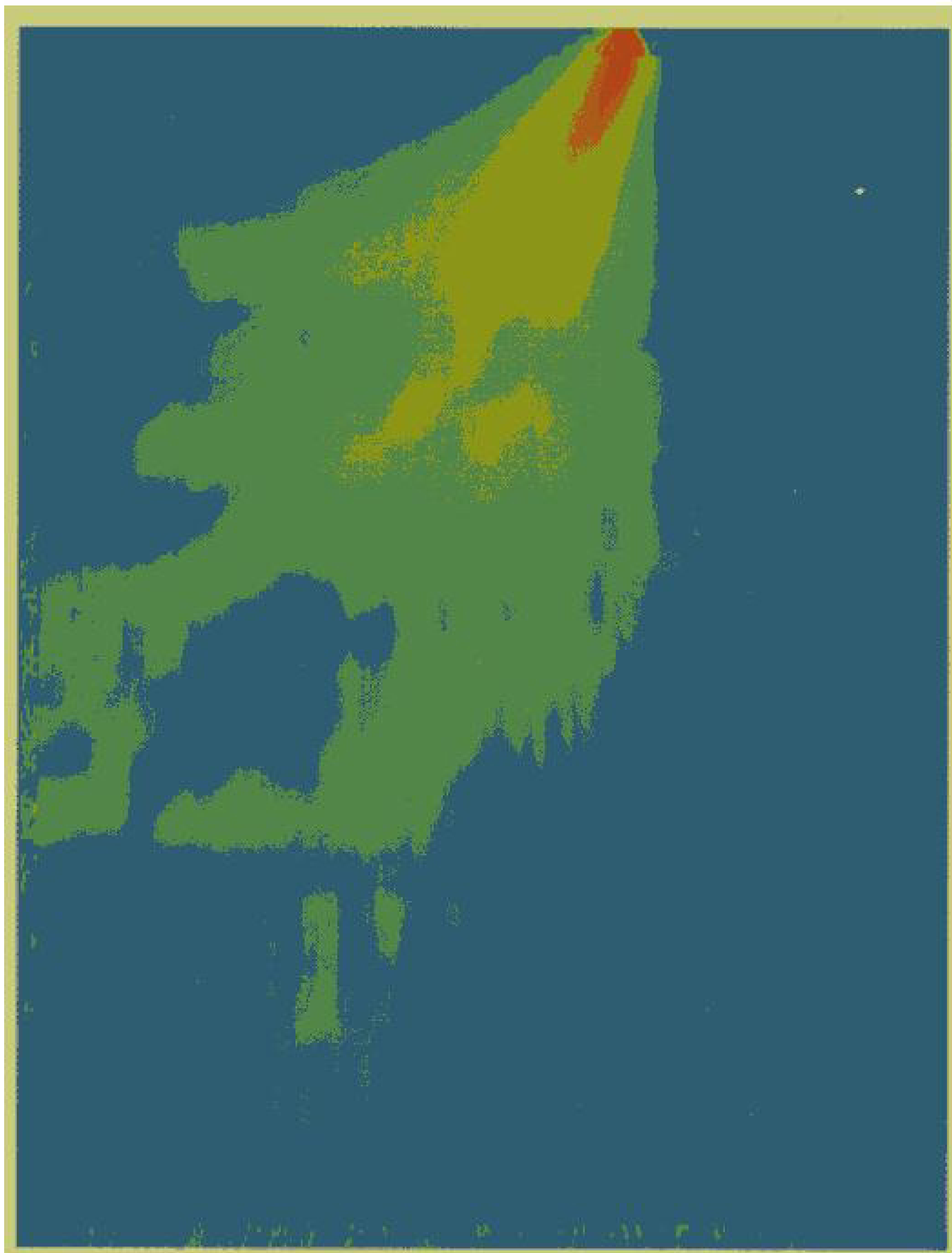
Pressure Profiles At Different Depths
 (Non-Normal Load 50g, 30 Degrees from Horizontal)





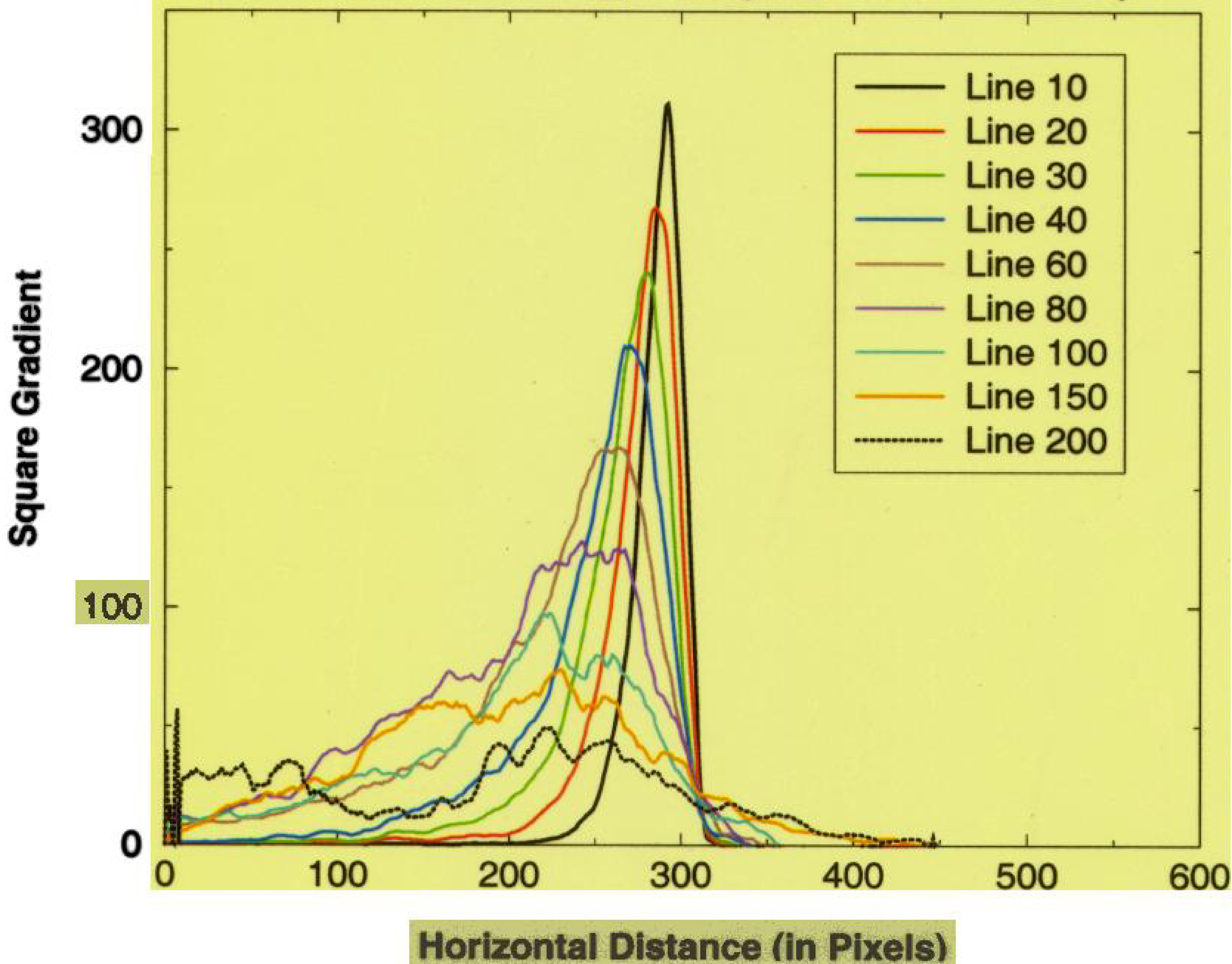
**Pressure Profiles At Different Depths
(Non-Normal Load 50g, 45 Degrees)**



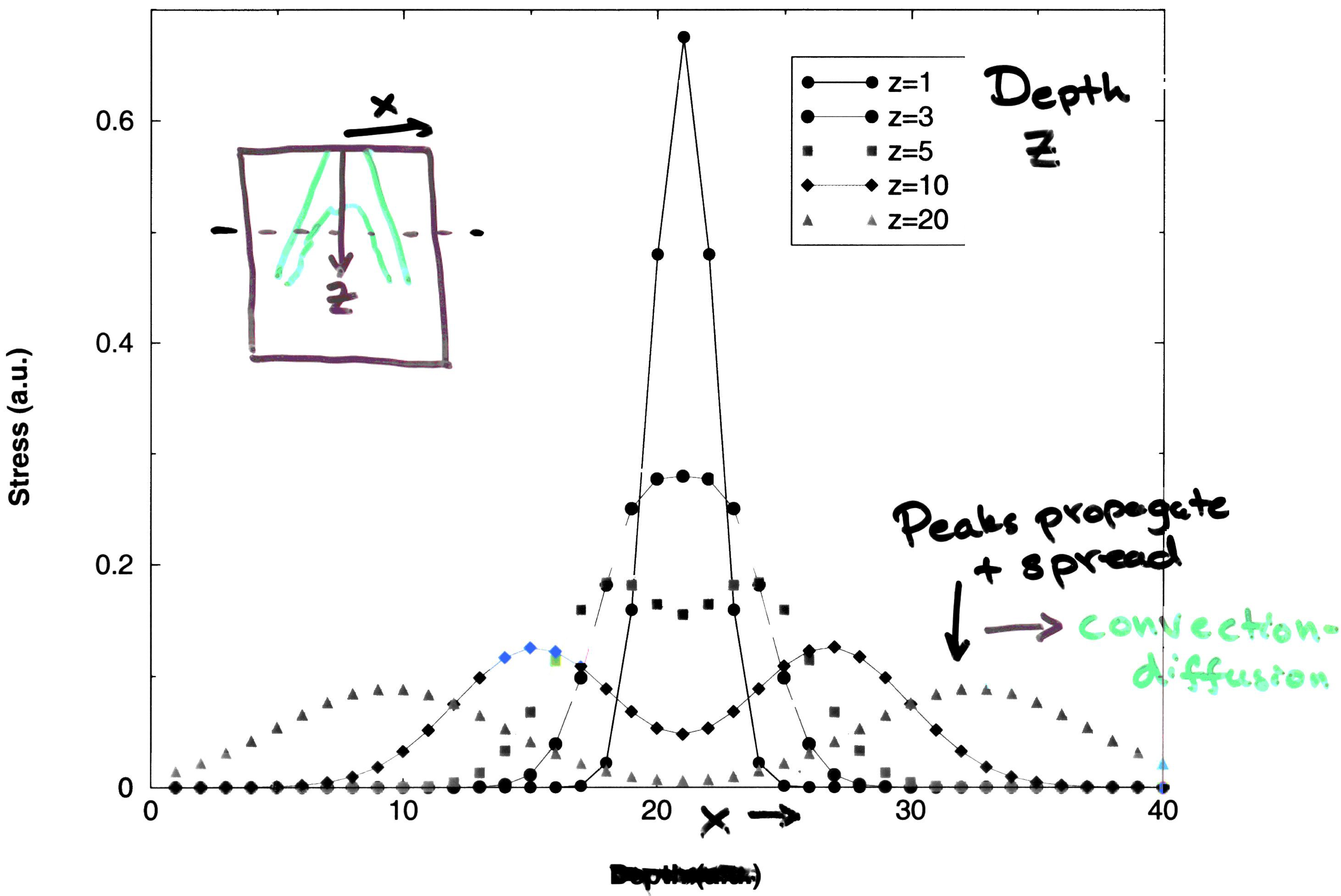


Pressure Profiles At Different Depths (Pentagons)

(Non-Normal Load 50g, 45 Degrees from Horizontal)



Pressure Profiles From Convection-Diffusion Eq. (C=0.58,D=0.5)



Conclusions

Order / Disorder crucial

Ordered Systems →
convection-diffusion
(wave-like)

eg ok

Disordered Systems → Elastic

Future Explorations

1) Vector nature of response

2) Systems under compressive
shear loads or

3) History dependence

Density dependence

Improved photoelastic techniques