New motivations to inspect the internal structure of N.E.A.s

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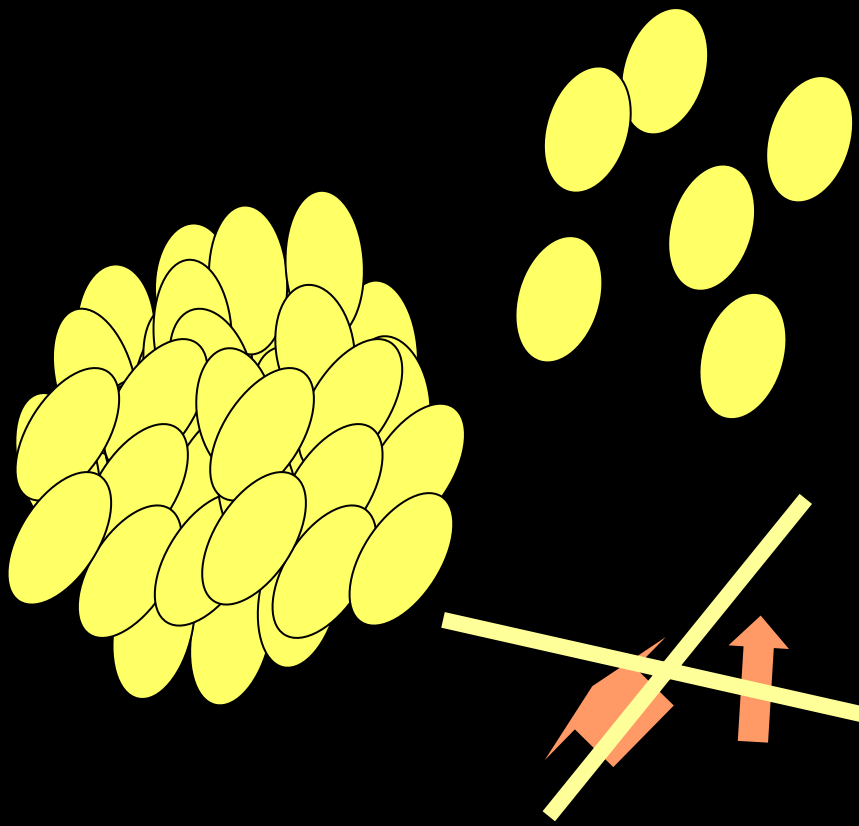
Internal structure of asteroids.

The big ones?

Coherent/ ~~Monolithic~~ | Fractured

Bulk density → Macro-porosity

Internal structure of asteroids.



Gravitational aggregate

Bulk density → Macro-porosity

Study of collisions on Gravitational Aggregates.

- Collisions and gravitational interactions by PKDGRAV N-body numerical code.
- Targets made of N spherical (equal, at the moment) particles
  (ρ=2500 kg/m^3; N: 100-5000)
  Restitution coefficient:

$$v_N = \varepsilon_N u_N$$
$$v_P = \varepsilon_P u_P$$

  (ε_N=0.3-0.5; ε_P=0.8)

  Negligible dependence on ε_p, but sensible to ε_N
- Checked against spurious biases
  (time step, # time steps, etc.)

Study of collisions on Gravitational Aggregates.

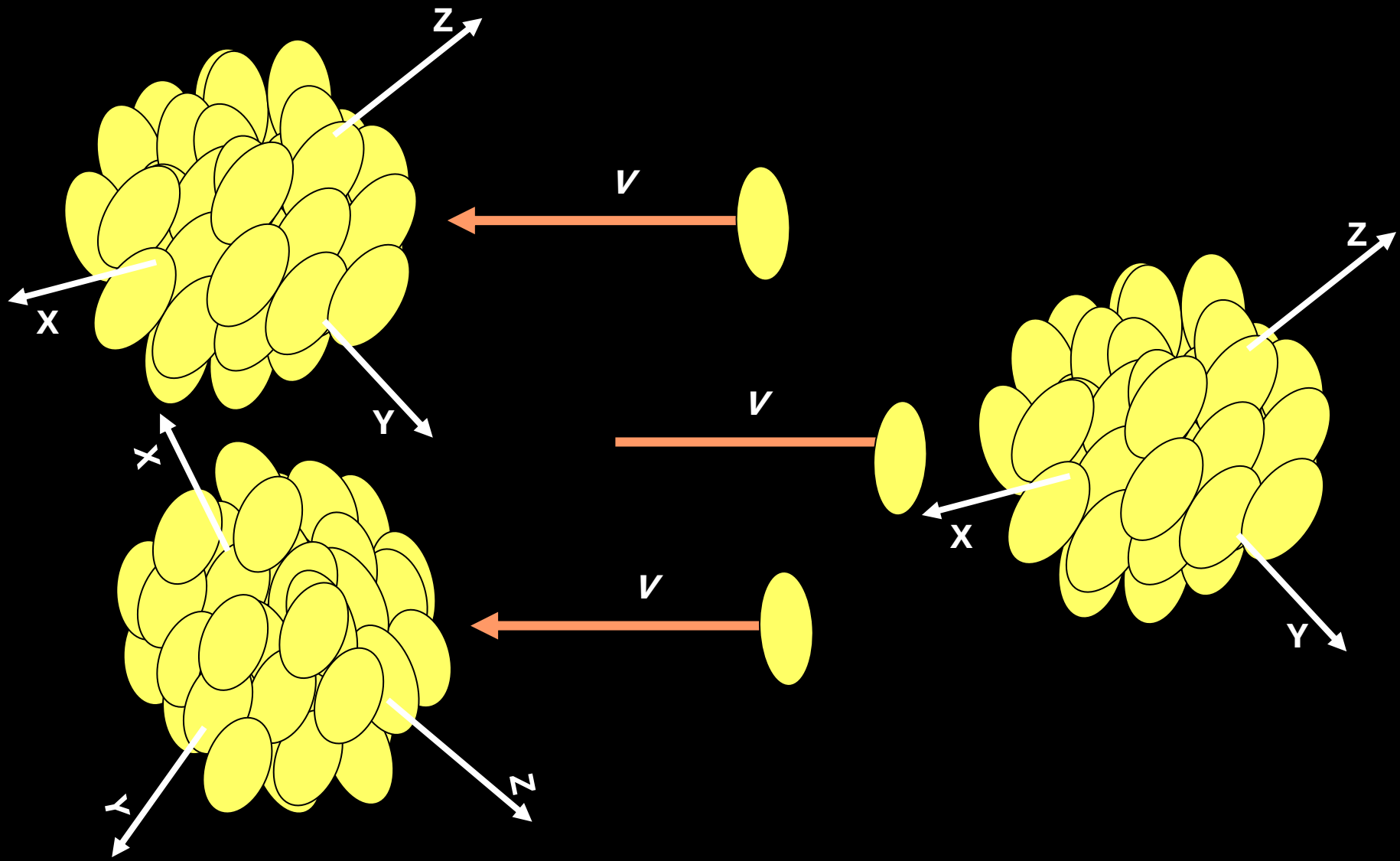
$$Q^*_D = E_p/M_t \mid f_r = M_r/M_t = 0.5$$

1. Dependence of Q^*_D on target and projectile texture (N particles)
2. Determination of Q^*_D vs. D_t
3. Dependence of Q^*_D on impact angle
4. Dependence of Q^*_D on momentum of projectile (same K.E.)
5. Dependence of Q^*_D on target's rotation

1. Dependence of Q^*_D on texture

- **Targets: 333 m; 1 km; 10 km**
- **Non-rotating targets**
- **N = 100, 250, 500, 1000, 2500 and 5000.**
- **6 head-on collisions on each N-particle target**
- V_{col}=4800 **m/s**

Same energy collisions on same target at same impact angles,
but from different directions.



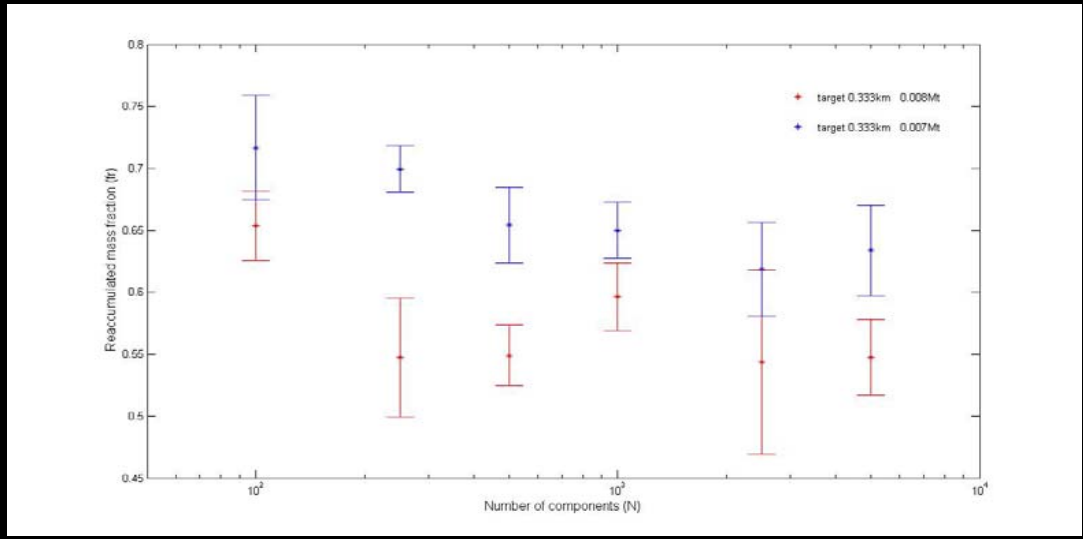


Table 1. Dispersion rows colour code. White to green: increasing dispersion.

Target size: 333 m. Impact Energy: 0.007 Mt							
N	100	250	500	1000	2500	5000	$<f_R>$ dispersion
$<f_R>$	0,72	0,699	0,65	0,650	0,62	0,63	0,10
st. dev.	0,04	0,019	0,03	0,023	0,04	0,04	
dispersion	0,27	0,123	0,20	0,154	0,25	0,21	
Target size: 333 m. Impact Energy: 0.008 Mt							
N	100	250	500	1000	2500	5000	$<f_R>$ dispersion
$<f_R>$	0,65	0,55	0,549	0,60	0,54	0,55	0,11
st. dev.	0,03	0,05	0,024	0,03	0,07	0,03	
dispersion	0,17	0,30	0,156	0,17	0,54	0,12	

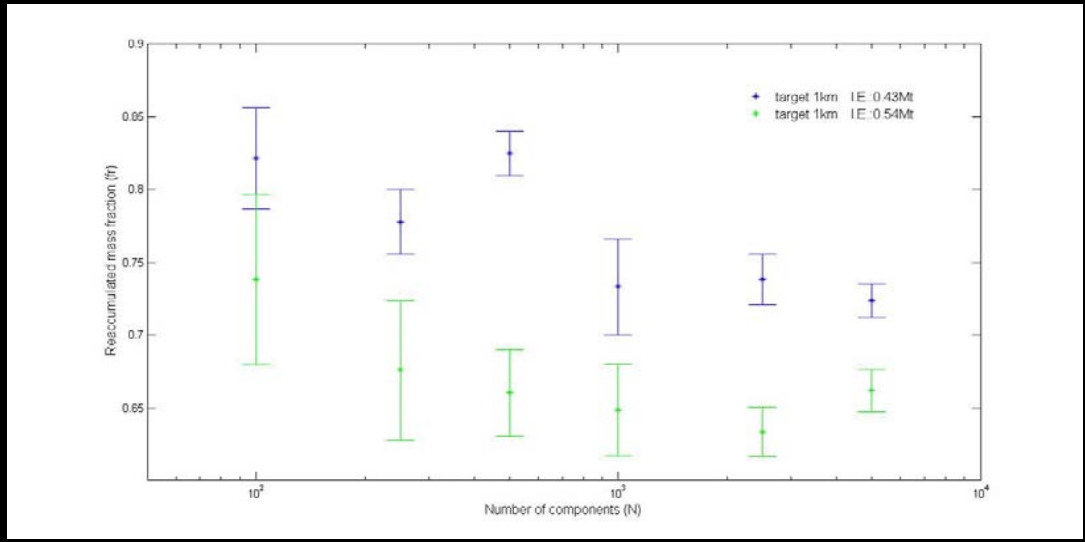
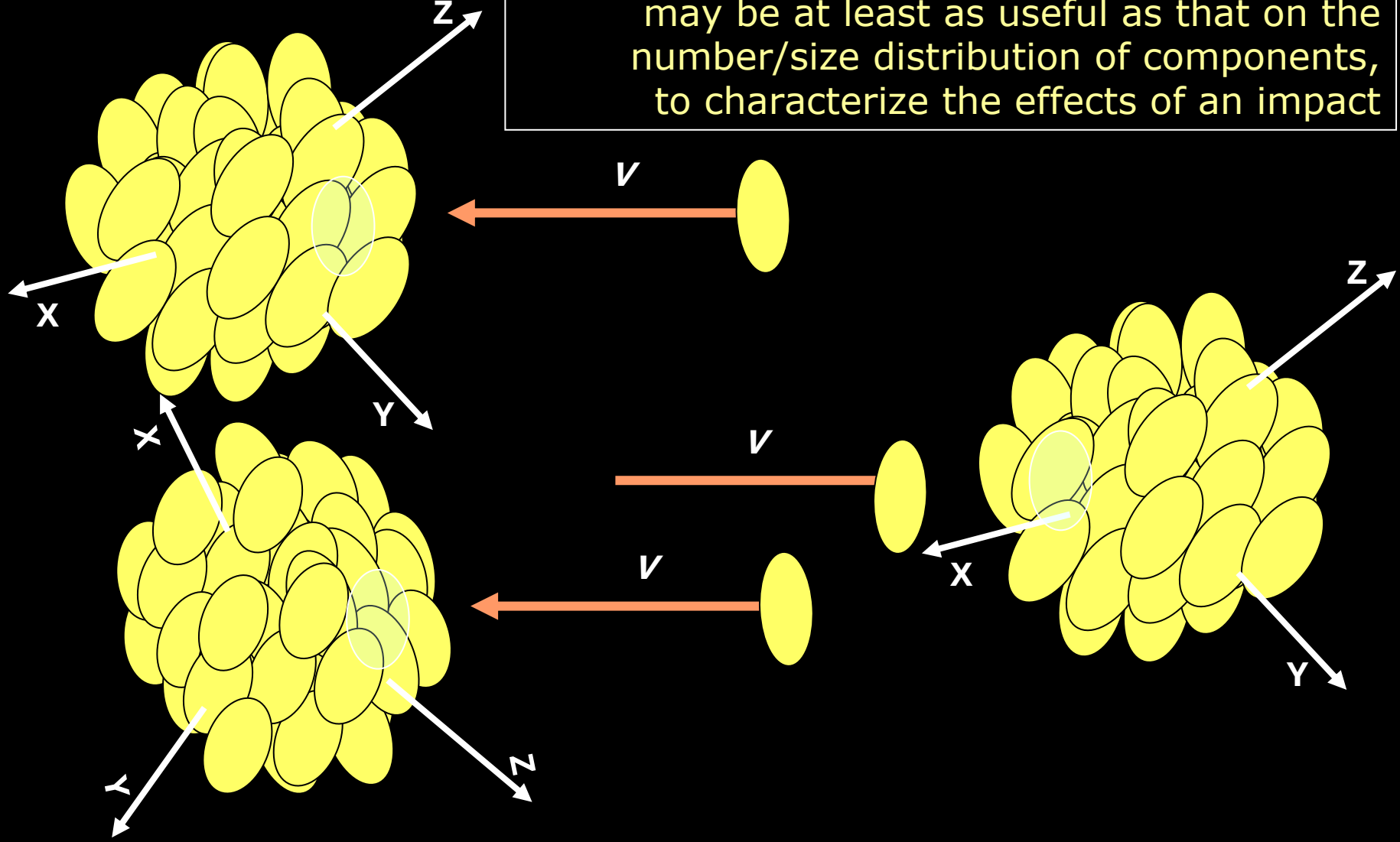


Table 2. Dispersion rows colour code. White to green: increasing dispersion.

Target size: 1 km. Impact Energy: 0.43 Mt							
N	100	250	500	1000	2500	5000	$<f_R>$ dispersion
$<f_R>$	0,82	0,778	0,825	0,73	0,739	0,724	0,101
st. dev.	0,04	0,022	0,015	0,03	0,017	0,011	
dispersion	0,19	0,130	0,106	0,24	0,104	0,076	
Target size: 1 km. Impact Energy: 0.54 Mt							
N	100	250	500	1000	2500	5000	$<f_R>$ dispersion
$<f_R>$	0,74	0,68	0,66	0,65	0,633	0,662	0,105
st. dev.	0,06	0,05	0,03	0,03	0,017	0,014	
dispersion	0,32	0,30	0,19	0,20	0,126	0,095	

The dispersion of the averages $<f_r>$ is normally smaller than the dispersion of f_r in different direction impacts on the same target.

Information about the local internal structure may be at least as useful as that on the number/size distribution of components, to characterize the effects of an impact



Conclusions

Inspecting internal structure of asteroids is needed because…

- ***It is interesting for science, and***
- ***It can't be derived from bulk density measures***

(but we already knew that)

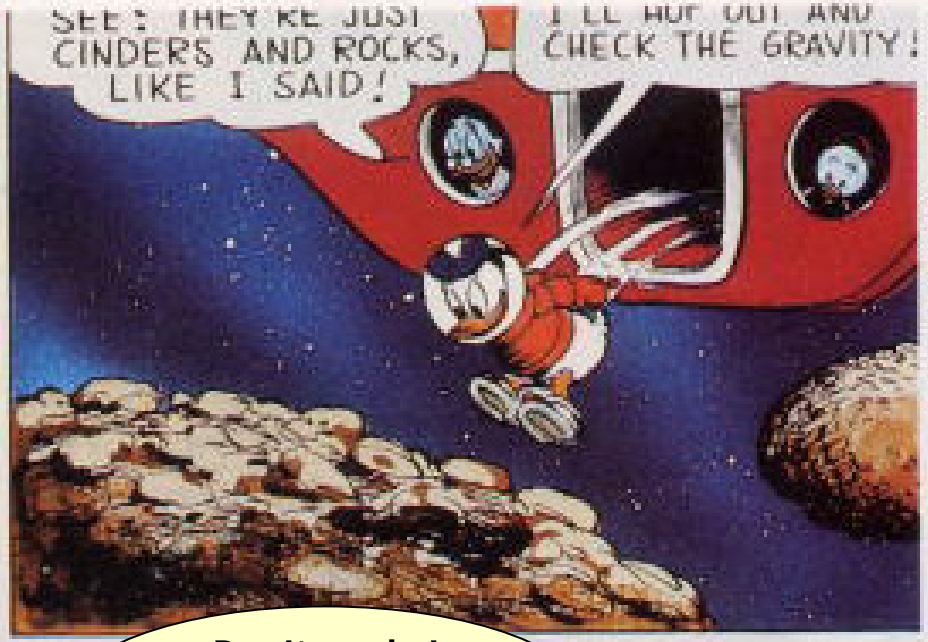
New motivation:

- This information may be crucial in case an hazardous N.E.A. should be mitigated by a deflection/dispersion strategy.

What is the internal structure of asteroids ?

Are they monolithic bodies, or gravitational aggregates?

New motivations to inspect the internal structure of N.E.A.s



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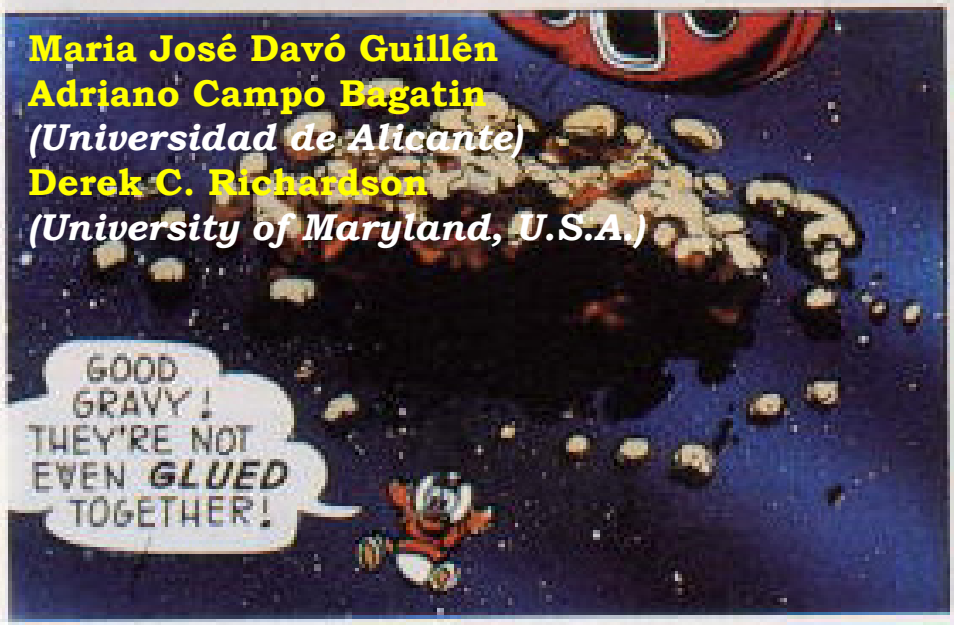

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