
Dante's Inferno
The Nine Circles of Hell
Circle I: Limbo
The souls of Pagans and the unbaptized wander the caves of Limbo in loneliness with the desperation to meet God.
Circle II: Lust
The souls lust are endlessly blown and spiraling in the winds of a violent storm.
Circle III: Gluttony
Because of their cold nature, the souls of gluttony suffers the coldness of a ceaseless icy rain.
Circle IV: Greed
The souls of greed are consumed in a pit of smelting gold, as they claw their way to escape, only to be swept back into the pit.
Circle V: Anger
An endless battle of wailing souls takes place on a murky swamp.
Circle VI: Heresy
Souls are entrapped in a flaming pit, guarded by demons for those who attempt to escape.
Circle VII: Violence
Those who possessed a thirst for violence are condemned to drown in a lake of boiling blood.
Circle VIII: Fraud
Souls are thrown into a pit of darkness, endlessly beaten and tortured by demons.
Circle IX: Treachery
Satan is imprisoned in ice from the waist down in the very center of Circle IX, displayed as a trophy of treachery.

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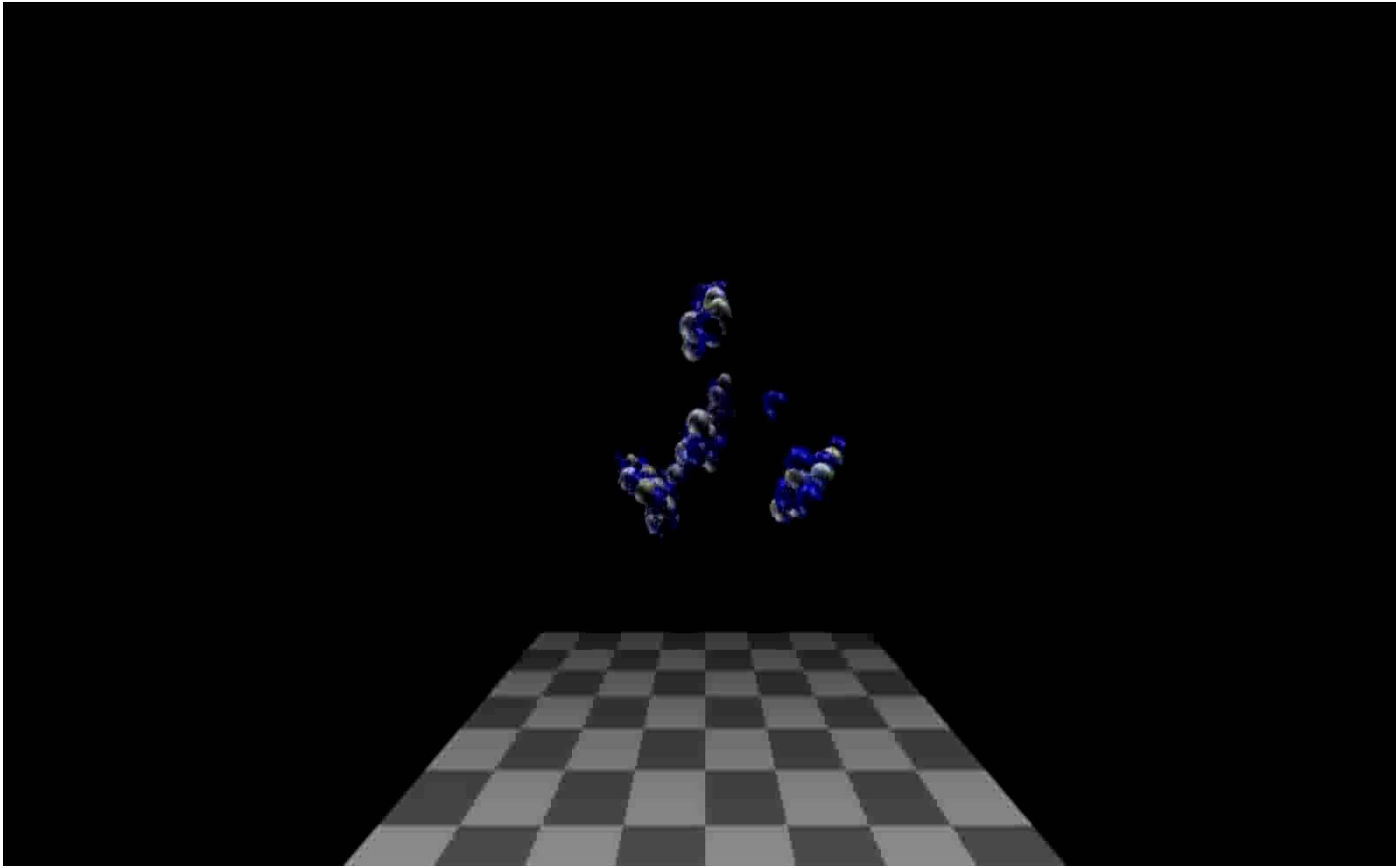

Fragment definitions/recognition algorithms

MST_algorithm

Given a set of particles i,j,k,..., clusters are defined such that :

$$i \in C \Leftrightarrow \exists\, j \in C \,/\, \left(r_i - r_j \right) < r_{clust}$$

With r_{clust} the clusterization radius

MSTE algorithm

In this case clusters are defined in the following way:

$$i \in C \Leftrightarrow \exists\, j \in C \,/\, \left(\frac{p_{ij}^2}{4\mu} - v_{ij} \right) < 0$$

With μ the reduced mass and p_{ij} the relative momentum

Early Cluster Formation Model

Given a set of particles (i,j,k..) clusters are defined as thos
partitions C_i that minimize the following expression:

$$E = \sum_{C_i} \left[\left(\sum_{i \in C_i} \frac{p_{ij}^2}{2m} \right)_{c.m.C_i} + \sum_{i<j, \in C_i} v\left(r_{ij}\right) \right]$$

This is a highly self consistent problem that has been solved by devising a method in the spirit of simulated annealing (ECRA).

For such a problem a Markov chain in the space of partitions is constructed

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PHYSICS LETTERS B

Early recognition of clusters in molecular dynamics

C. Dorso [1] and J. Randrup
Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720, USA

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Problema de extremar alguna función

Sea un problema realmente complicado (NP complete)

Recordemos MMC

$$\pi(s) = \frac{\exp(-\beta E(s))}{\sum \exp(-\beta E(s))}$$

$$p_{ij} = p^*_{ij} \quad \text{si} \ \frac{\pi_j}{\pi_i} \geq 1$$

$$= p^*_{ij} \frac{\pi_j}{\pi_i} \quad \text{si} \ \frac{\pi_j}{\pi_i} < 1$$

Ahora interpretamos

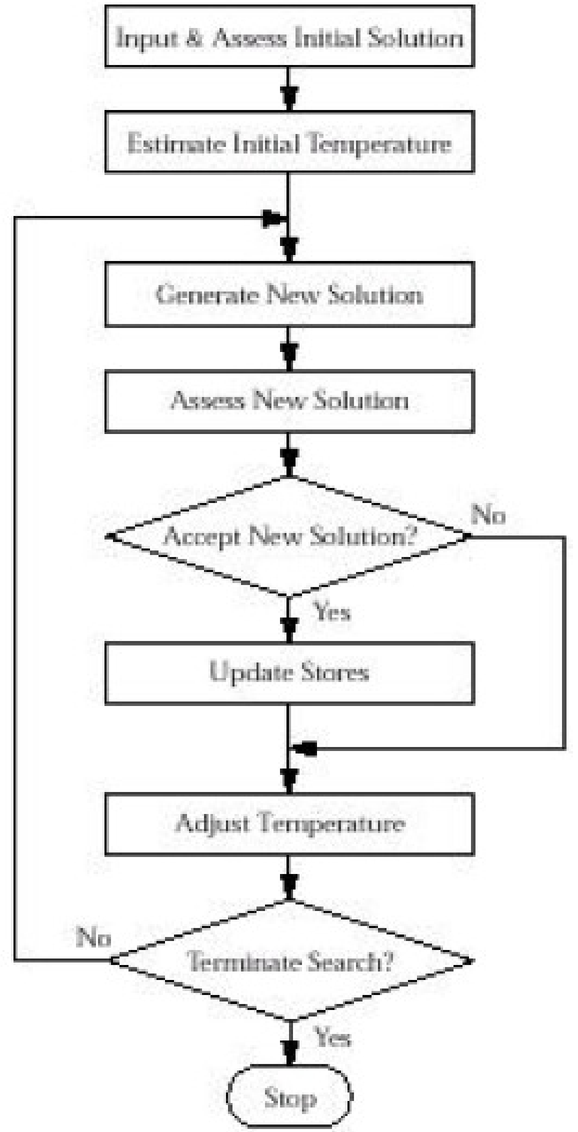
$$\pi(s) = \frac{\exp(-\beta E(s))}{\sum \exp(-\beta E(s))}$$

$E(s)$ → funcion de merito

$\beta = \frac{1}{\tau}$ → "Temperatura efectiva"

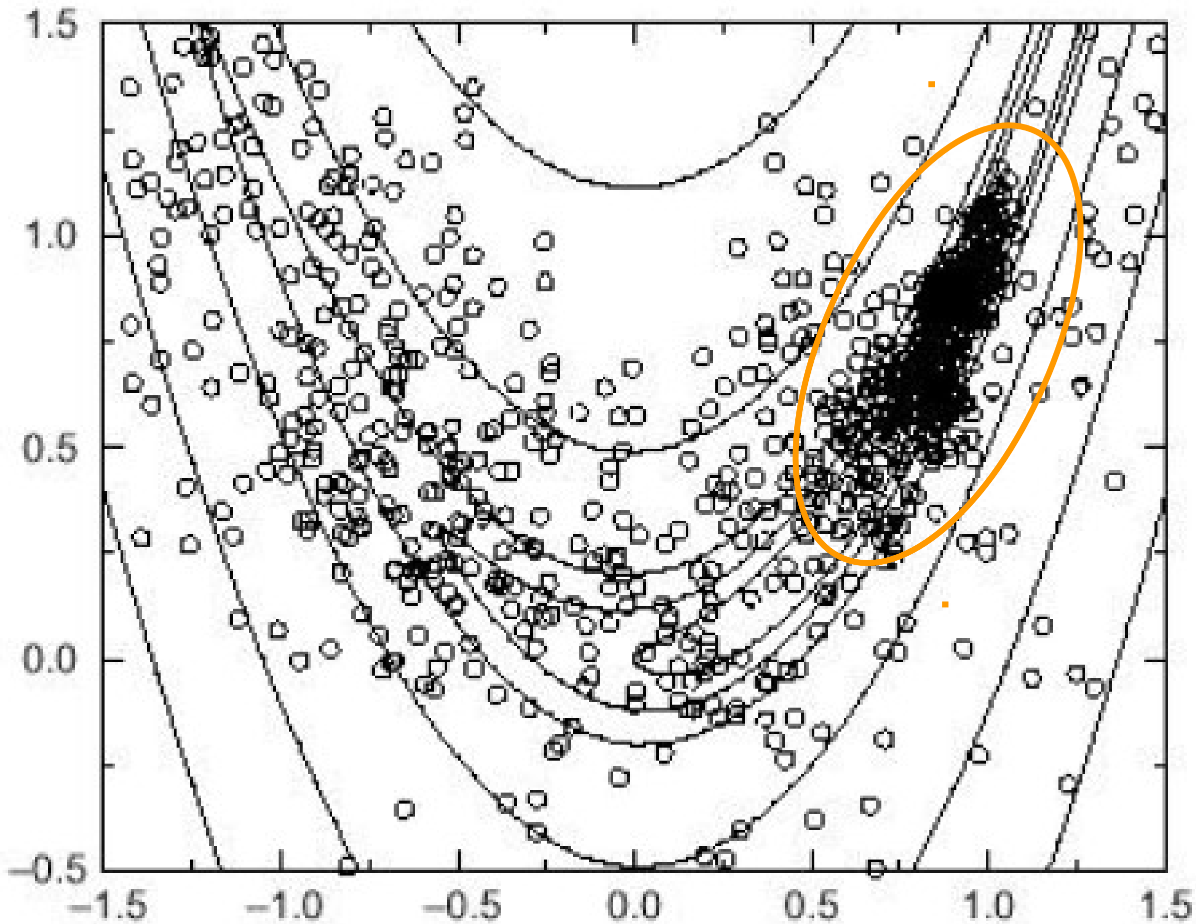
$\tau \rightarrow \mathbf{0}$

buscamos el "ground state en la pseudo energía con una pseudo temperatura que regula el ritmo de aceptación



The structure of the simulated annealing algorithm

The following figure shows the progress of a SA search on the two-dimensional Rosenbrock function, $f = [(1-x_1)^2 + 100\,(x_2 - x_1^2)]^2$:



Search pattern

NP completo

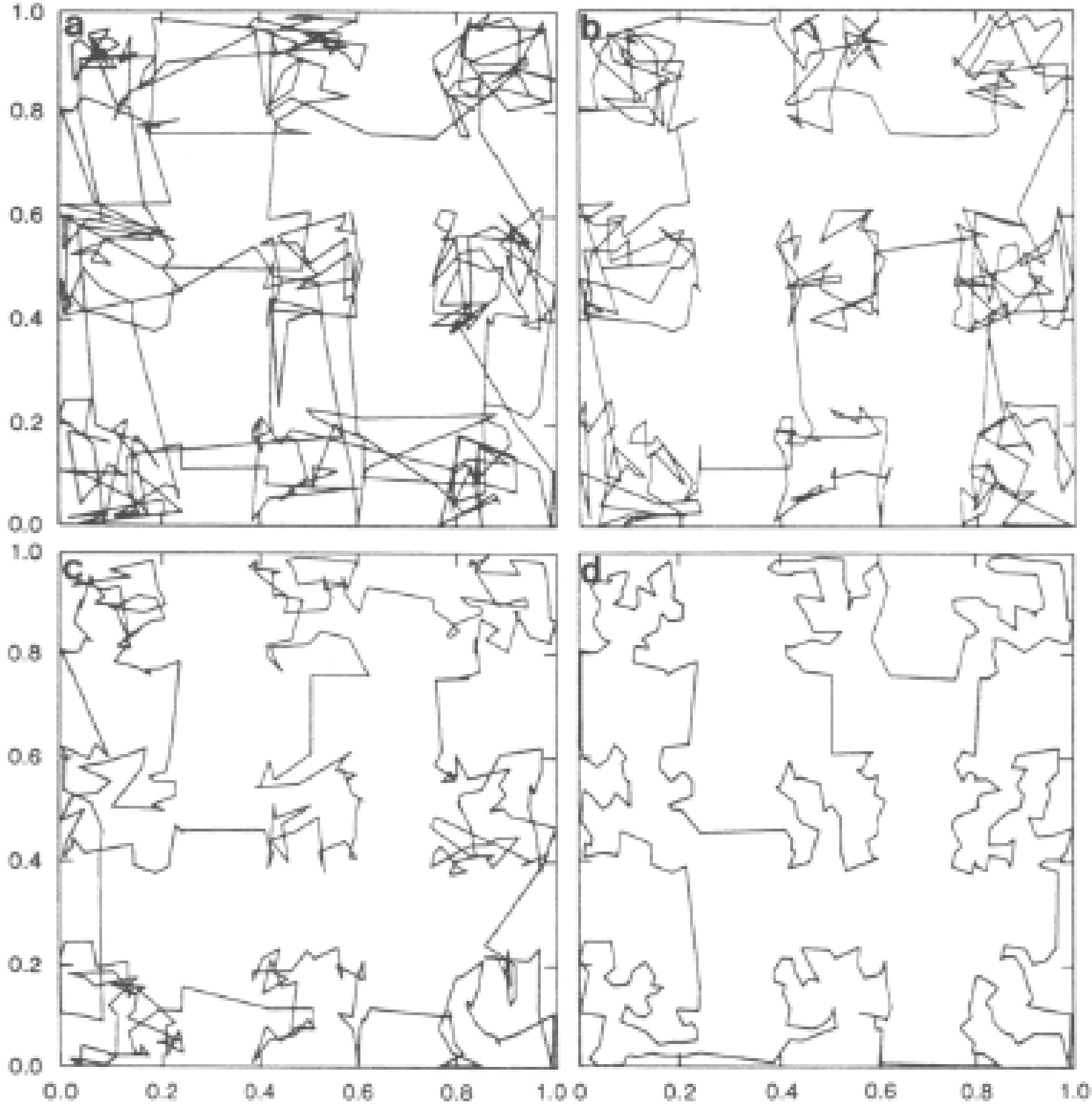


Fig. 9. Results at four temperatures for a clustered 400-city traveling salesman problem. The points are uniformly distributed in nine regions. (a) $T = 1.2$, $\alpha = 2.0567$; (b) $T = 0.8$, $\alpha = 1.515$; (c) $T = 0.4$, $\alpha = 1.055$; (d) $T = 0.0$, $\alpha = 0.7839$.

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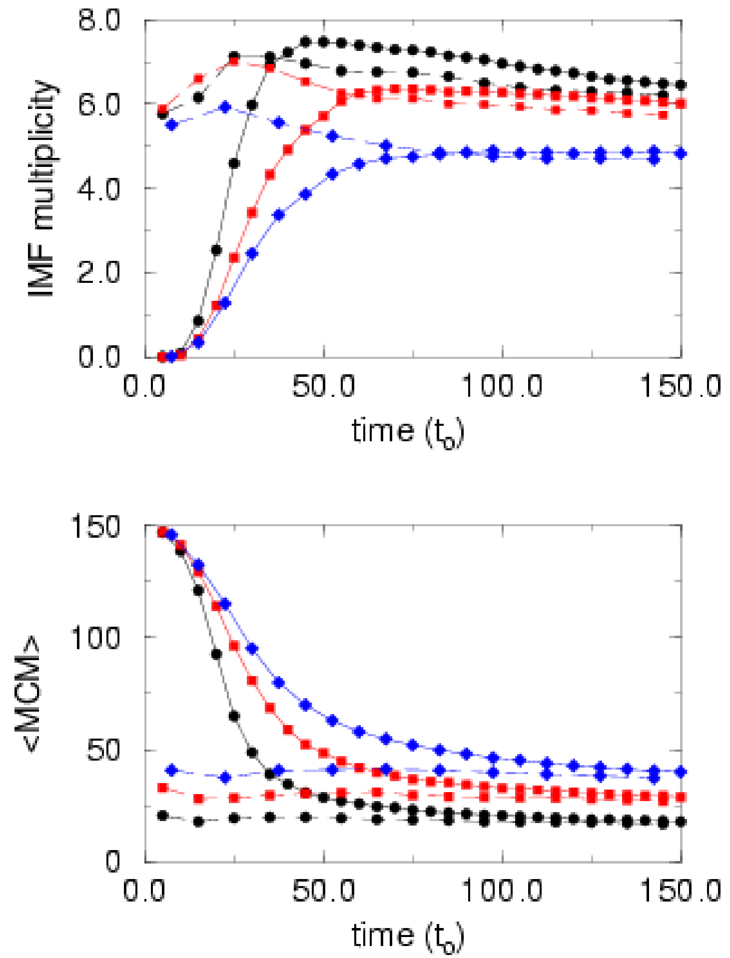
Como se resuelve esto que es tan auto consistente ?

MST vs ECRA

In this figures we show the multiplicity of intermediate mass fragments and the size of the biggest fragment according to MST and ECRA analysis, as a function of time, for different values of the total energy.

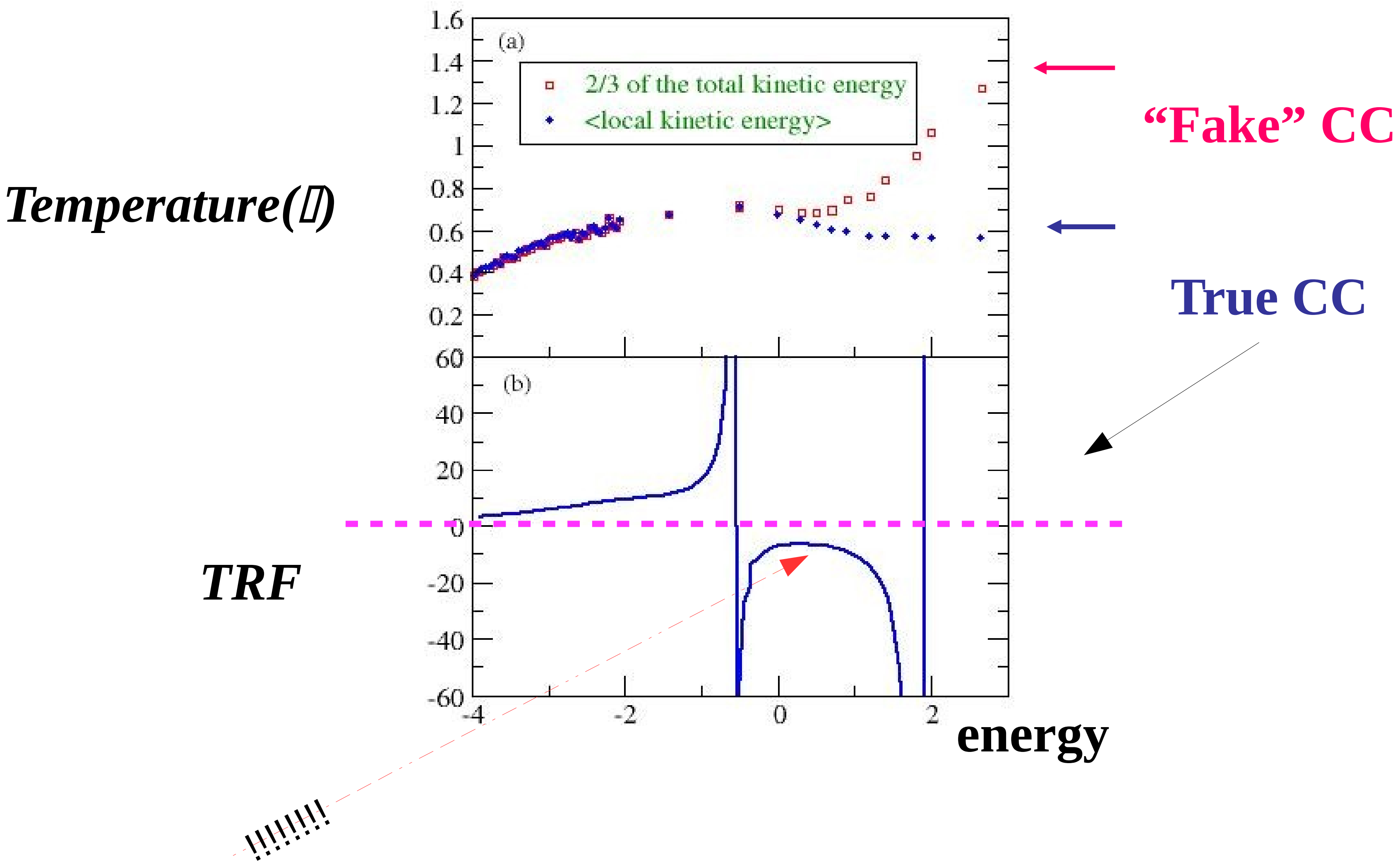
ECRA results show that fragments are formed early in the evolution

E=1.8
E=0.9
E=0.5



3≤IMF≤15

Free System CC and TRF



$$V^{\mathrm{P}}(r, p) = V_0^{\mathrm{P}} \exp(-r^2/2q_0^2 - p^2/2p_0^2)\delta_{\sigma\sigma'}\delta_{\tau\tau'} ,$$

$$V^{\mathrm{N}}(r) = V_0\left[\left(\frac{r_1}{r}\right)^{p_1} - \left(\frac{r_2}{r}\right)^{p_2}\right] \times (1+\mathrm{e}^{\beta(r-d)})^{-1}\theta(r-r_{\mathrm{c}}) ,$$

$$V^{\mathrm{C}}(r) = e^2/r.$$

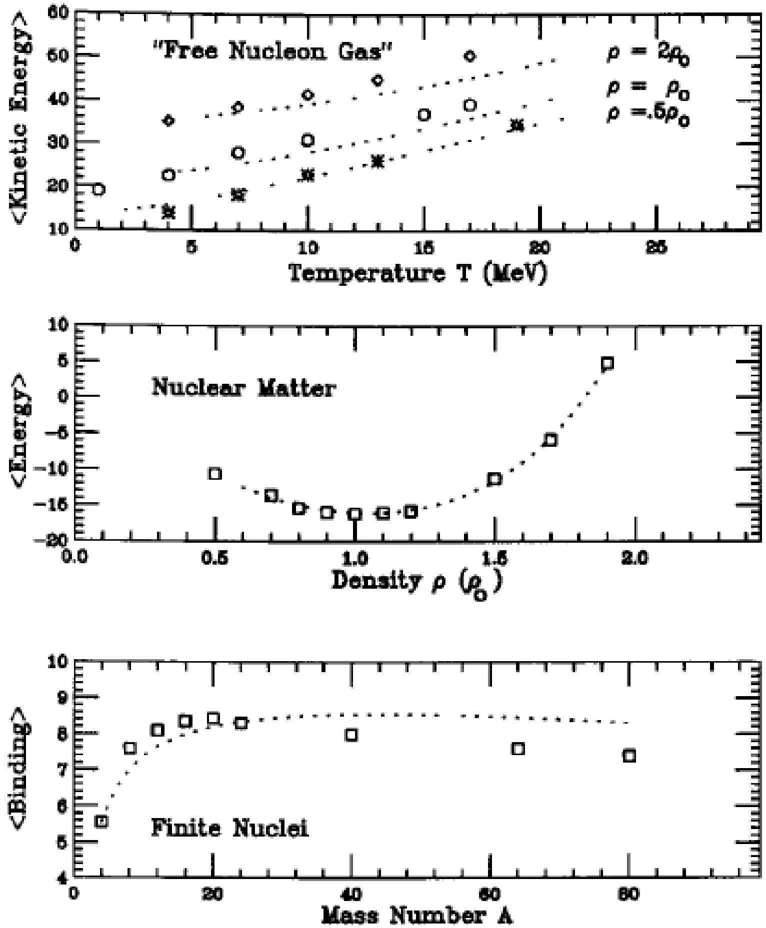


Fig. 1. The kinetic energy of a gas of nucleons that interact only via the Pauli potential (top panel), the binding energy of nuclear matter as a function of the density (middle panel), and the binding energy of finite nuclei as a function of their mass number (bottom panel), as calculated with the employed molecular dynamics model.

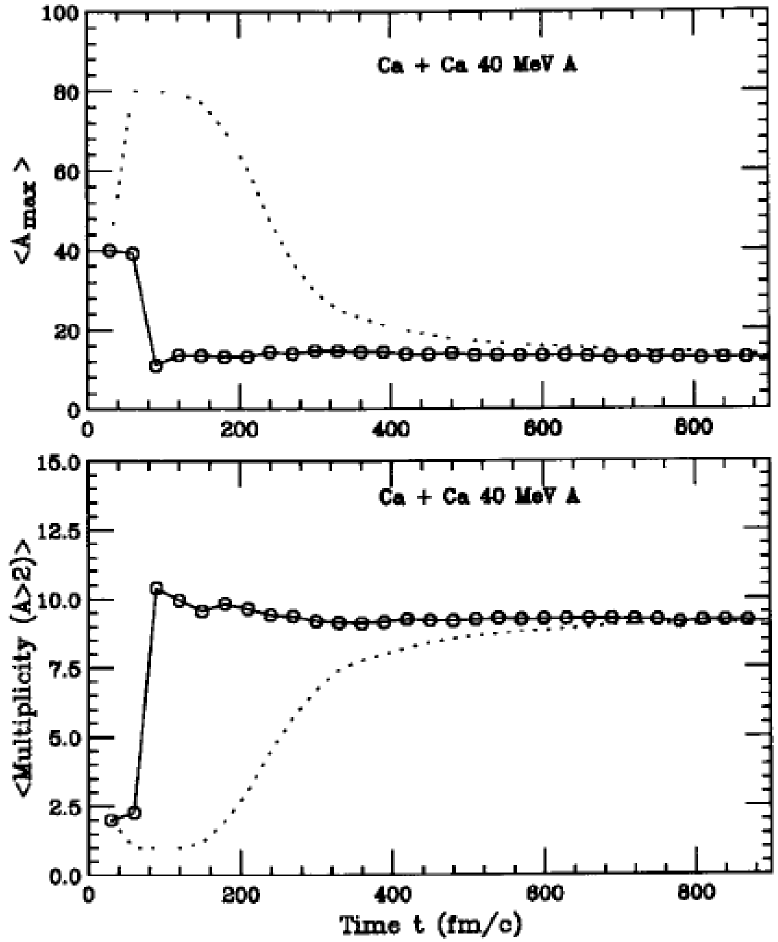


Fig 2 Based on 106 head-on collisions of Ca with Ca at 40 MeV per nucleon, the figure shows the average particle number of the largest fragment $A_{\max}$ (top panel) and the average multiplicity of clusters containing more than two particles (bottom panel), both as functions of the time elapsed since the first contact was made The full curve connects the results of the simulated annealing analysis, whereas the dots indicate the results of a spacial analysis using a cluster range of $r_c = 6$ fm

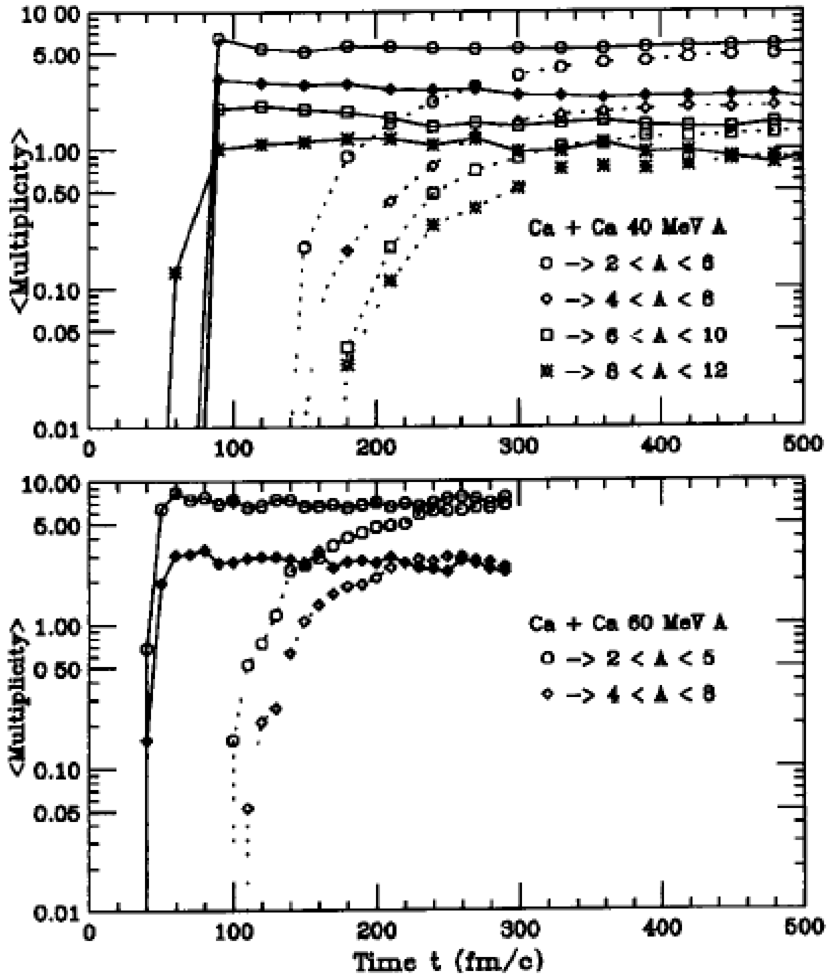


Fig 3 The average multiplicity binned according to the number of particles A, for central collisions of two calcium nuclei. Top panel the same 106 events as used in fig 1 Bottom panel: 40 events corresponding to a bombarding energy of 60 MeV per nucleon.

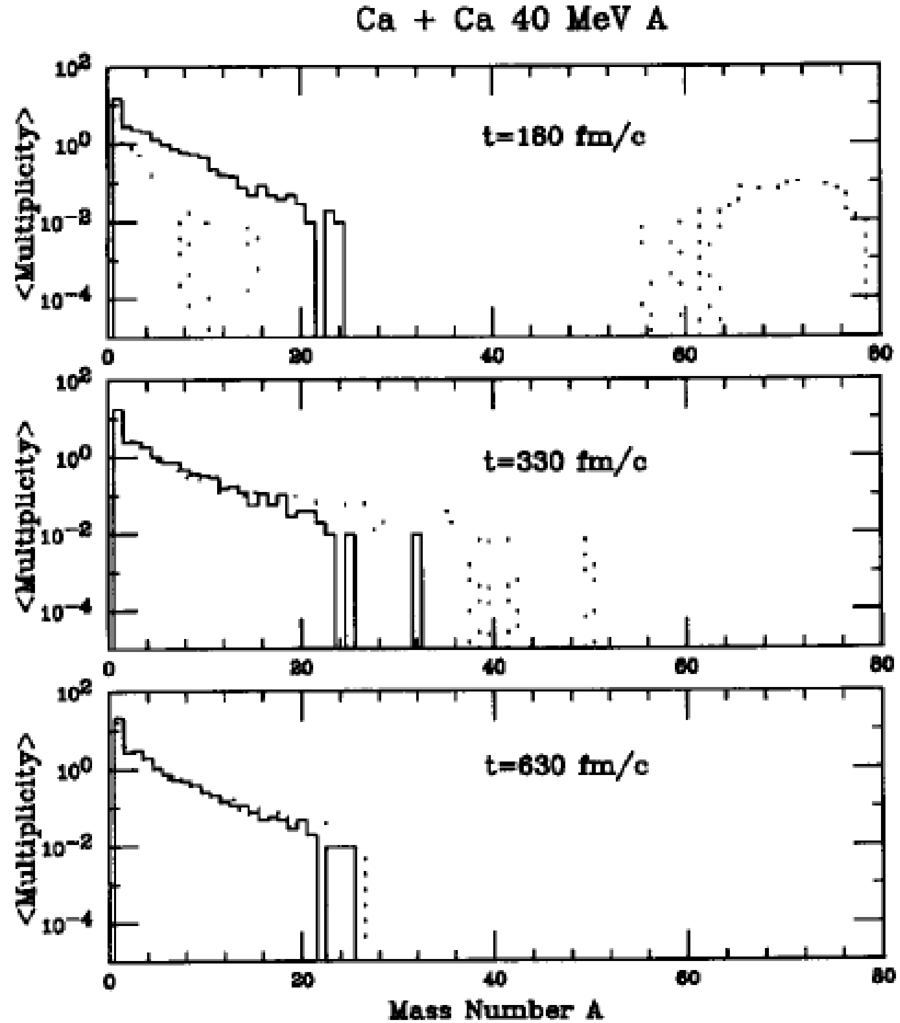


Fig 4 The multiplicity distribution at three different points in time, for the same event set as in fig 2, using either simulated annealing (solid histogram) or spatial analysis (dotted histogram).