Title: Dwarf galaxies in voids

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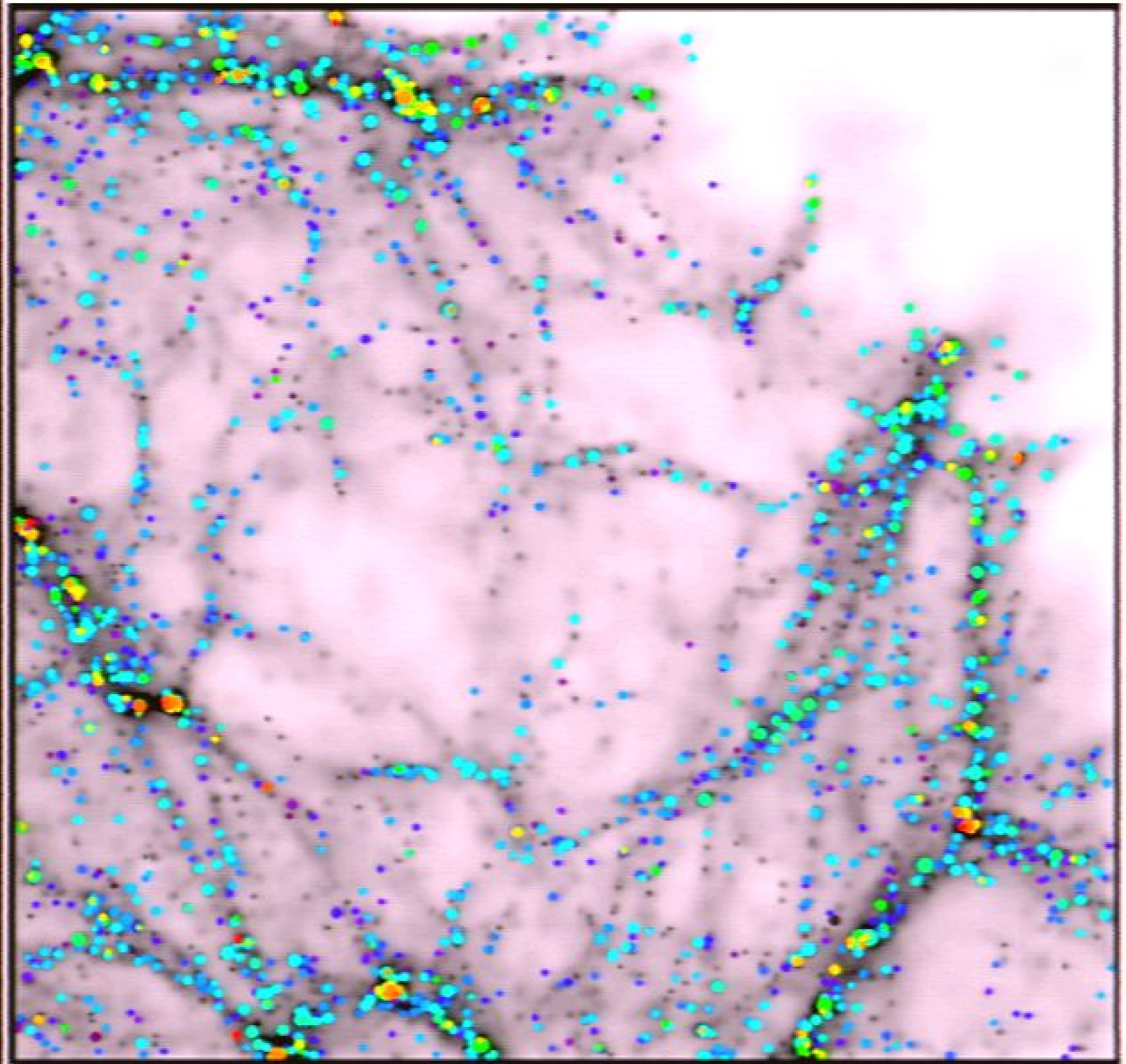
Abstract:

Small-Scale Structure of Dark Matter
The Void Phenomena

Perimeter Institute
P. J. E. Peebles
June. 2008



Mathis and White 2002

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Low mass CDM halos trail into voids defined by more massive halos. This is a Curious Thing.

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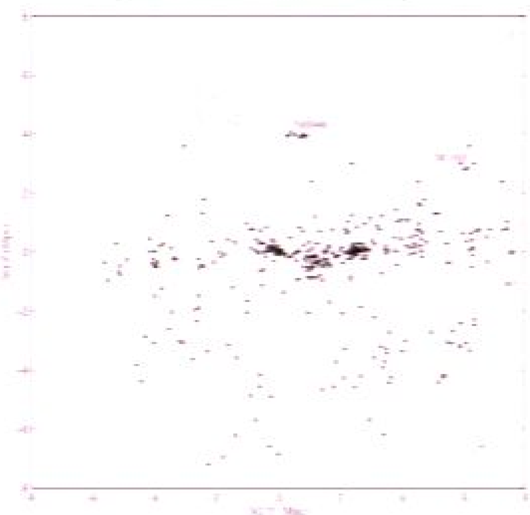

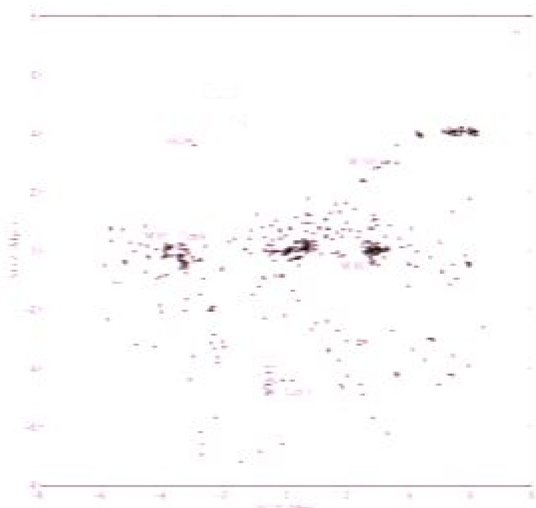

These are the seven most luminous galaxies within 8 Mpc (Karachentsev *et al.* 2004).

It is interesting that the range of luminosities is just a factor of two.

It seems curious that two edge into the Local Void. Do they show signatures of their unusual environment? Do simulations suggest there ought to be observable signatures?

1. Andomeda
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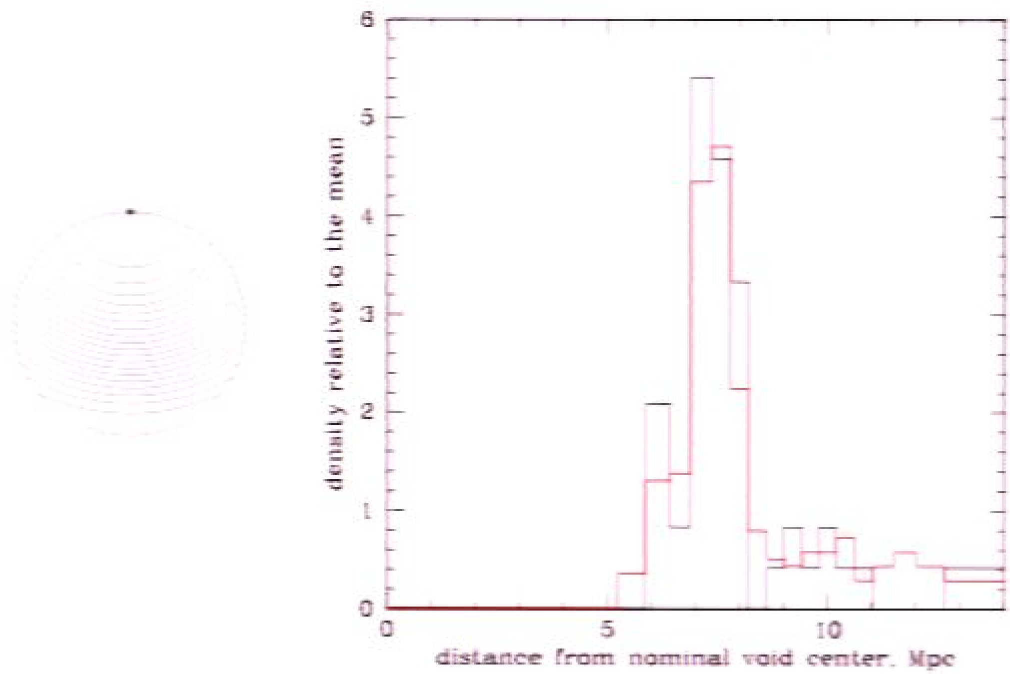

Fig. 2. – Number density of galaxies as a function of distance from a nominal center of the Local Void in the 20 spherical slices of equal volume illustrated at the left. The black line shows the run of number density of more luminous galaxies, $M_B < -17$, relative to the mean in the sample, and the red line shows the run of density relative to the mean for dwarfs at $M_B > -17$.

ESO 215. $M_{\rm HI} = 5 \times 10^{[illegible]} m_\odot$ — $M_{\rm HI}/L_B \sim 20$, $v_c \simeq 50$ km s^{-1}

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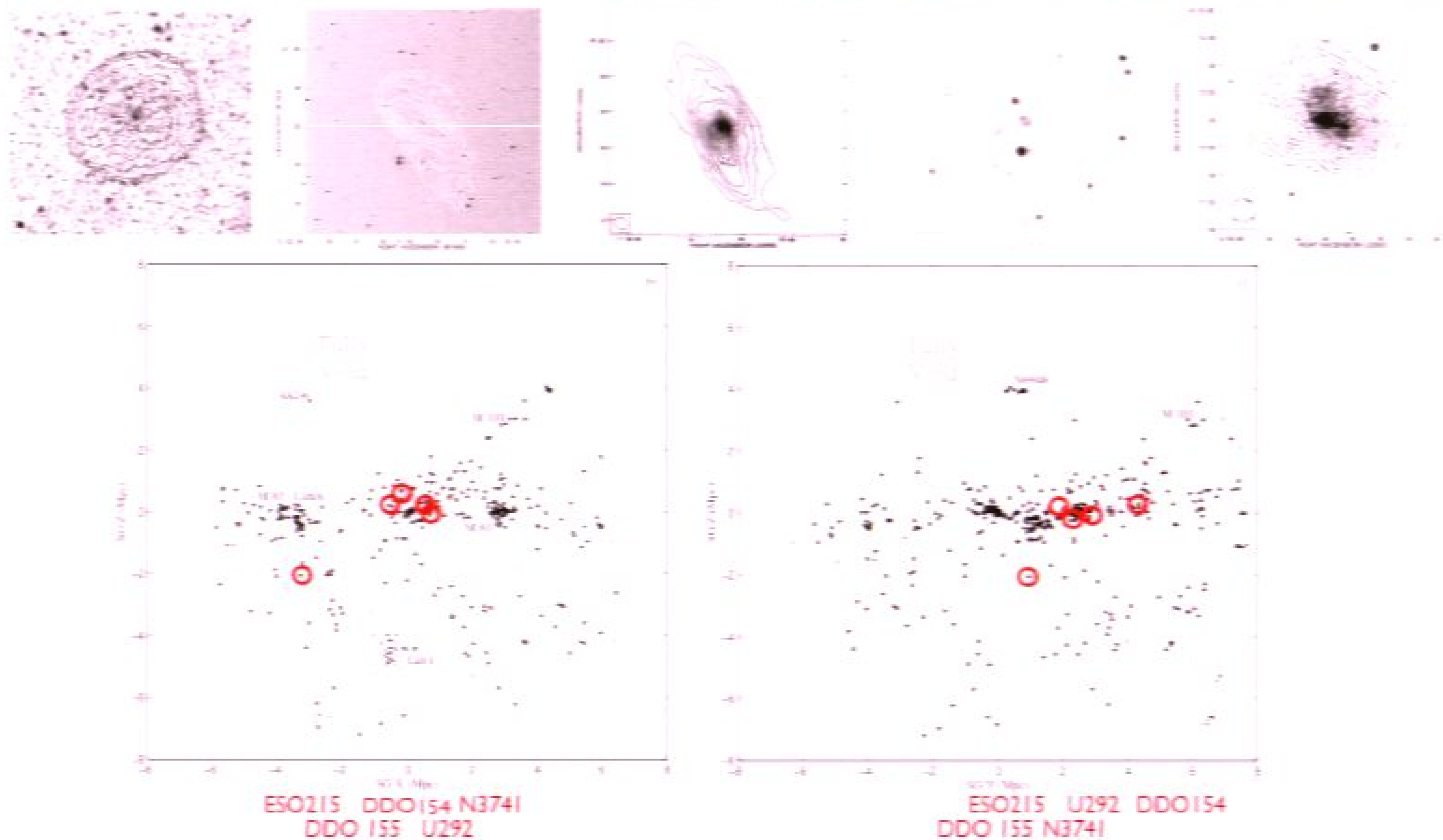

Why do gas-rich and apparently delicate dwarfs such as these avoid the Local Void?

Two points:

1. I don't know of a gas cloud detected in H I ($\Sigma \gtrsim 10^{19}$ cm^{-2}) that is further than maybe 300 kpc from an optical galaxy. Apparently a dwarf galaxy with this surface density has to have formed some stars to support itself in its DM halo.

2. There is considerable mass in plasma detected by the Lyα resonance absorption line, in effect — maybe really — the remnants of the Lyα forest, in clouds more than 1.5 Mpc from the nearest L_* galaxy. The cloud heavy element abundances are low (Stocke *et al.* 2007).

I don't know of any observational evidence that these plasma clouds are still attached to their DM halos. I'd love to know the bare DM halo mass capable of accreting enough of this plasma to become a optically detectable galaxy.

The Theory and Observation of Dwarf Galaxies
in the Voids Defined by $L \sim L_*$ Galaxies

1. Conditions for survival of a gas-rich dwarf seem to be

a. isolation, to avoid mergers and tidal disruptions (gas-rich dwarfs tend to be $\gtrsim 300\,\mathrm{kpc}$ from the nearest $L \gtrsim L_*$ galaxy).

b. surface density $\Sigma_{HI} \gtrsim 10^{18}$ cm^{-2}, circular velocity $v_c \gtrsim 20\,\mathrm{km\,s^{-1}}$, apparently sufficient to resist ionization and evaporation by ionizing radiation;

2. so theoretical issues are

a. the predicted comoving number density of CDM halos with $v_c \gtrsim 20\,\mathrm{km\,s^{-1}}$ at redshift $z \sim 20$, which, absent merging, translates to about one tenth that in a low redshift void with mass density $\sim 10\%$ of the mean,

b. the predicted loss of numbers of void dwarfs by merging, I suppose modest,

c. the rate of formation of dwarf void halos at $z < 20$, I suppose low;

3. and observational issues are

a. the present abundance of gas-rich void dwarfs, prominent in H I but hard to find, a problem Arecibo ALFALFA is addressing,

b. the present abundance of early-type extreme dwarfs, maybe a real problem if the Local Void is not a fair sample.

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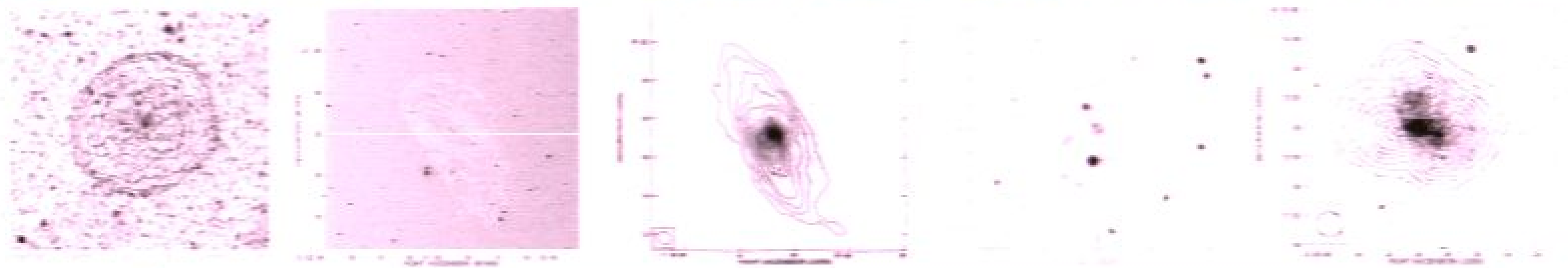

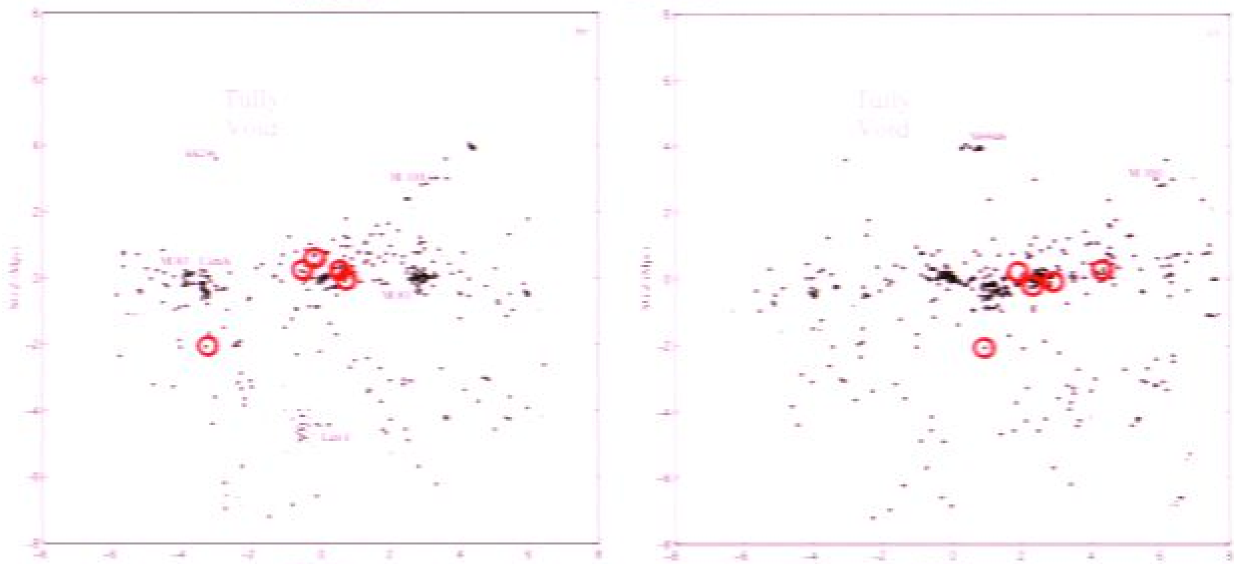

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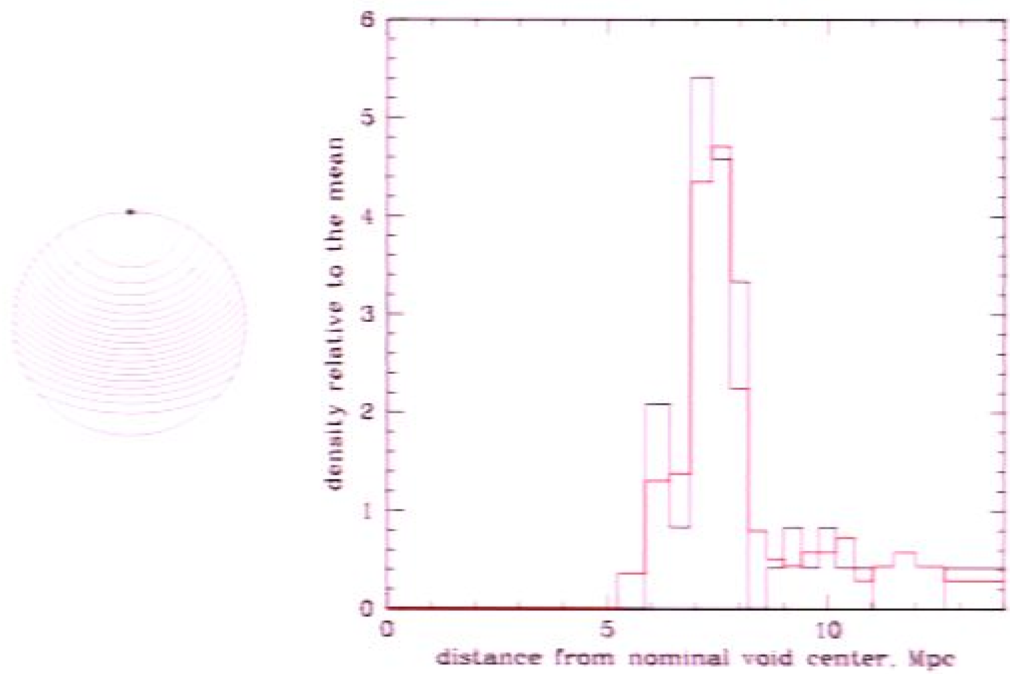

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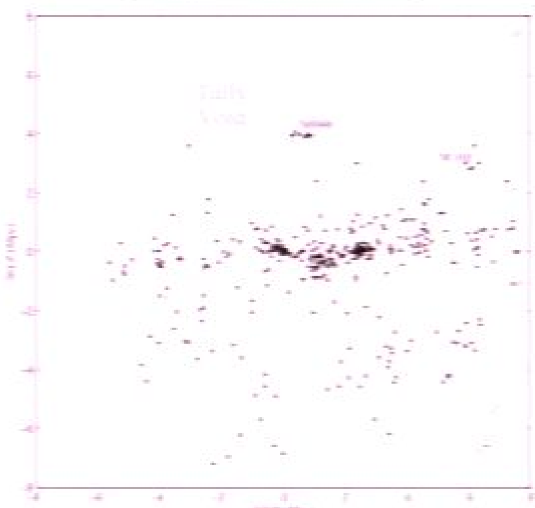

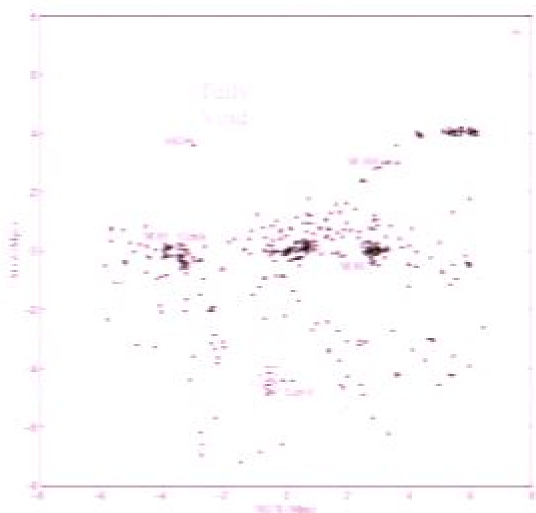

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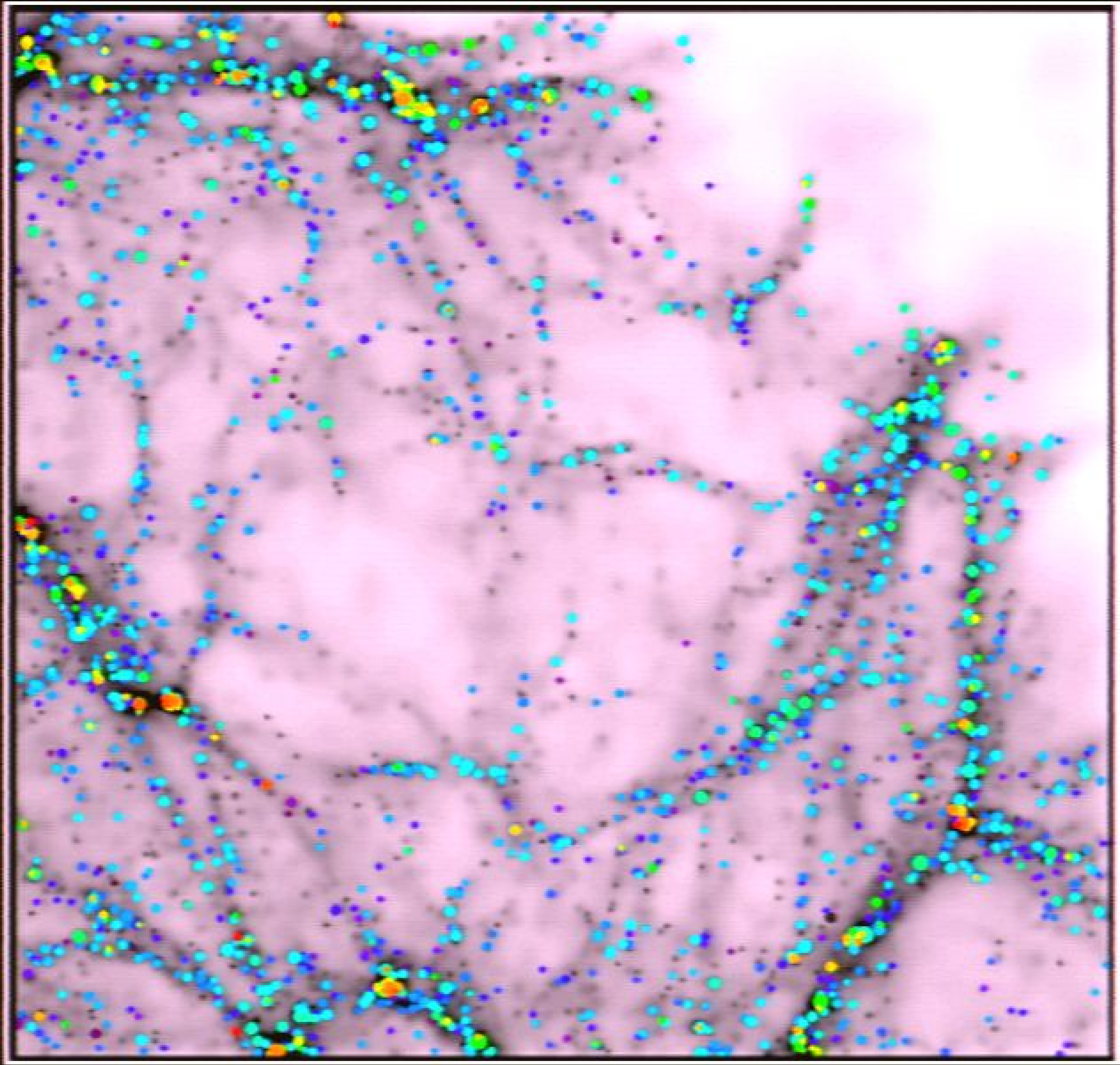

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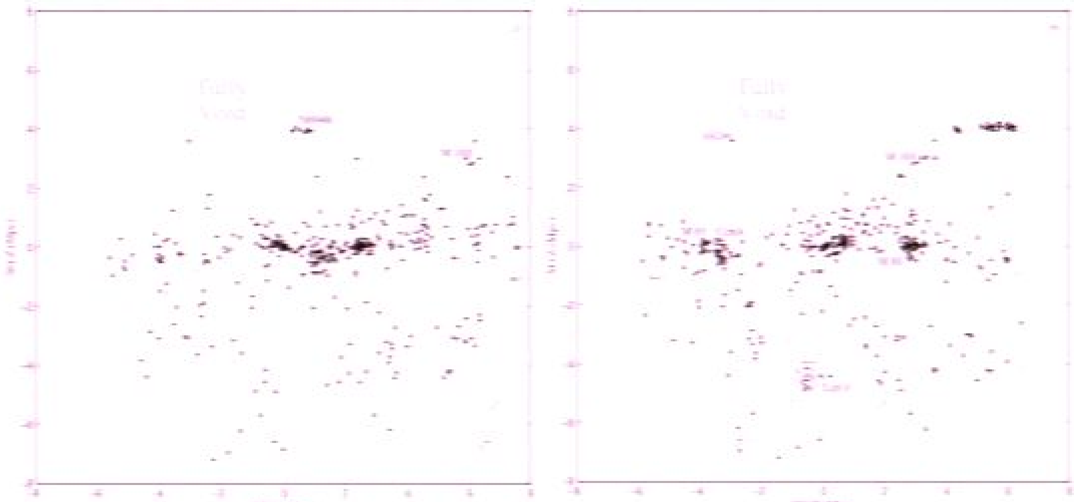

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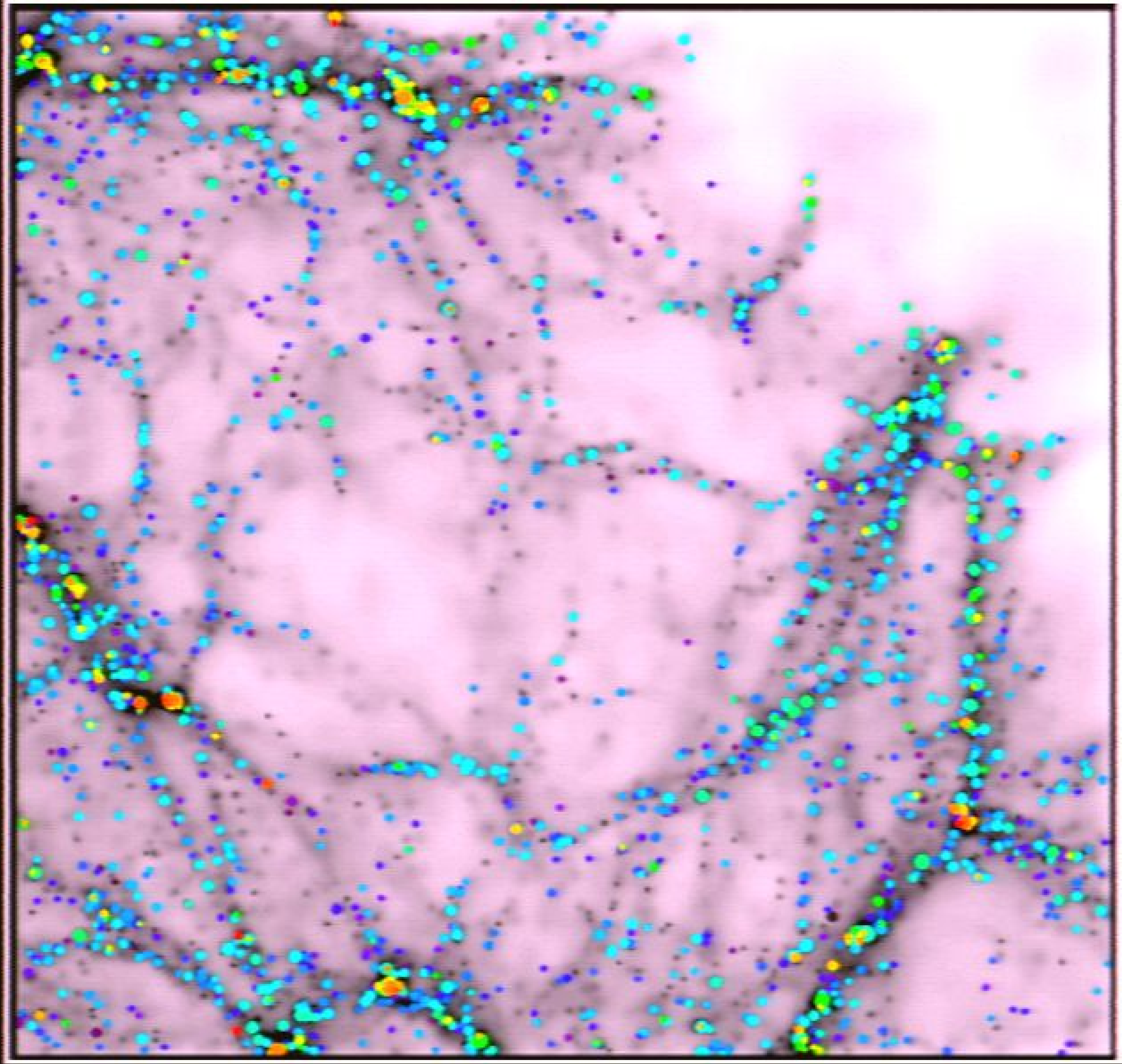

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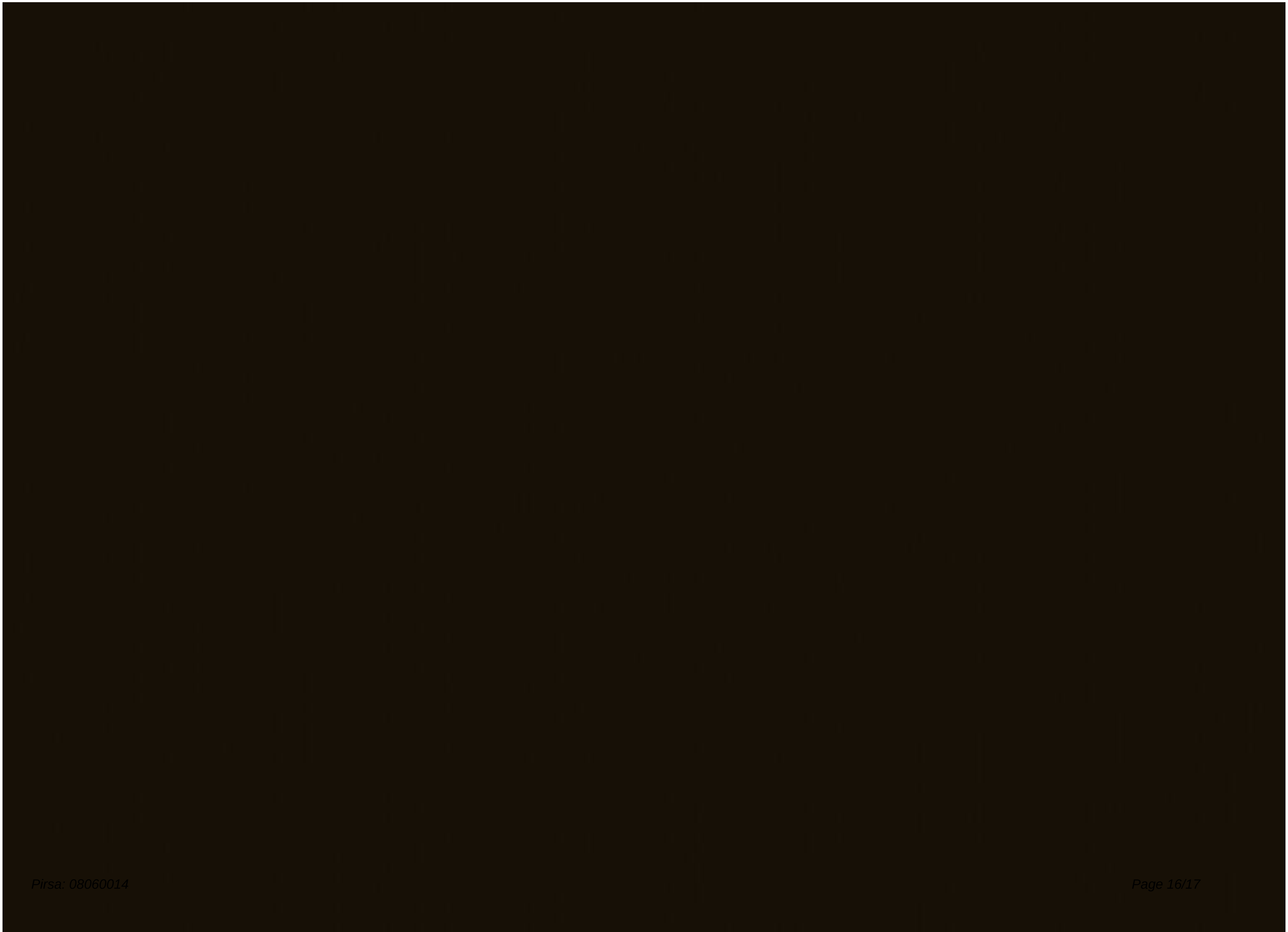

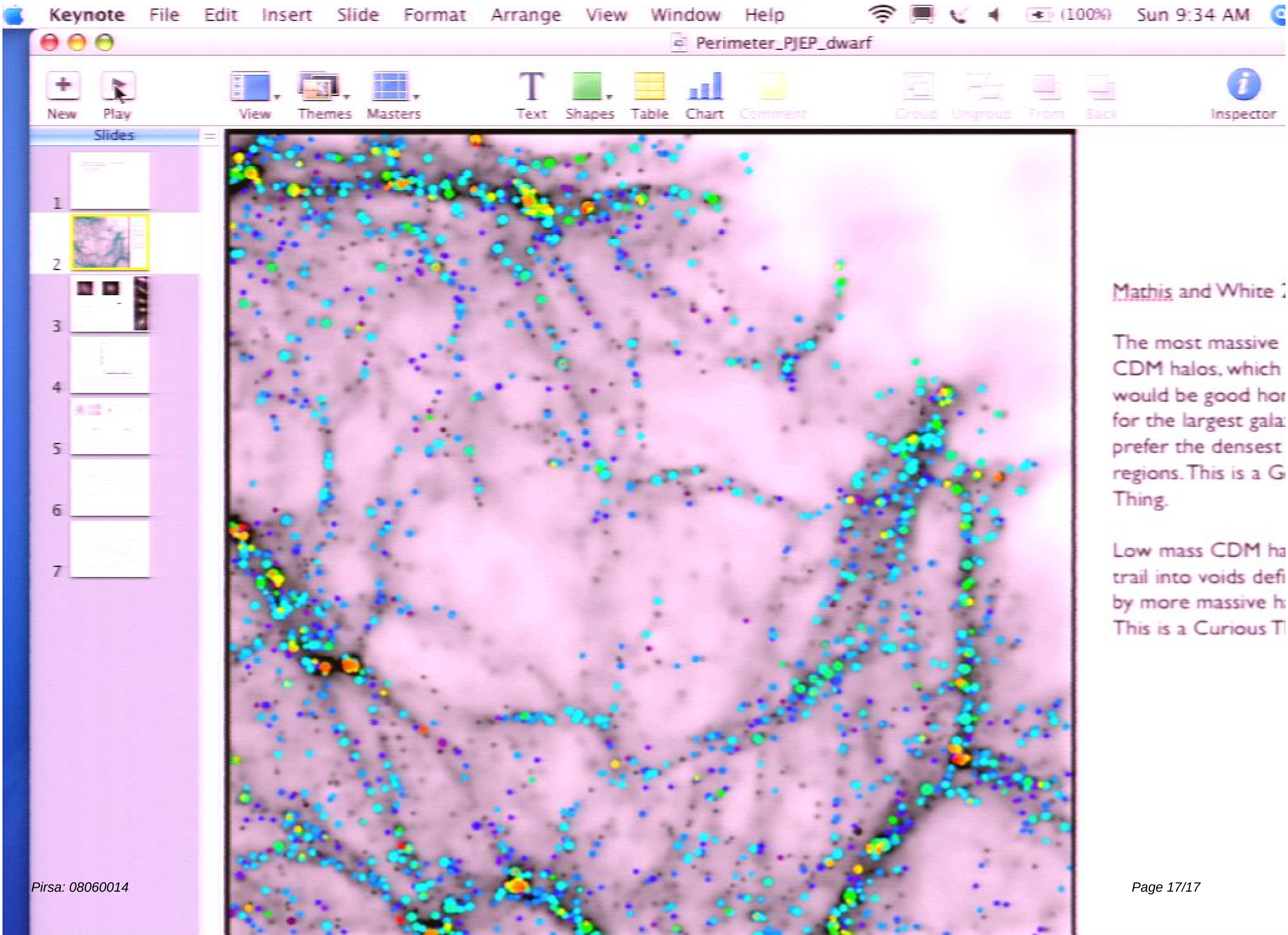
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