Fighting to Survive: PAHs in the Stormy Cosmos

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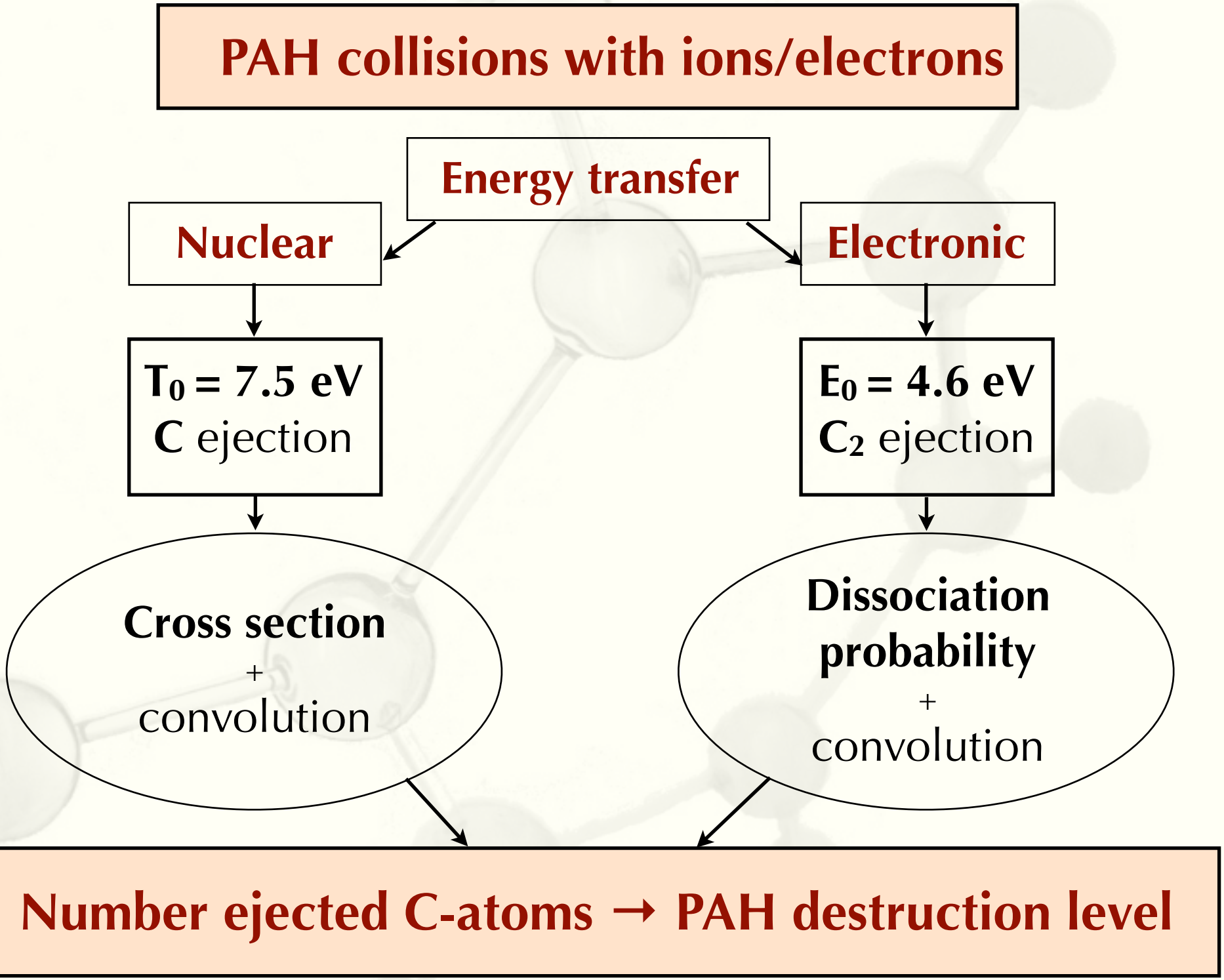
PAH collisional processing is missing!!!

↓

Physics
of PAH collisional processing:
Molecular target → SPECIFIC MODELS

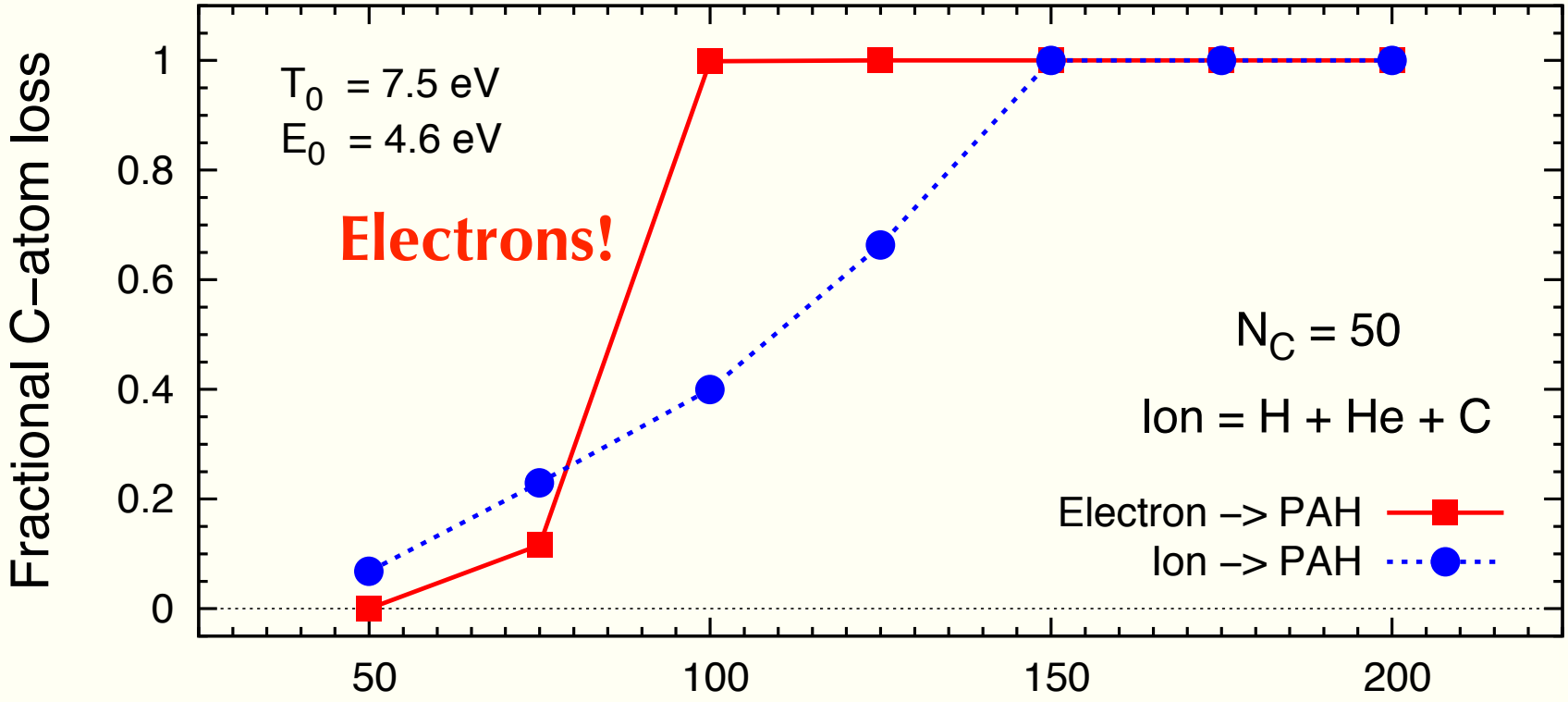
↓

Astrophysical implications
of PAH collisional processing


PAH collisions with ions/electrons
Energy transfer
Nuclear
Electronic
T0 = 7.5 eV
C ejection
E0 = 4.6 eV
C2 ejection
Cross section
+
convolution
Dissociation
probability
+
convolution
Number ejected C-atoms → PAH destruction level

Interstellar Shocks:

Inertial motion: **E = 10 eV - 10 keV**
Thermal motion: **E = 5 - 50 eV**



Micelotta et al. 2010a

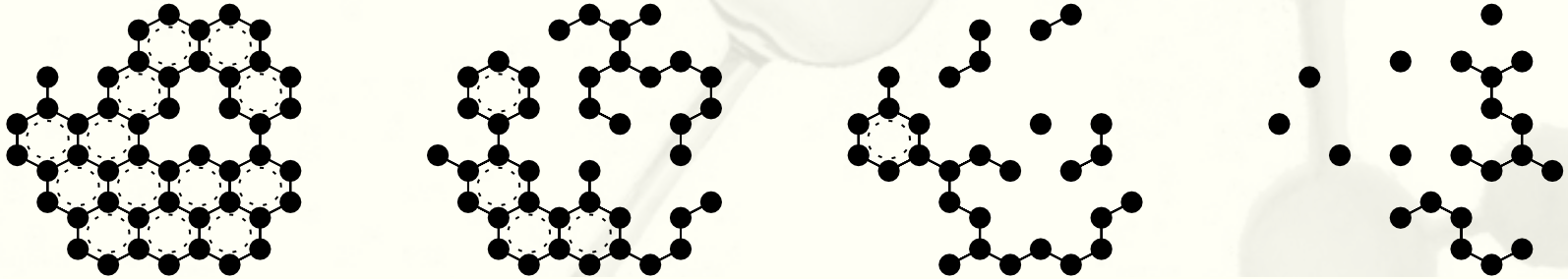
τ_{SNR} = **1.6x10^8 yr**

τ_{grains} = 6x10^8 yr, **τ_{inj} = 2.5x10^9 yr**, Jones 1996

Protection and/or reformation required

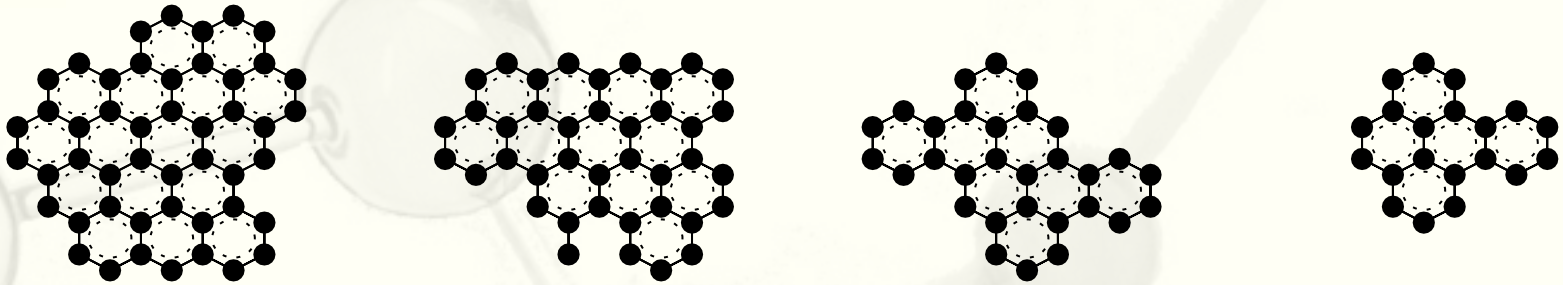
PAH evolution

Random removal of carbon atoms



N_C(lost) = 2 | N_C(lost) = 10 | N_C(lost) = 21 | N_C(lost) = 29

V_{shock} = 50 | 75 | 100 | 125 km/s



N_C(lost) = 2 | N_C(lost) = 10 | N_C(lost) = 20 | N_C(lost) = 30

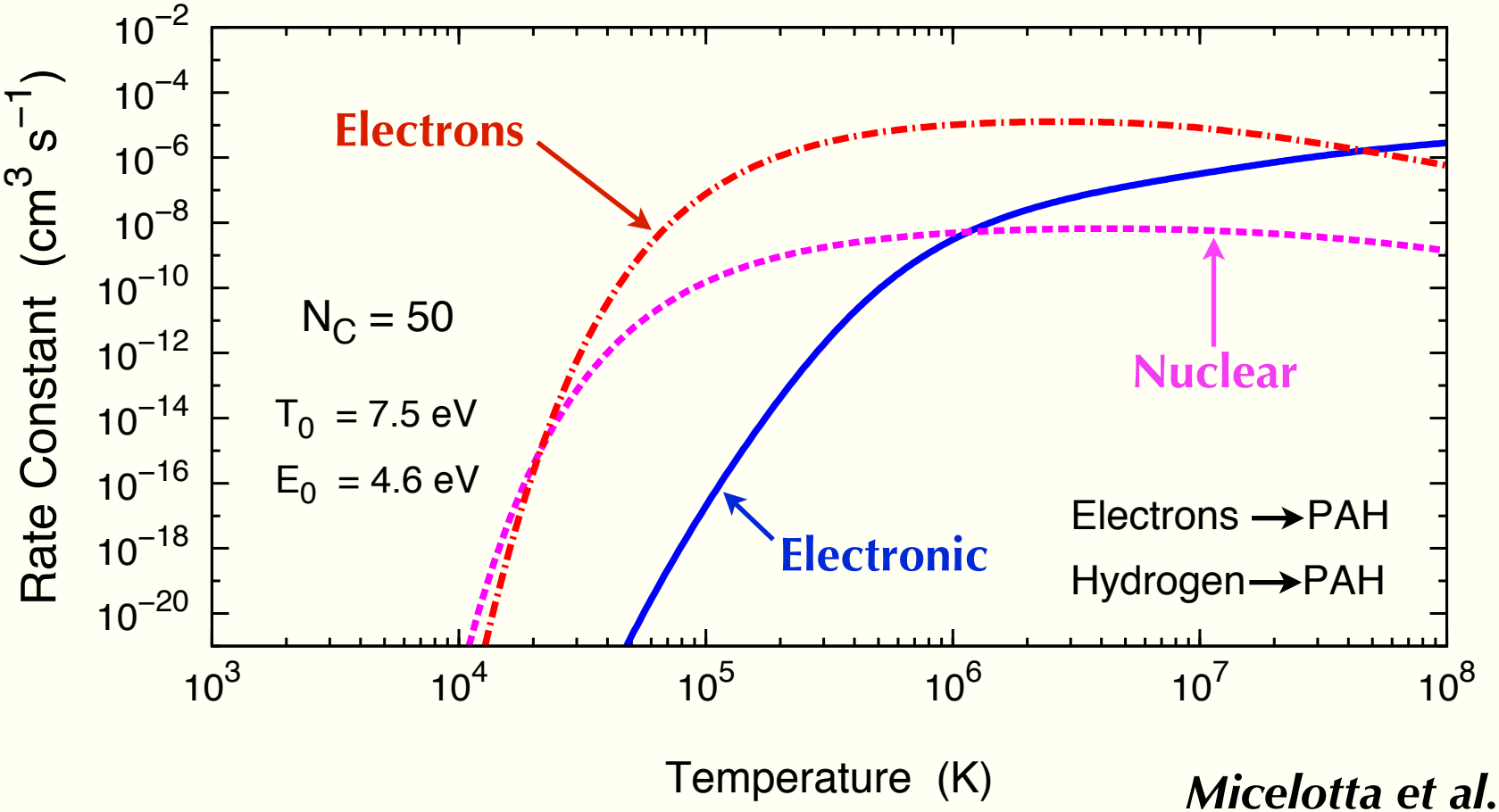
Minimal aromatic domain loss

Micelotta et al. 2010a

Hot Gas:

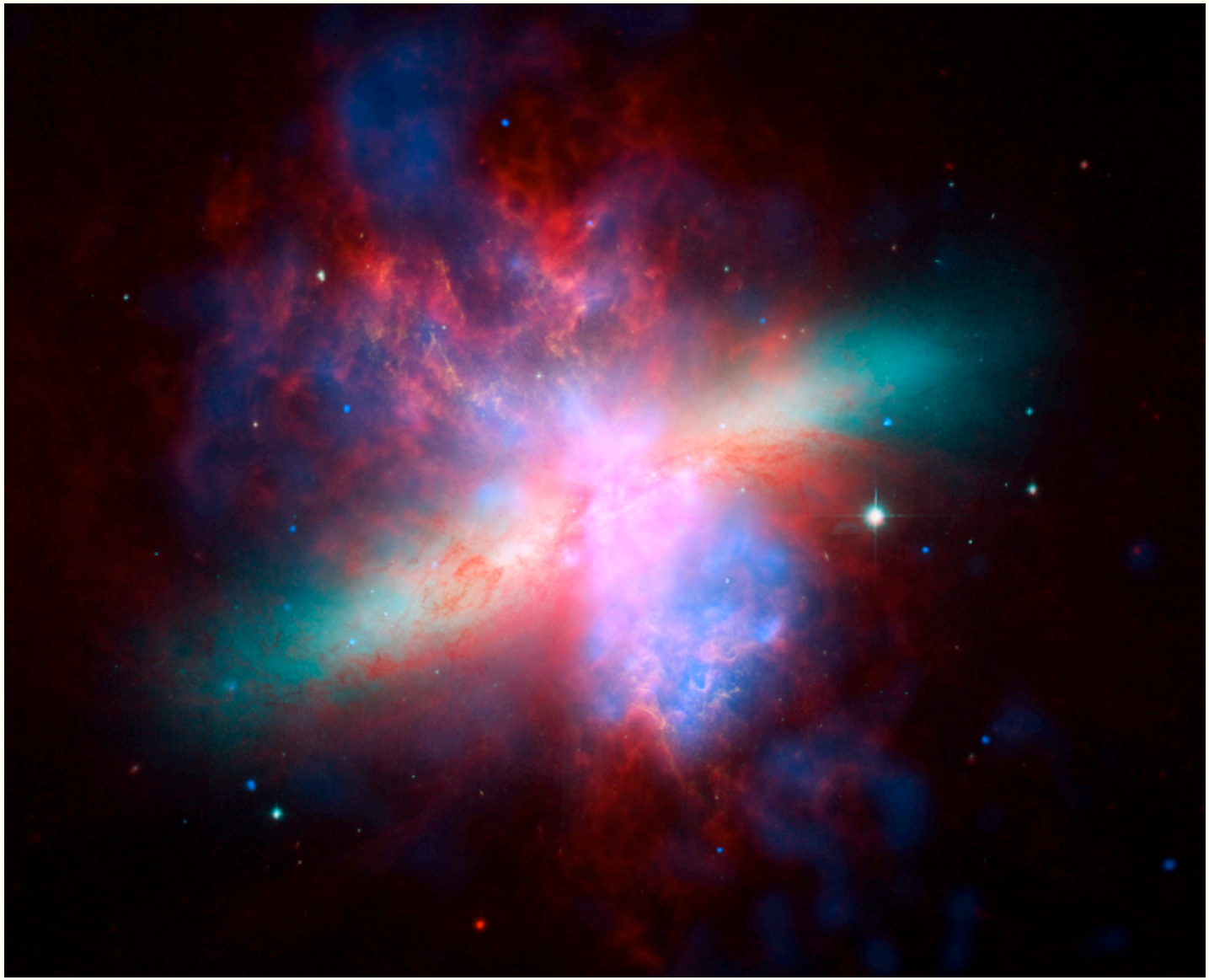
Temperature of gas: **T = 10^5 - 10^8 K**

Thermal motion: **E = 10 eV - 10 keV**



Micelotta et al. 2010b

(Rate constant) x density = ejection rate



Red = Spitzer IRAC 8.0 µm
Green/Orange = optical
Blue = Chandra.

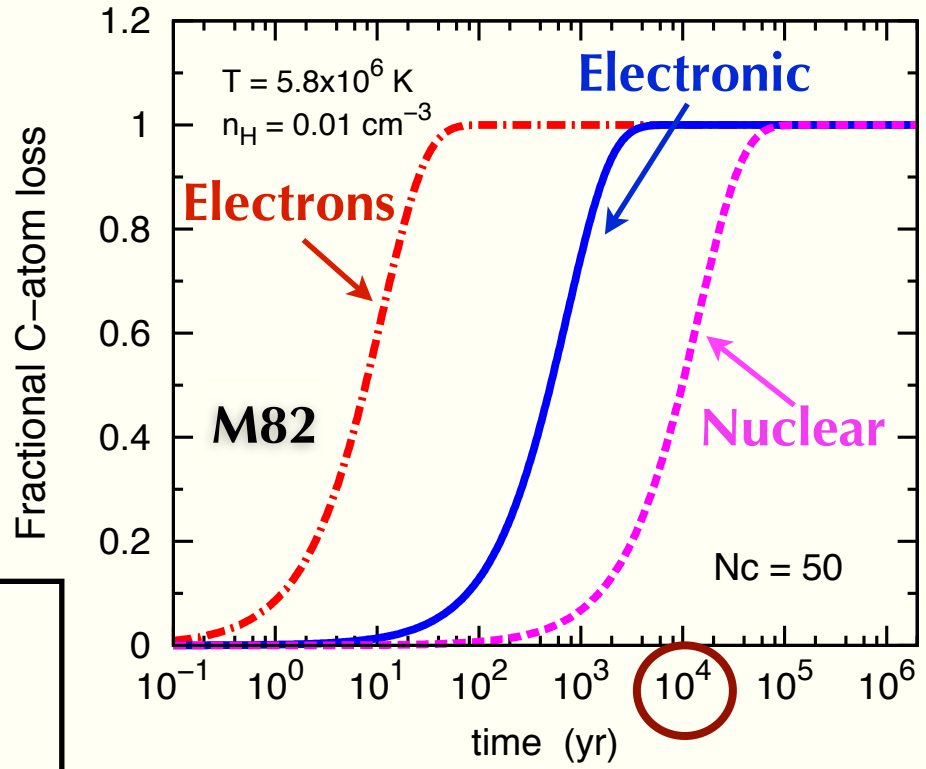
τ_0 =
Nc/ejection rate =
PAH lifetime

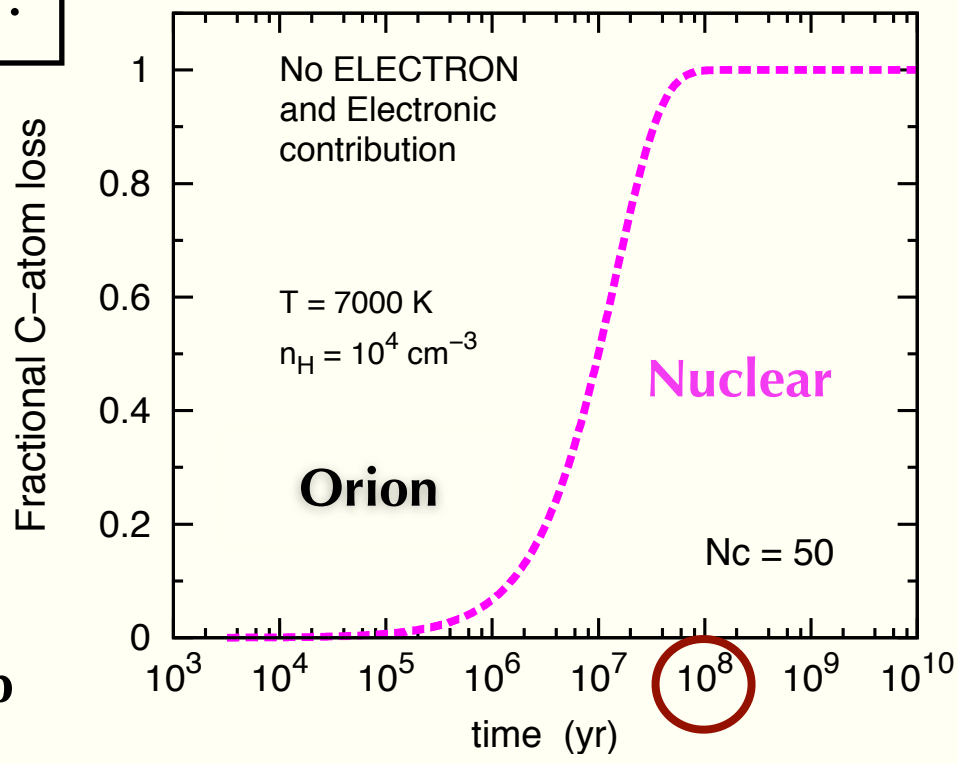
M82: τ_0 = 10 yr, τ_{obj} = 20 Myr.

Orion: τ_0 = 10 Myr, τ_{obj} = 1 Myr.

Uncertainty ~ factor 10

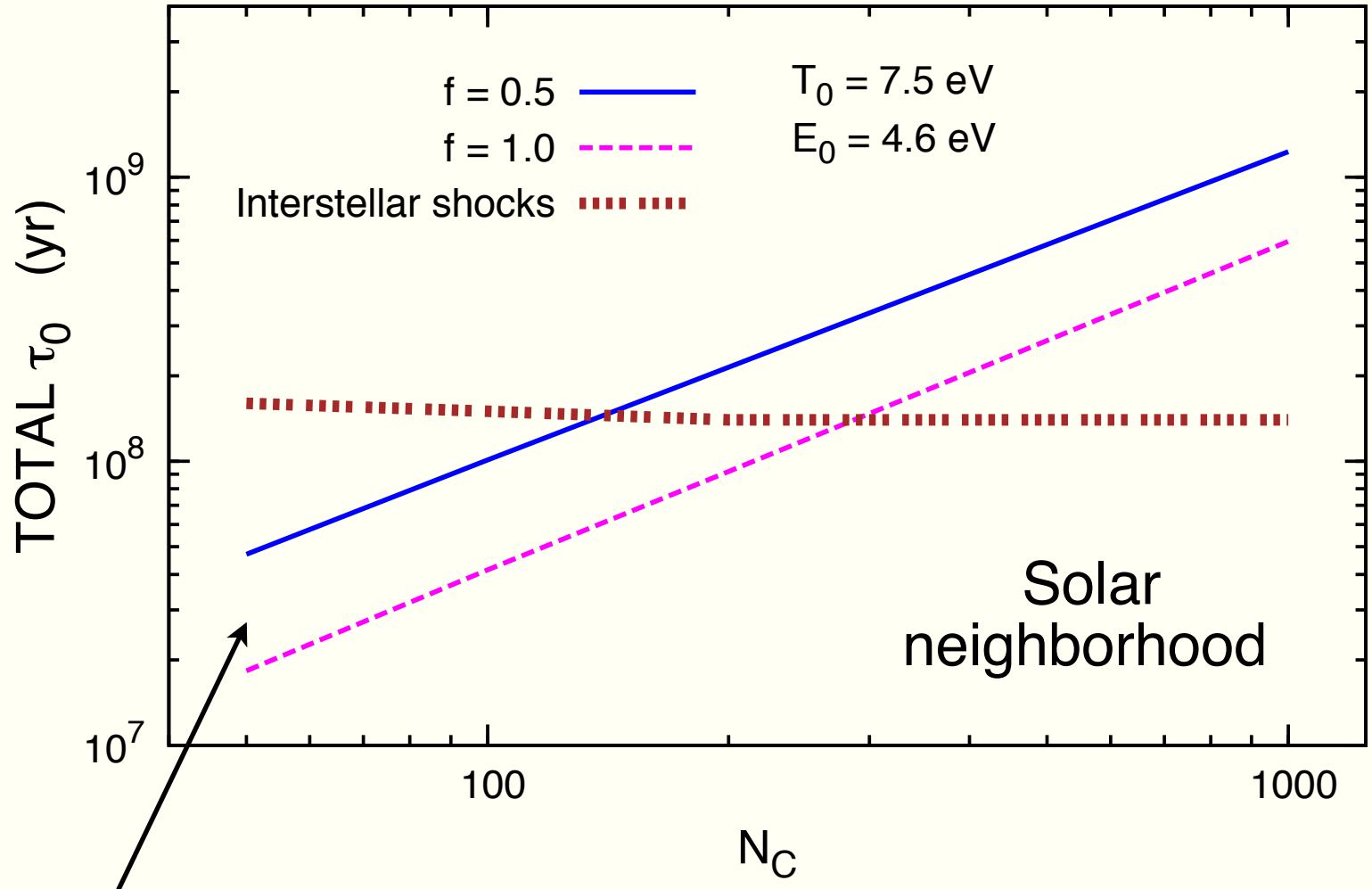
PAH entrained in cold material





Micelotta et al. 2010b

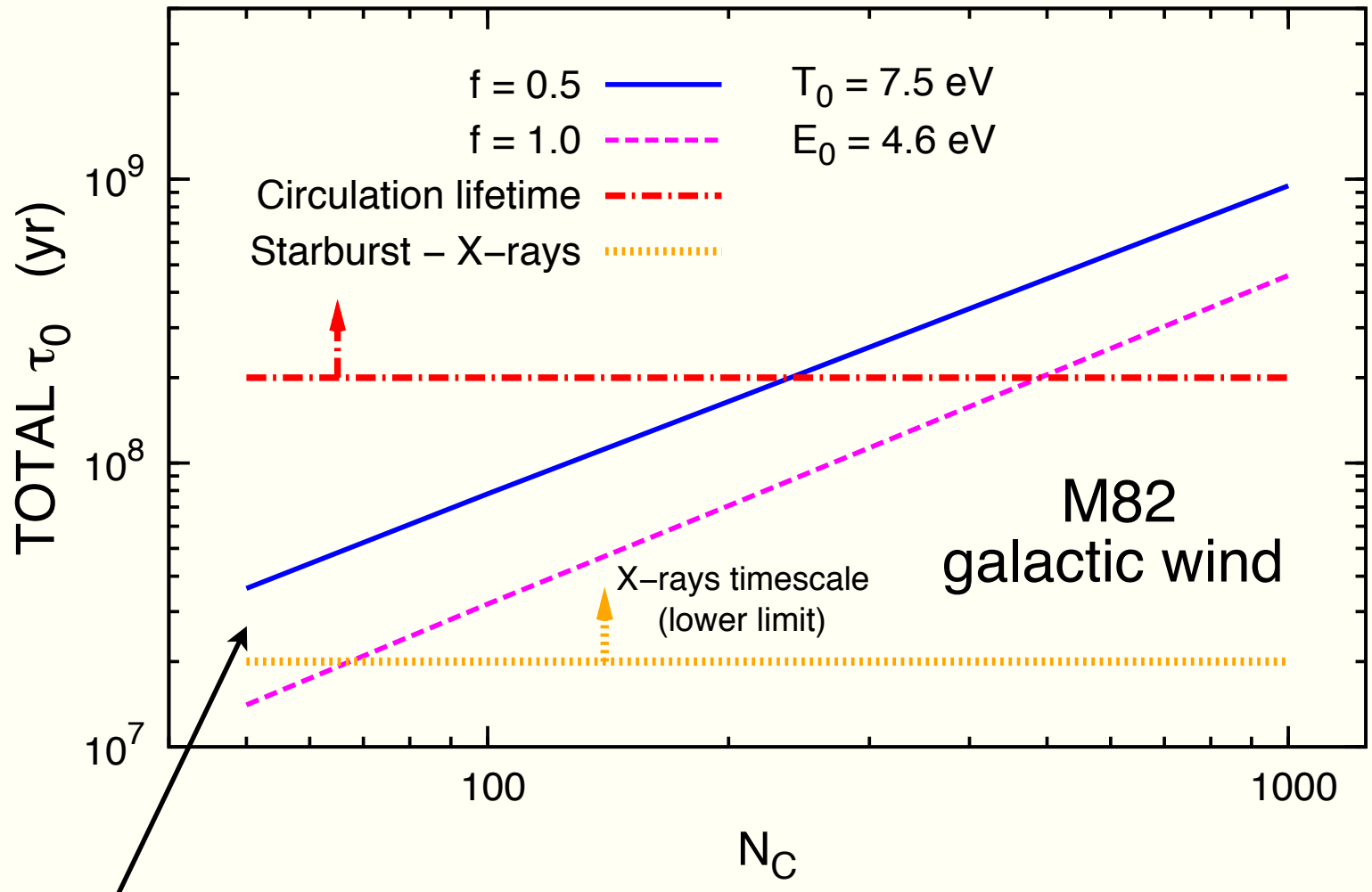
PAH lifetime: solar neighborhood



Cosmic Rays: E = 5 MeV - 10 GeV

Micelotta et al. 2010c, A&A, in press

PAH lifetime: galactic wind



Cosmic Rays: E = 5 MeV - 10 GeV

Micelotta et al. 2010c, A&A, in press

Physics of collisional processing

N_C = 50 C-atoms

v_s < 100 km/s

denaturation

N_C = 50 C-atoms

$v_s \geq$ 100 km/s & hot gas

complete destruction by thermal electrons

Cosmic Rays

destruction by

inelastic coll. with ions

Astrophysical implications

Inter-cloud ISM
Small PAHs
destruction by **Cosmic Rays**

Inter-cloud ISM
Larger PAHs
destruction by **shocks**

Protected PAHs
lifetime set by
Cosmic Rays & X-rays

$T_{PAH} < T_{inj}$

Re-formation mechanism required
Which one?

Perspectives

PAHs in the ISM: **origin?**

From PAHs to grains: **filling the gap**

Micelotta et al. 2010a, A&A, 510, A36
Micelotta et al. 2010b, A&A, 510, A37
Micelotta et al. 2010c, A&A, in press

Thank you!