Phase transition shocks in the WNM***

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*** Origin of neutral carbon at high pressure

Introduction Physics of phase transition shocks Origin and dissipation rate Origin and dissipation rate A possible solution ?



courtesy of P. Lesaffre

probabilistic evolution



- turbulent cascade in multiphase environment?
 - transfer / dissipation of mechanical energy ?



 $f_2 = N(C^3 P_2) / N(C)$

IntroductionTracers of turbulent dissipation ?Physics of phase transition shocksMystery of CI at high pressureOrigin and dissipation rateA possible solution ?





high velocity shocks in the WNM







log(Distance)→

Lehmann et al. (2020)

Introduction Chemistry & radiative transfer Physics of phase transition shocks Origin and dissipation rate Production & excitation of CI

Paris-Durham shock code

multi-ionized species

chemistry (coll / photo ion, recomb)

cooling (thousands levels / lines)

feedback on shock chemistry

- exact radiative transfer
- iterative scheme

shock velocity up to 500 km s⁻¹









Observations

Shock models







	Largeur à mi-hauteur (km/s)		
Vs(km/s) \ B(uG)	0.1	0.2	0.3
90	4.81	5.08	5.22
80	4.79	5.08	5.21
60	4.84	5.13	5.28
45	4.89	5.30	5.46



J. Laporte

Introduction Dissipation rate Physics of phase transition shocks Origin and dissipation rate Link with interstellar turbulence







can these shocks be terminal shocks of SNR?



SN 1572, Tycho's SNR J.Warren & J.Hughes et al.



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background sources in Jenkins & Tripp sample are OB stars => should be correlated with SNR positions

dissipation rate in WNM

20 20 percentage of sources percentage of sources 10 10 0 0 10⁻²⁶ 10⁻²⁶ 10⁻²⁸ 10⁻²⁷ 10⁻²⁵ 10⁻²³ 10⁻²⁸ 10⁻²⁷ 10⁻²⁴ 10⁻²³ 10⁻²² 10⁻²² 10⁻²⁵ 10⁻²⁴ ϵ_{diss} (erg cm⁻³ s⁻¹) $\epsilon_{turb}~(erg~cm^{\text{--}3}~s^{\text{--}1})$

turbulent transfer rate in CNM

Hennebelle & Falgarone (2012) Miville-Deschênes et al. (2017)

turbulent transfer rate in CNM 20 20 percentage of sources percentage of sources 10 10 0 10⁻²⁸ 10⁻²⁷ 10⁻²⁶ 10⁻²⁵ 10⁻²⁴ 10⁻²⁸ 10⁻²⁷ 10⁻²⁶ 10⁻²² 10⁻²² 10⁻²³ 10⁻²³ 10⁻²⁵ 10⁻²⁴ ϵ_{diss} (erg cm⁻³ s⁻¹) ϵ_{turb} (erg cm⁻³ s⁻¹)

dissipation rate in WNM

- \rightarrow surprising similarity between both quantities
- → link between supersonic dissipation & interstellar turbulence