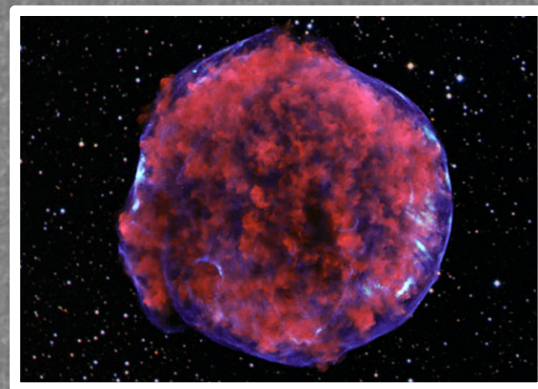




What is the density of the material in the sub-pc environment around SNe-Ia



$10^{16}$  cm



$>10^{18}$  cm



The

KNOWLE

GAP



DGE



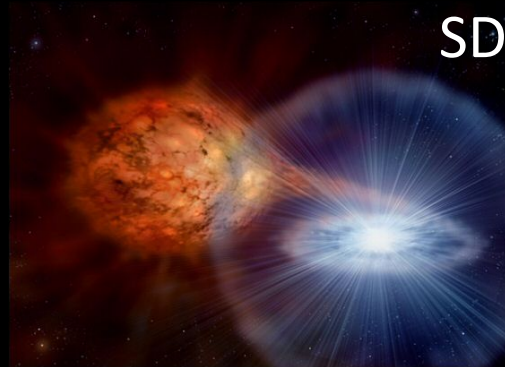
P



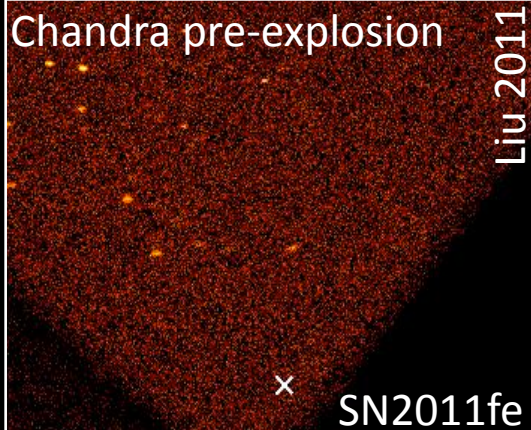
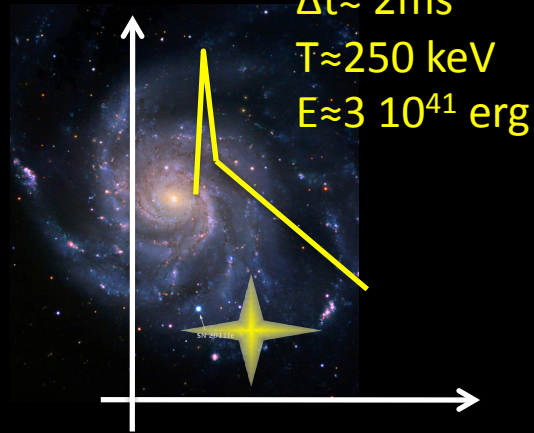
# Science with Zero photons: Type Ia SNe in the X-rays (and radio)

Raffaella Margutti  
Harvard University

Pre-SN X-ray  
emission

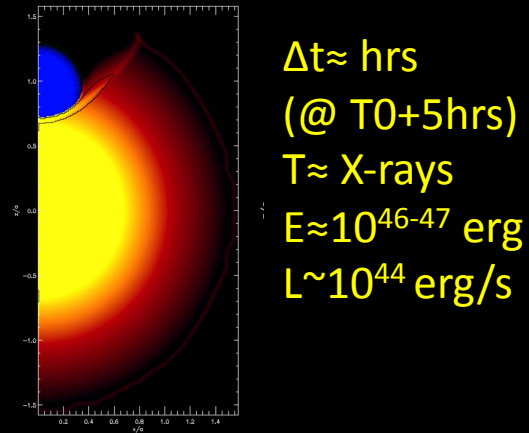


Shock Break Out

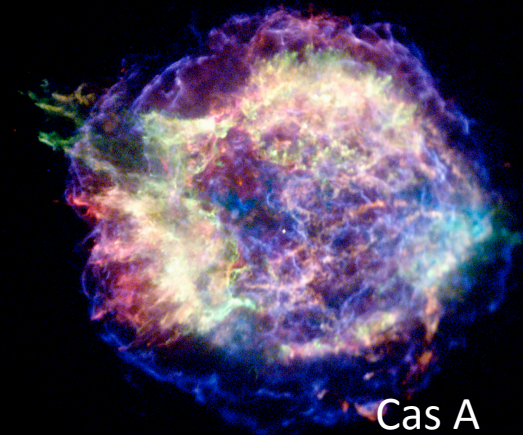


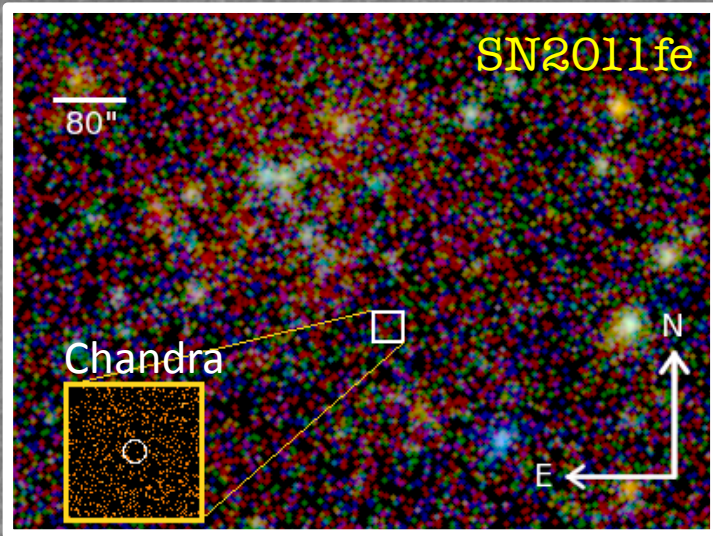
Super-soft X-ray source

Shock Interaction w.  
companion



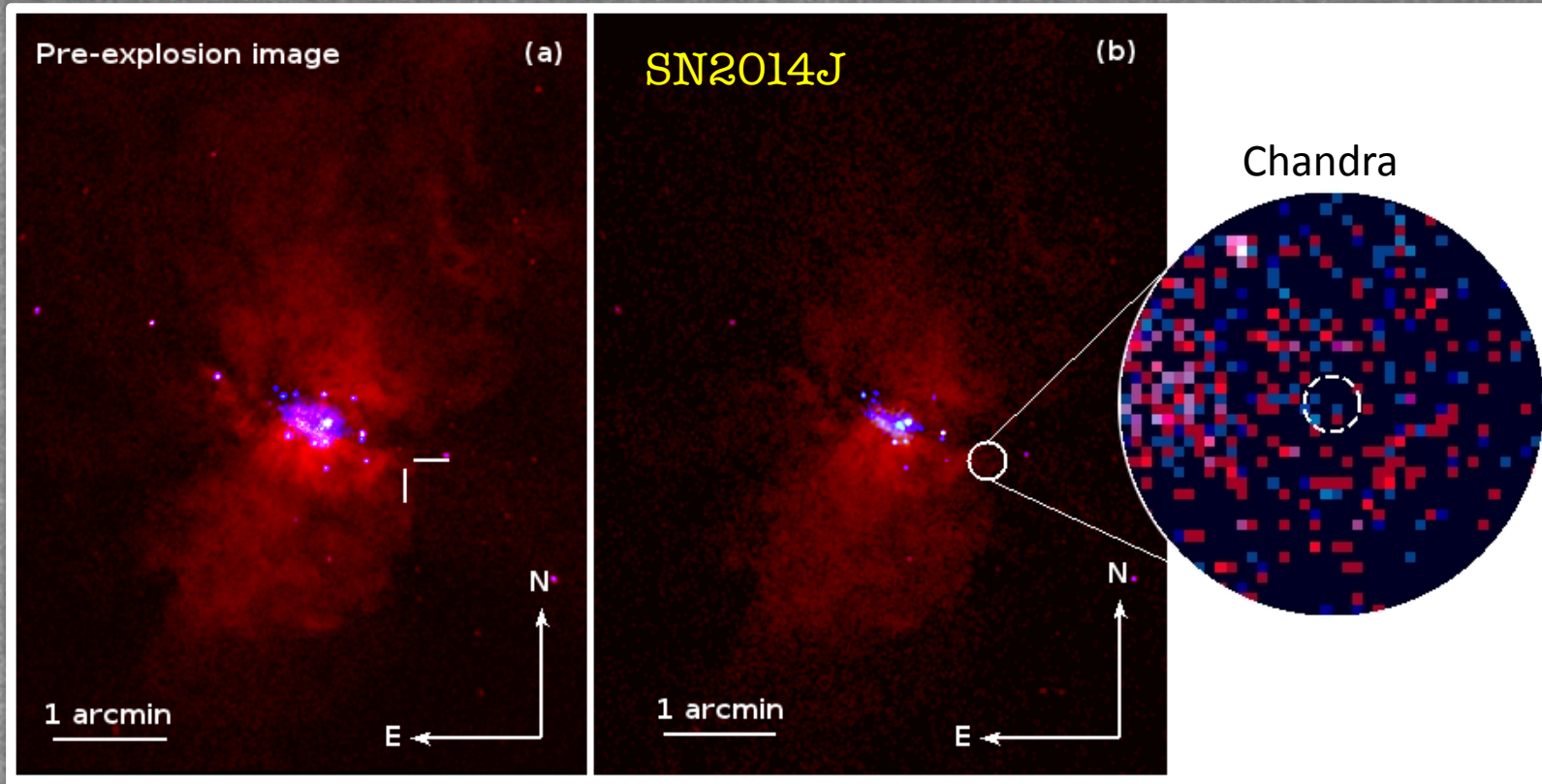
Shock interaction  
with the ambient  
medium





## SUMMARY:

We repointed the most sensitive instruments to the most nearby Ia SNe and found NOTHING



*Detective Gregory: “Is there any other point to which you would wish to draw my attention?”*

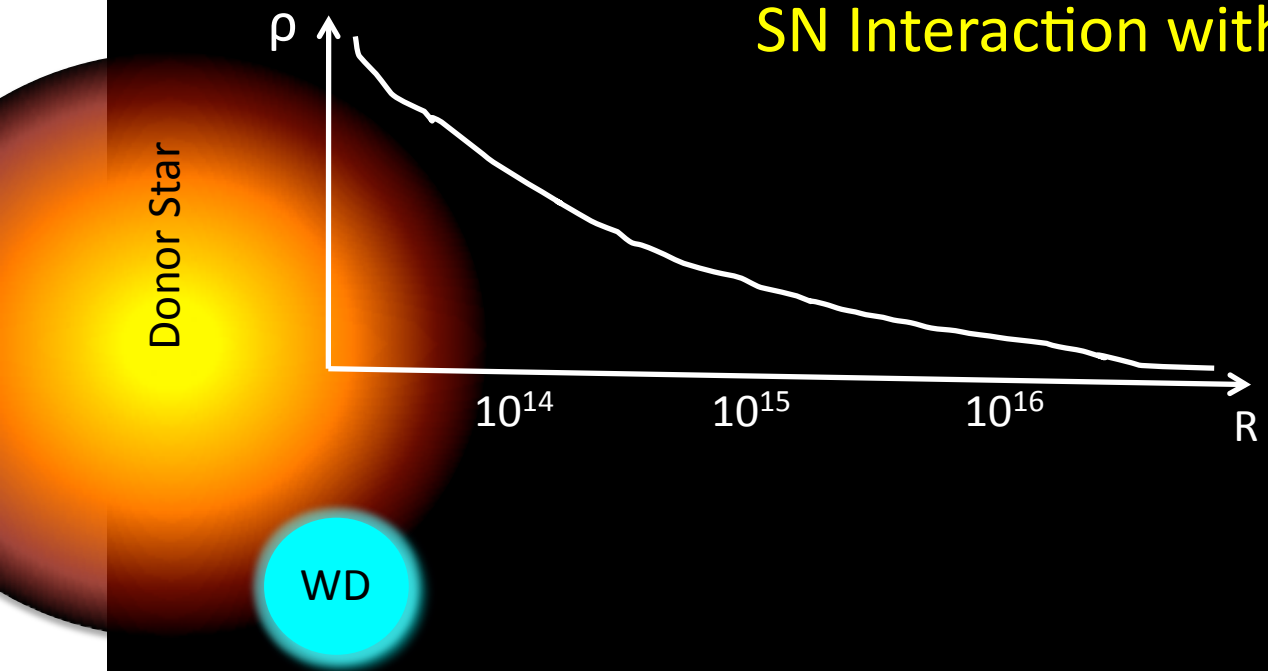
*Holmes: “To the curious incident of the dog in the night-time.”*

*Gregory: “The dog did **nothing** in the night-time.”*

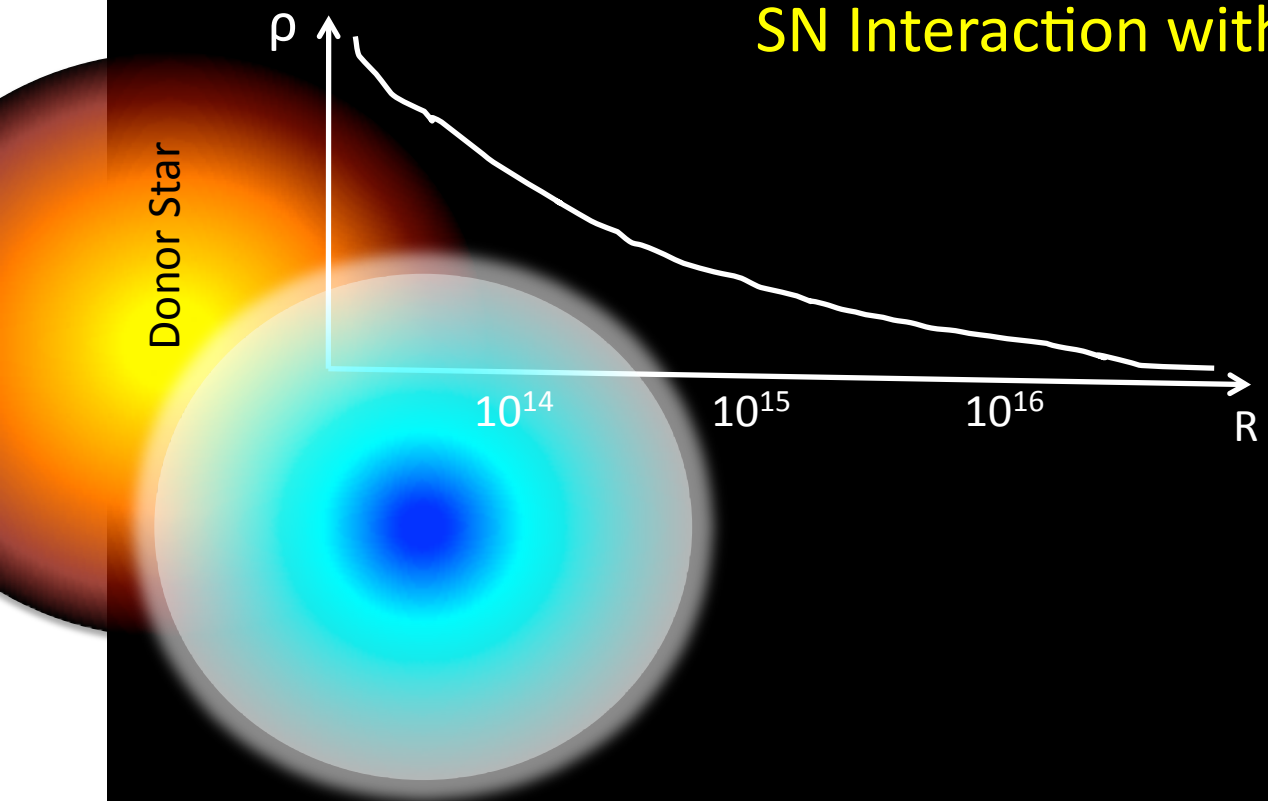
*Holmes: “That was the curious incident.”*

— “Silver Blaze,” by Arthur Conan Doyle

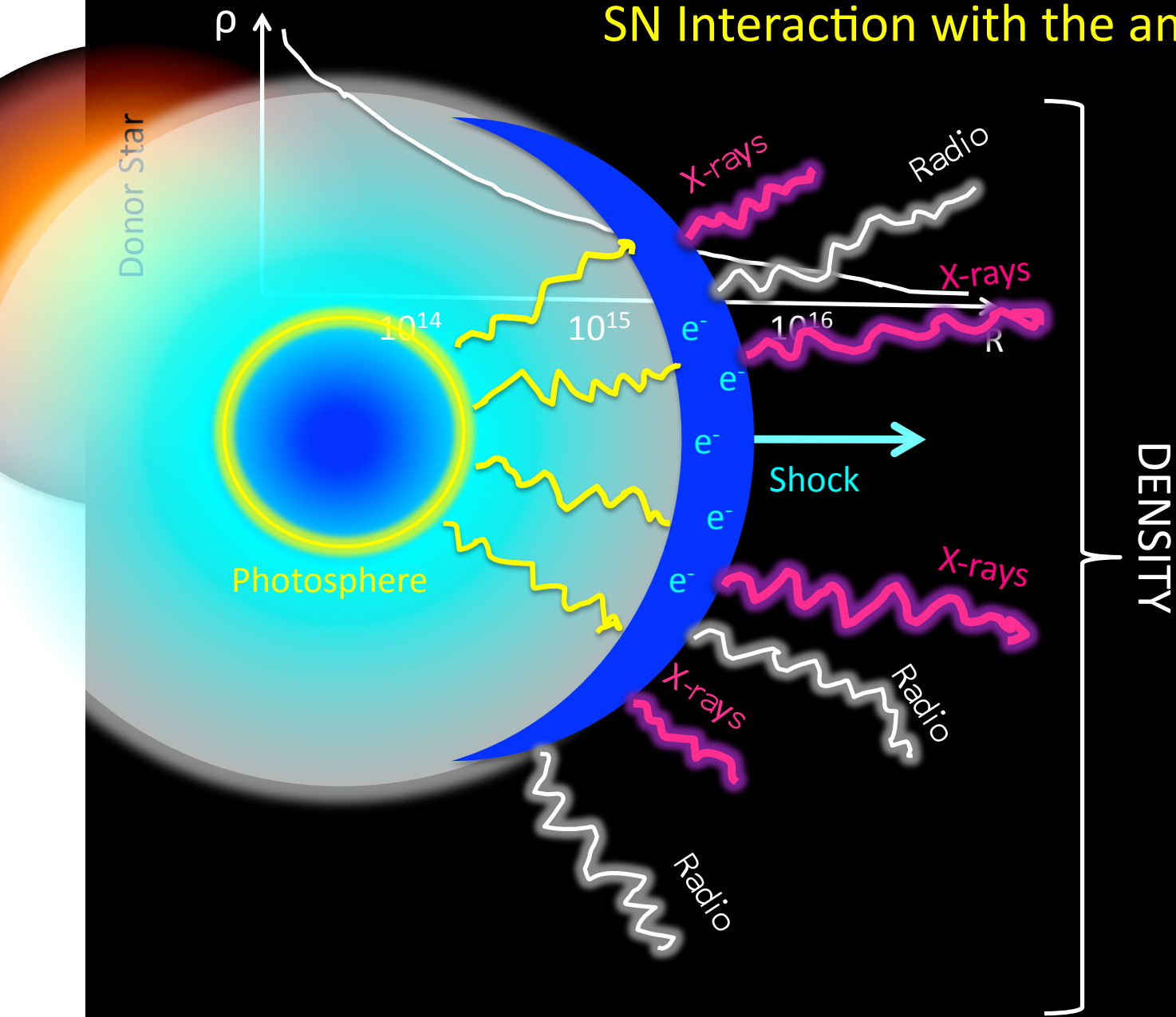
# SN Interaction with the ambient medium



# SN Interaction with the ambient medium

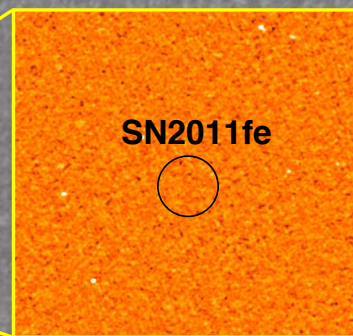
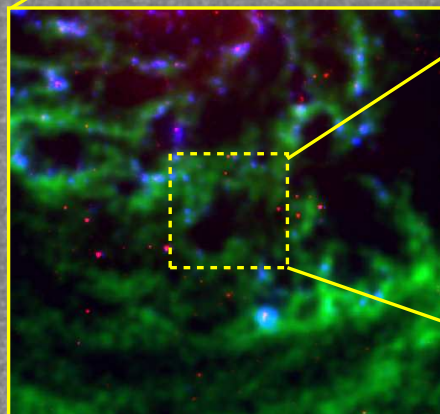
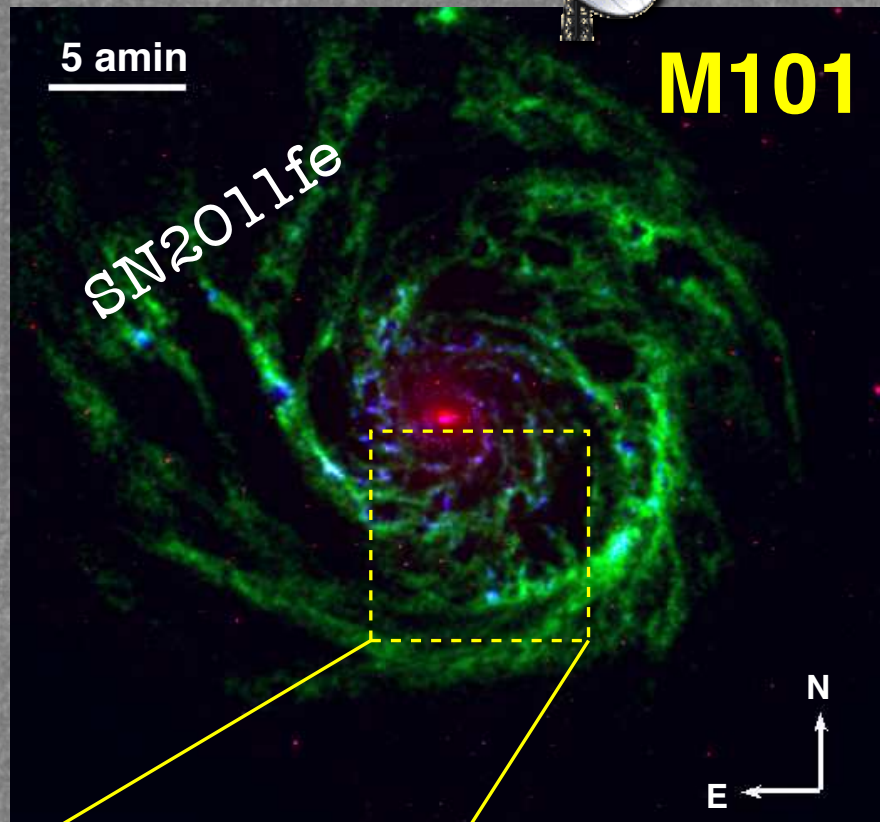


# SN Interaction with the ambient medium





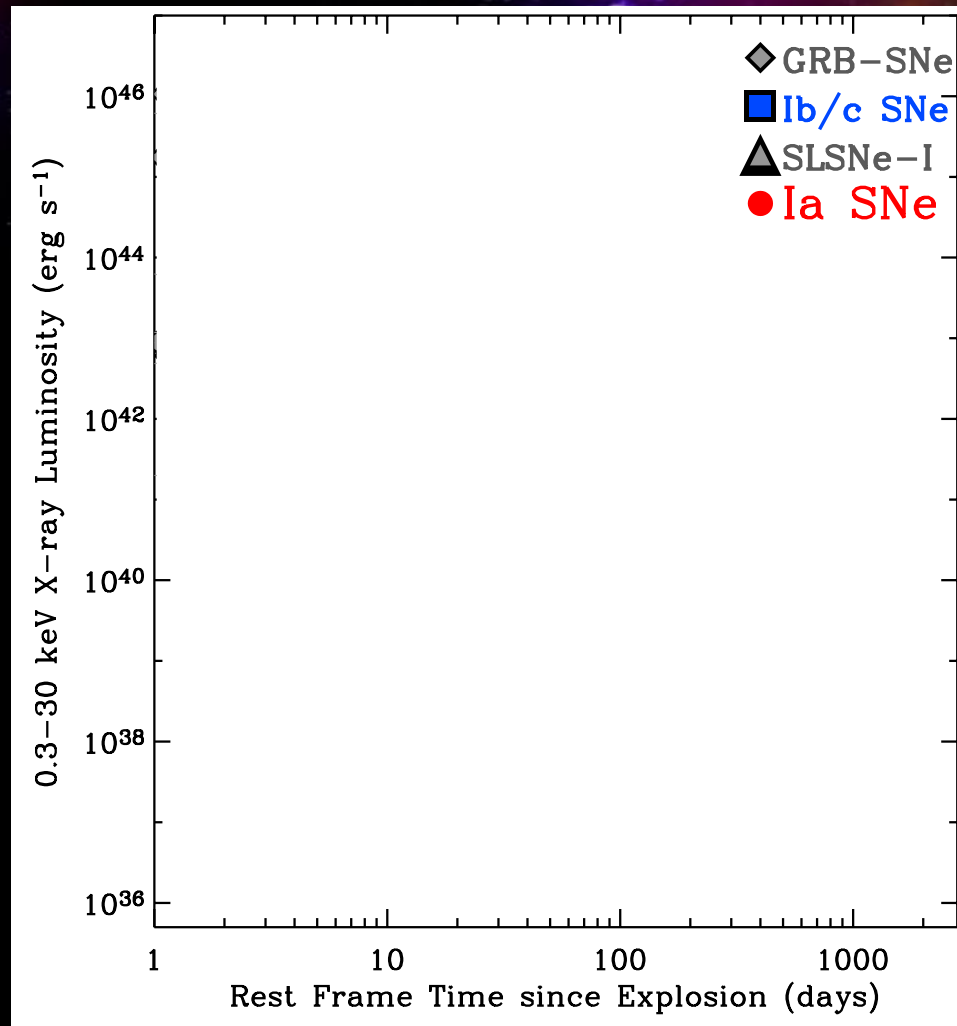
# RADI



EVLA 5.9 GHz

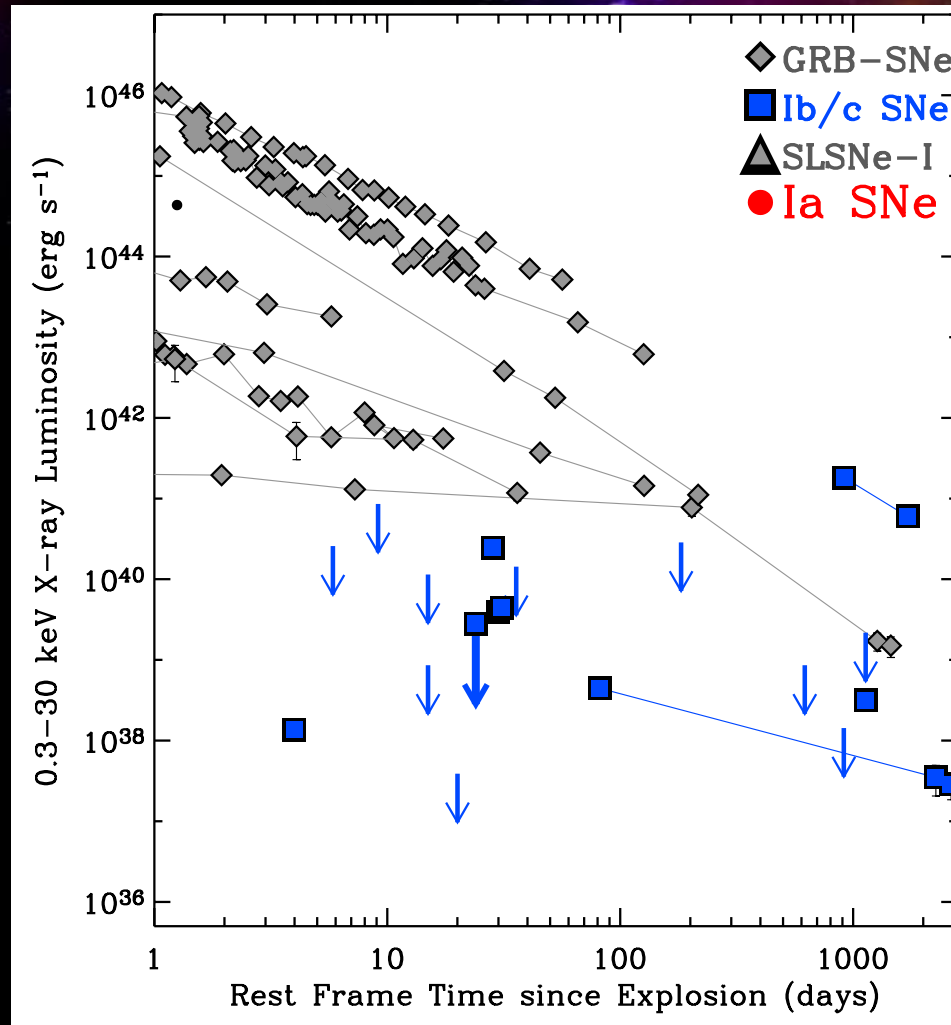
Chomiuk 2012; Horesh 2012;

# Type-I SN X-ray phase space



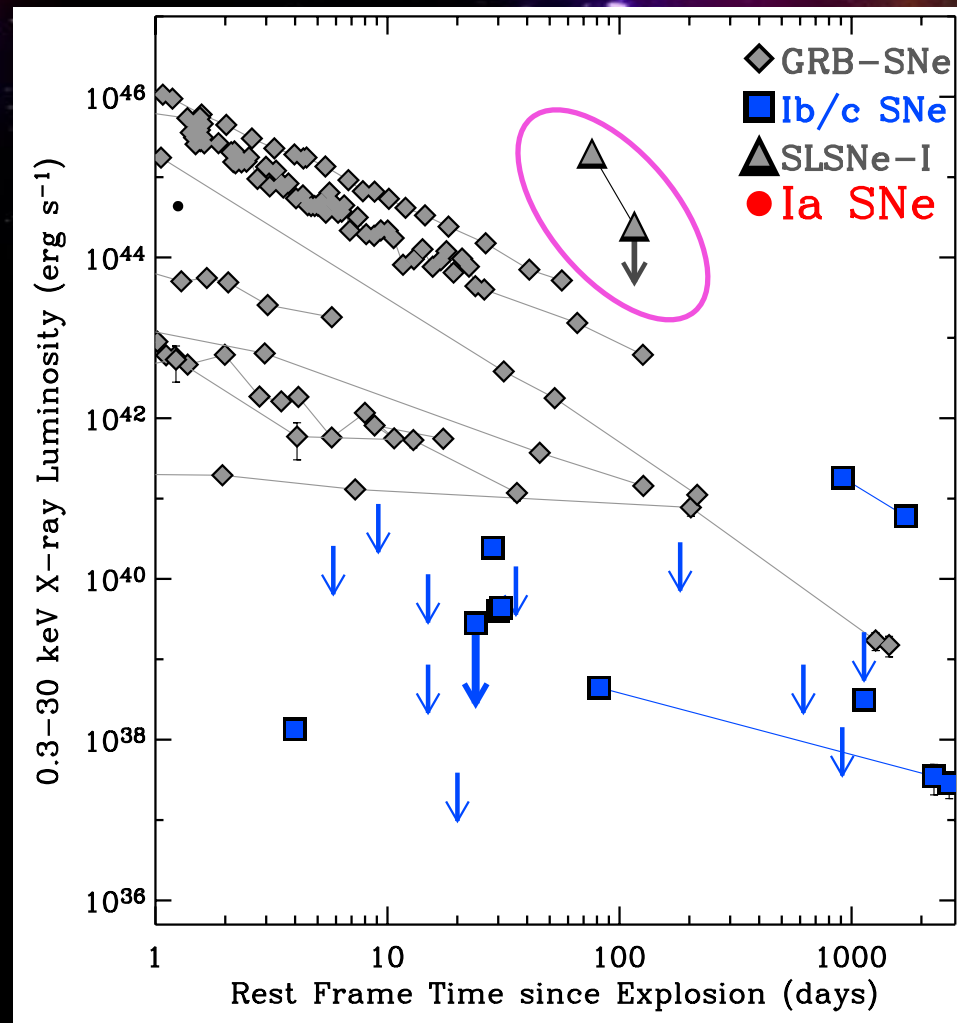
No Type Ia SN has EVER been detected in the X-rays

# Type-I SN X-ray phase space



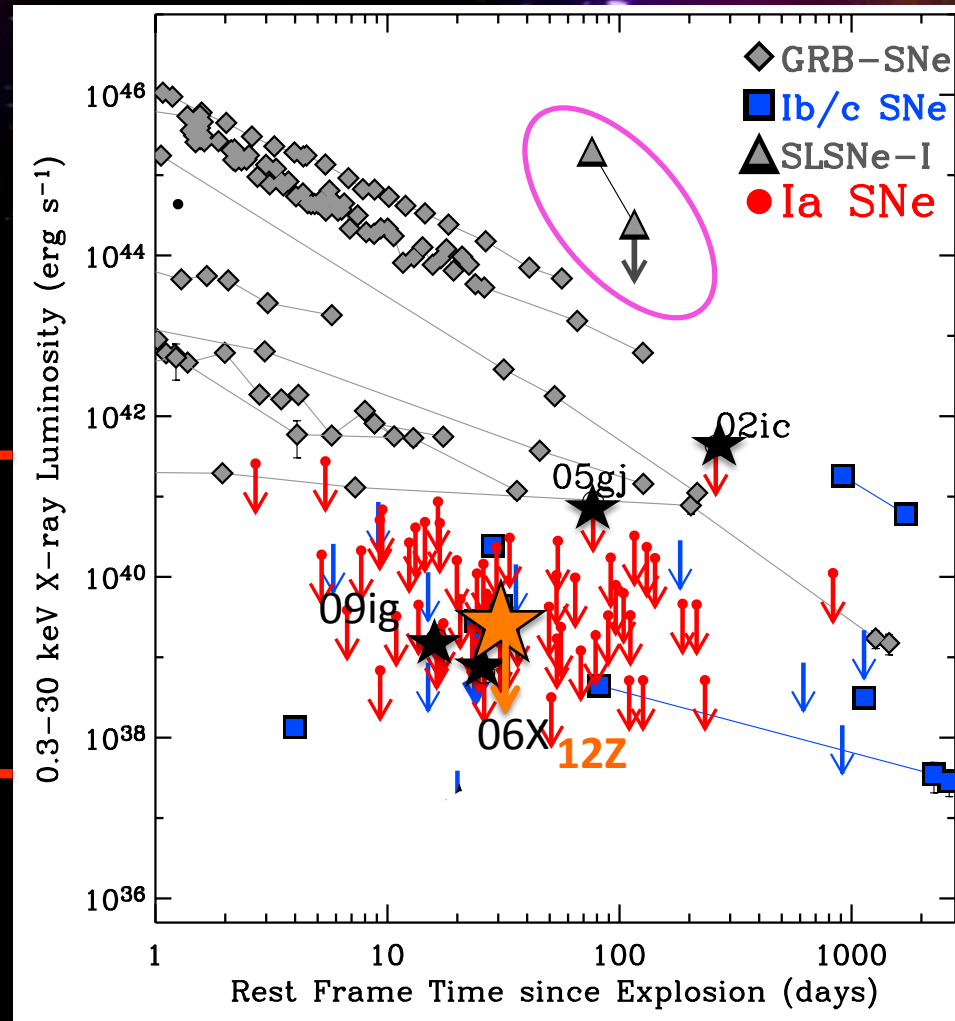
No Type Ia SN has EVER been detected in the X-rays

# Type-I SN X-ray phase space



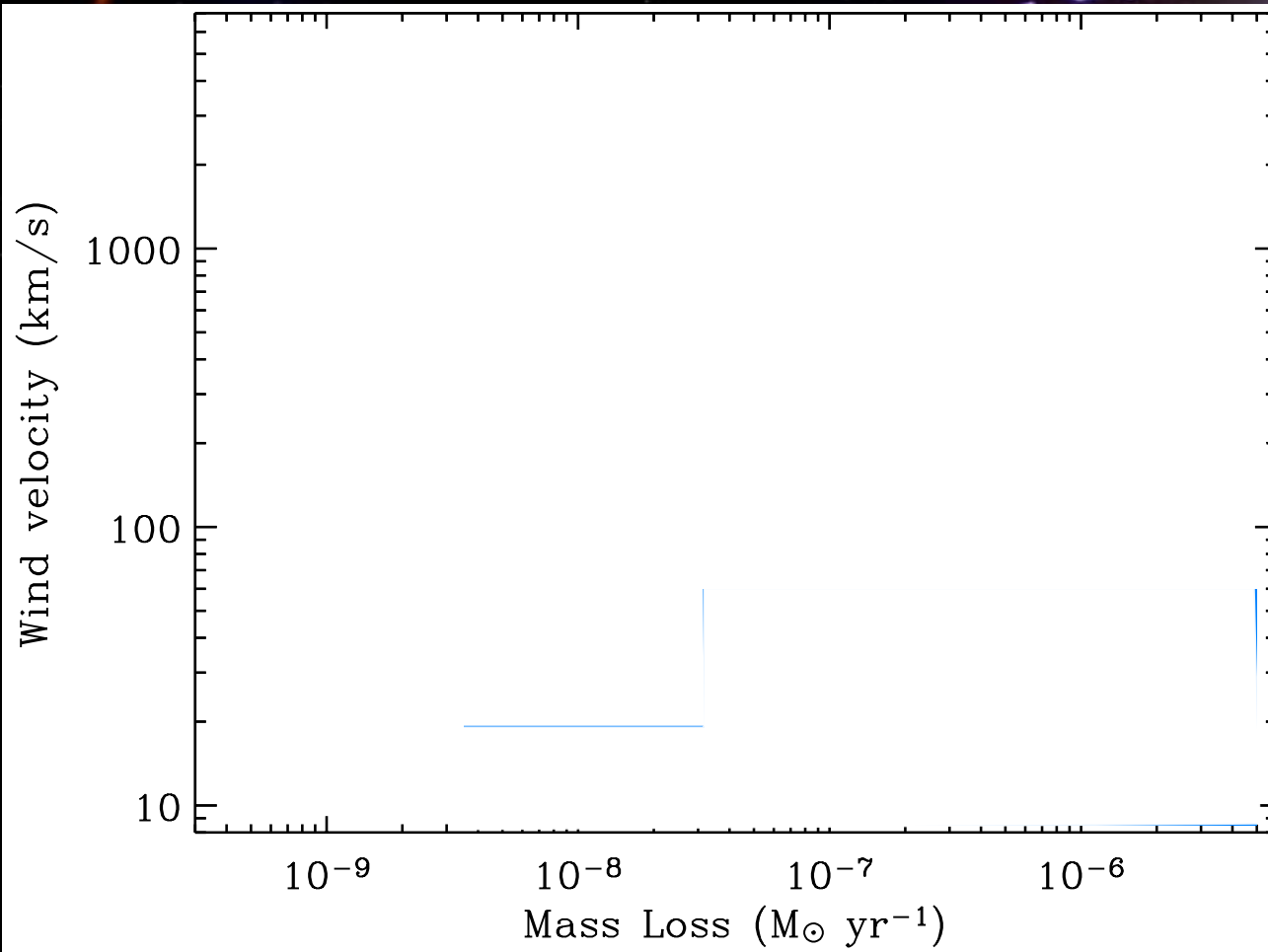
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# Type-I SN X-ray phase space



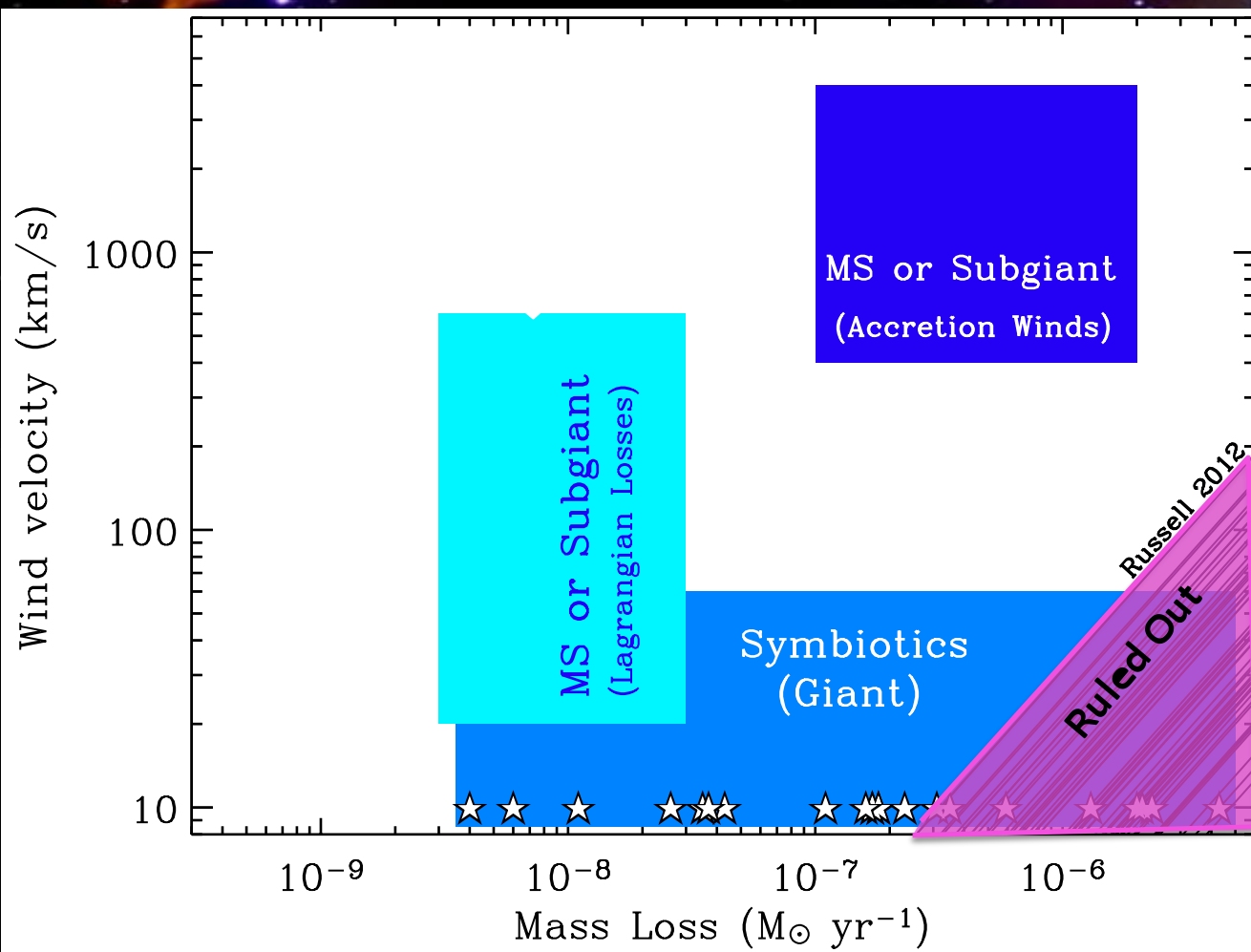
No Type Ia SN has EVER been detected in the X-rays

$$\rho = \frac{\dot{M}}{4\pi R^2 v_w} \quad @ R \approx 10^{16} \text{ cm}$$



SD  
systems  
with  
STEADY  
mass-  
loss

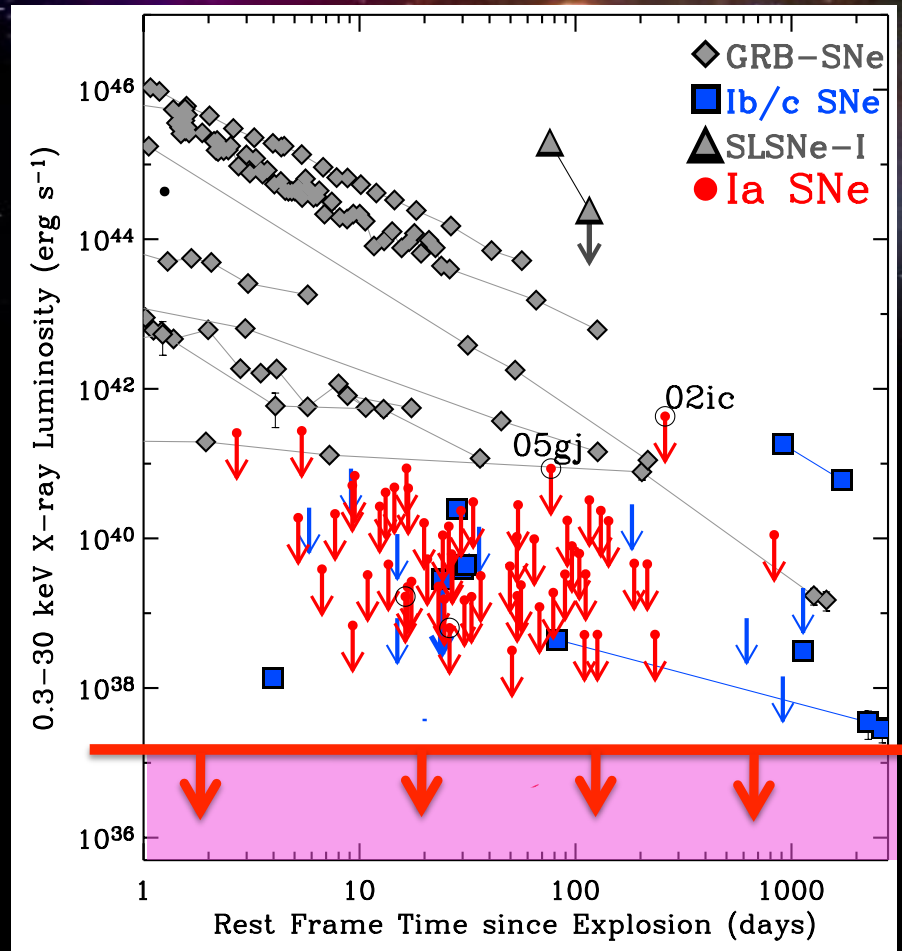
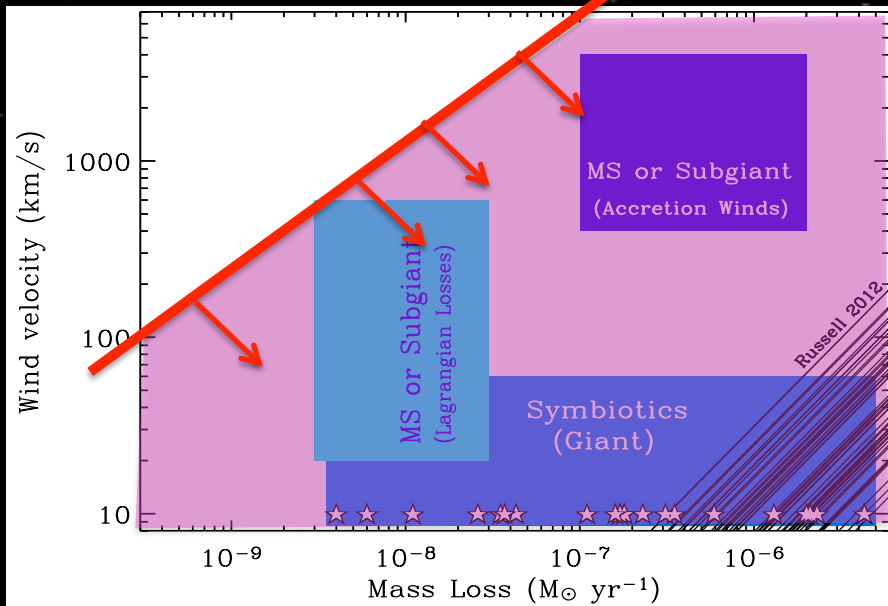
Margutti +14



SD  
systems  
with  
STEADY  
mass-loss

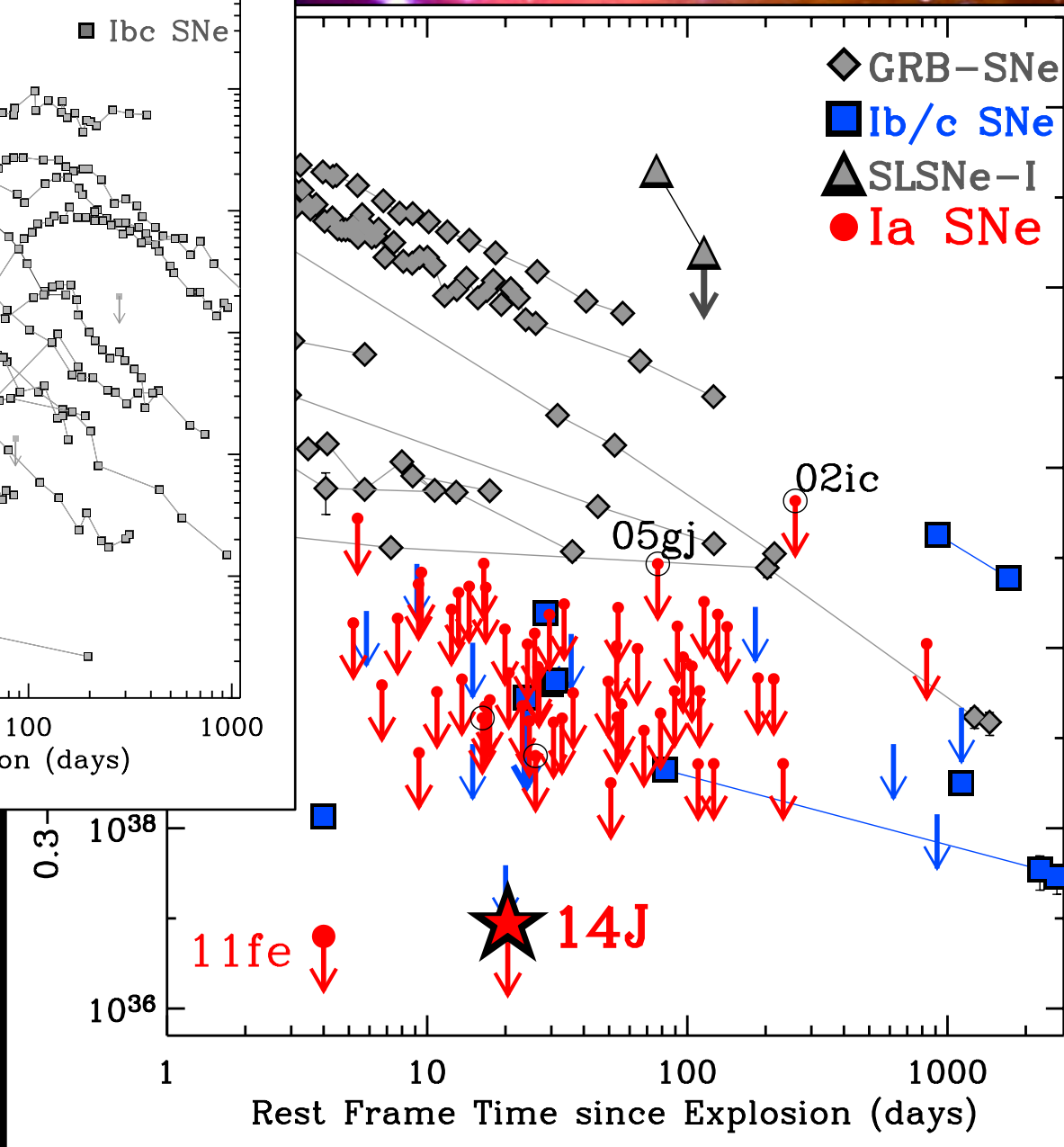
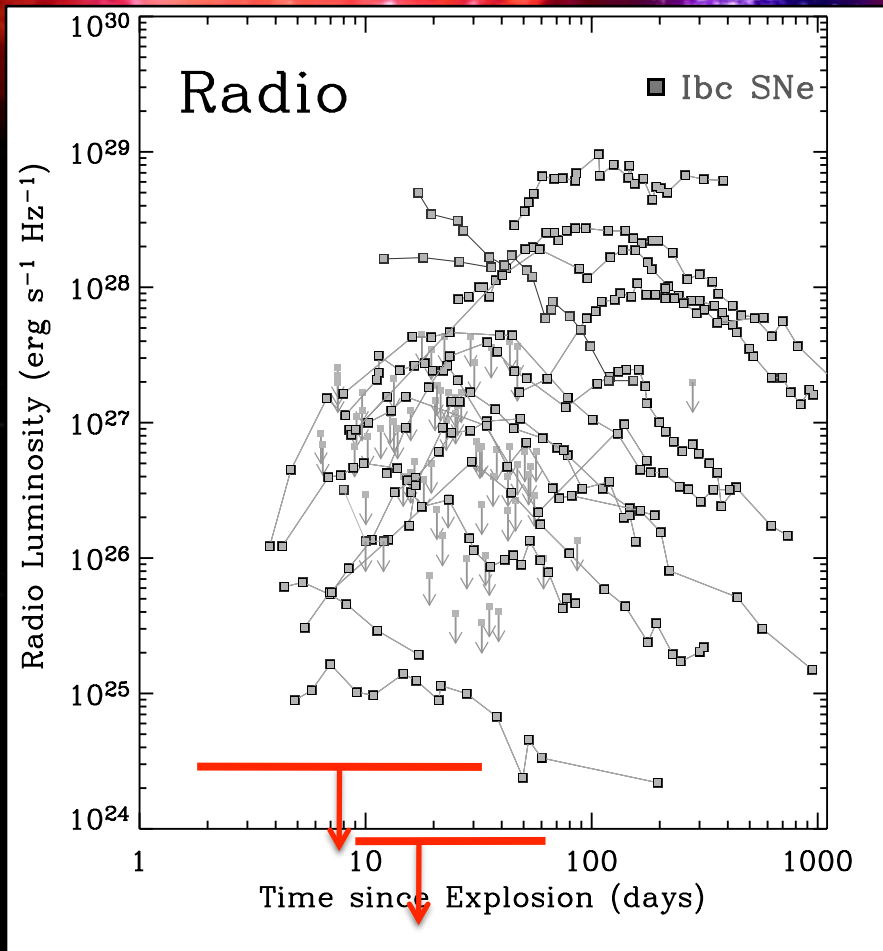
Margutti +14

# STEADY mass loss

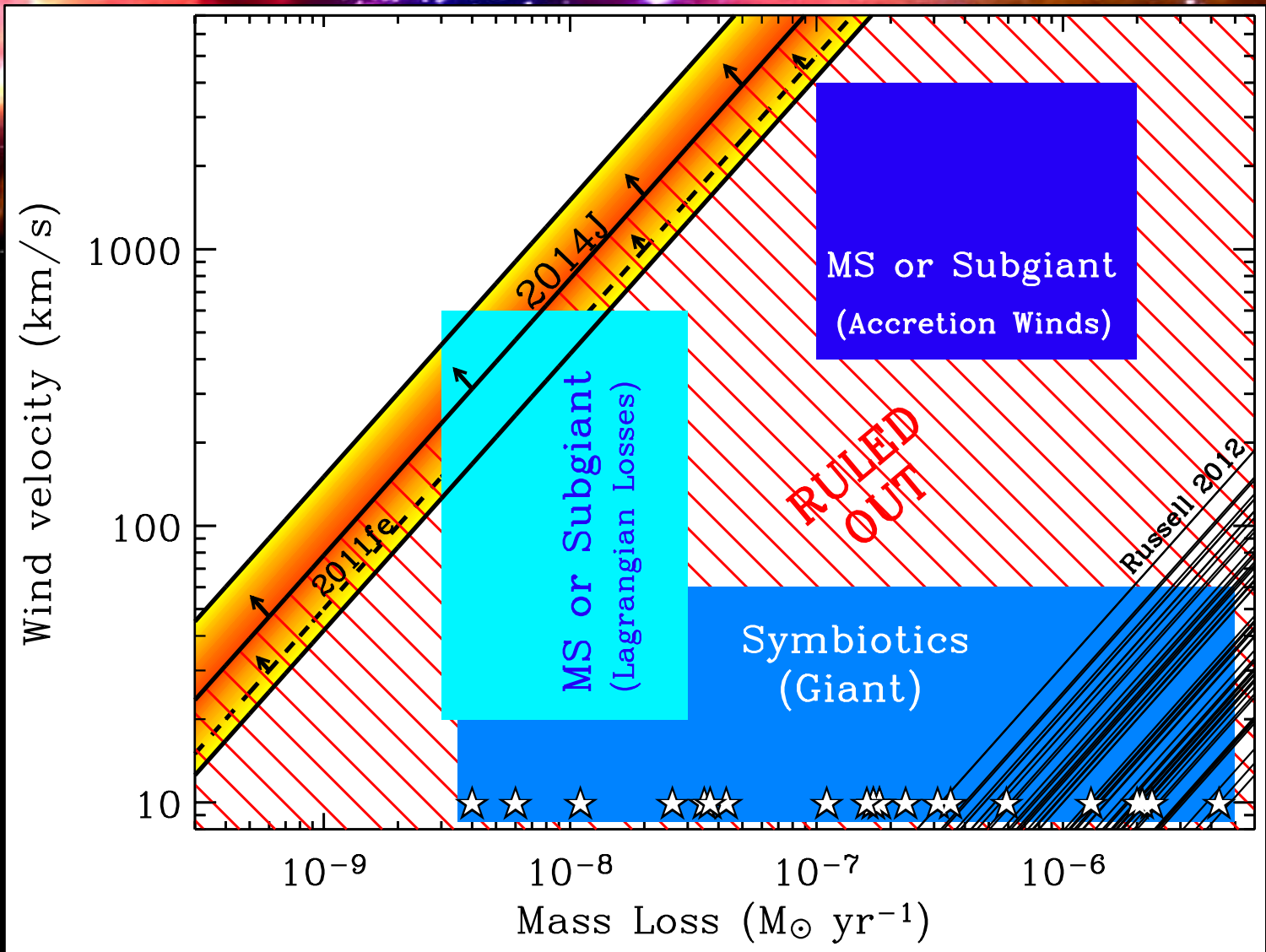


... "It's black cats in dark rooms" ... (S. Firestein)





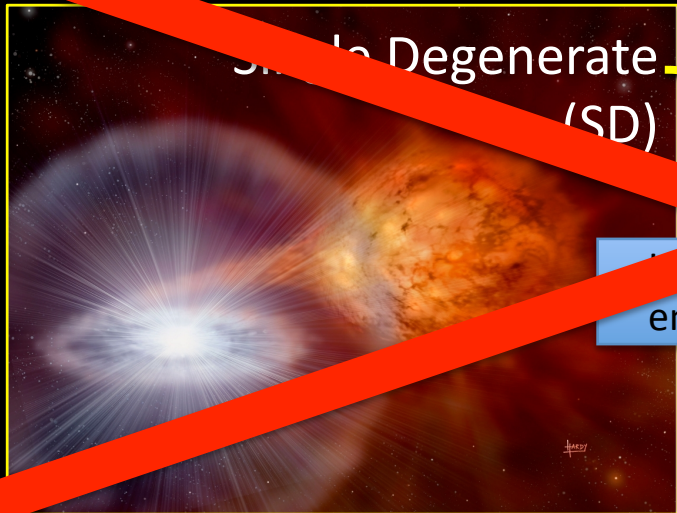
Margutti +12; +14



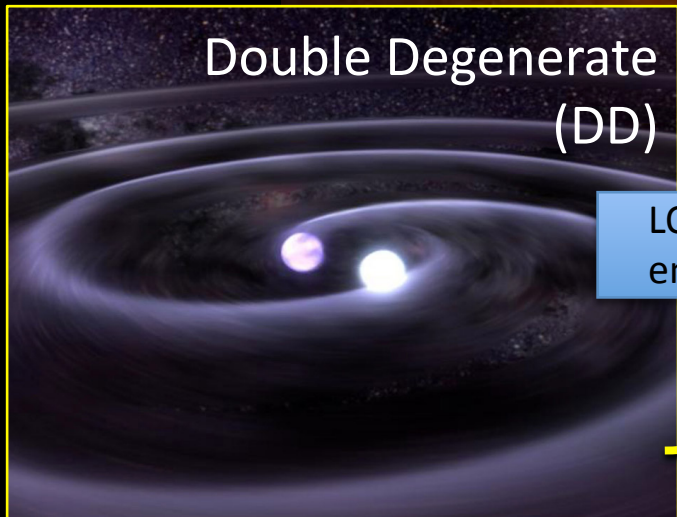
Margutti +14

... "Its black cats in dark rooms... and there may be no cat in the room" (S. Firenstein)

Two possible answers



High density environment

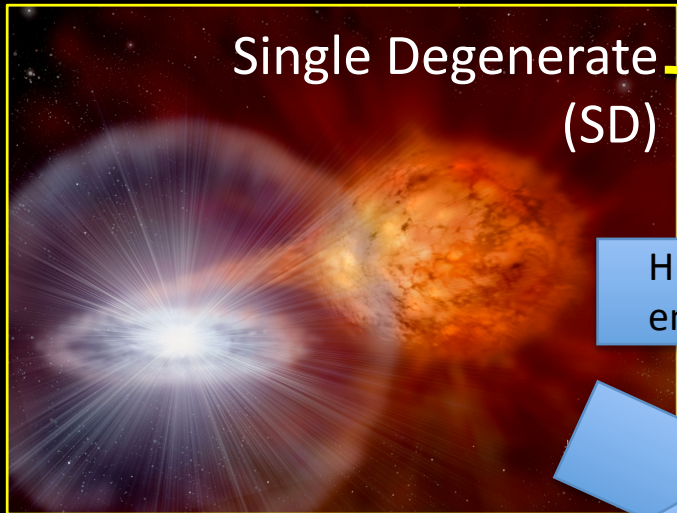


LOW-density environment



“Old” way of thinking

# Two possible answers



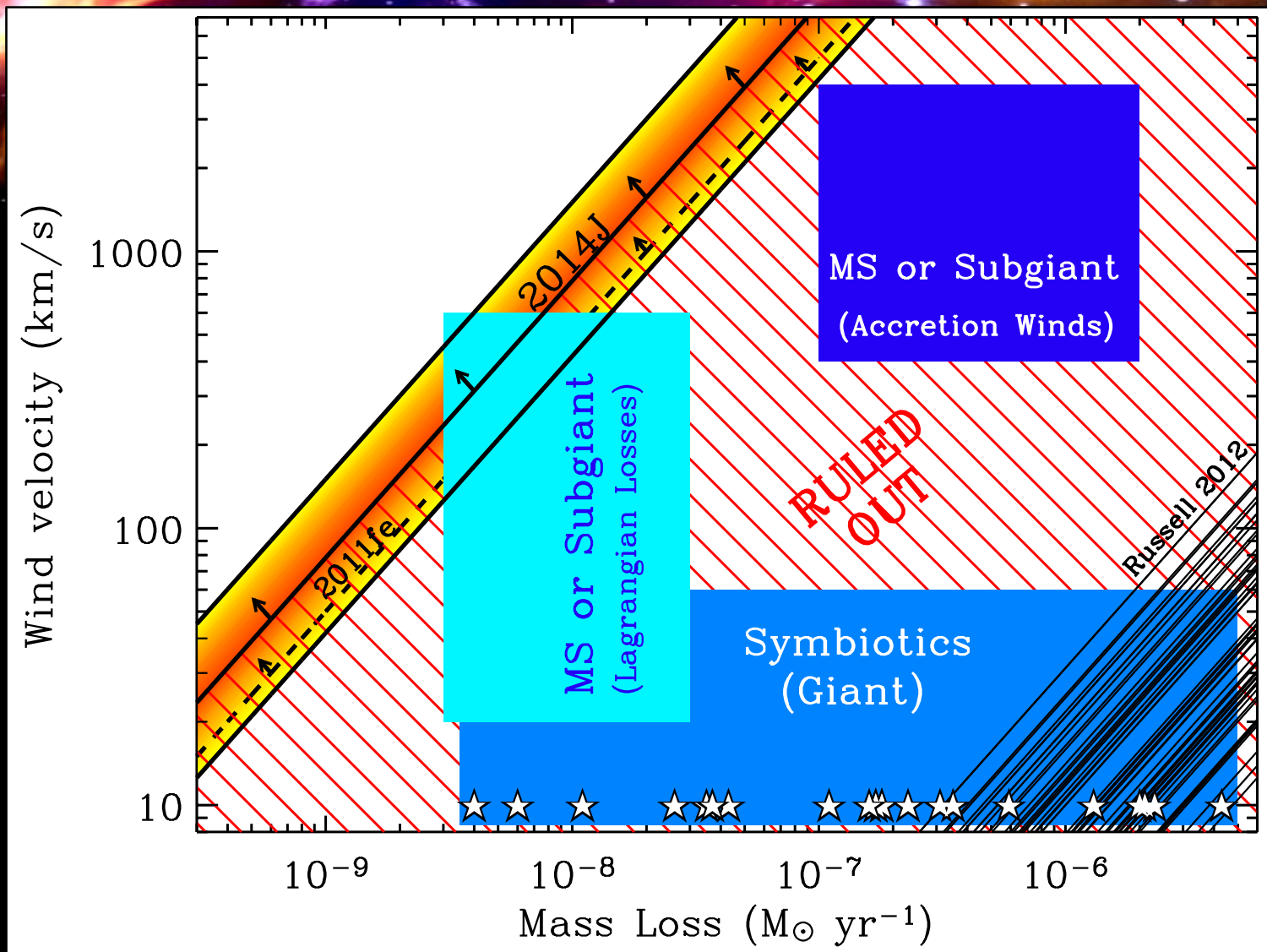
HIGH-density environment



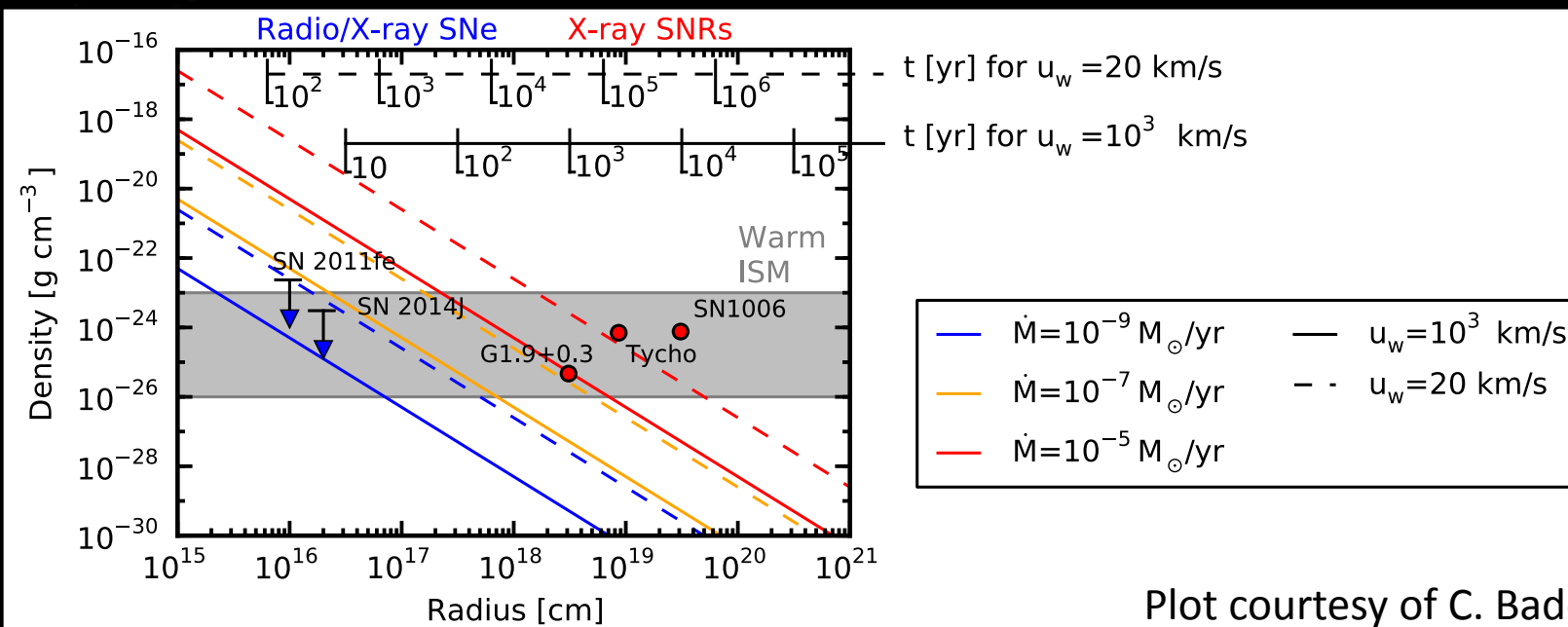
LOW-density environment



“Current” way of thinking

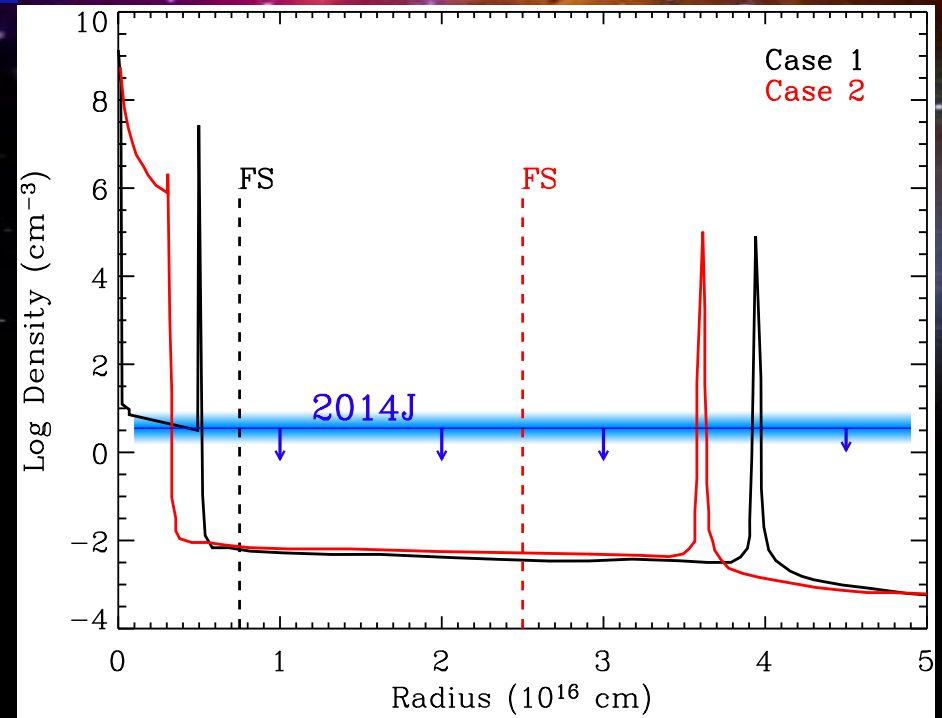
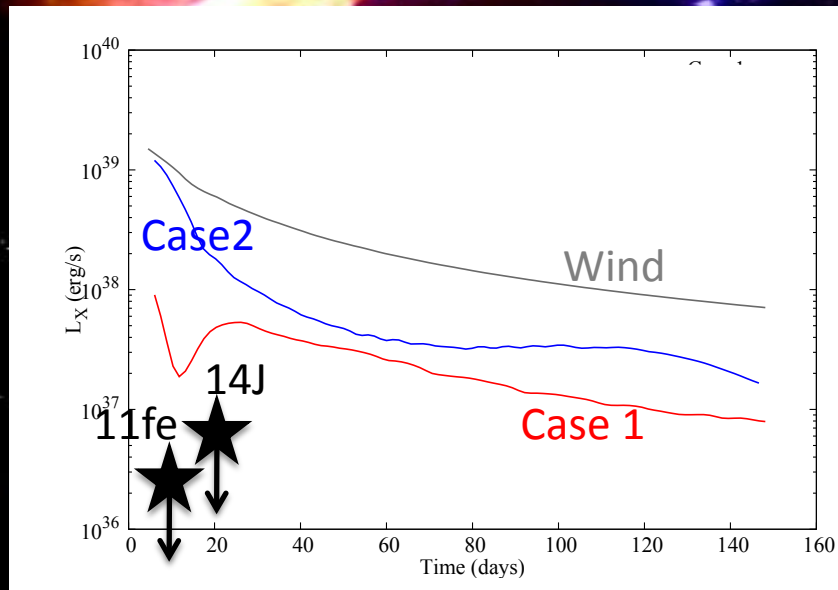


Margutti +14



Plot courtesy of C. Badenes

# (1) Unsteady mass loss

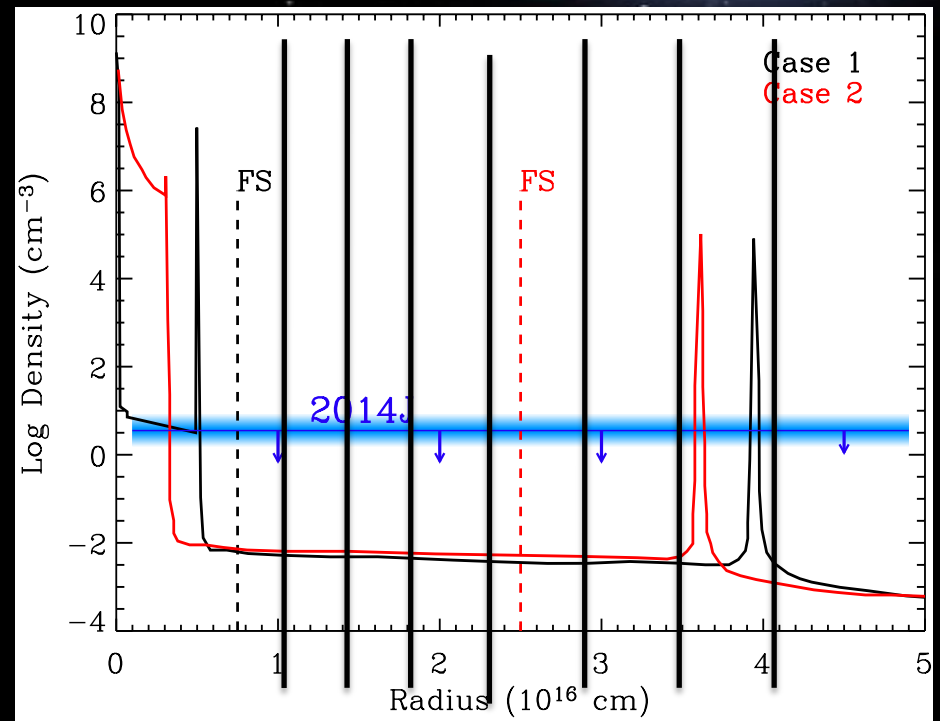
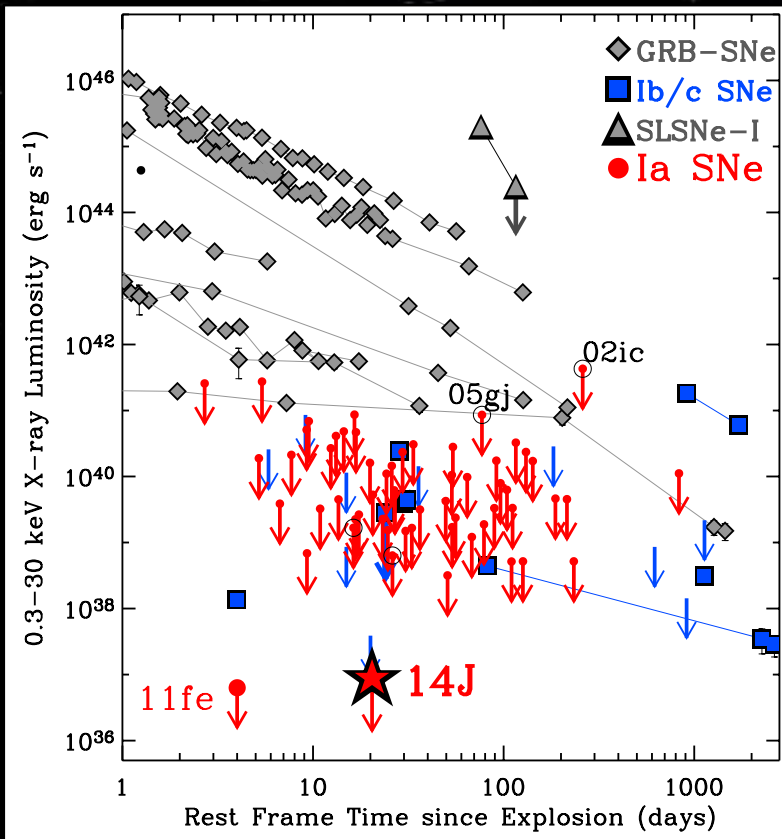


Margutti+14  
Dimitriadis+14

“One never notices what has been done; one can only see what remains to be done”, M. Curie

(1) Unsteady mass loss  $\longrightarrow \rho(R, \Theta)$

(2) Multiple epochs of deep observations

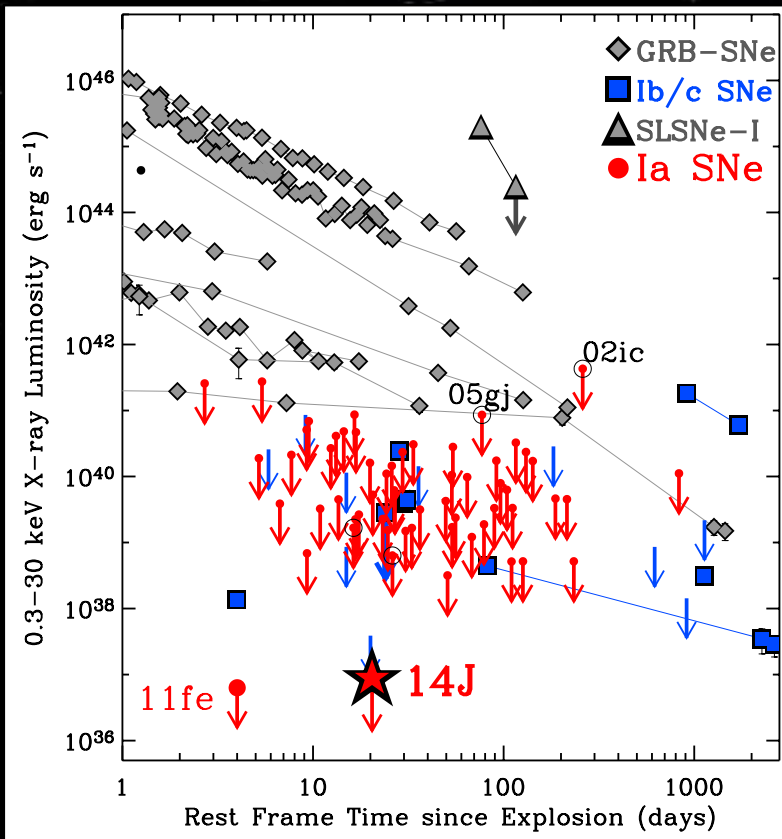


“One never notices what has been done; one can only see what remains to be done”, M. Curie

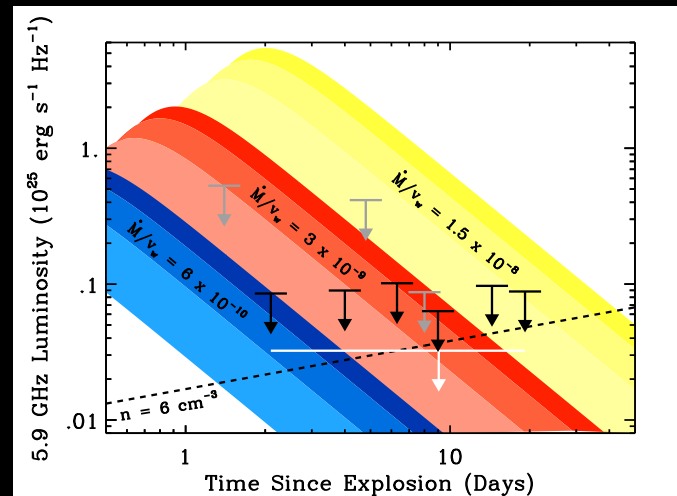


(1) Unsteady mass loss  $\longrightarrow \rho(R, \Theta)$

(2) Multiple epochs of deep observations



(3) Very Late-time radio observations



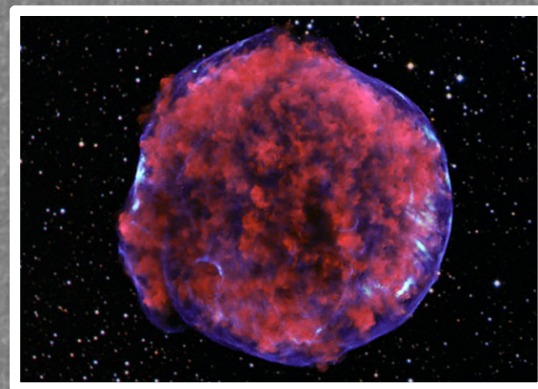
“One never notices what has been done; one can only see what remains to be done”, M. Curie



What is the density of the material in the sub-pc environment around SNe-Ia



$1d16$  cm



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