radiative signatures of relativistic magnetic reconnection

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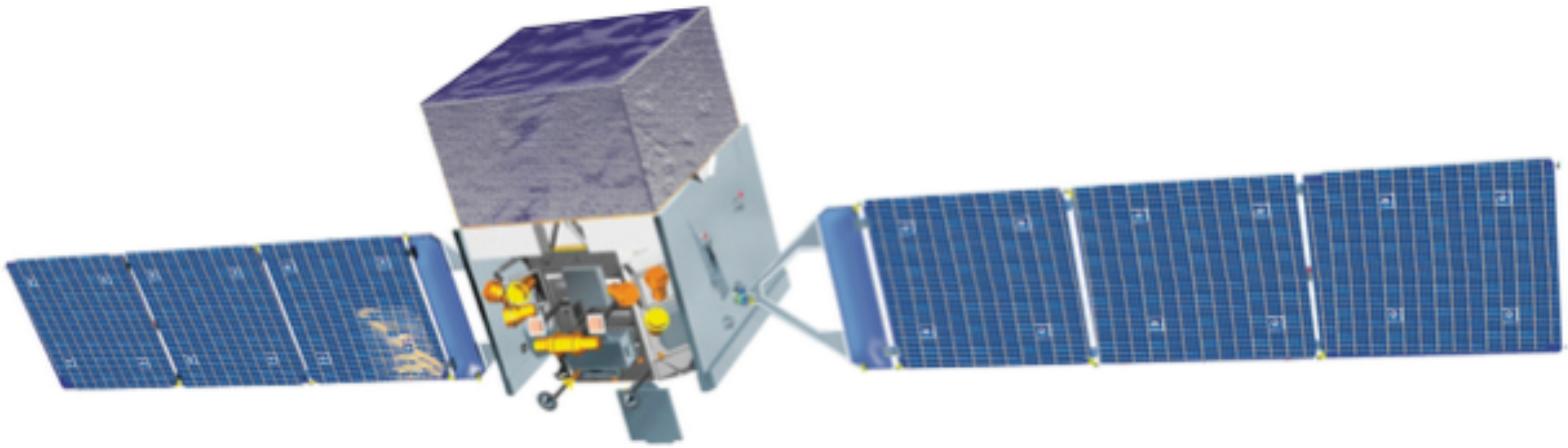
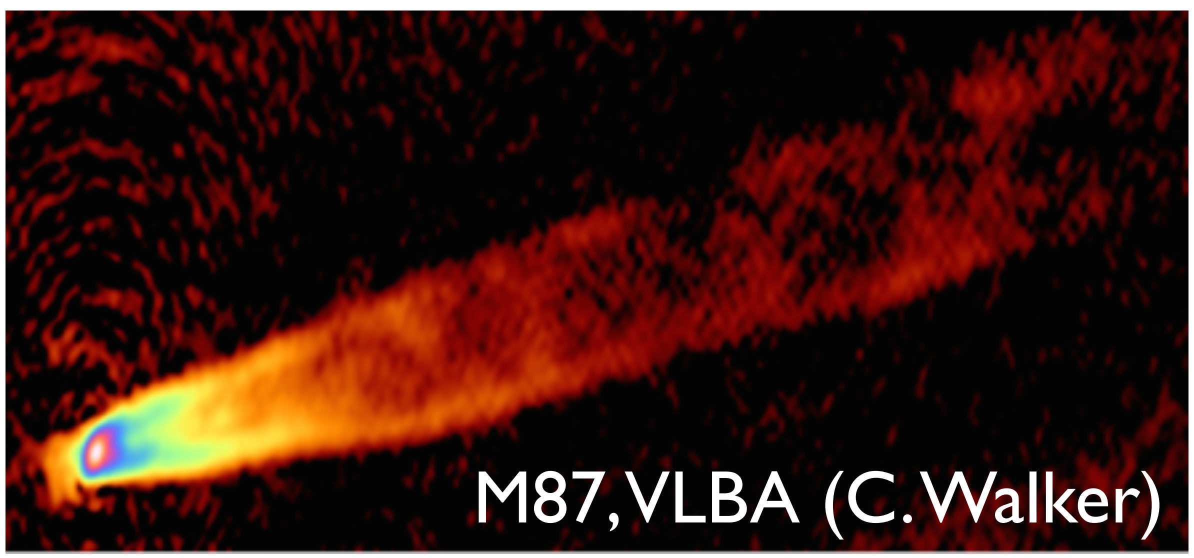
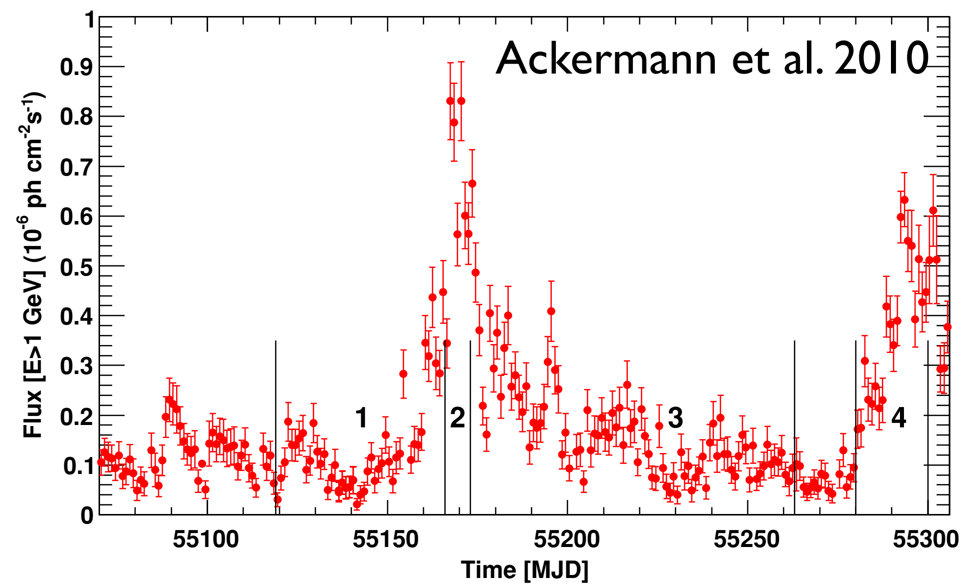
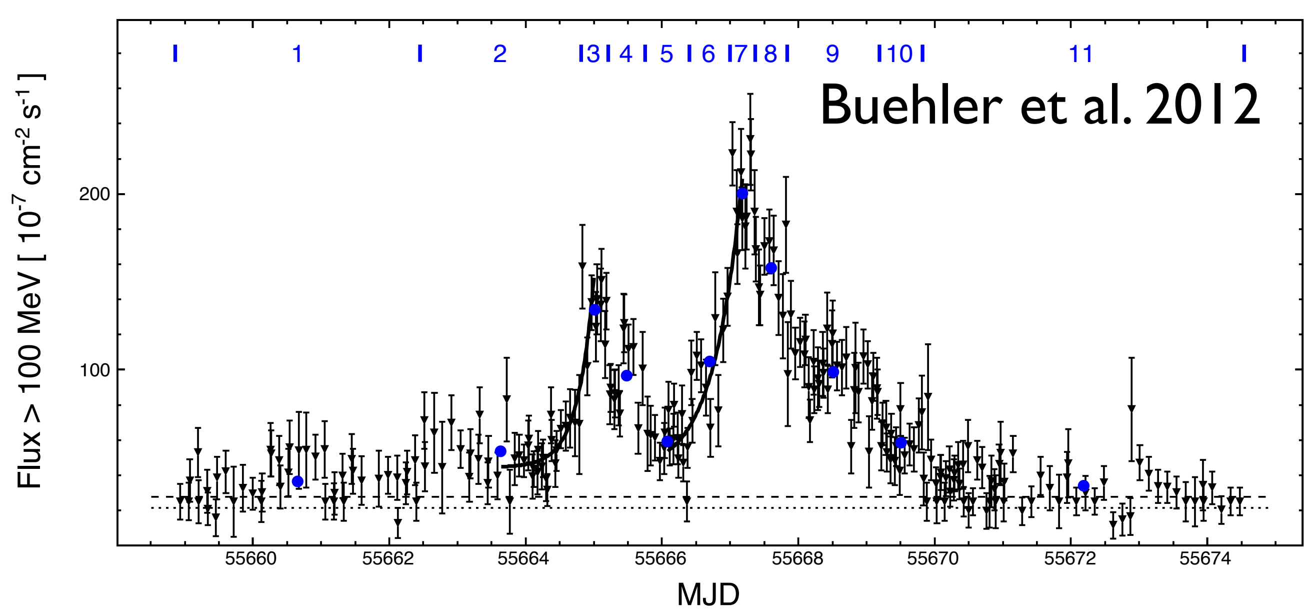
supporting Fermi









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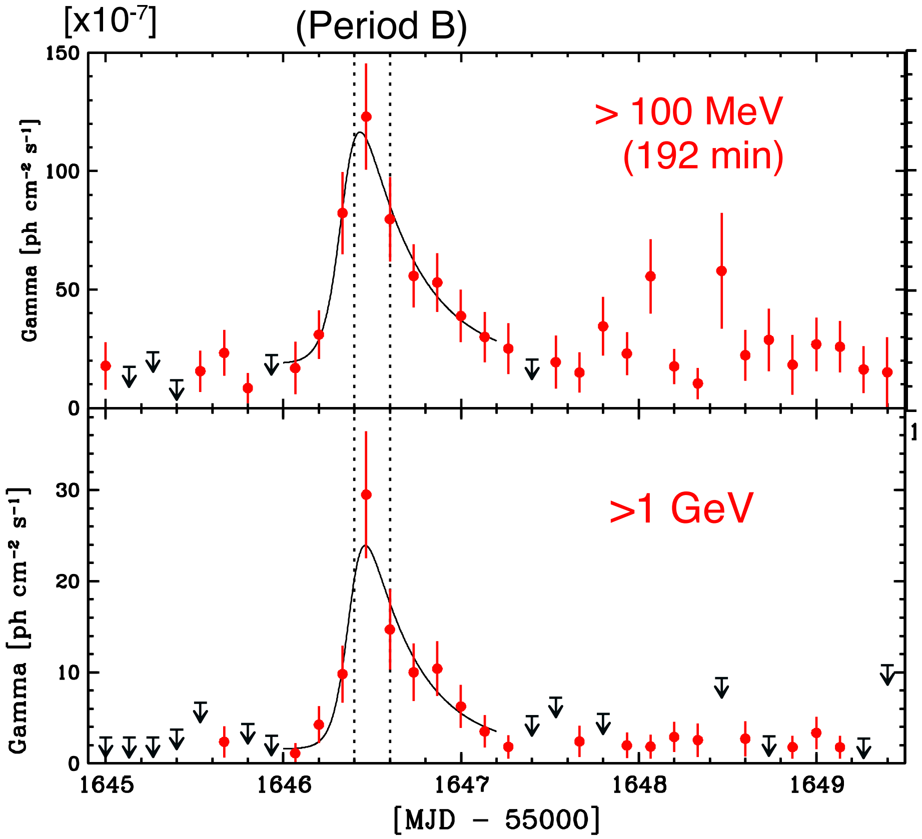
new flare in 3C 279

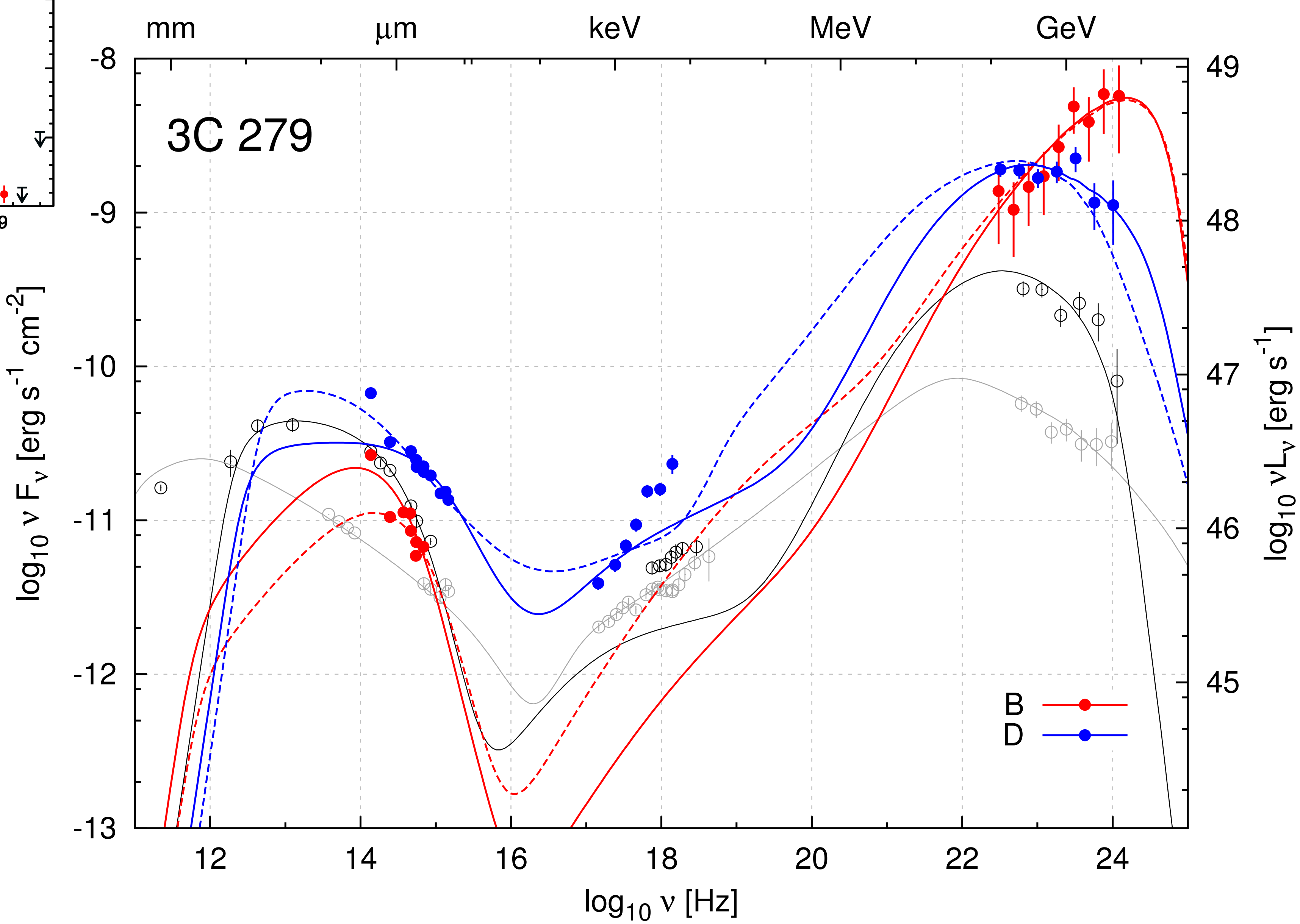


t_{var} = 2h

L_g = 6e48 erg/s

$q = L_g / L_{syn} > 300$

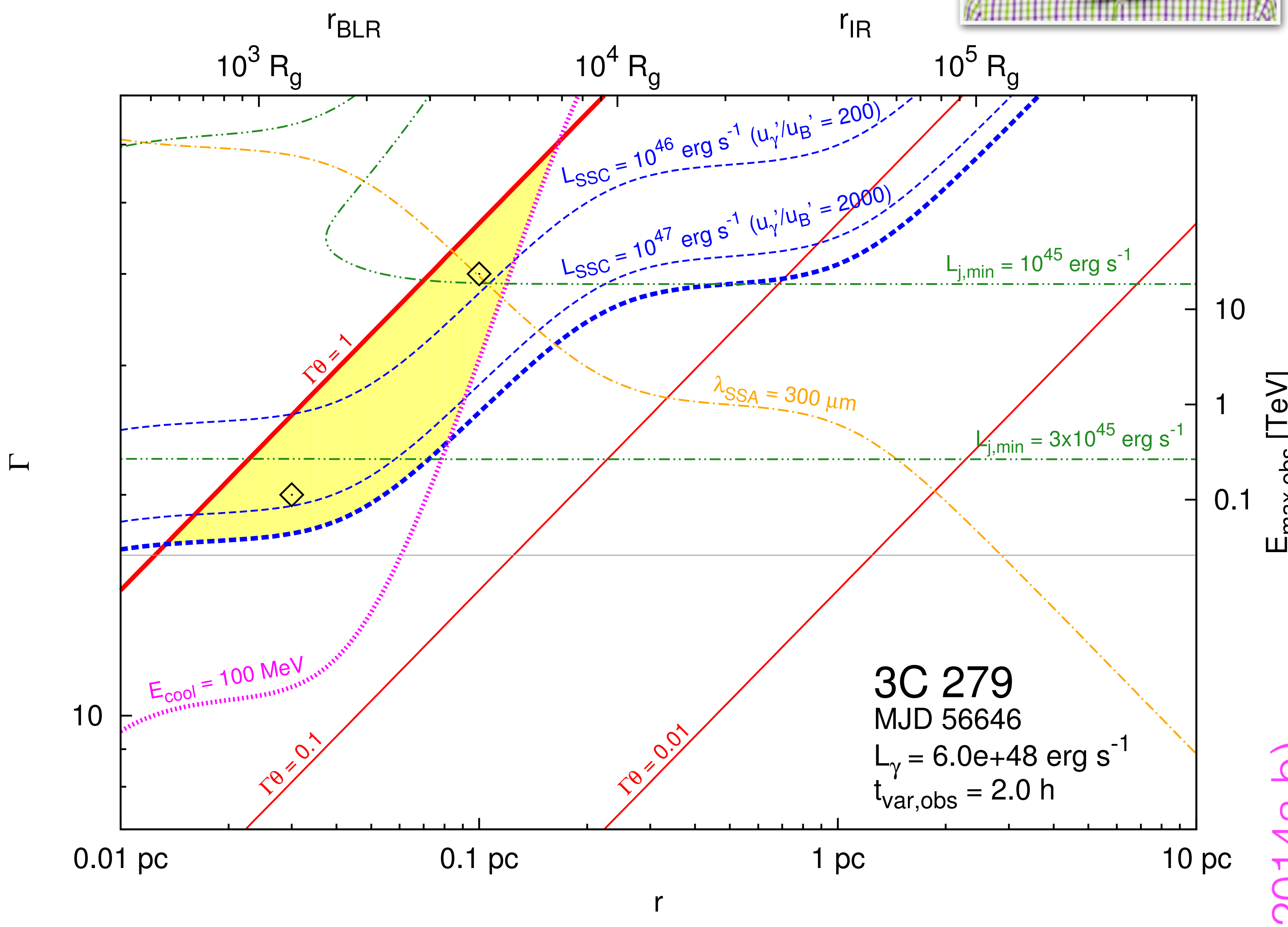
p = 1



Hayashida et al. (2014?)

constraining blazars

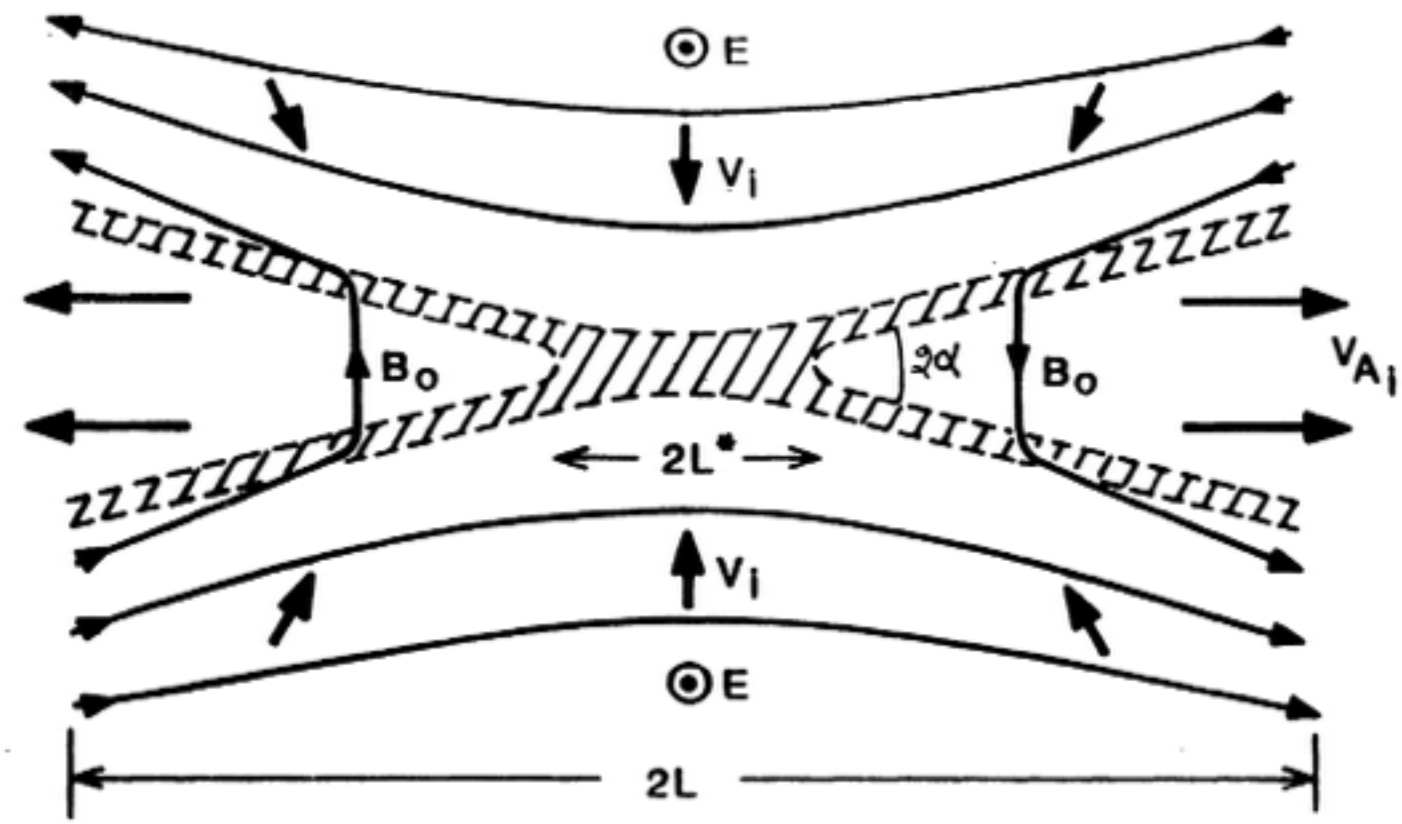
- modeling blazars is ambiguous
- main unknowns:
  distance r
  Lorentz factor Γ
- 3 constraints:
  $\Gamma\theta < 1$
  $L_{SSC} < L_X$
  $E_{cool} < 100$ MeV
- one can estimate:
  jet power L_j
  magnetic field B



high Compton dominance $q \gg 1$
means low magnetization $\sigma \ll 1$

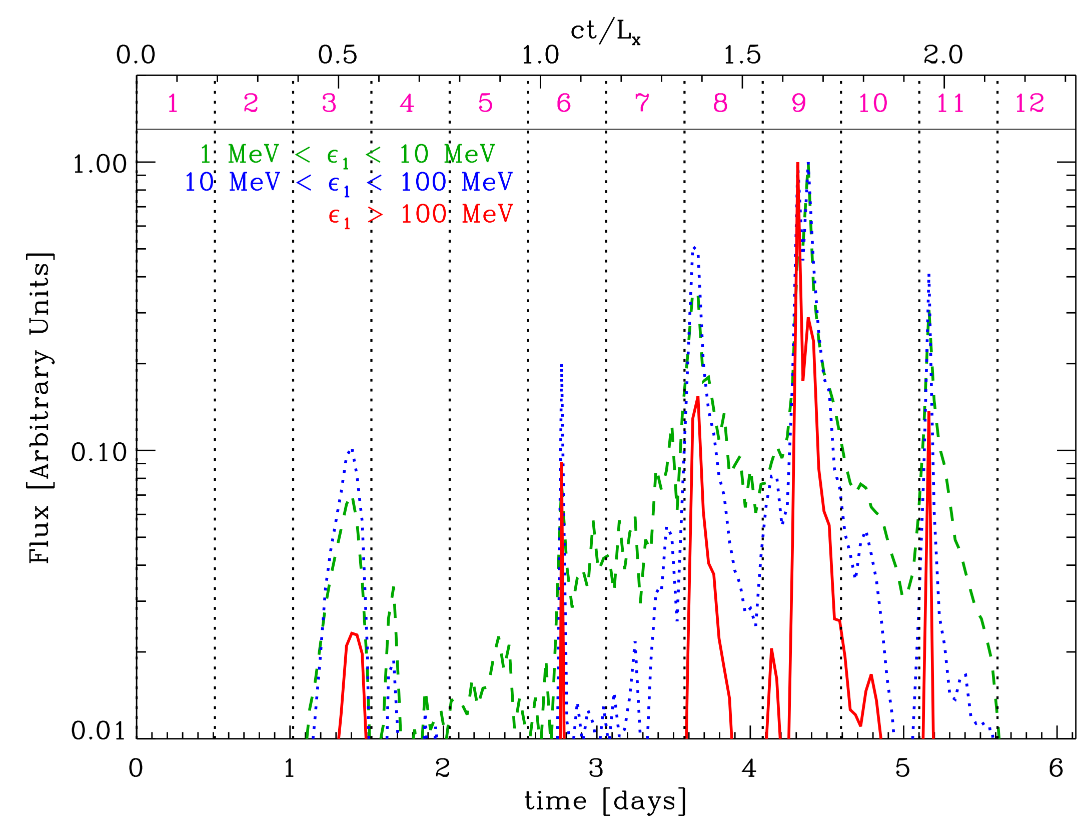
KN et al. (2014a,b)

relativistic reconnection



$t_{obs} \ll L/c$

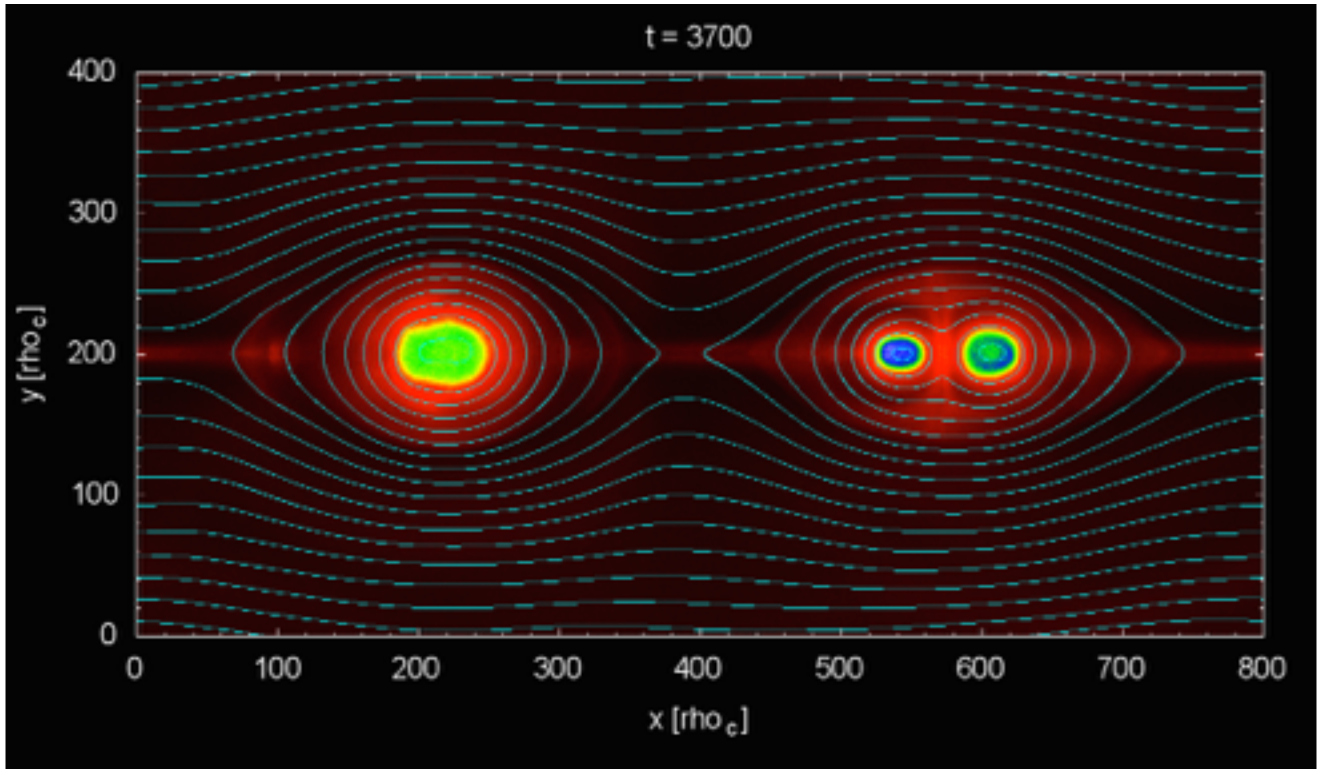
- possible dissipation mechanism in relativistic jets and other environments
- efficient particle accelerator (L. Sironi)
- what are its radiative signatures?



Cerutti et al. (2013)

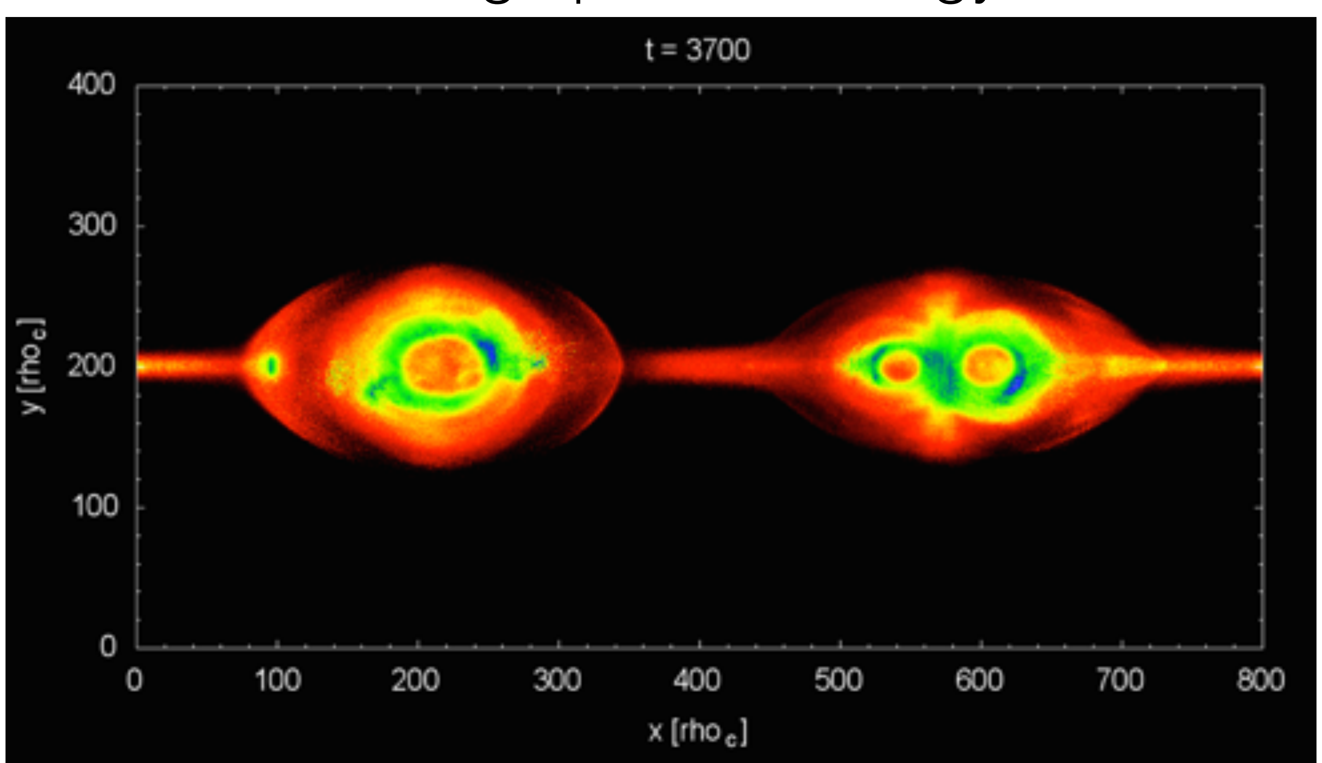
relativistic reconnection

particle density and field lines

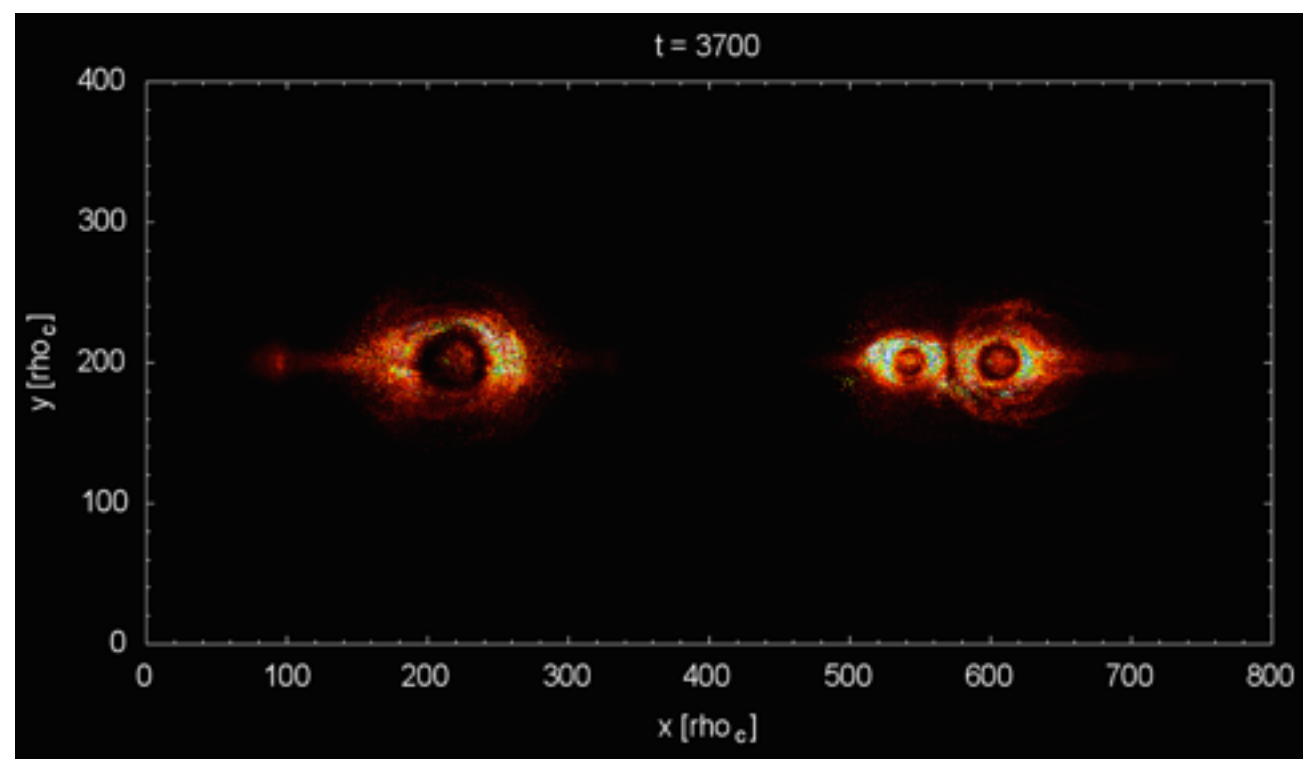


particle-in-cell
code Zeltron
pair plasma
$\sigma = 16$
$kT = m_e c^2$

average particle energy

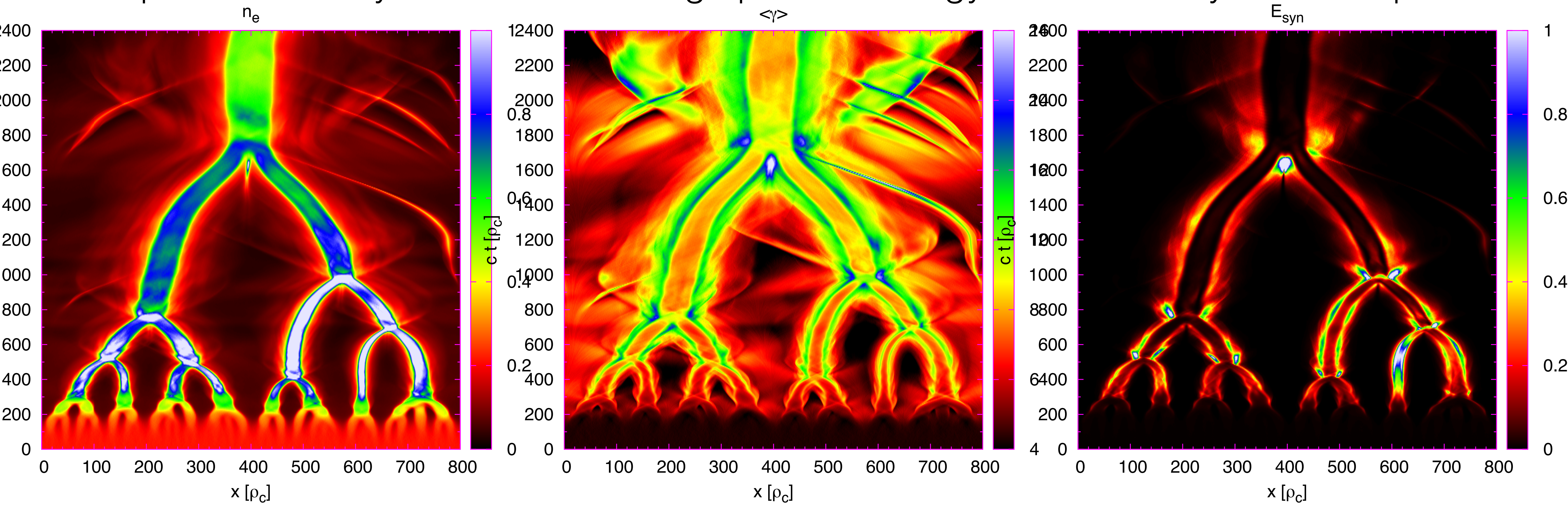


total synchrotron power



spacetime diagrams

particle density | average particle energy | total synchrotron power

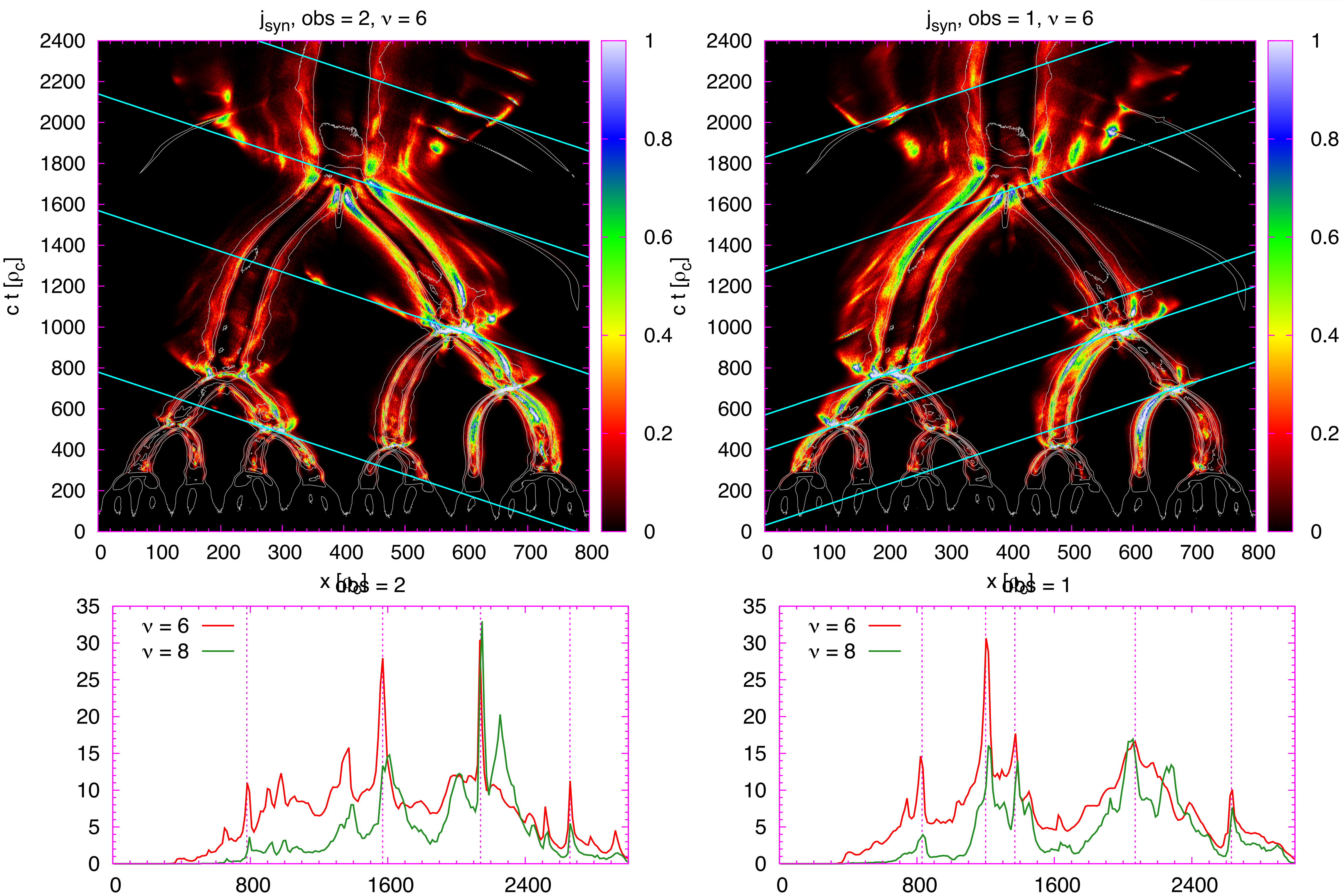


- dense plasmoid cores are cold and dark
- hot plasmoid shells dominate synchrotron emission
- brief radiation enhancement during plasmoid mergers

light curves

observed flares can be located to plasmoid mergers

observer at -x

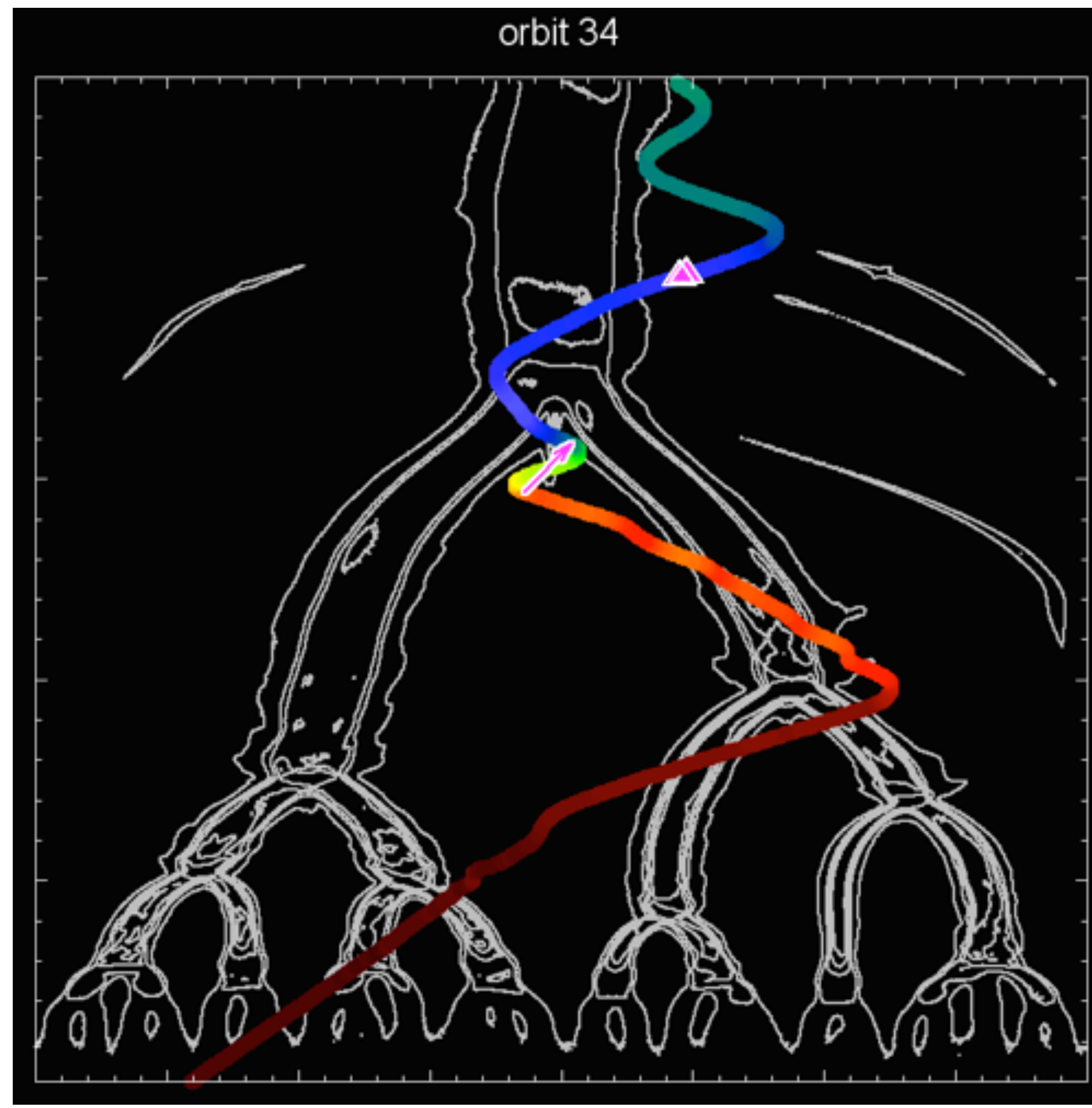


observer at +x

particle acceleration

- complete sample of tracked particles with $\gamma_{max} > 20$
- main acceleration phase: shortest time when $\Delta\gamma = (\gamma_{max}-\gamma_{min})/2$
- connection with emission towards ±x

particle histories

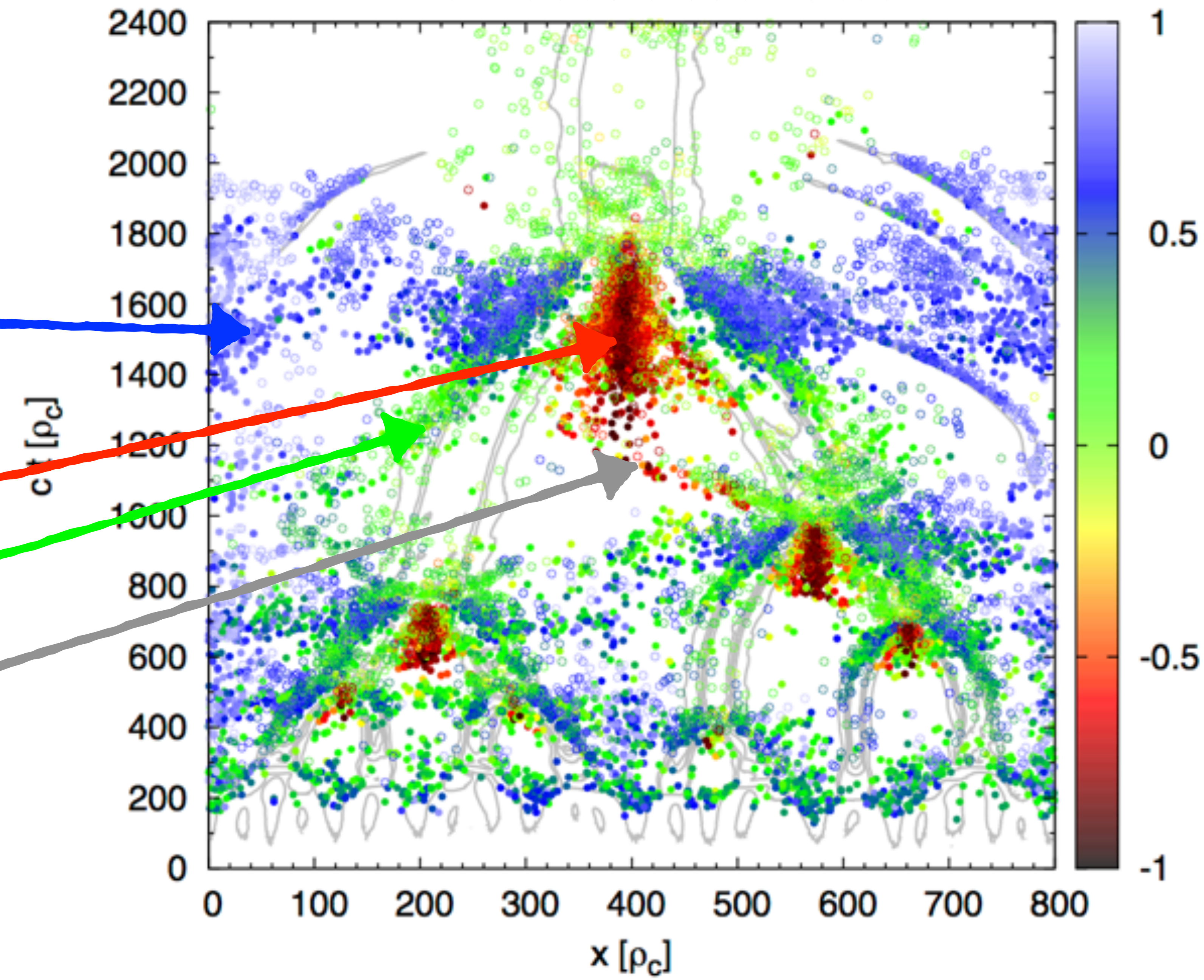


color — particle energy
arrows — main acceleration phases
triangles — emission along ±x

particle acceleration

- acceleration sites identified by **z drift**
- magnetic X-points
- merging plasmoids
- plasmoids
- other

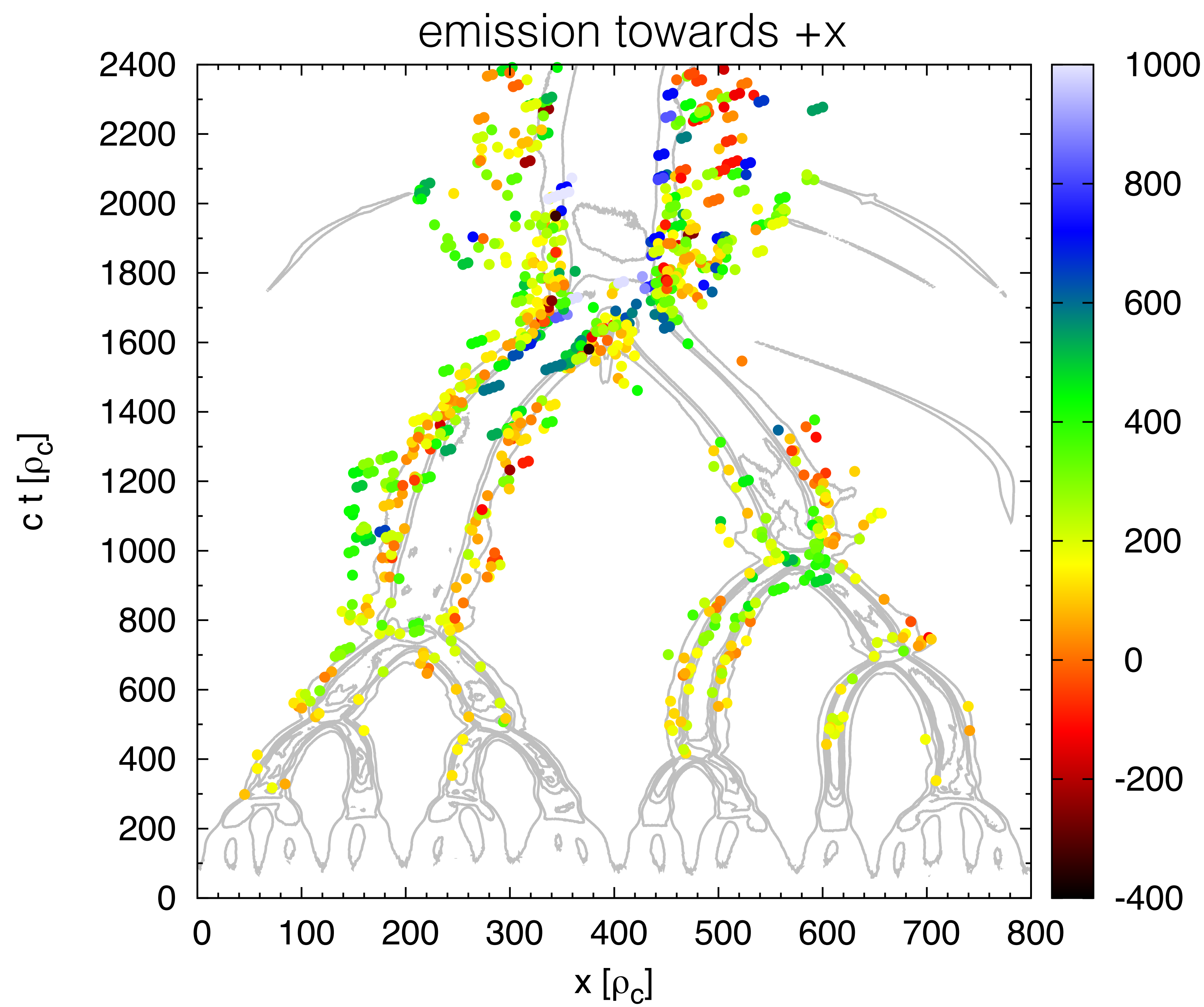
main acceleration sites



color — mean z velocity
filled/open — acceleration start/end

connection to radiation

- position of particles emitting towards +x
- high-energy emission produced mainly by particles accelerated at magnetic X-points and plasmoids (green/blue)



color — z value

summary

- extreme gamma-ray flares may be produced by relativistic magnetic reconnection
- synchrotron radiation can be calculated self-consistently from kinetic simulations of reconnection
- radiation is produced mainly along hot plasmoid shells and enhanced (flaring) during mergers
- multiple sites of particle acceleration, not all contribute to high-energy flares