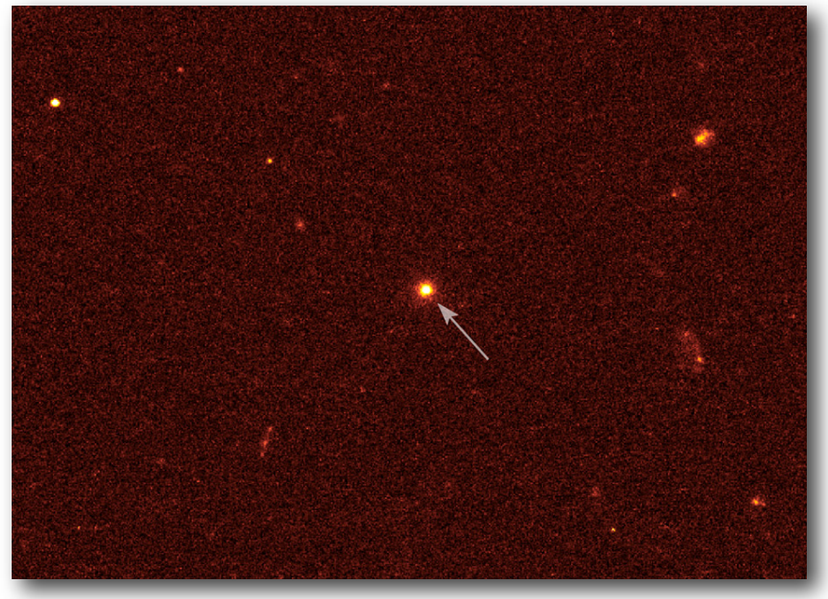
GRB 110328A / Swift 1644+57

- Over 46 Telegrams & Circulars
- Δt~months accretion onto SMBH (!)
- 5 GHz detection 2 days after Swift trigger (EVLA)
- 1.7 mJy @ 8.4 GHz (VLBI)
- 15 mJy @ 98 GHz (CARMA)

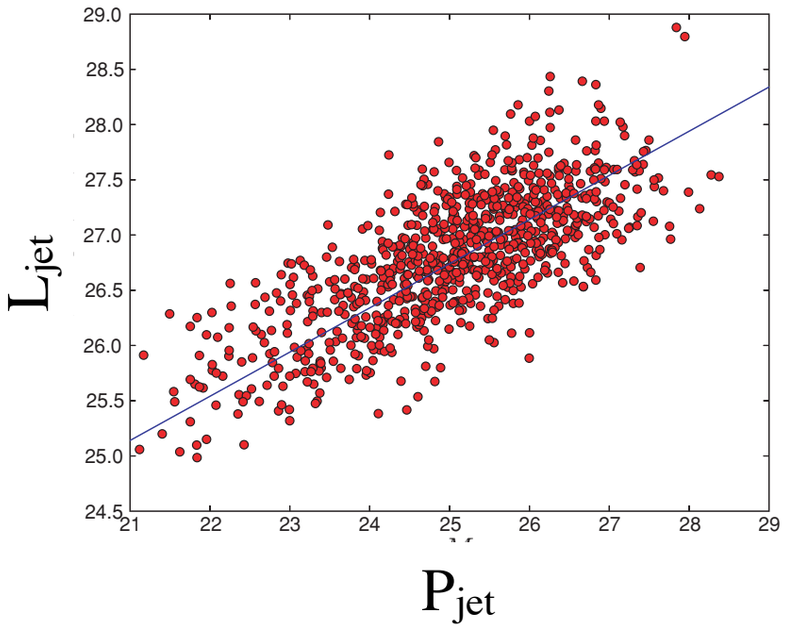


credit: HST NASA

Model: synchrotron emission from jet core

$$L_\nu = C_{\rm eq}\delta^2 \int_{z_{\rm ssa}}^{\infty} {\rm d}z\, z^2 \epsilon_{\rm syn}(z, \nu/\delta) \propto (q_j L_d)^{17/12}$$ (Falcke & Biermann 1995)

- Normalization, C_{eq}, given by observations (Körding et al. 2008)



- Accretion given by fallback: $\dot{M} \propto t^{-5/3}$

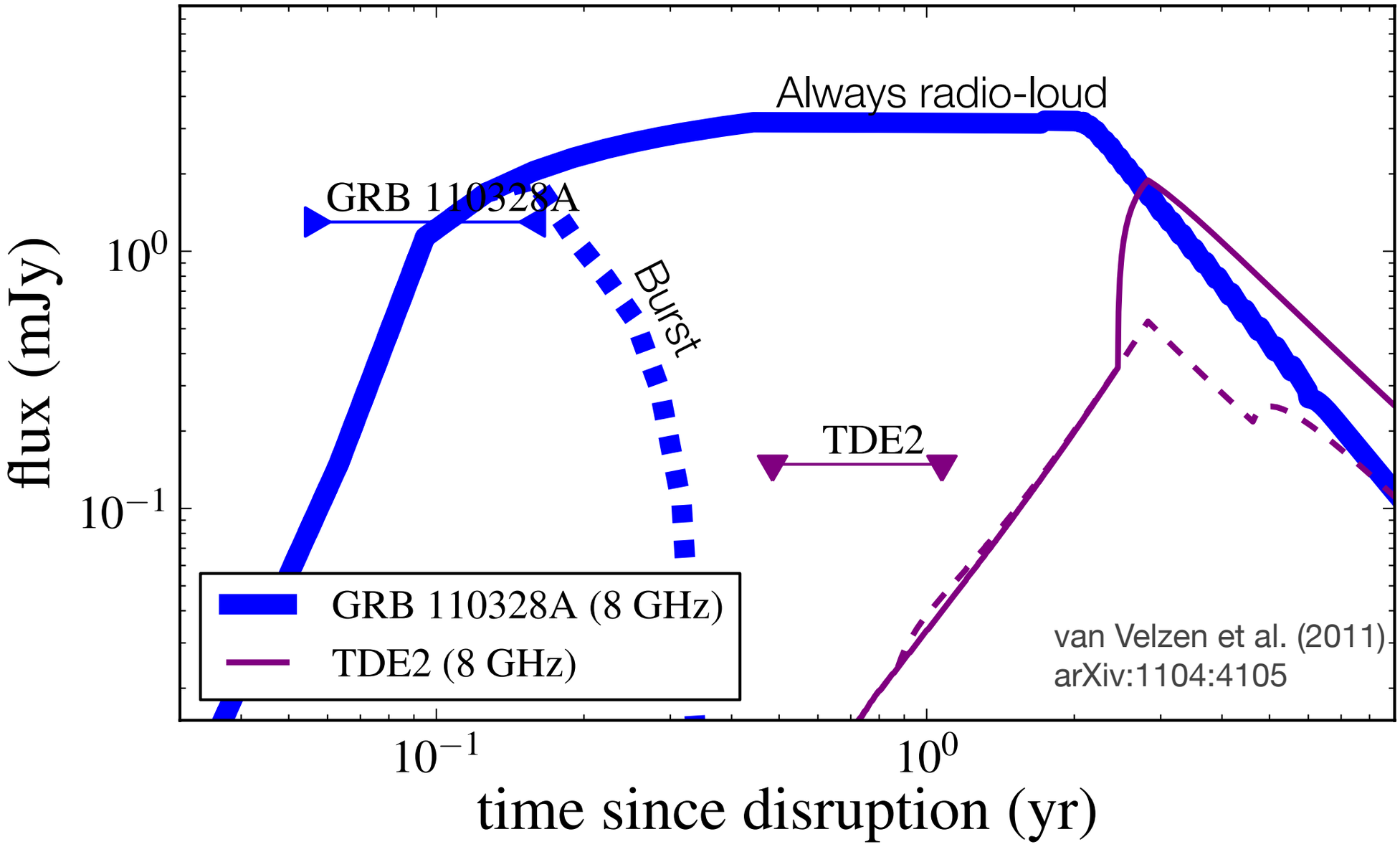
  (Rees 1988)

$$q_j = \begin{cases} 0.2 & \text{all times} \quad (a) \\ 2\times10^{-3} & \dot{M}(t) > 2\%\dot{M}_{\rm Edd} \quad (b) \\ 0.2 & t < t_{\rm fallback} \quad (c) \end{cases}$$

- Complementary to Giannios & Metzger (2011)

My “Fit”

$$M_{\rm BH} = 10^6\,M_\odot, \quad i_{\rm obs} = 1^\circ, \quad \Gamma_j = 5$$



Problems and opportunities

$$z_{\rm ssa}(\nu = 8\,{\rm GHz}) \approx 0.4\,{\rm pc} > 1.3\,{\rm yr}$$

- Radio emission too soon after disruption?
  - Jet launching time
  - Site of γ-ray and radio emission
  - Jet propagation without central engine

- Soon we will have a sample of 1000 1/yr (LSST)

Back-up I

$$L_\nu(t) = C_{\rm eq}\delta^2 \int_0^{z_{\rm dec}} {\rm d}z\, z^2 \epsilon_{\rm syn}(t_r, z, \nu/\delta)\Theta_{\rm ssa}(t_r, z, \nu/\delta)$$

$$z_{\rm dec} \sim 10\,{\rm pc}\left(\frac{q_j}{0.2}\frac{L_d}{10^{45}\,{\rm erg\,s^{-1}}}\right)^{1/3}$$

$$z_{\rm ssa} = 1\,{\rm pc}\, f\frac{\rm GHz}{\nu/\delta}\left(\frac{q_j(t)}{0.2}\frac{L_d(t)}{10^{45}\,{\rm erg\,s^{-1}}}\right)^{\frac{2}{3}}\left(\frac{\beta_j}{\sin(\frac{i}{30^\circ})}\frac{5}{\gamma_j}\right)^{\frac{1}{3}}$$

Backup II

$$N(F_{\rm lim},\nu) \quad = \quad (4\pi)^{-1}\dot{N}_{\rm tde}\int {\rm d}\Omega_{\rm obs}\int {\rm d}z\, 4\pi d_C^2(z)\,\times$$

$$\int {\rm d}M_{\rm BH}\ \phi_{\rm BH}\tau_{\rm eff}(L_\nu, d_L(z), F_{\rm lim})\ .$$