

# SMA OBSERVATIONS OF GAMMA RAY BURSTS



B. Ashley Zauderer

Edo Berger (CfA)  
Dale Frail (NRAO)  
Shri Kulkarni (Caltech)  
Glen Petitpas (CfA)  
Nimesh Patel (CfA)

SMA Community Day  
July 11, 2011

VELA

4



RESEARCH  
MOONLETS

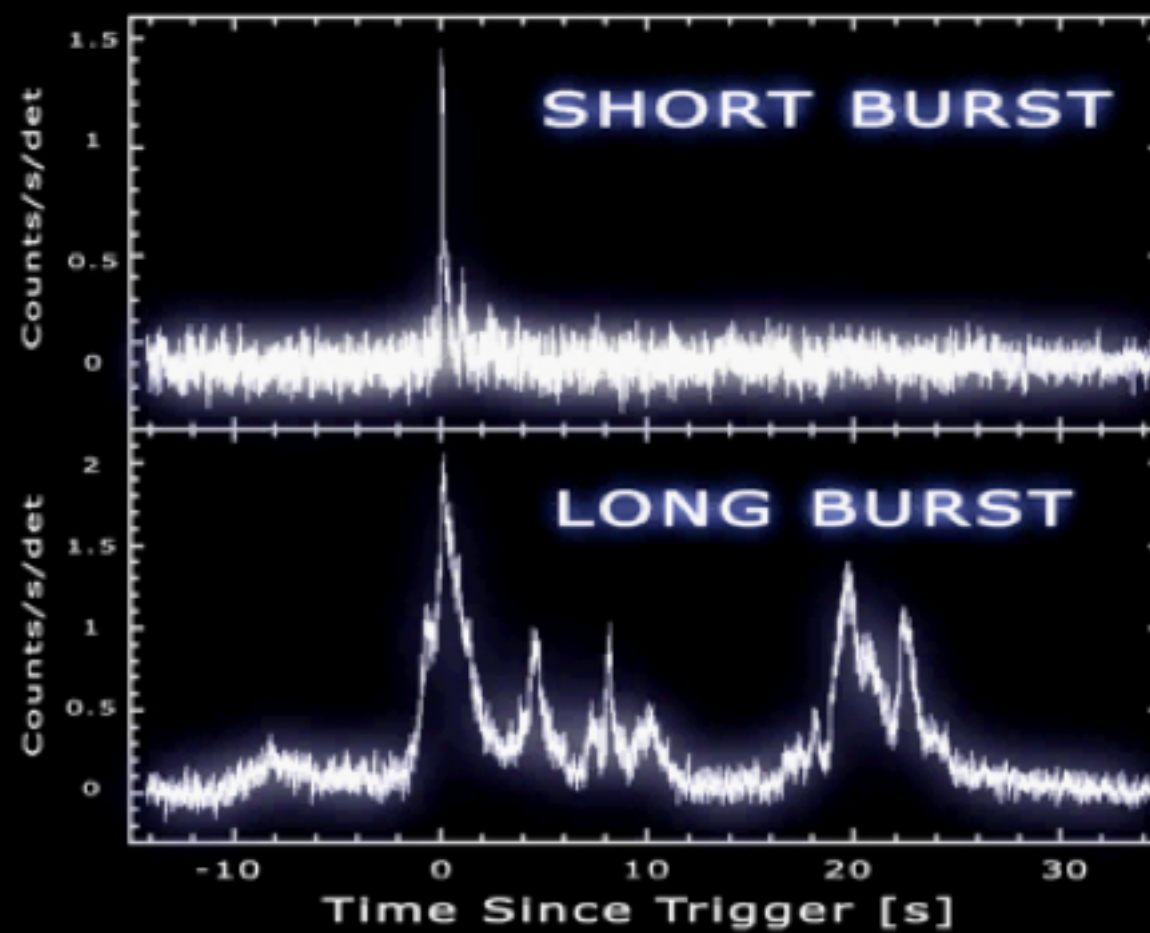


NUCLEAR  
DETECTION  
SATELLITES

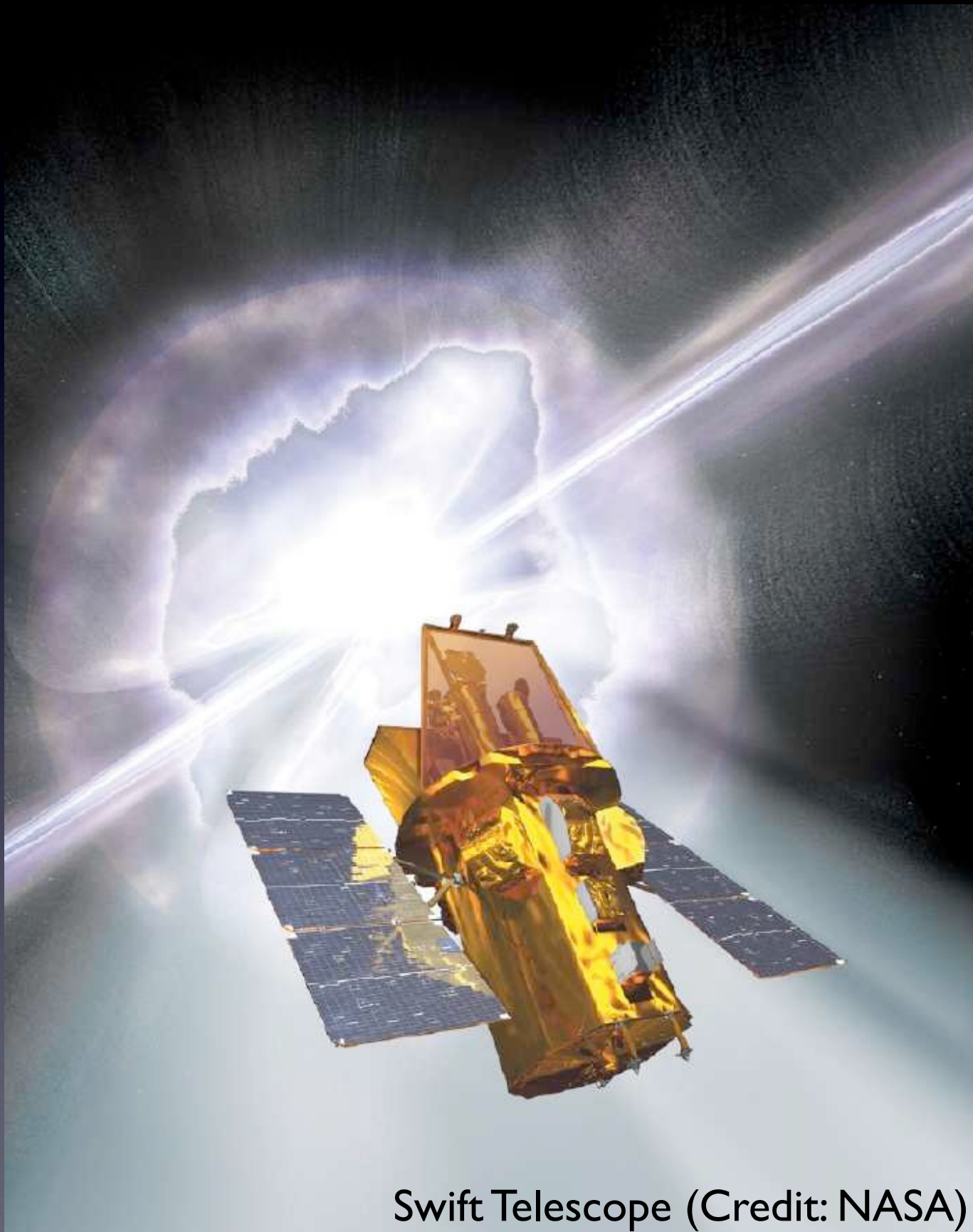
On Patrol.....  
Protection from  
clandestine atomic  
blasts in space

**CLASSIFIED**

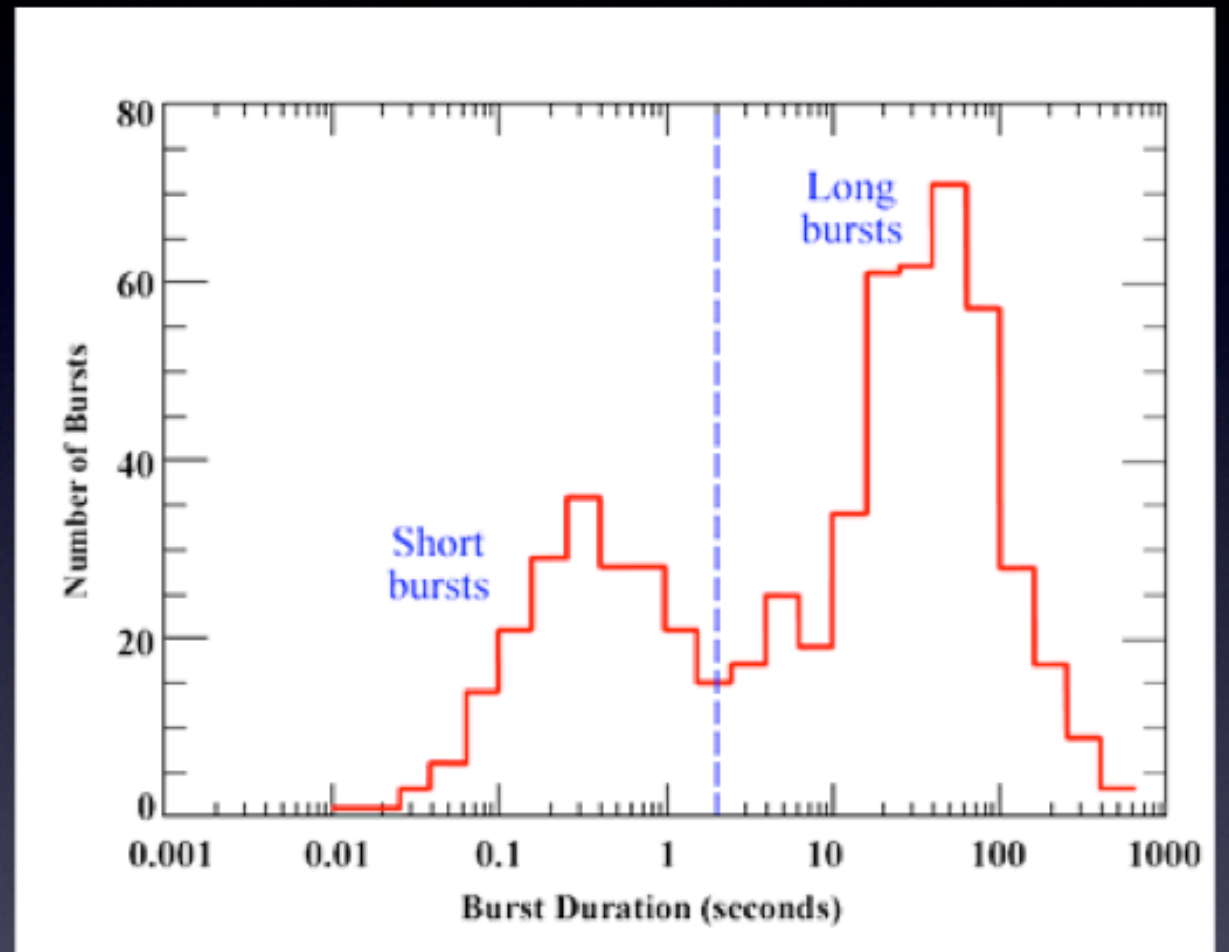
- Intense short bursts of energy
- Approx. 3 per day, 2 per week detected
- Energy release: Isotropic:  $10^{52} - 10^{54}$  ergs / Actual:  $10^{51} - 10^{52}$  ergs  
(typical beaming  $10^\circ$ )
- outflow highly relativistic:  $\Gamma = 100 - 1000$
- Prompt emission: .01 - 100 s / Afterglow - longer timescales



Swift Telescope (Credit: NASA)

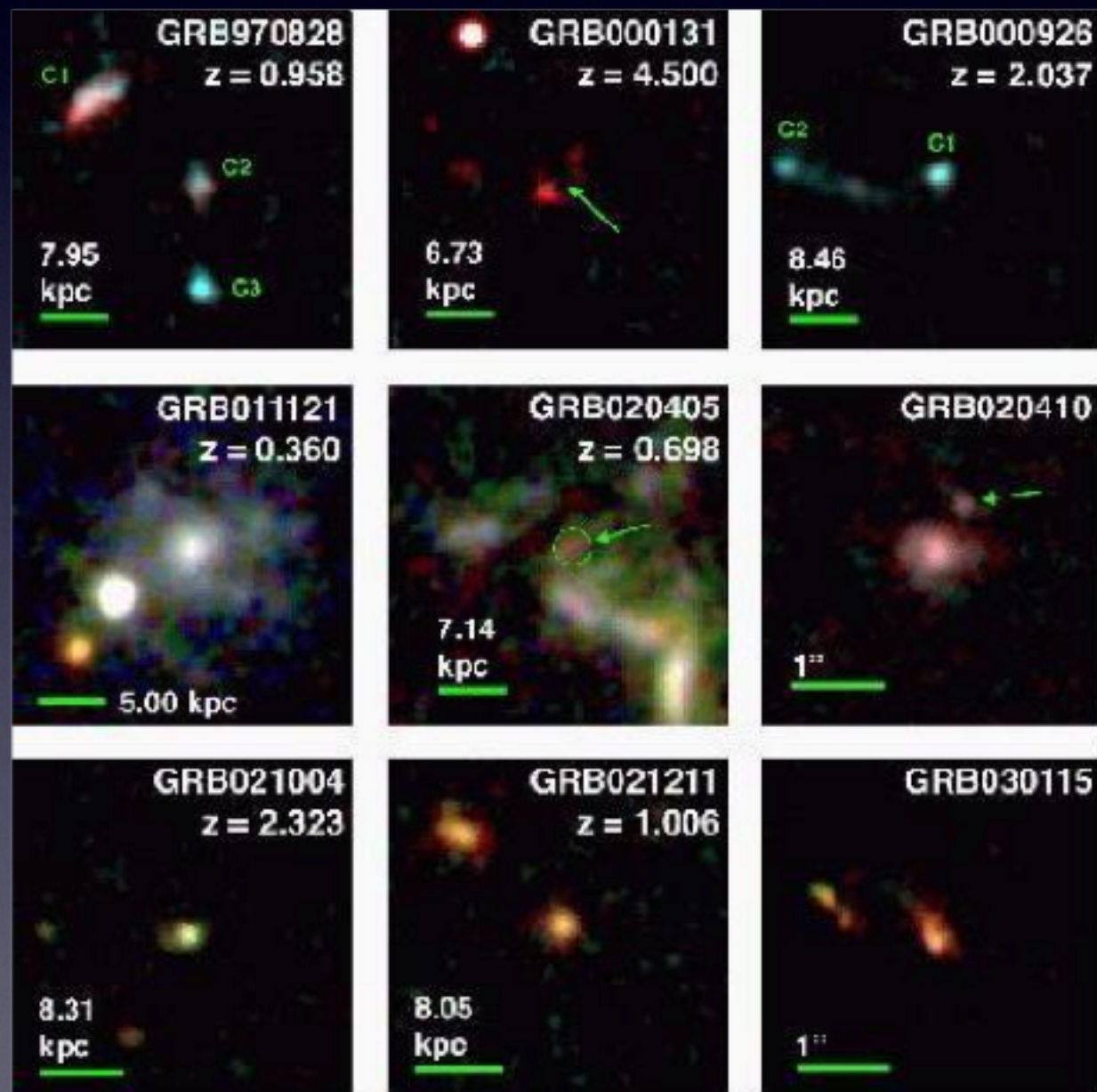


Swift Telescope (Credit: NASA)



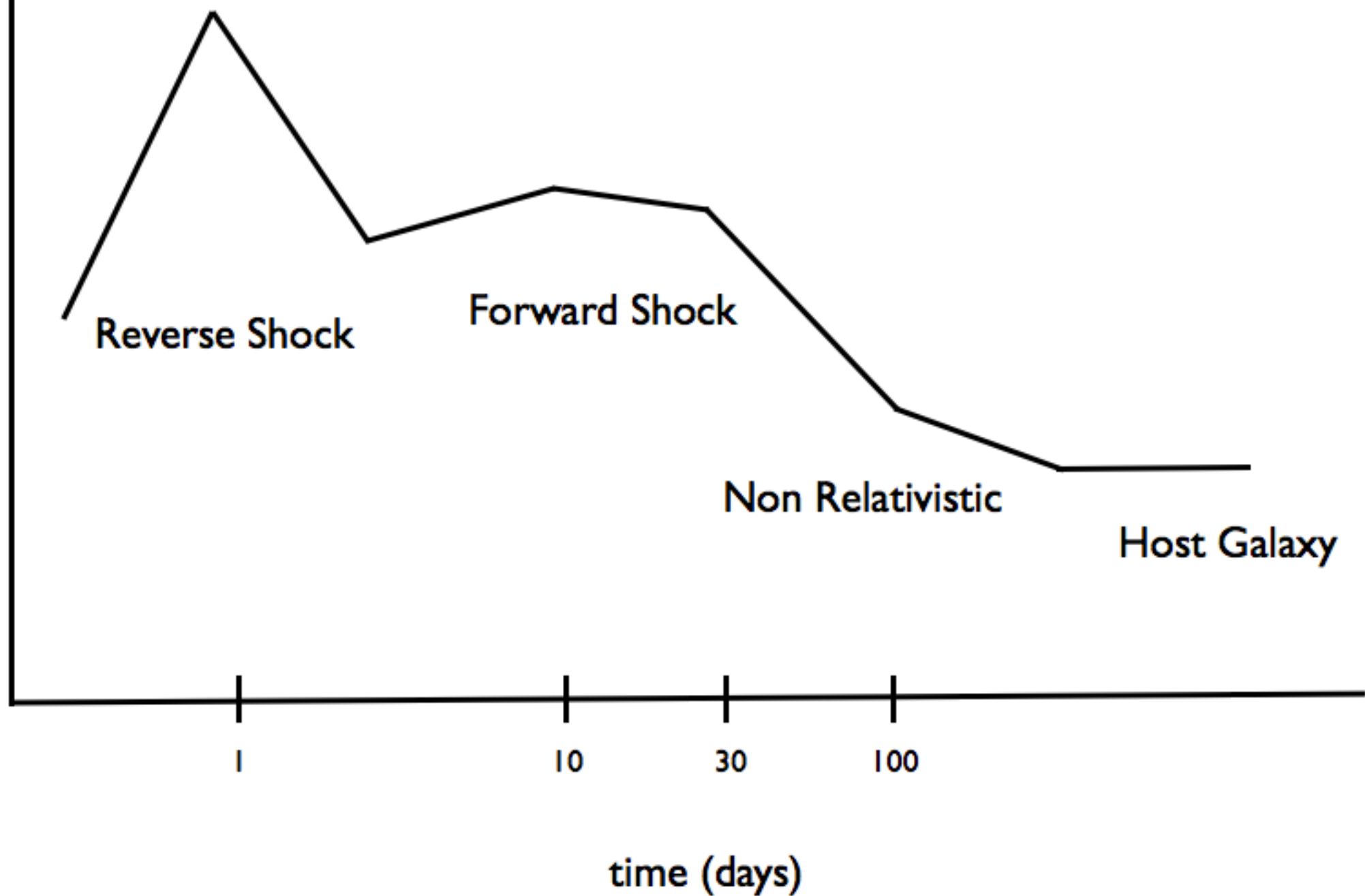
Kouveliotou et al. 1993

# Progenitors of Long Bursts

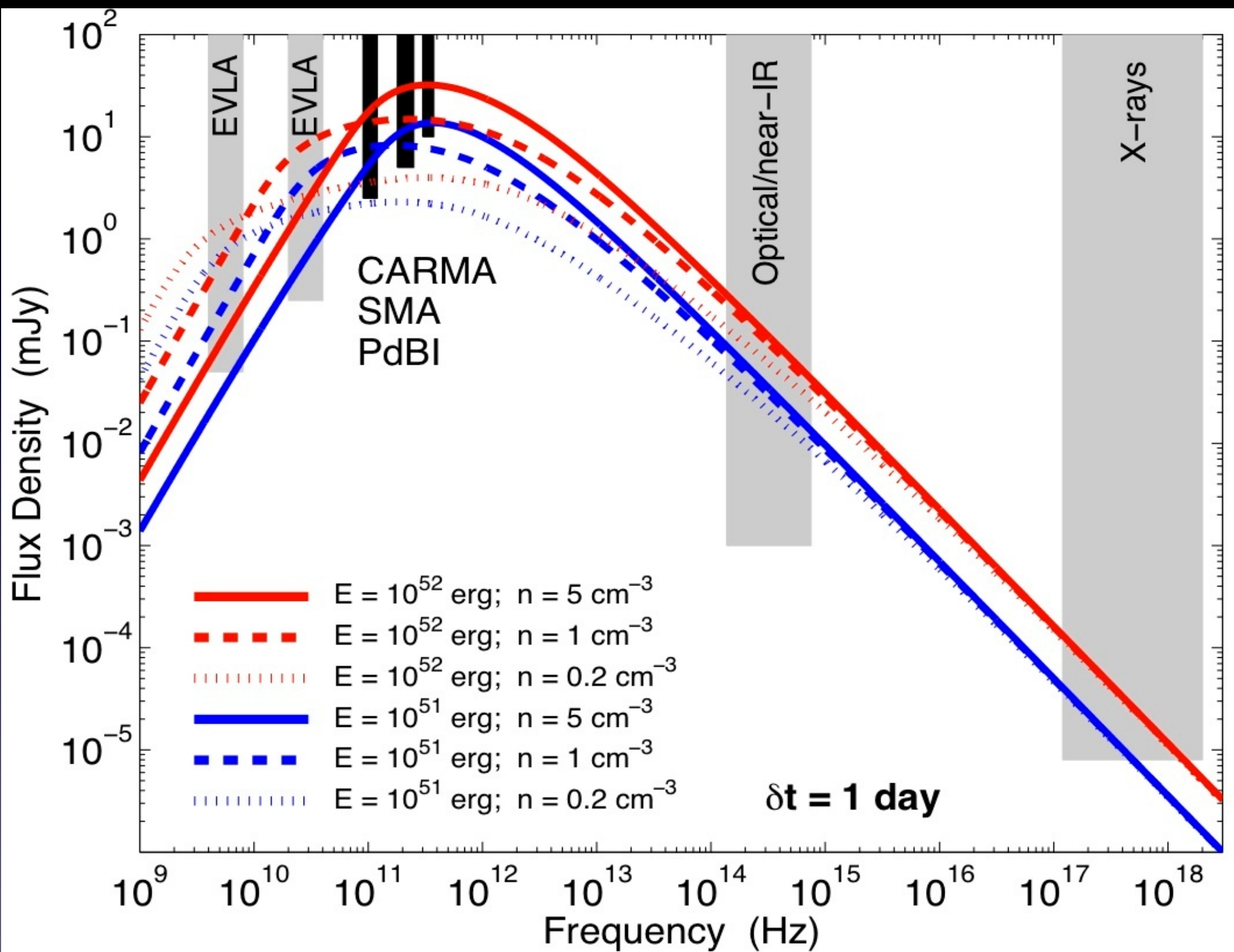


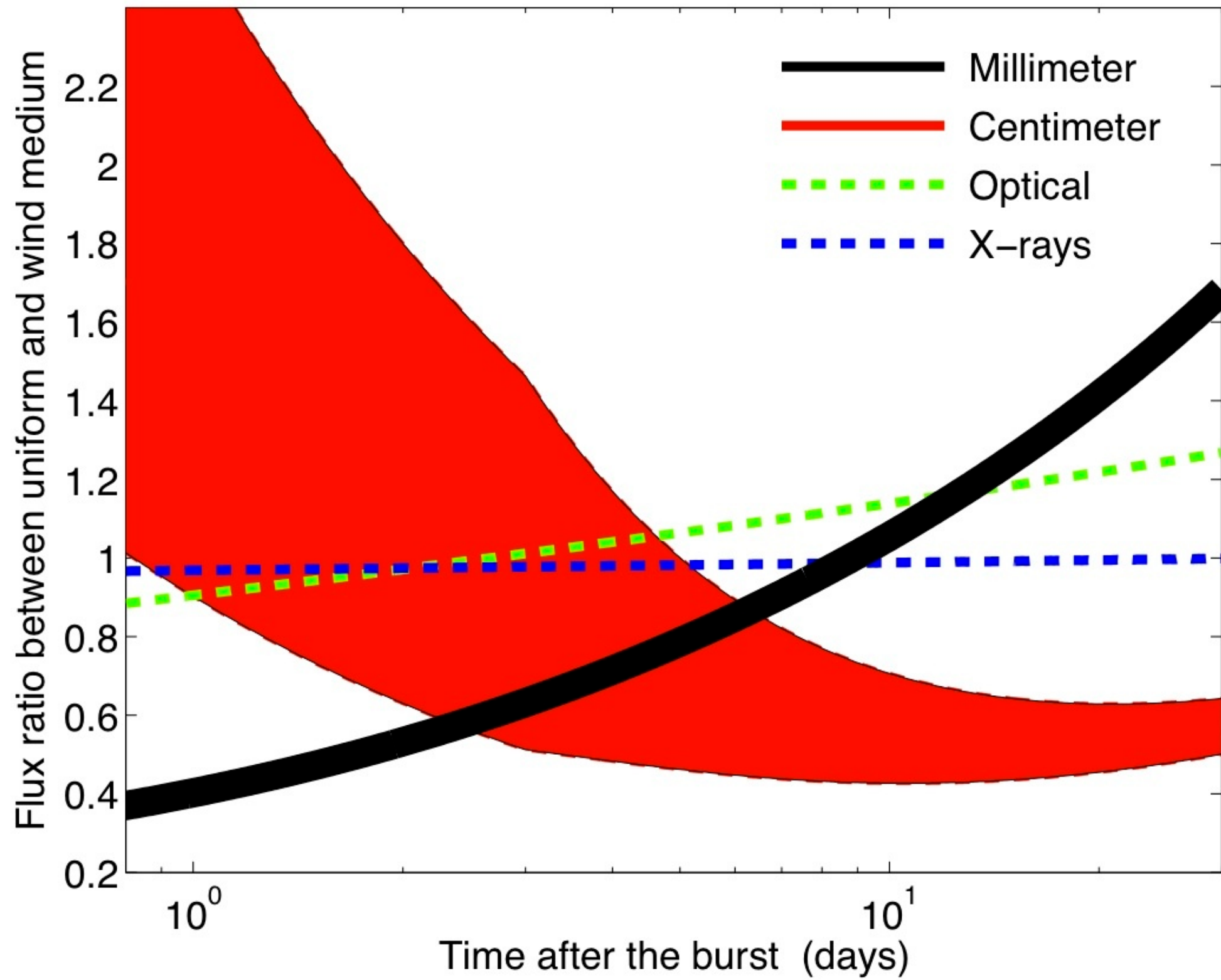
- \* Star-forming Galaxies
- \* Massive-star/SN Connection
- \* Average  $z$  of  $\sim 2$
- \* Metallicity relation (e.g. Levesque et al. 2010)

# Interaction with : Ejecta      Local Environment



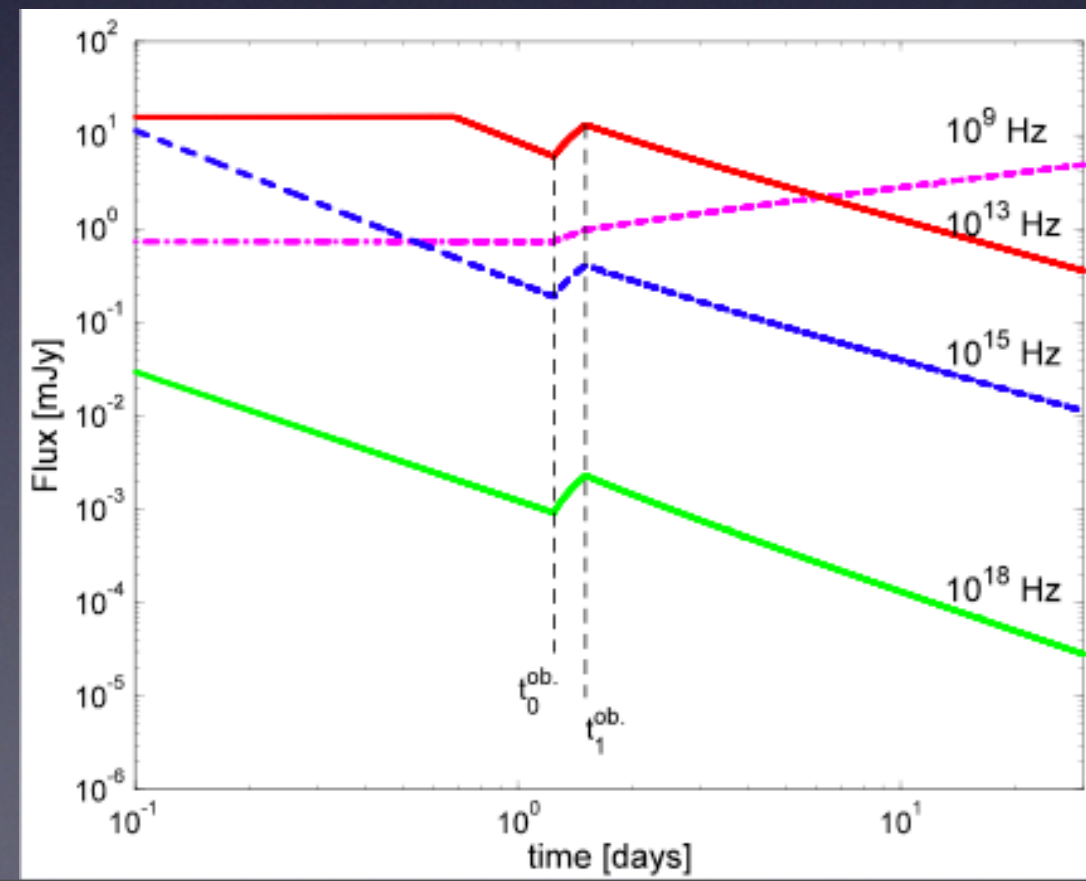






# Our Search for GRBs...

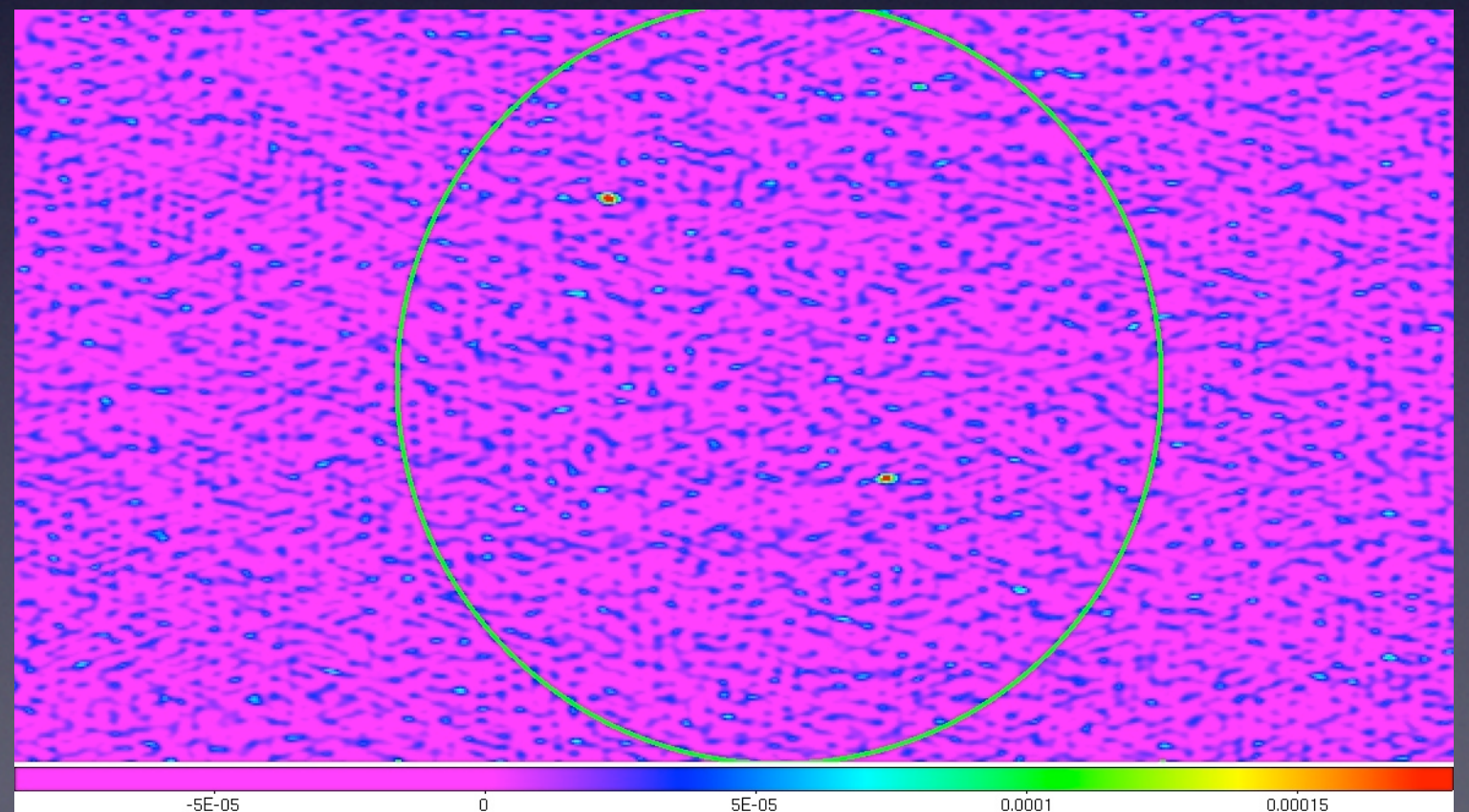
- Reverse Shocks (esp. time critical)
- High and low  $z$
- Unusual long GRBs (brightness, duration)



Pe'er and Wijers, ApJ 643, 1036 (2006)

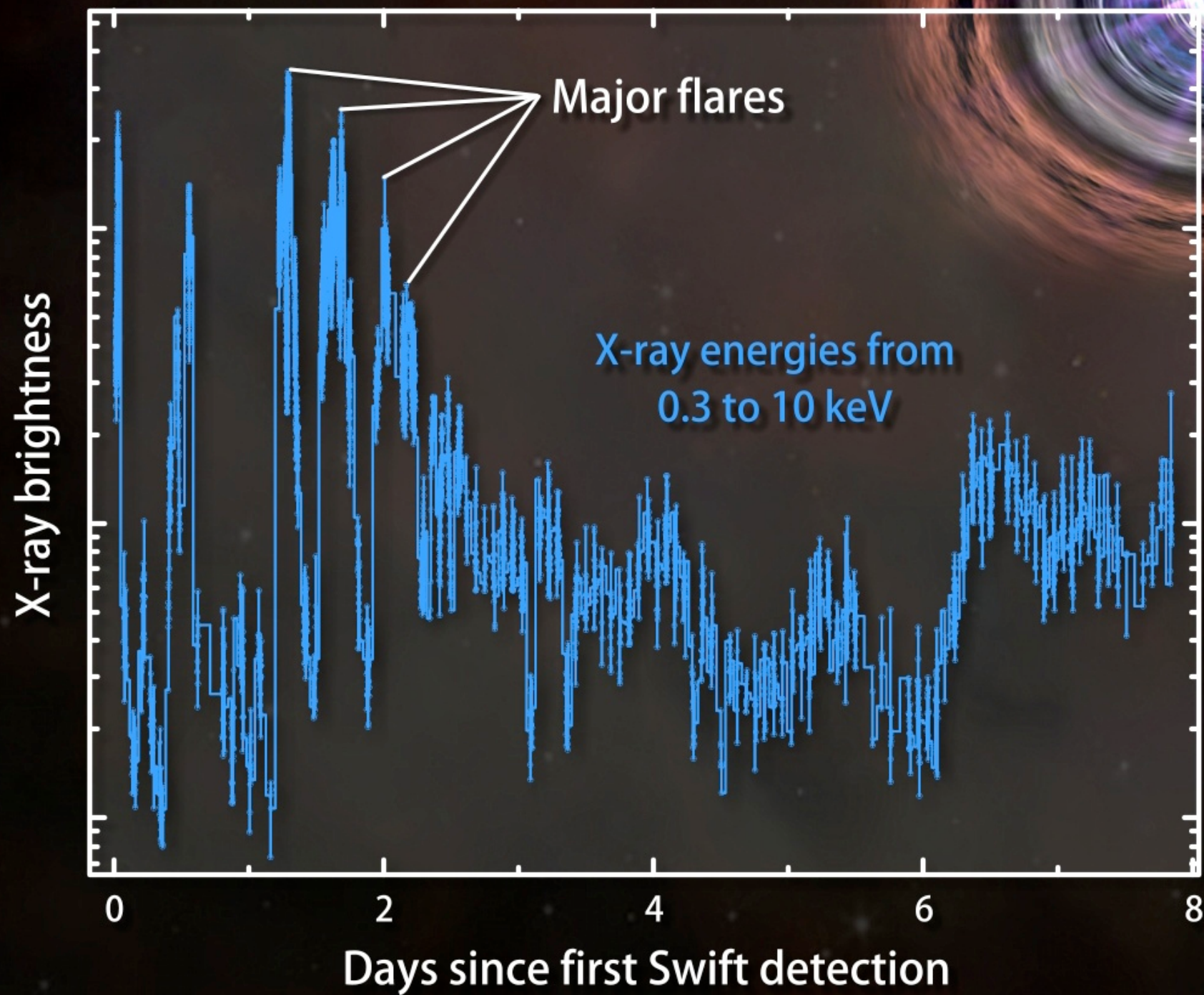
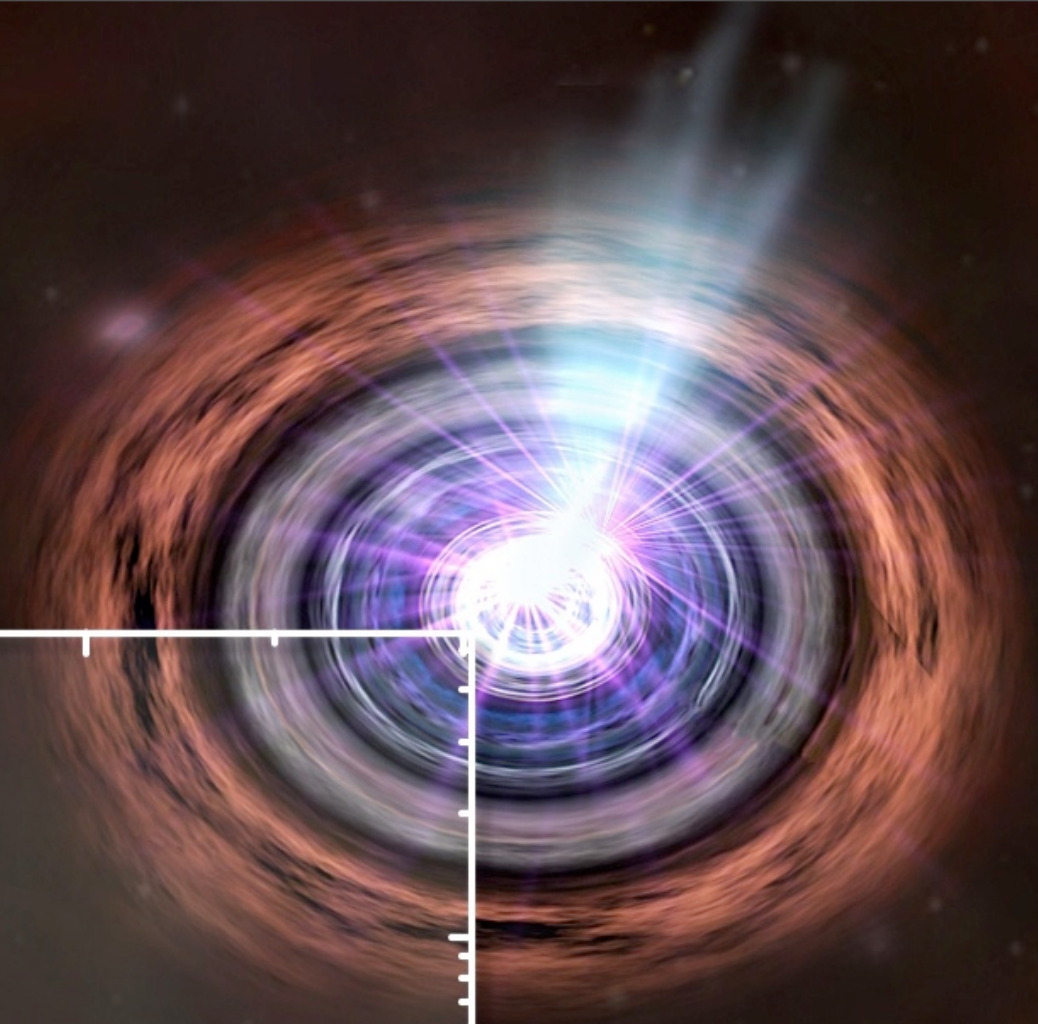
# Searching for GRBs mm / sub-mm contribution

- EVLA
- CARMA
- SMA

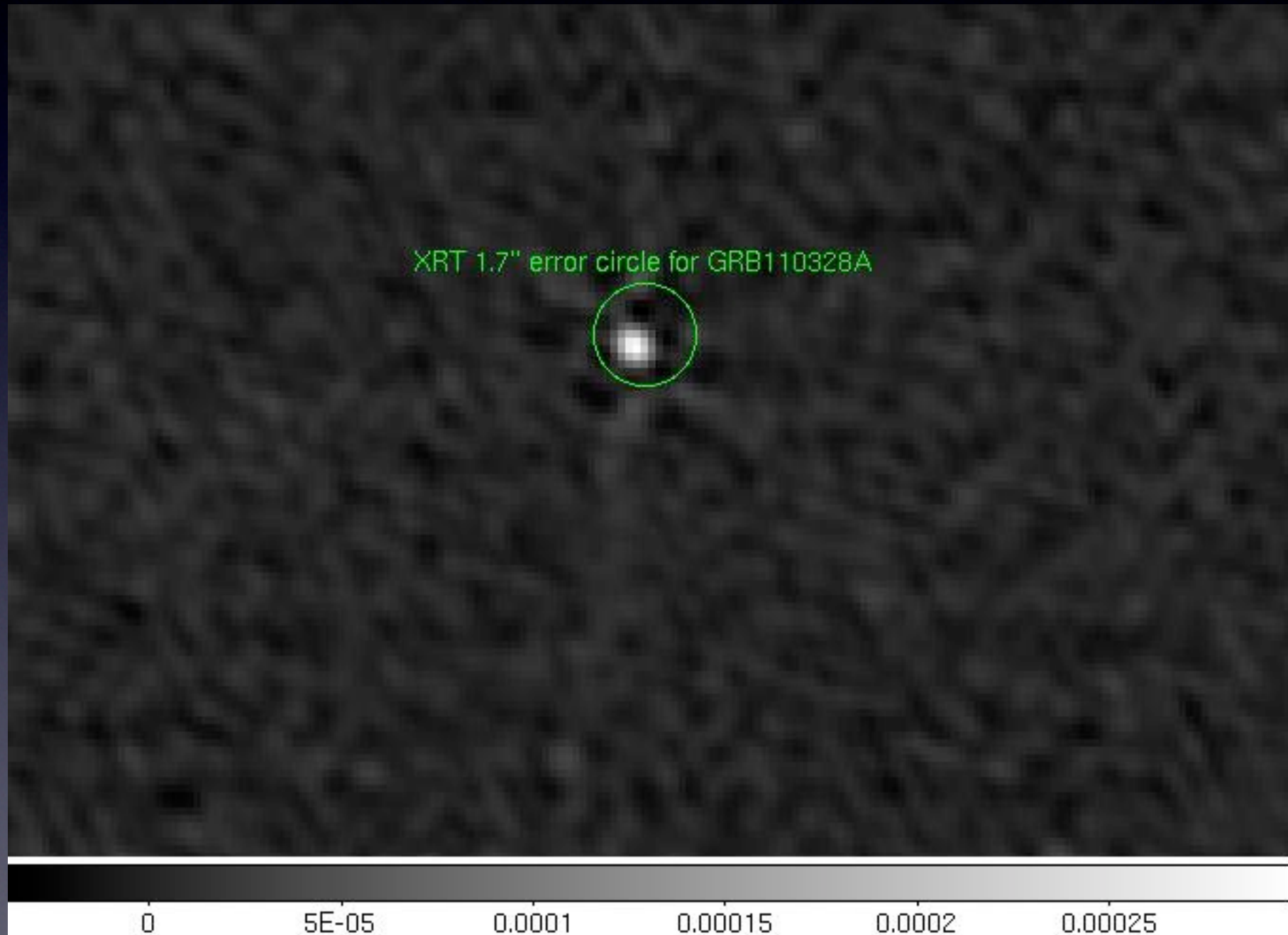


# GRB 110328A

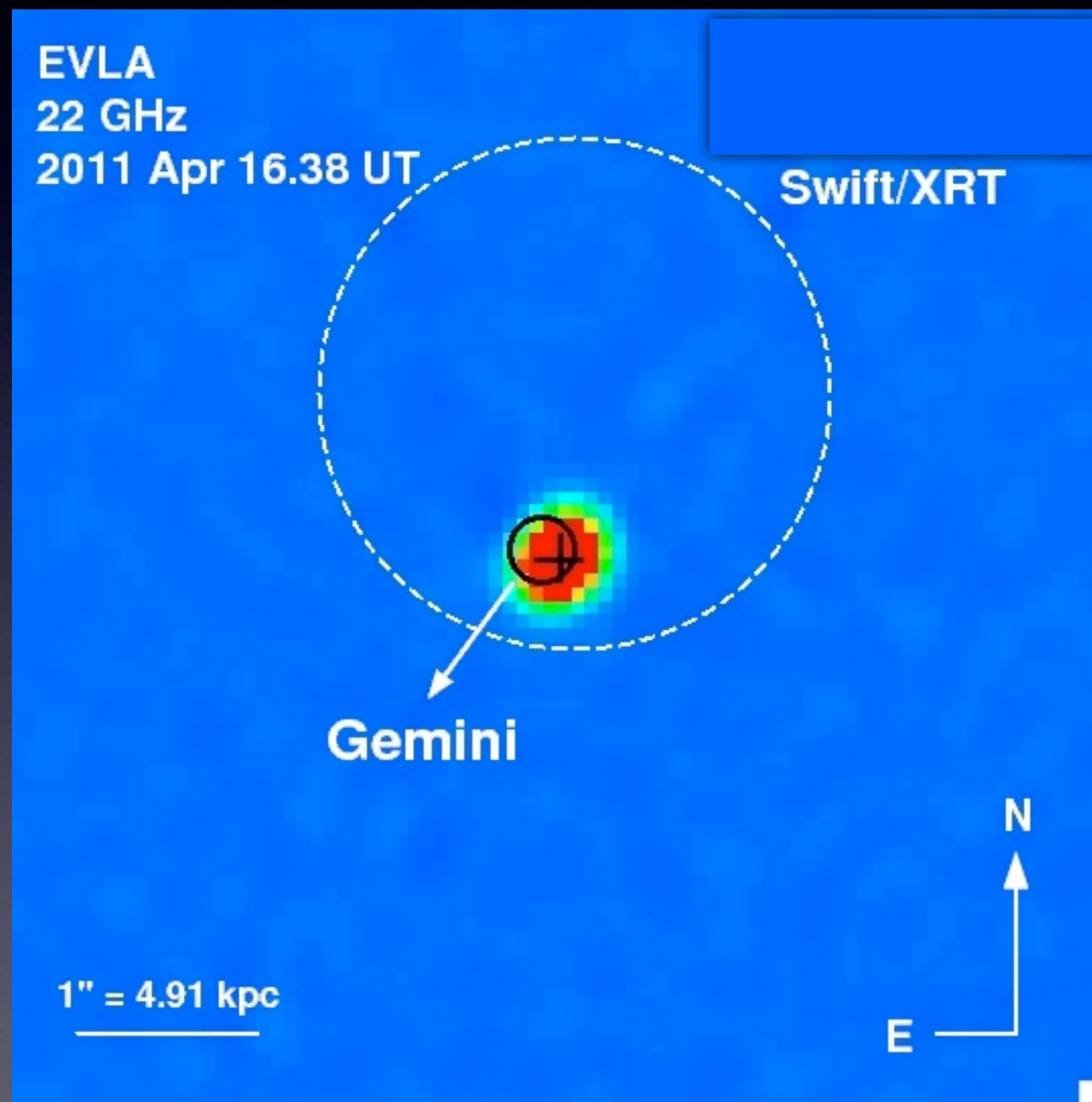




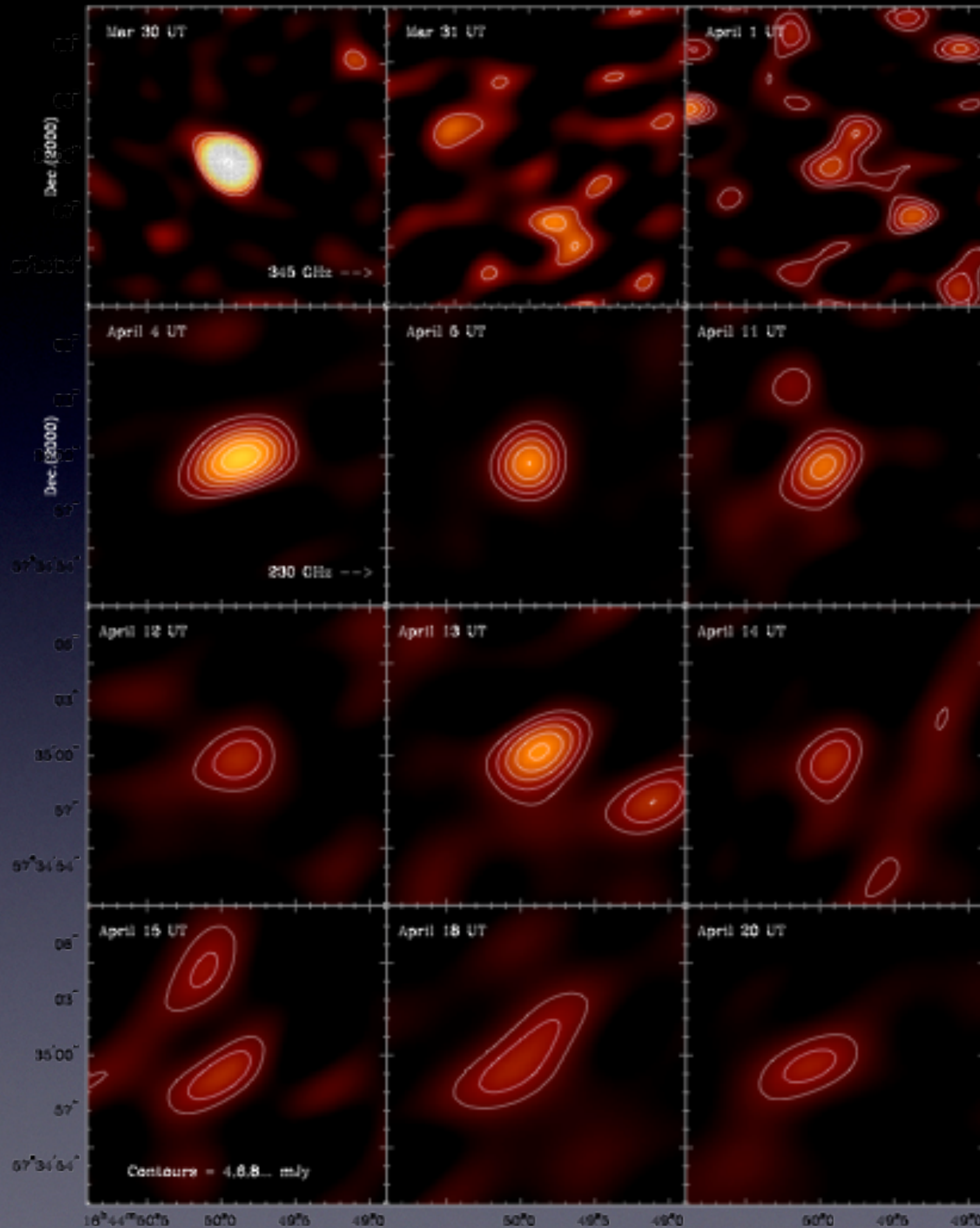
# GRB 110328A



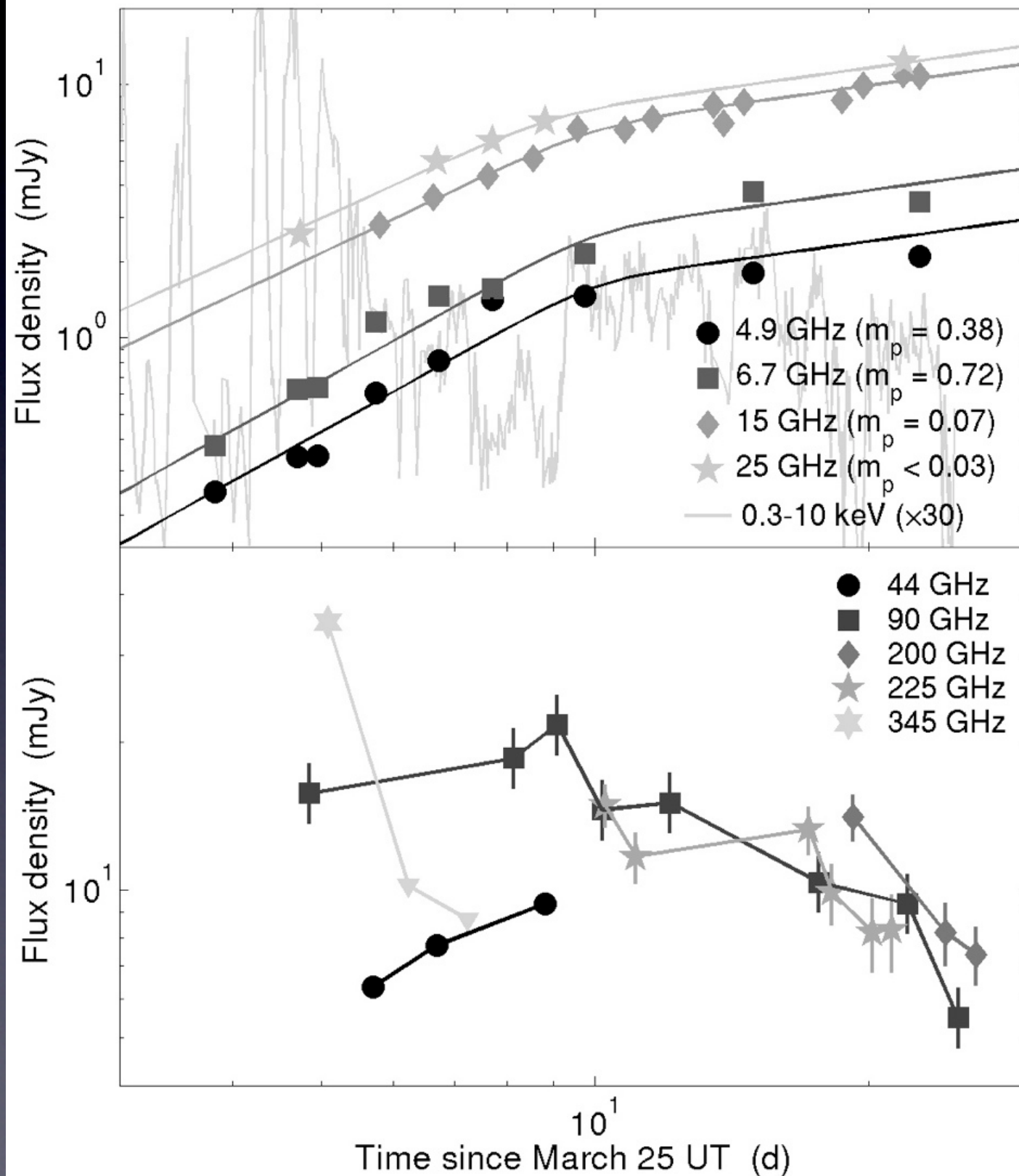
# GRB 110328A



Zauderer et al. 2011 (Nature, accepted)



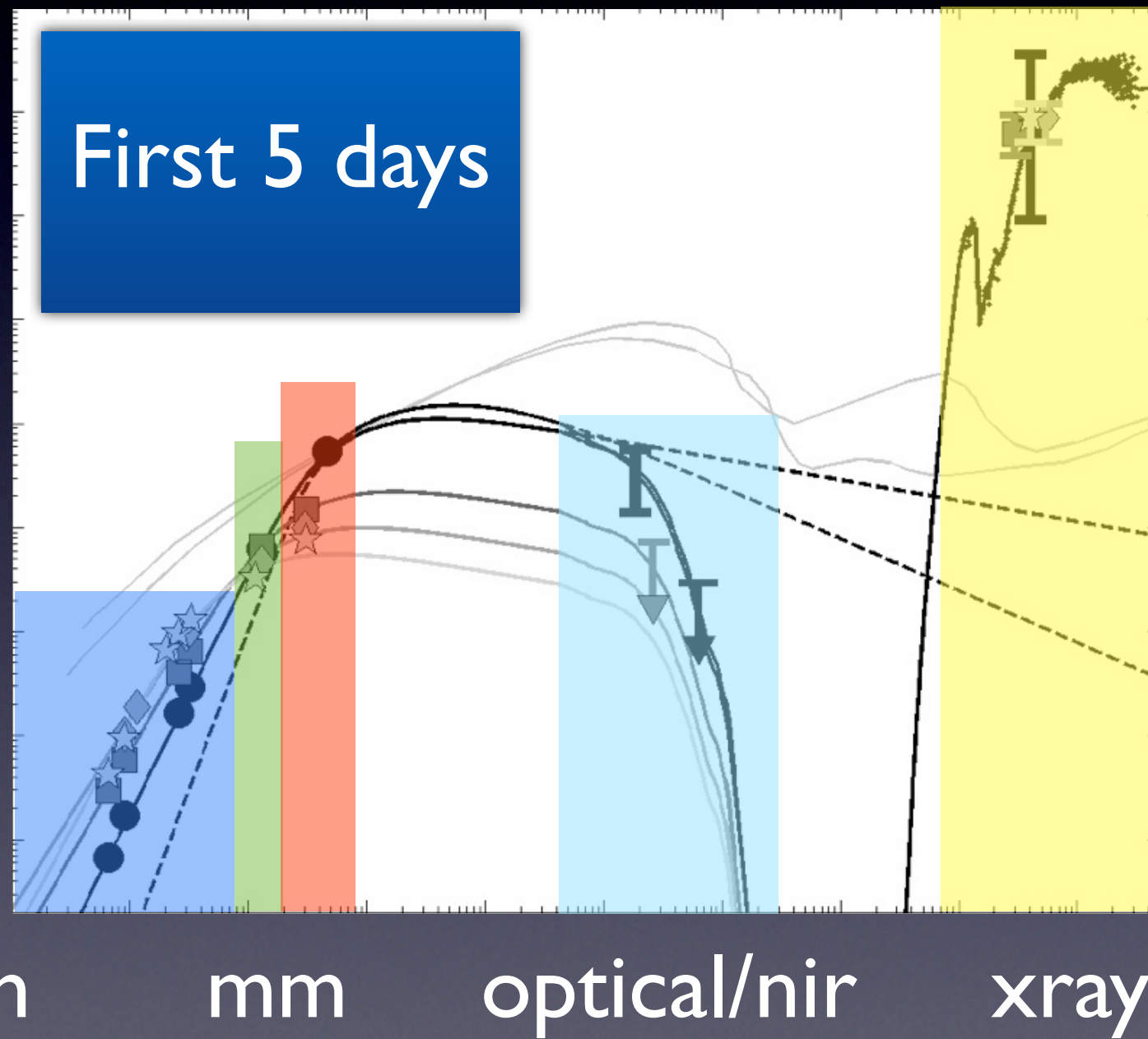
Glen Petitpas  
SMA



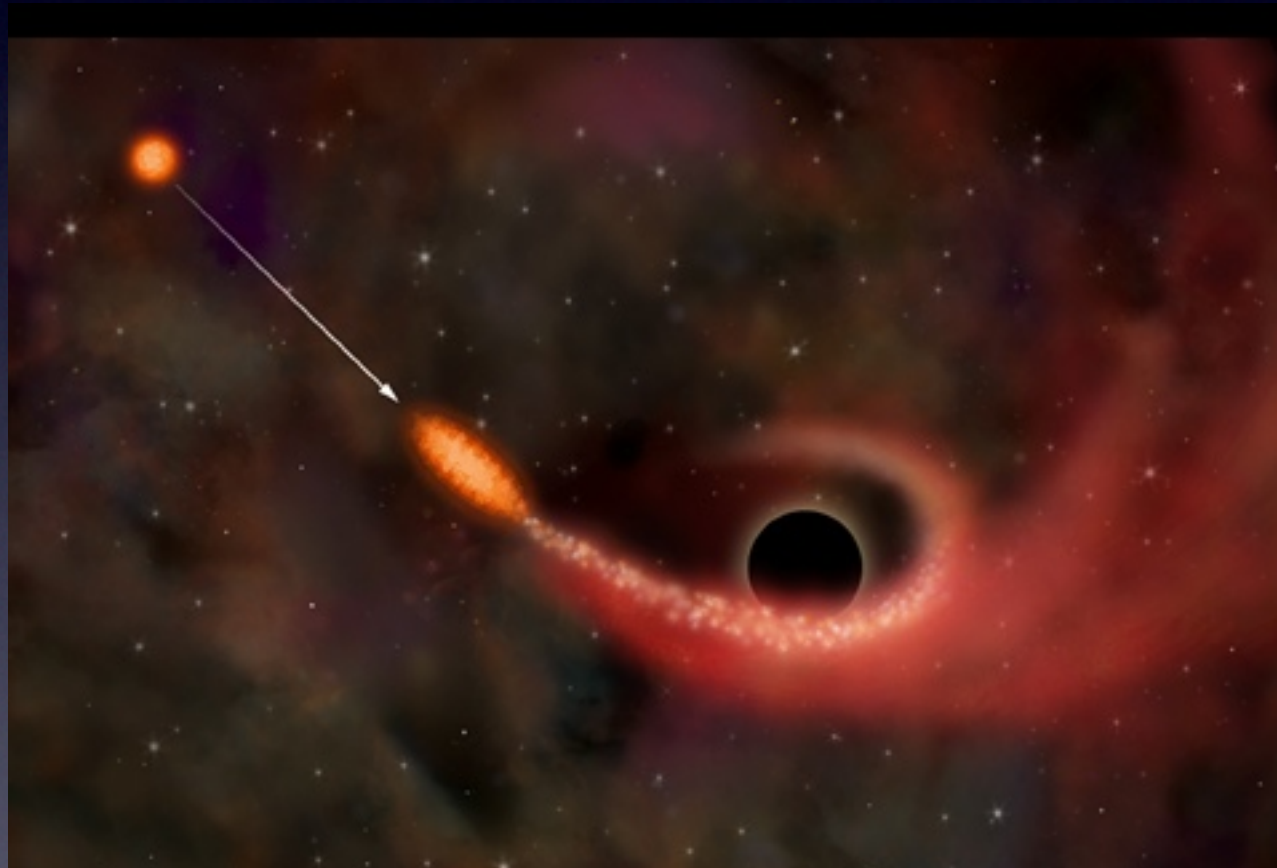
From paper submitted  
in collaboration with:

E. Berger  
A. Soderberg  
A. Loeb  
R. Narayan  
D. Frail  
G. Petitpas  
A. Brunthaler  
R. Chornock  
J. Carpenter  
G. Pooley  
K. Mooley  
S. Kulkarni  
R. Margutti  
D. Fox  
E. Nakar  
N. Patel  
et al.

Flux



# Tidal Disruption



(Illustration: NASA/CXC/M.Weiss)

# Time Domain

- LSST, PANSTARRS, PTF...
- Astronomical events: SN, GRBs, flaring stars, brown dwarfs, x-ray binaries...
- Fast response and increase in sensitivity –

