CTA transient factory
divergent pointingによる広視野突発天体サーベイの展望

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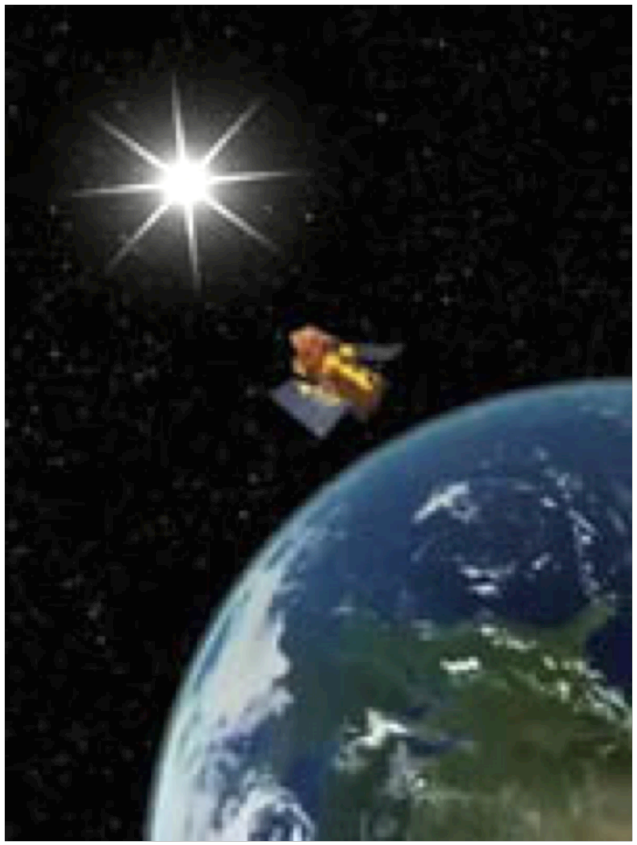
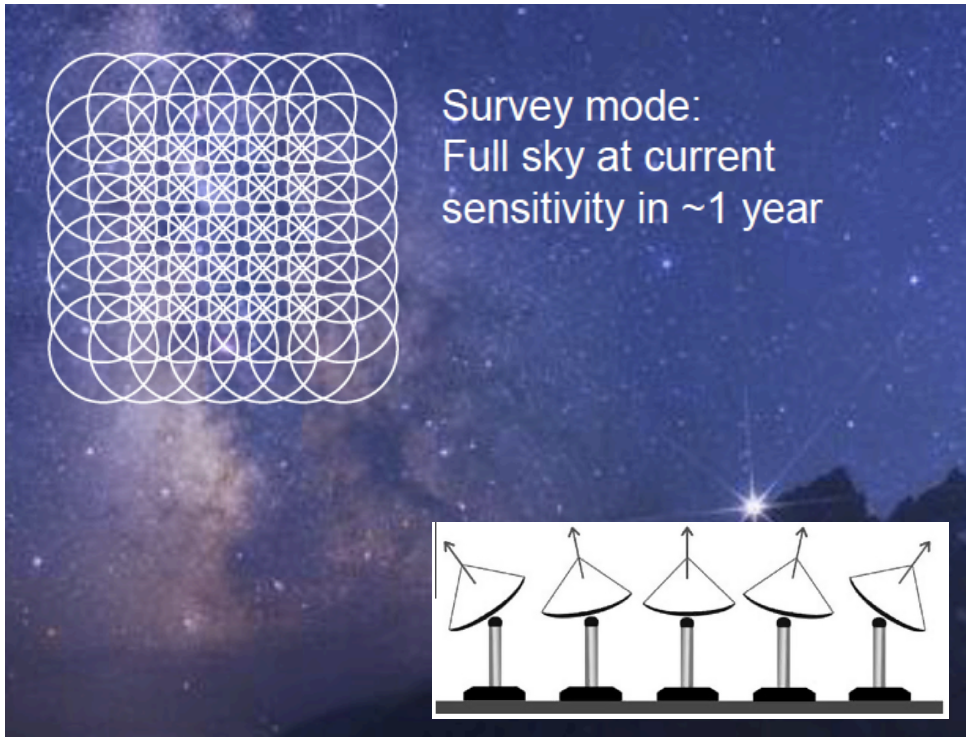
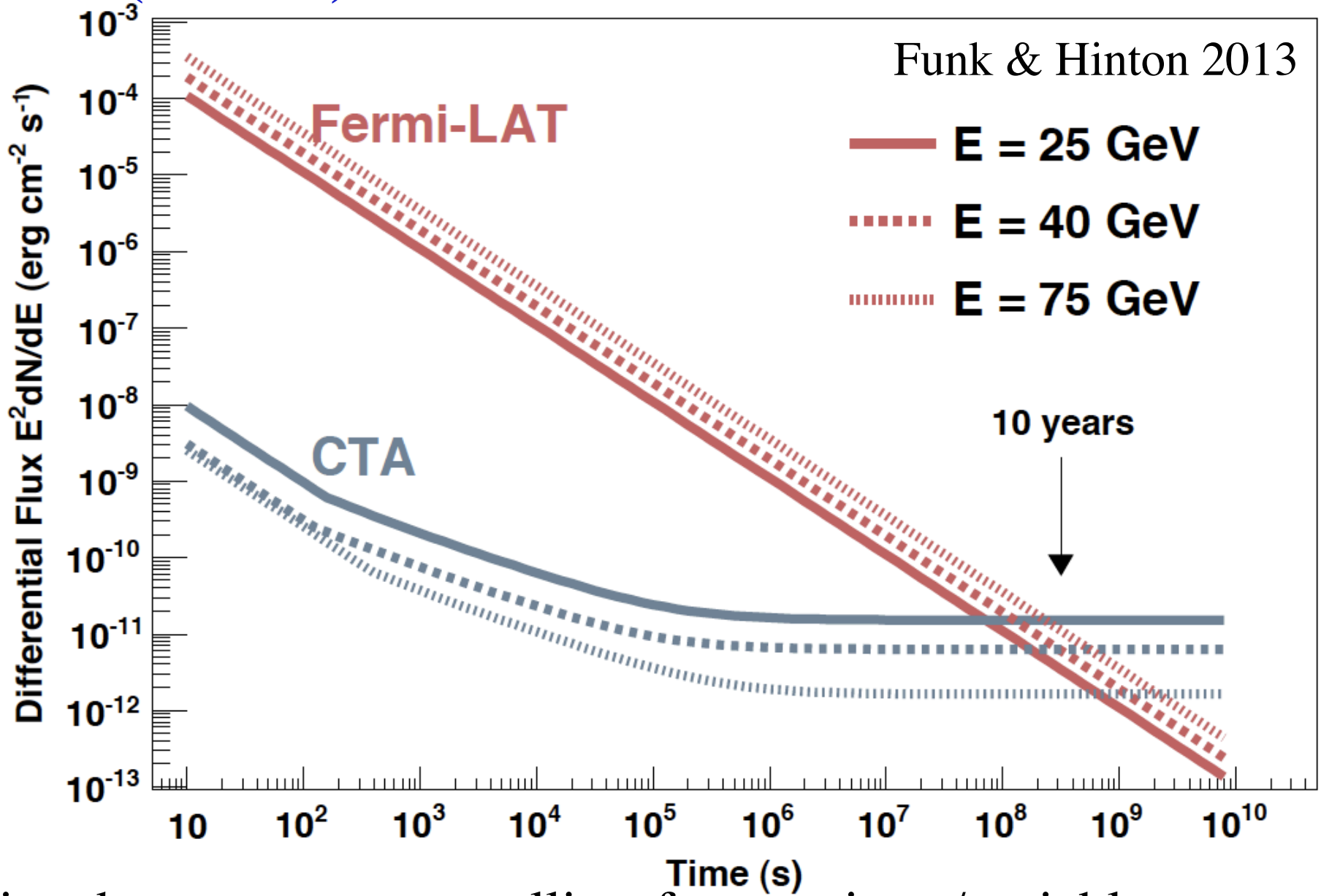




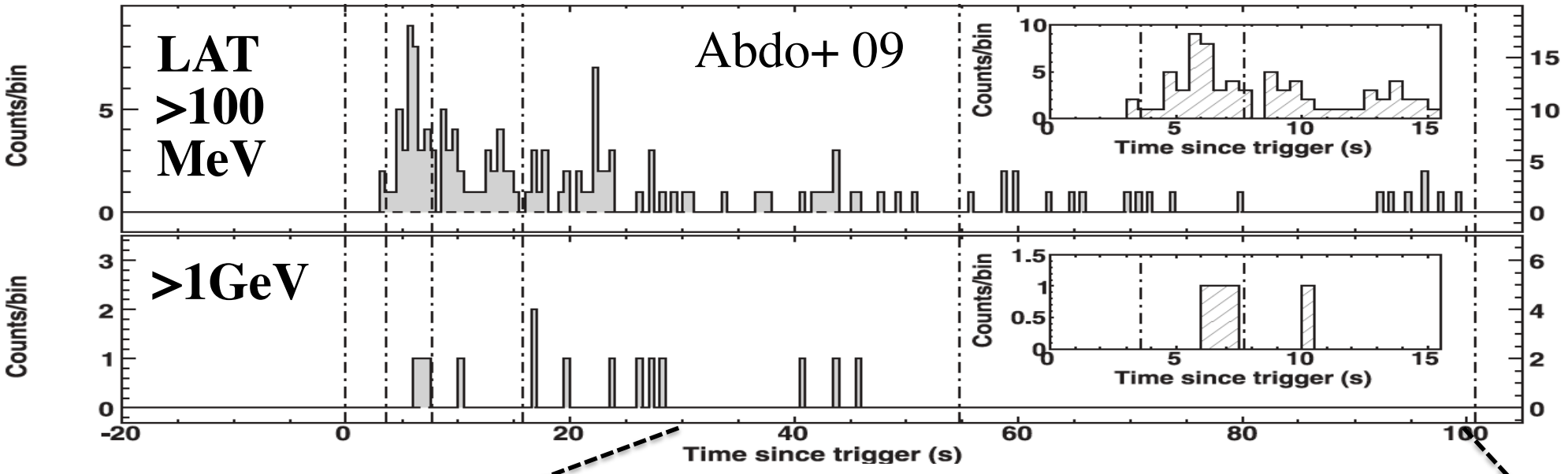
CTA (IACTs) vs Fermi

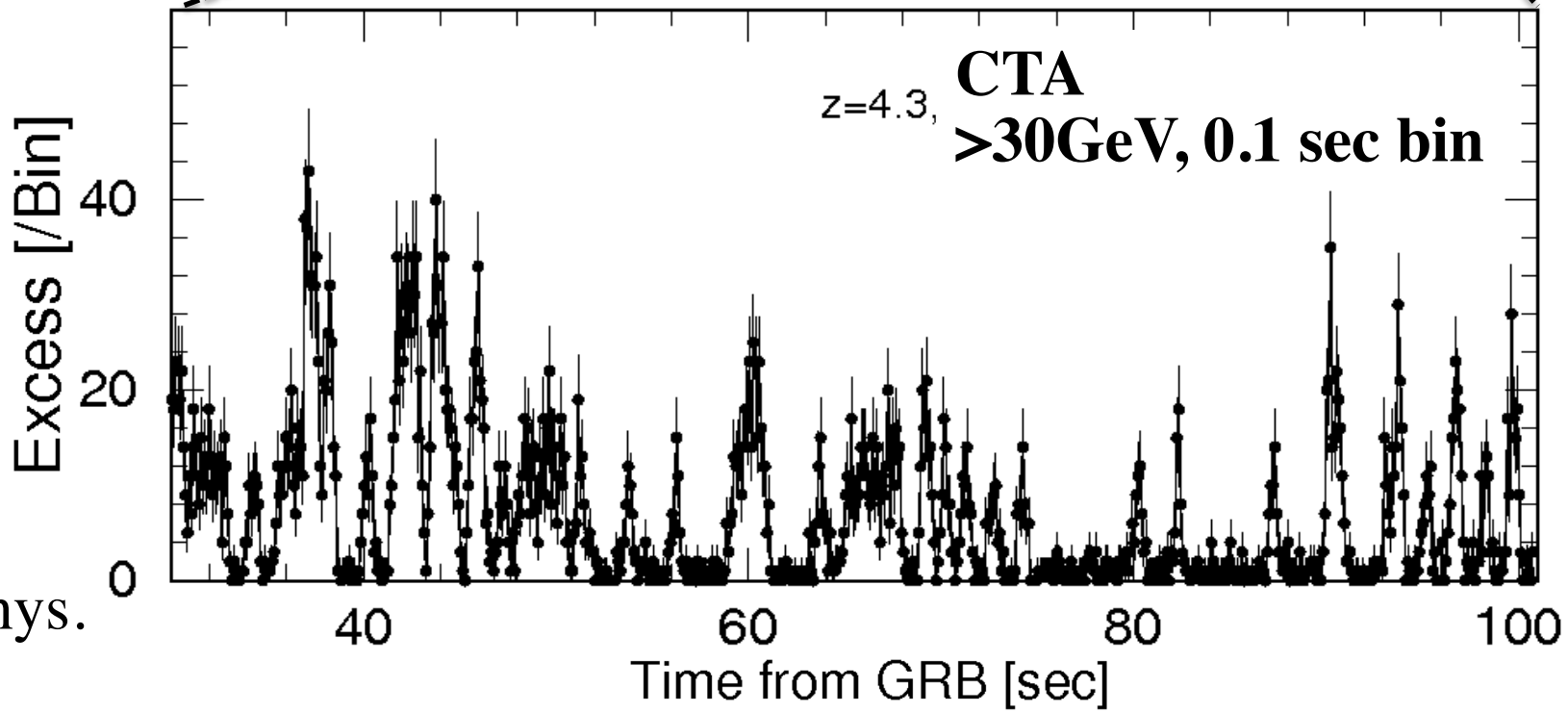


big advantange over satellites for transients/variables:
effec. area ~10^4 x LAT@30GeV

GRB light curve: Fermi vs CTA

GRB 080916C





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GRB light curve: Fermi vs CTA

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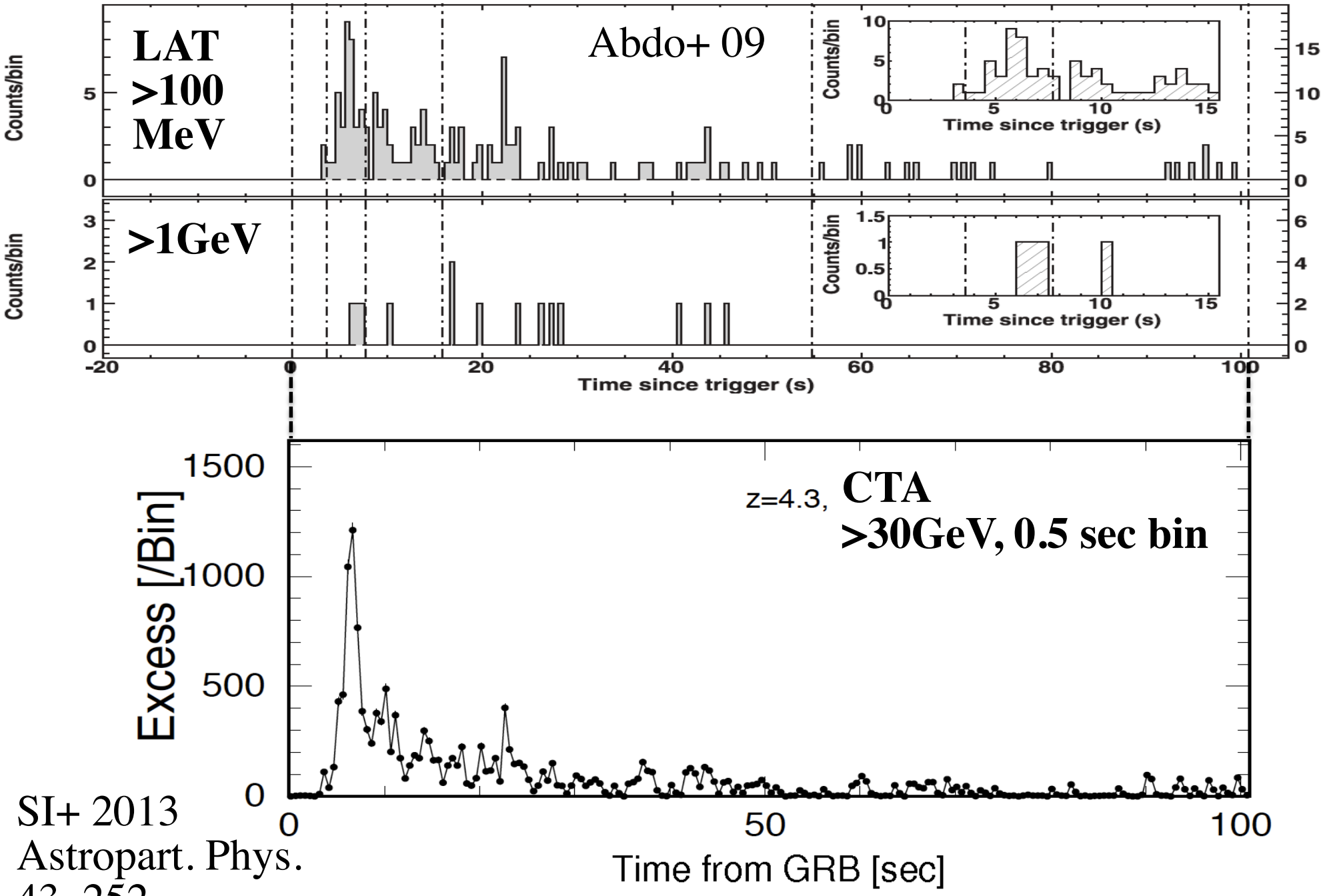

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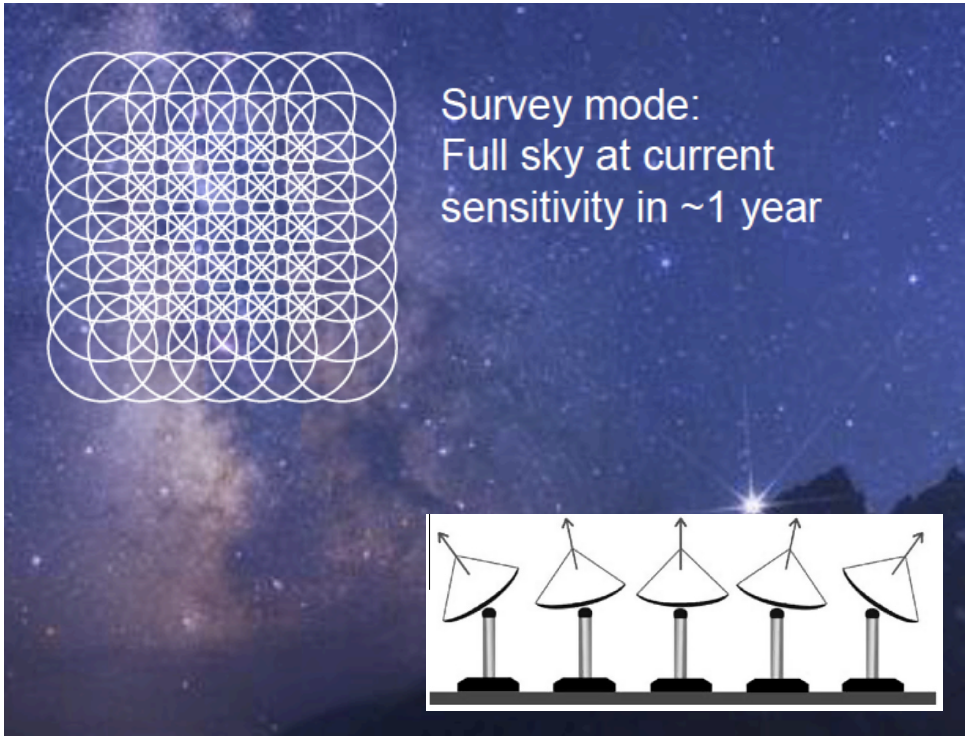
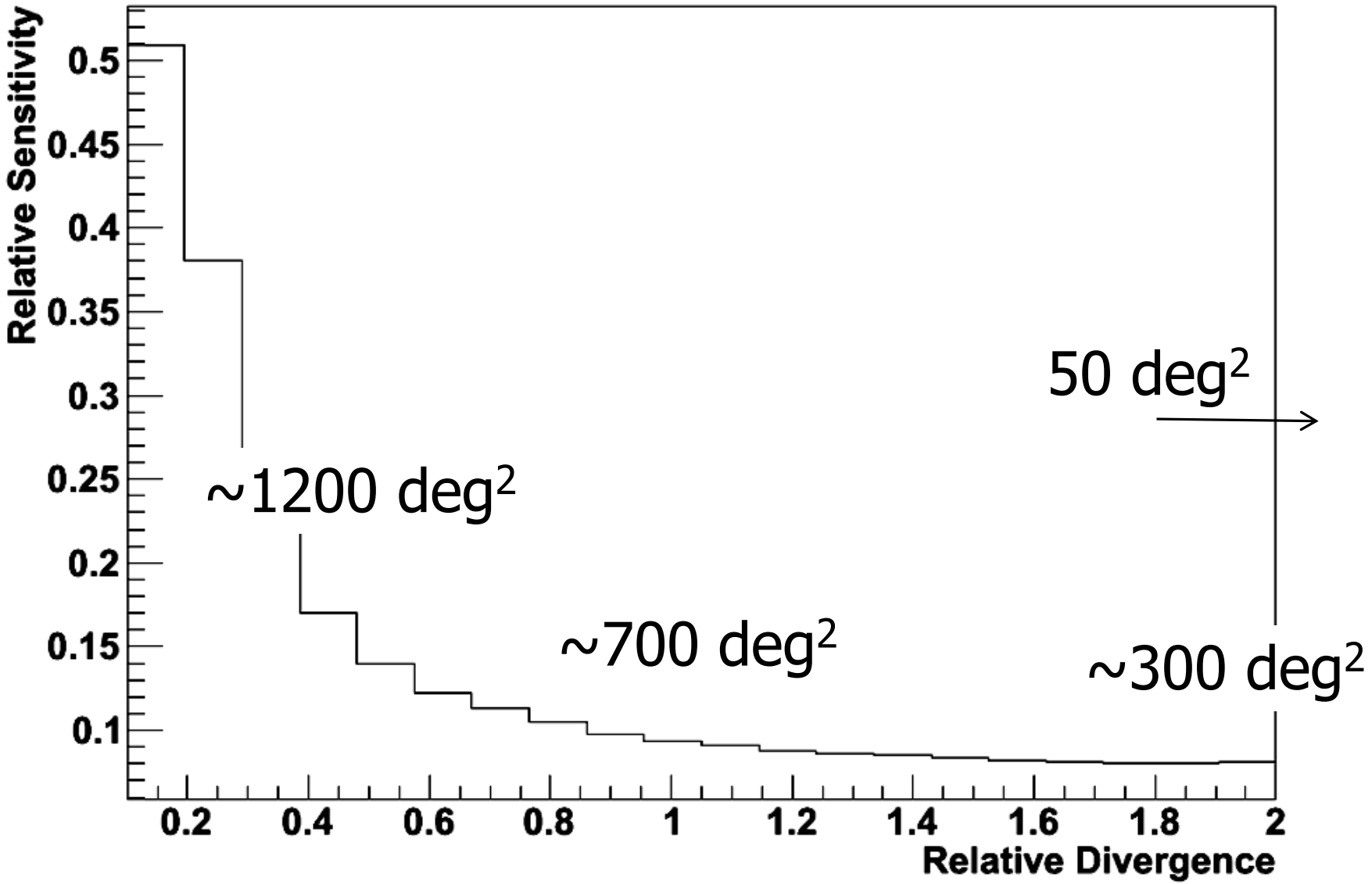
divergent pointing mode for MSTs



- more effective for surveys of persistent point sources
- GRBs from onset
  prompt emission physics
  (crucial but poorly understood)
- short GRBs
  Lorentz invariance violation
  (big improvement over Fermi)
- unbiased transient survey
  e.g. fast radio bursts

GRBs occurring in FoV (not necessarily detectable):
GRB rate all sky ~800/yr (BAT), ~600/yr (GBM)
duty cycle 10%
IF field of view ~1000 deg^2 (0.025 sky; 25MSTs, no gap)
-> ~0.2-0.3 /100 hr -> ~2-3 GRBs /1000 hr

sensitivity for divergent mode: toy MC simulations

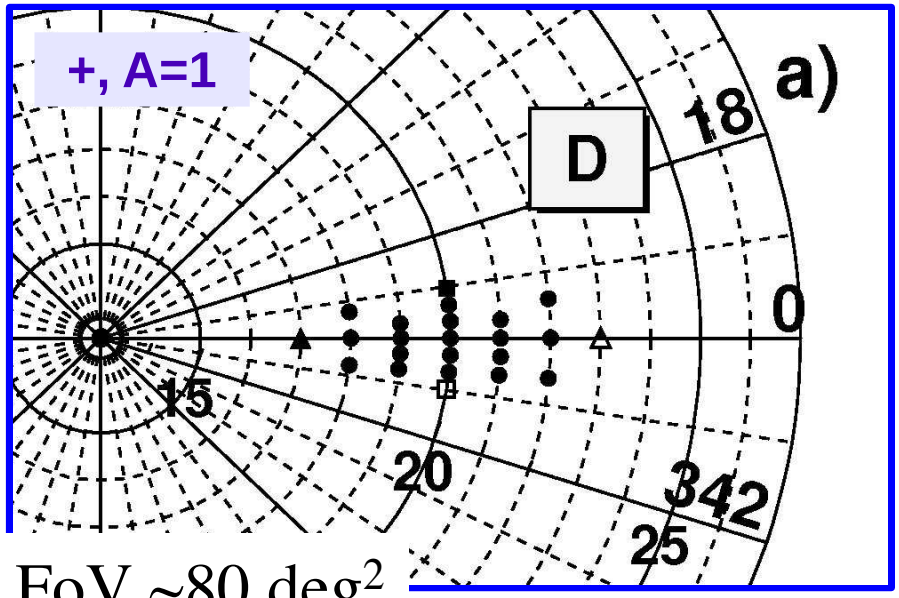


by Jim Hinton, presentation at Zeuthen 2010

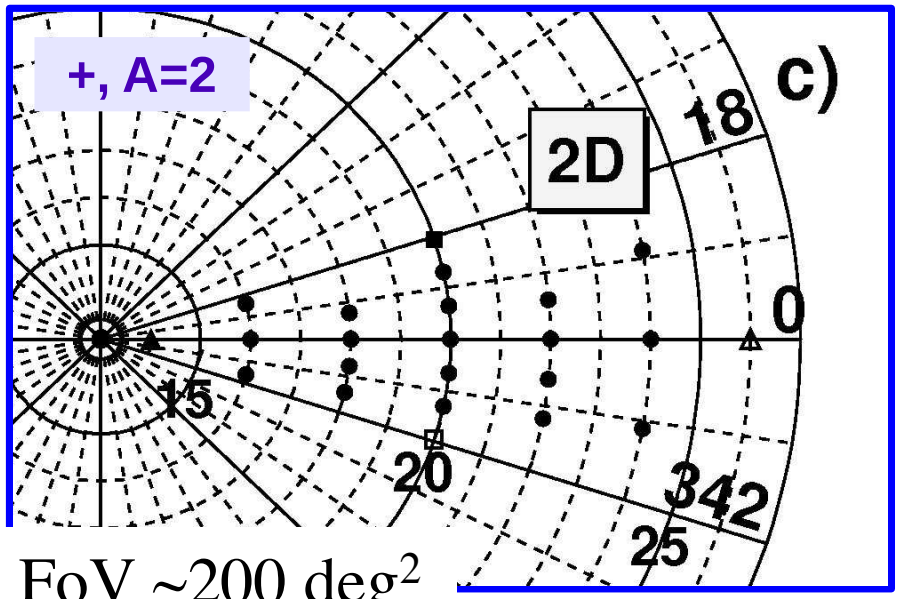
simulations for divergent pointing

Szanecki+ 15, Astropart. Phys. 67, 33

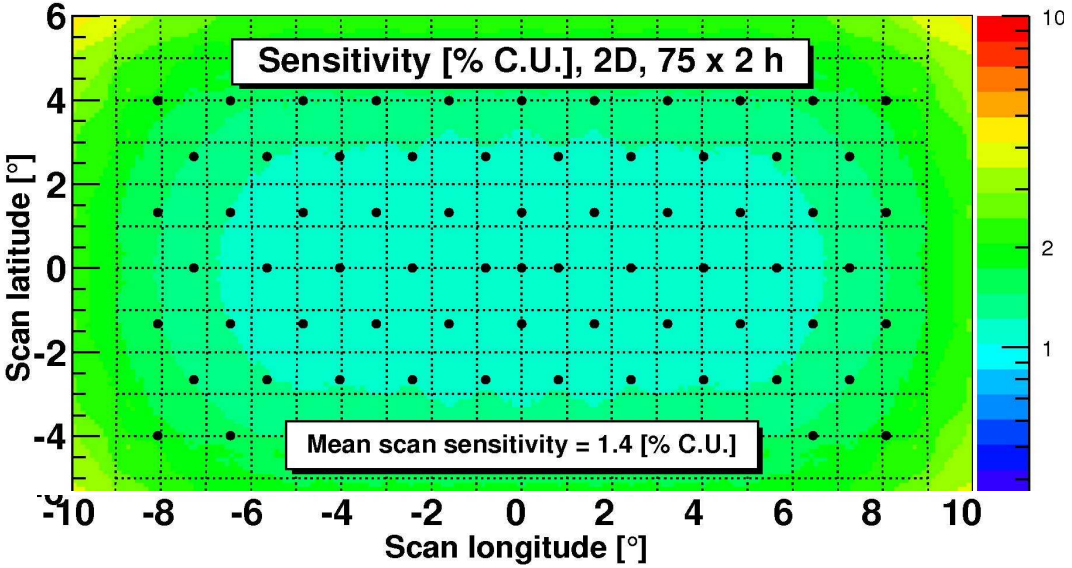
c.f. work by L. Gerard+



FoV ~80 deg^2



FoV ~200 deg^2



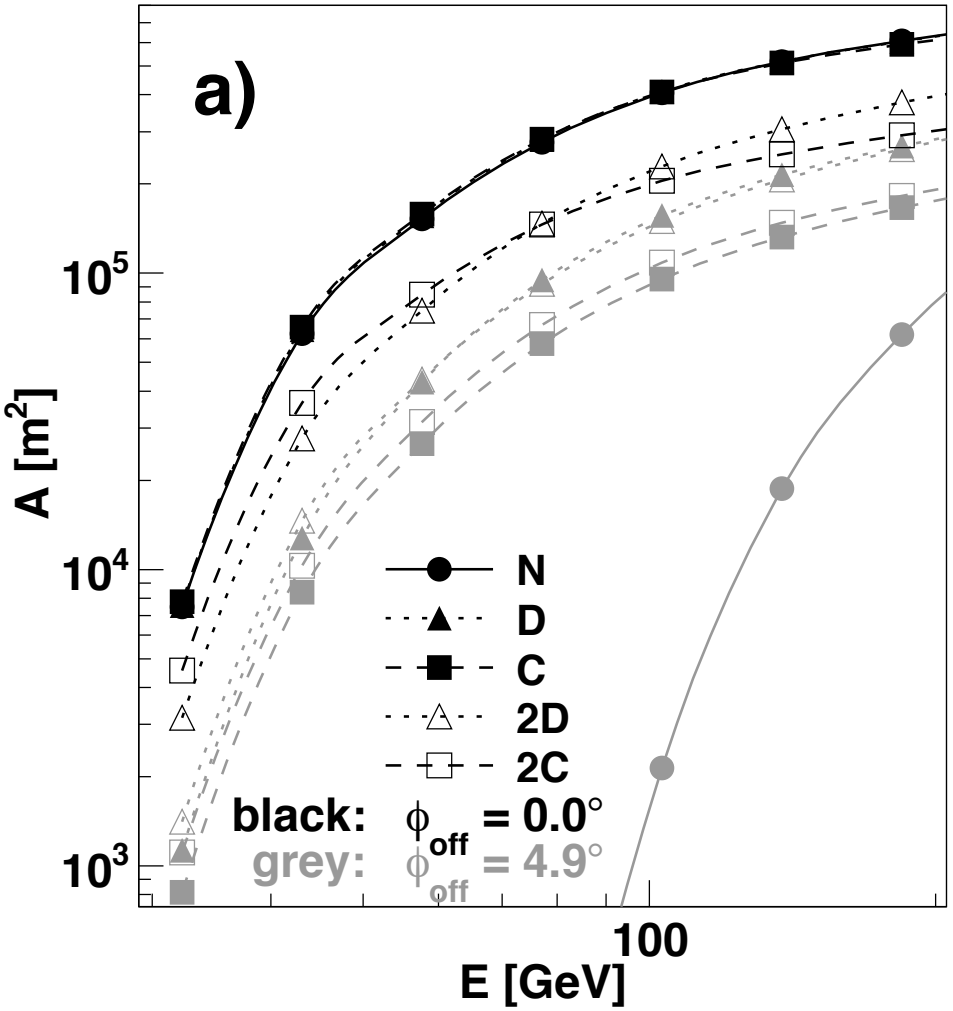
potential gain in survey efficiency for point sources by factor ~2-3 for FoV ~200 deg^2 but loss in angular and energy resolution

->

option for extragalactic survey

GRB detectability estimate

collection area vs energy



assume average prompt emission:
luminosity $L \sim 10^{52}$ erg/s
duration T~30 s, spectra Γ=-2.2
simplified z-dependent EBL cutoff

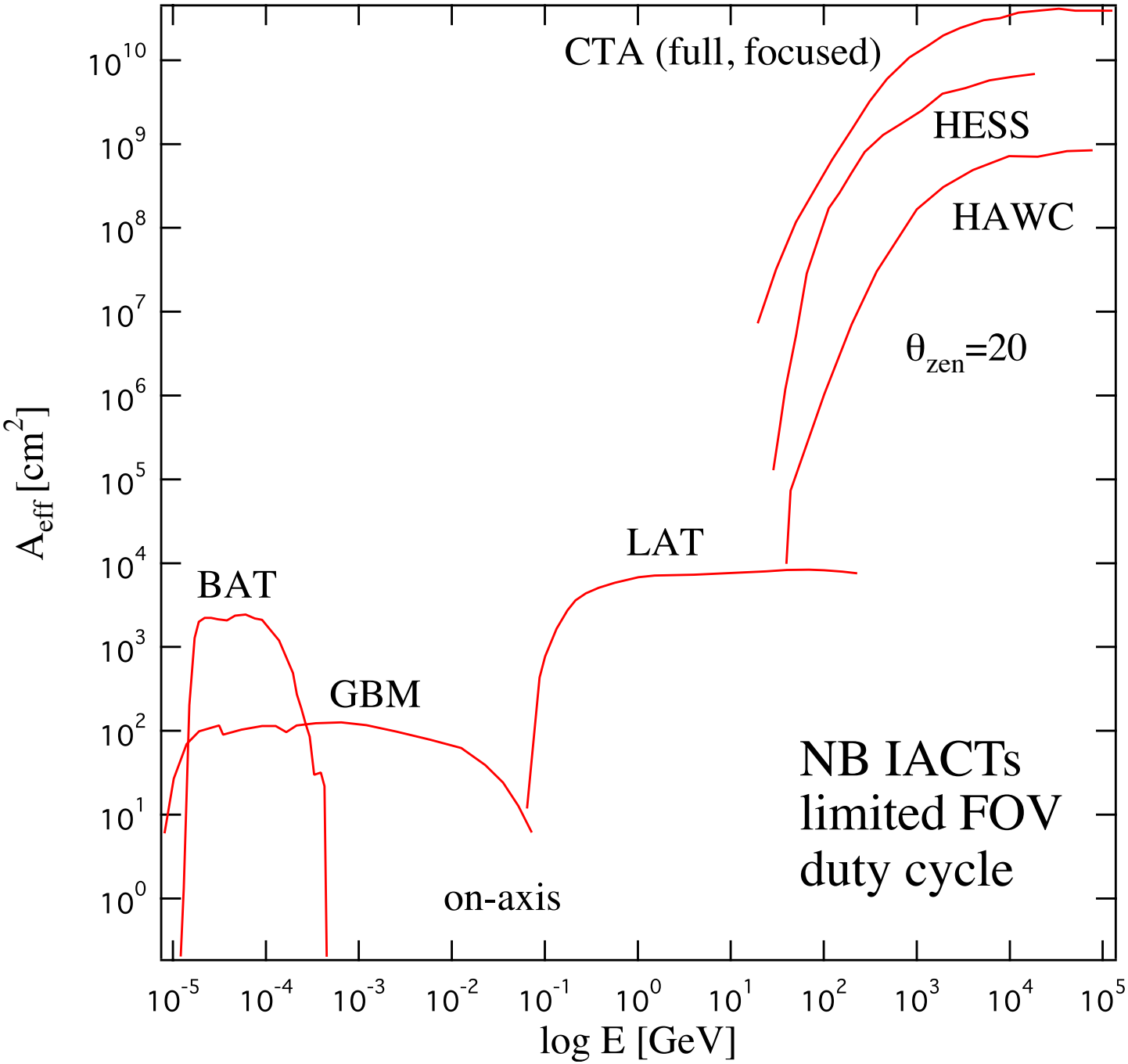
z=1: $dN/dE \sim 6 \times 10^{-9} (E/\mathrm{TeV})^{-2.2}$
x $\exp(-E/100\mathrm{GeV})$ $\mathrm{cm}^{-2}\,\mathrm{s}^{-1}\,\mathrm{TeV}^{-1}$
z=2: $dN/dE \sim 10^{-9} (E/\mathrm{TeV})^{-2.2}$
x $\exp(-E/55\mathrm{GeV})$ $\mathrm{cm}^{-2}\,\mathrm{s}^{-1}\,\mathrm{TeV}^{-1}$

…

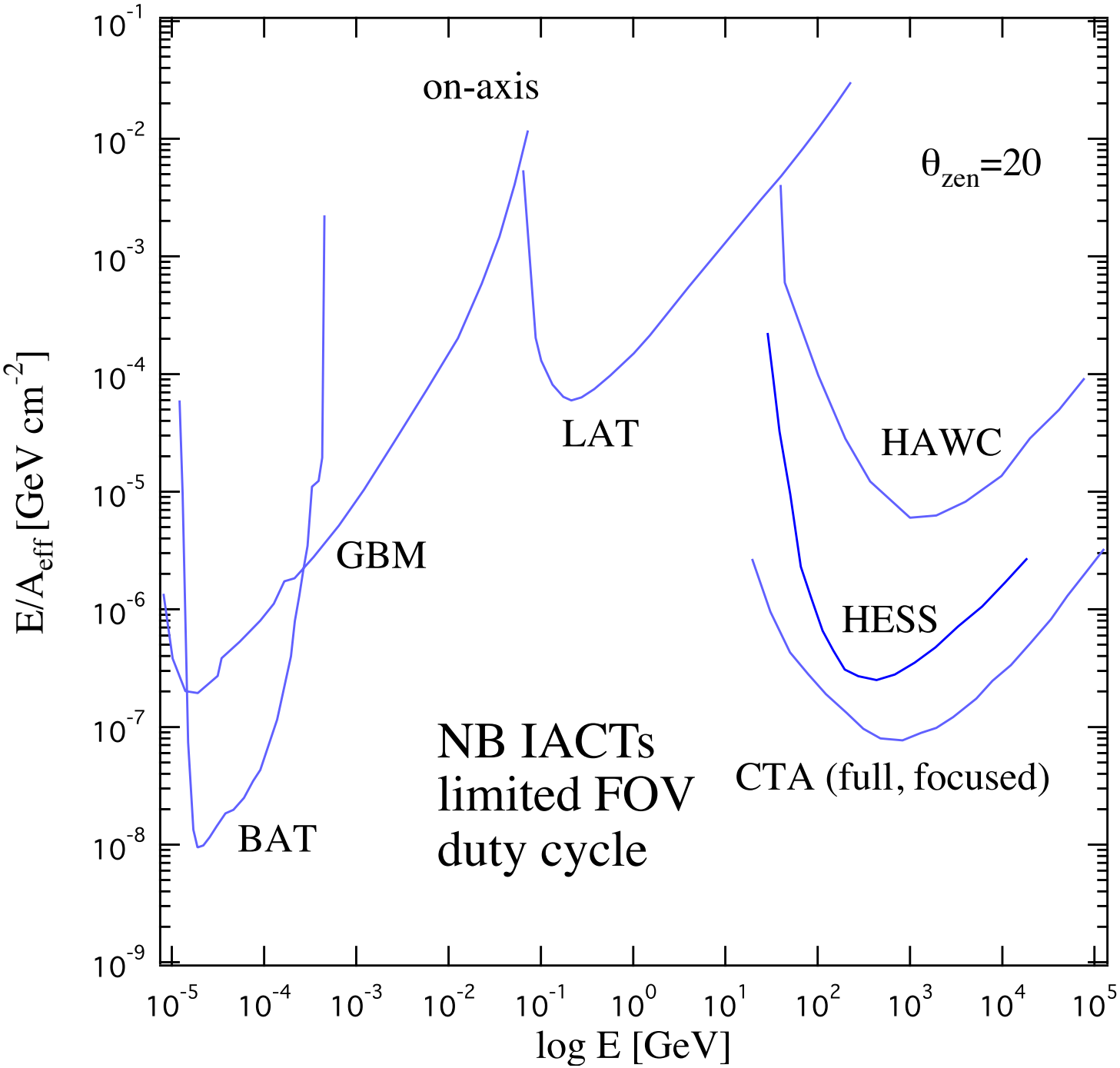
probably detectable out to z~3
(min. 10 photons)
FoV ~200 deg^2 -> 0.2-0.3 in 1000hr
wider FoV desirable!

MC simulations for wider FoV
under way

comparison of effective area



comparison of E/A_{eff} ("transient νf_ν sensitivity")



LAT GRBs:
luminous "tip
of the iceberg"

CTA GRBs:
includes those
with lower L
spectra?
z-distribution?

fast radio bursts:
correlated ms
TeV bursts
Lyubarsky 15

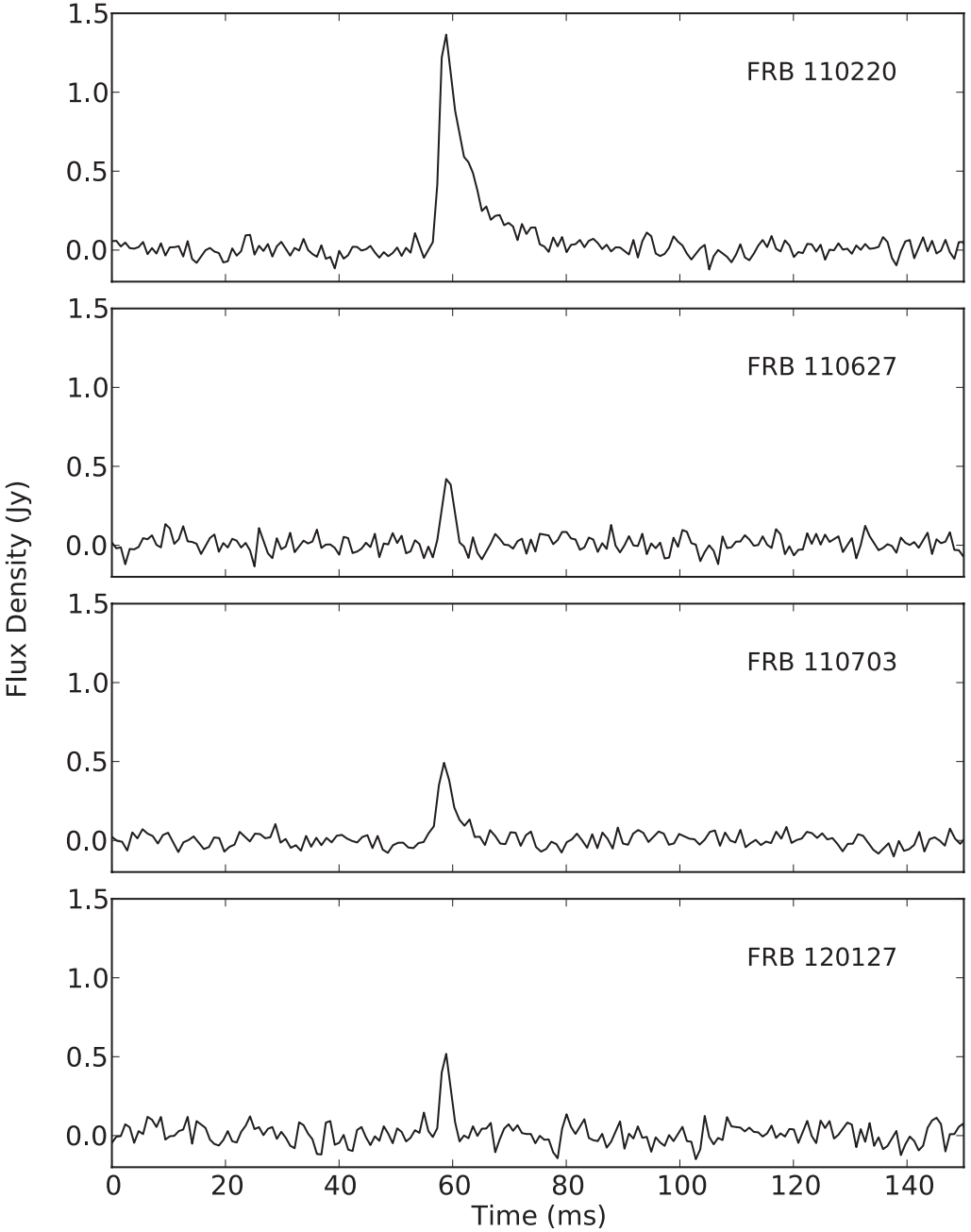
SKA FoV:
200 deg^2 @<1 GH

fast radio bursts

Thornton+ Science 13

see also Kulkarni+ arXiv:1402.4766

Parkes High Time Resolution Universe survey



S_ν~0.4-1.3 Jy @1.28-1.52 GHz

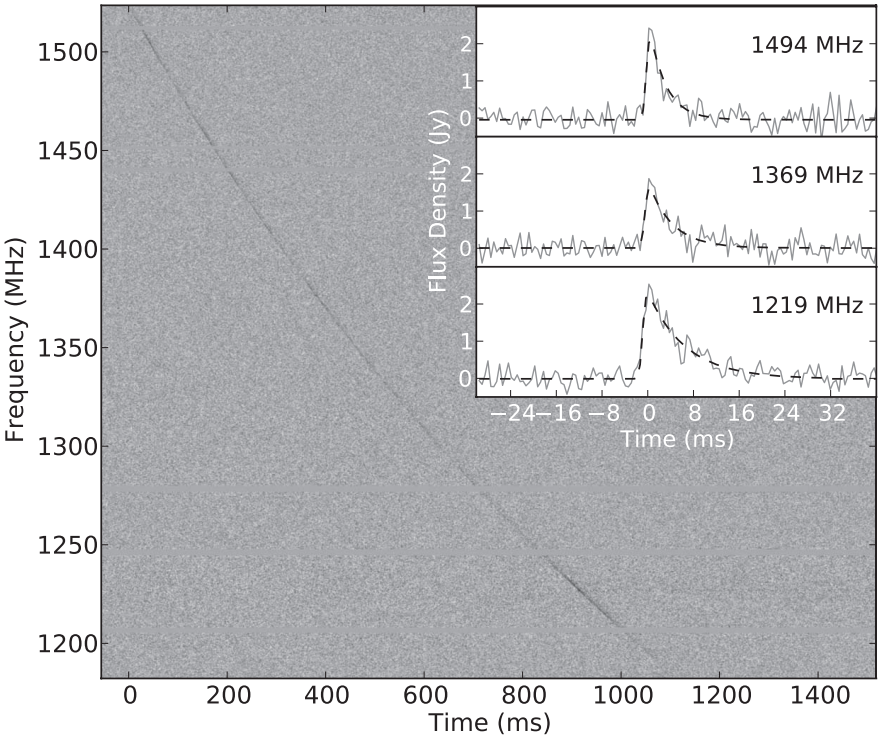
Δt~<5 ms

DM~550-1100 pc cm^{-3}

-> D~1.7-3.2 Gpc (z~0.45-0.96)

-> E~10^{37}-10^{39} erg

R_{FRB}~10^4 day^{-1}~$0.1R_{SN}$,$10R_{GRB}$!



summary divergent pointing observations

- 点源サーベイの効率向上の可能性
  銀河系外サーベイのモードとして検討中

- GRB：外部トリガーなしに発生時から捕捉可能
  long+short GRB即時放射の物理
  ローレンツ不変性破れの探査…

- ~1000 deg2に迫る広視野が望ましい
  より詳細な検出可能性

- 無バイアス突発天体サーベイ: 大きなdiscovery potential
  fast radio burstsのVHE対応天体
  -> SKA aperture arrayと同時観測
  未知との遭遇：fast VHE bursts??

  transient factory (SKA+precursors, ZTF, LSST…)に
  CTAも仲間入り?