ガンマ線バースト観測超小型衛星群CAMELOTの現状

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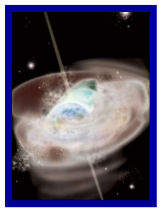
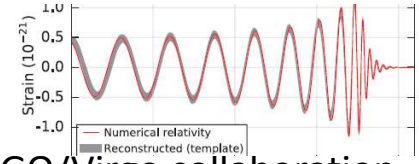
重力波天文学時代における電磁波対応天体探査

- 重力波+電磁波同時観測例(e.g. ショートGRB)の蓄積が今後の分野発展に必須
- 通常ガンマ線衛星：

  広い視野（2π str、２度の位置決定精度）or 狭い視野で数分角
- 単独衛星では地食、運用制限でチャンスを逃すこともしばしば
- **常時ガンマ線全天観測と高精度（１度以下）の天体位置決定が求められる**

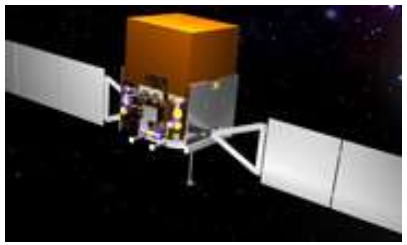
重力波、ガンマ線バースト発生

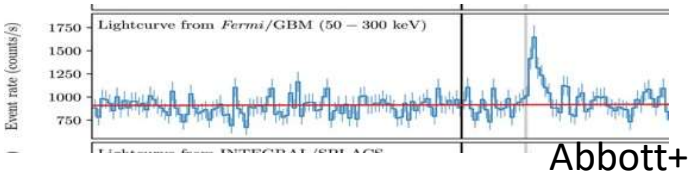




LIGO/Virgo collaboration

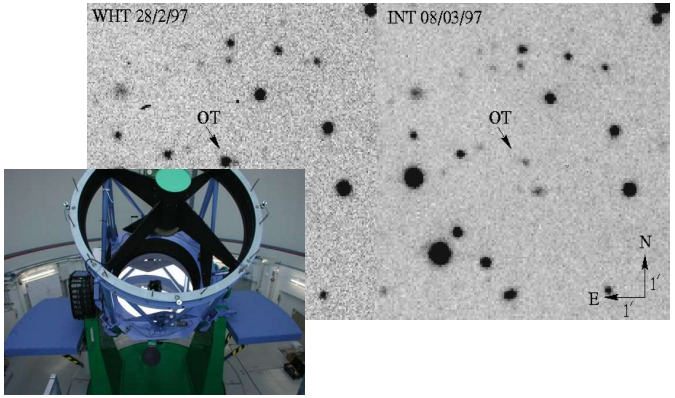
ガンマ線衛星で
粗く方向決定



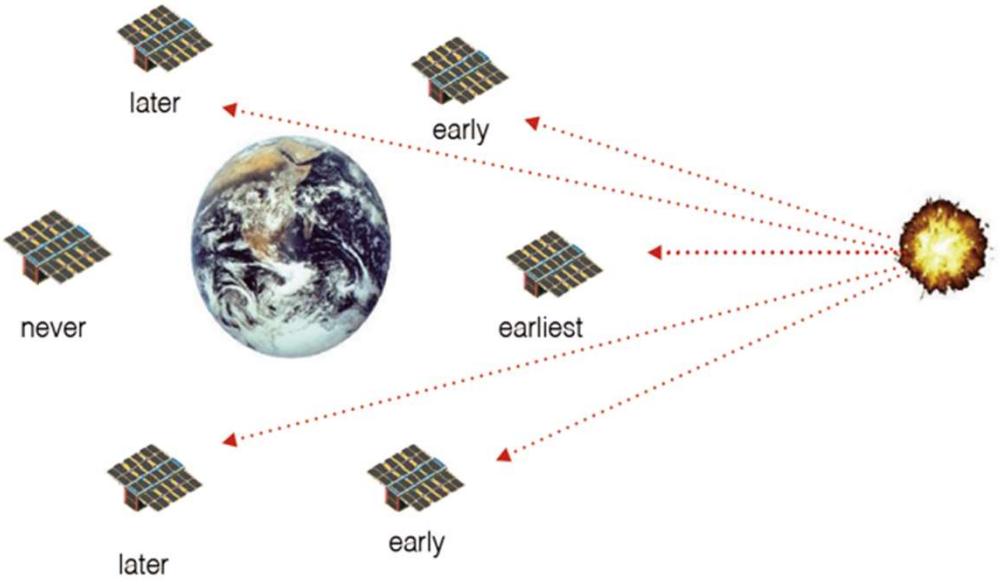


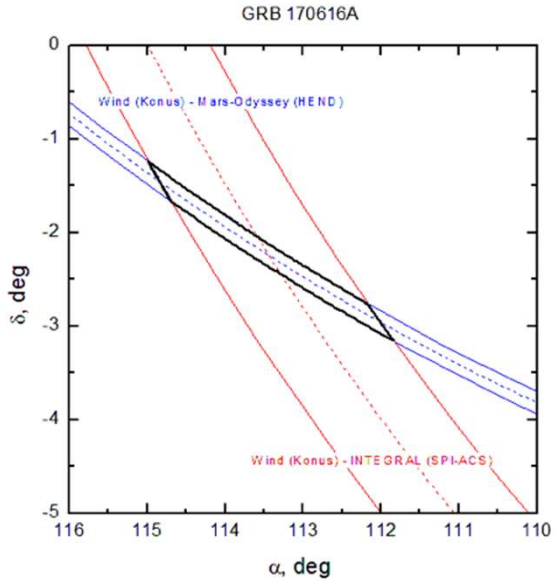
Abbott+17

可視光望遠鏡で詳細観測
（多くは視野0.5度以下）



超小型衛星群によるガンマ線全天監視





- 10を超える超小型衛星による観測
  - ➔ 常時全天監視
    大面積ガンマ線観測

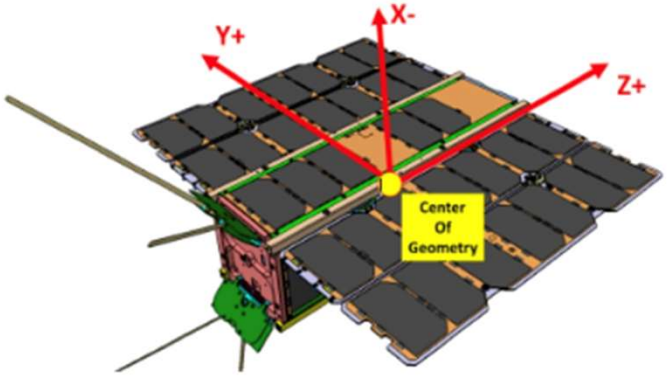
- 検出時刻差を利用した天体位置決定

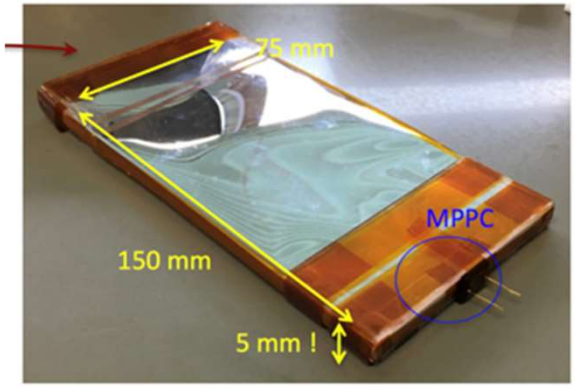
GPSによる衛星間の高精度時刻同期
➔ 100 us 以下の時刻同期精度で
degree~arcmin の位置決定が可能

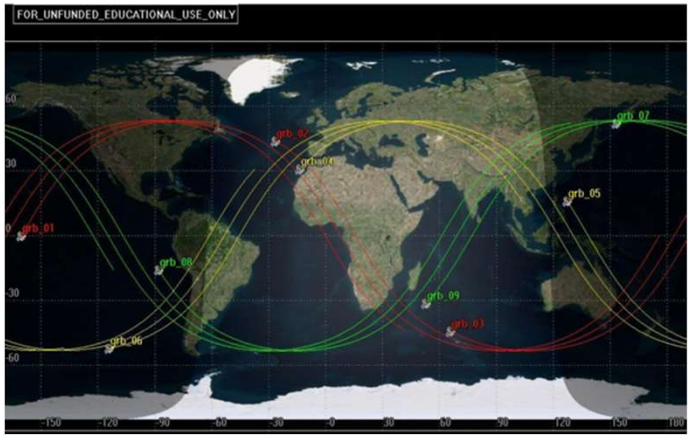
通常衛星でもなかなかできない
超小型衛星ならではの観測

“CAMELOT”
(Cubesats Applied for MEasuring and Localising Transients)

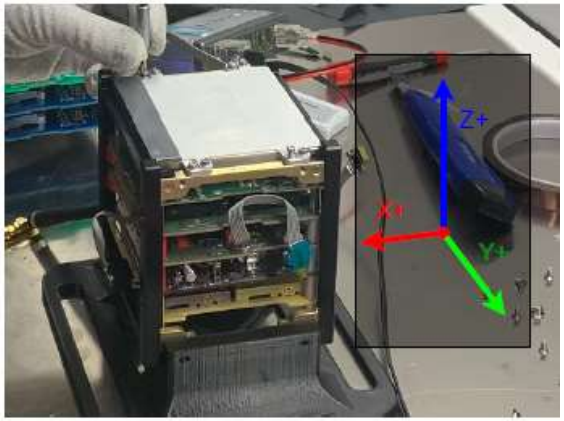
Werner et al. 2018



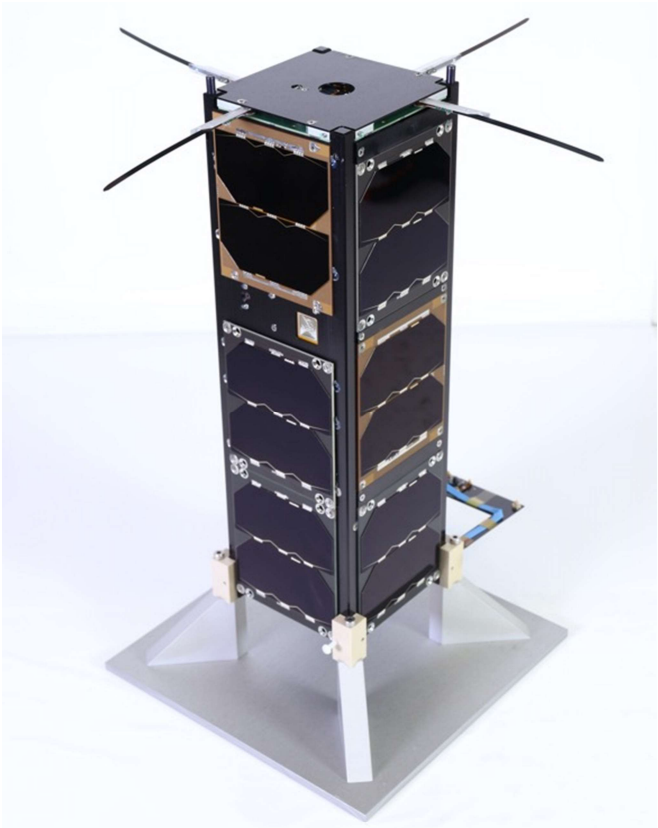




Satellite platform	**3-U Cubesat platform**
Target orbit	**>9 satellite consternation in LEO with various orbital configuration**
Payload	**150x75x5 mm^3 CsI readout by multi-channel (4chx2) MPPCs**
Goal	**SubDegree-scale timing-based localization with a similar sensitivity to the Fermi-GBM detector**



GRBAlpha
(2021.3 launch)



VZLUSAT-2
(2022.1 launch)

2024年に３号機を打ち上げ計画

GRBAlpha: 取得データの公開

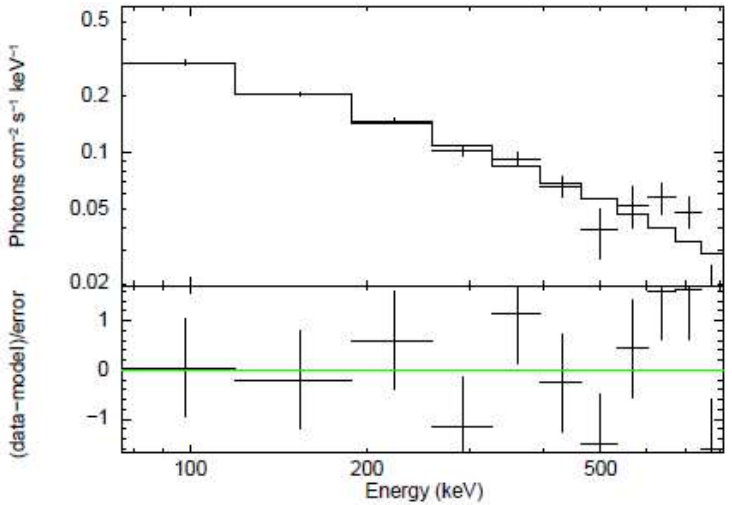
	GRBAlpha 2021.3-	VZLUSAT-2 2022.1-
GRB(short)	39(4)	25(6)
Solar flare	17	24
SGR	3	5

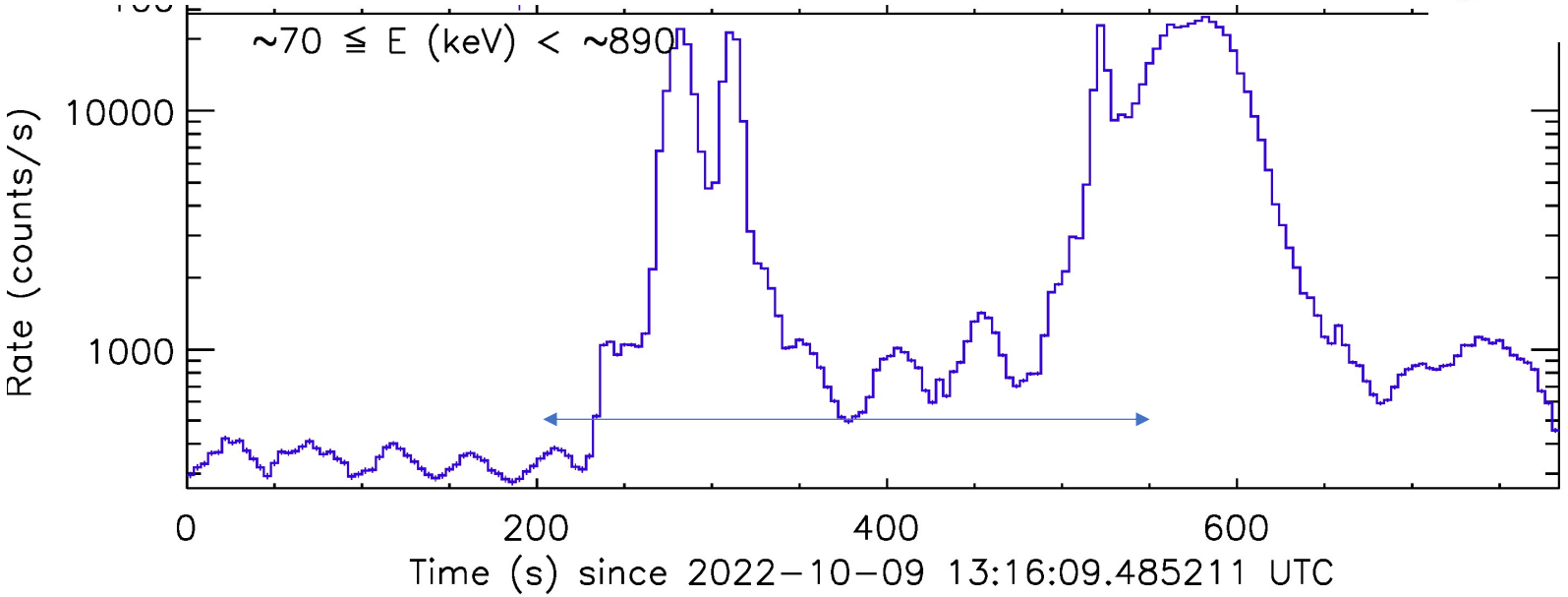
As of 2023.9.8

GRBAlpha

VZLUSAT-2

GRBAlpha detected and measured the flux of the brightest **GRB 221009A**.

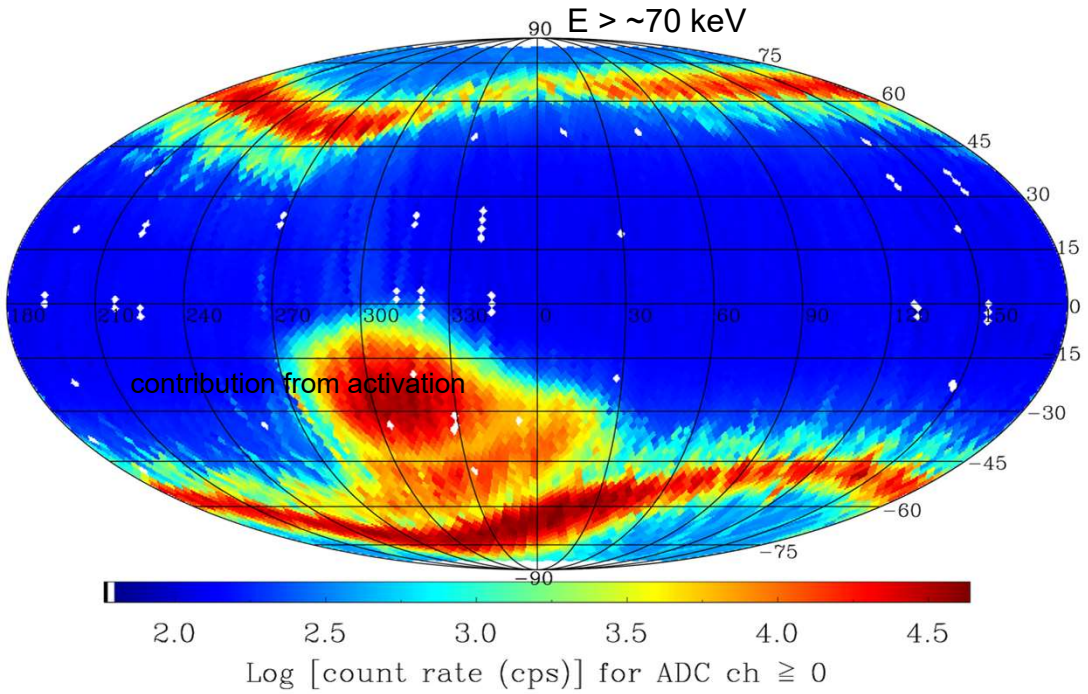




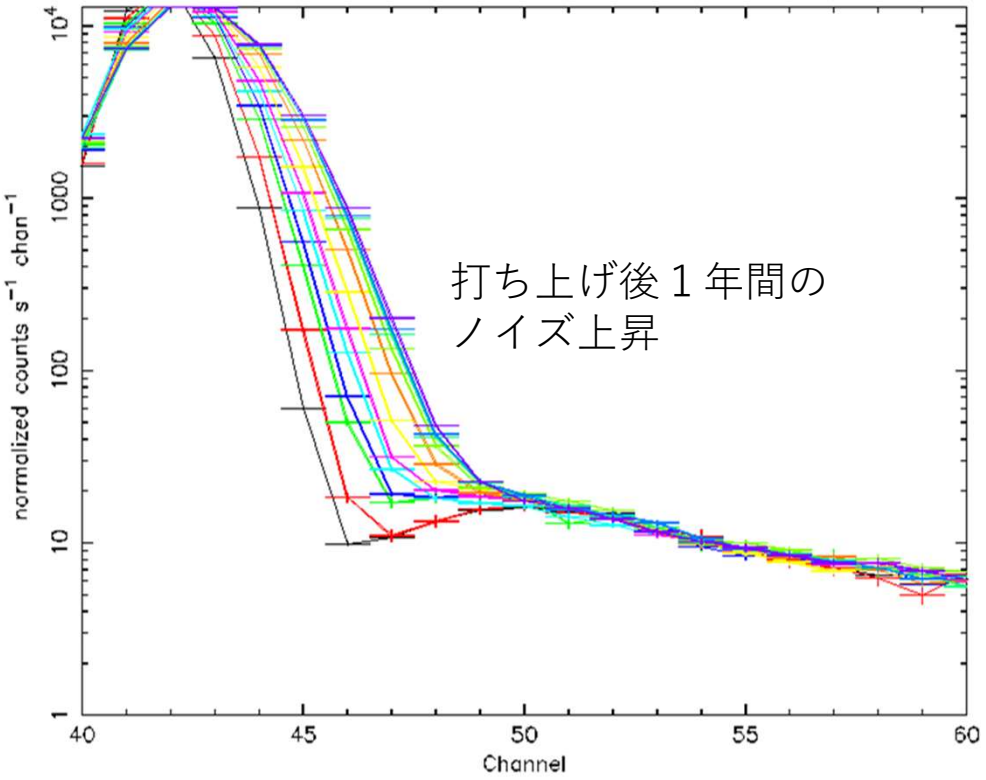
Ripa et al. 2023, Astro-ph/A&A in press

今後の超小型衛星などへの貴重なデータを得つつある

極軌道での放射線環境



軌道上でのSiPMの放射線劣化



ADC　チャンネル