

ガンマ線バースト観測超小型衛星群CAMELOTの現状

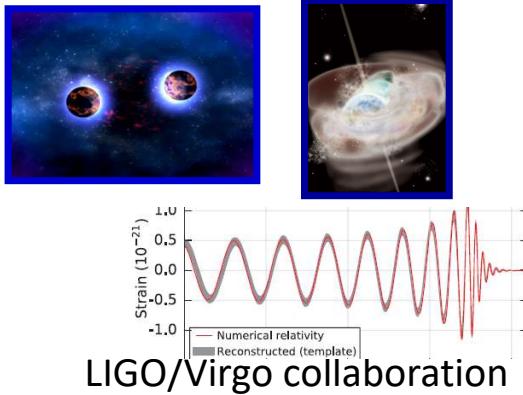
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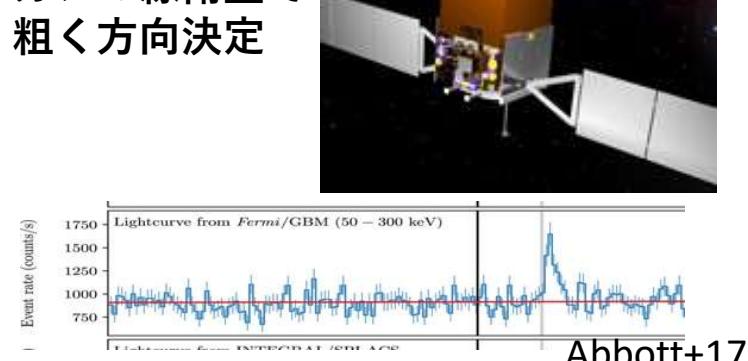
重力波天文学時代における電磁波対応天体探査

- 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 狹い視野で数分角
- 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

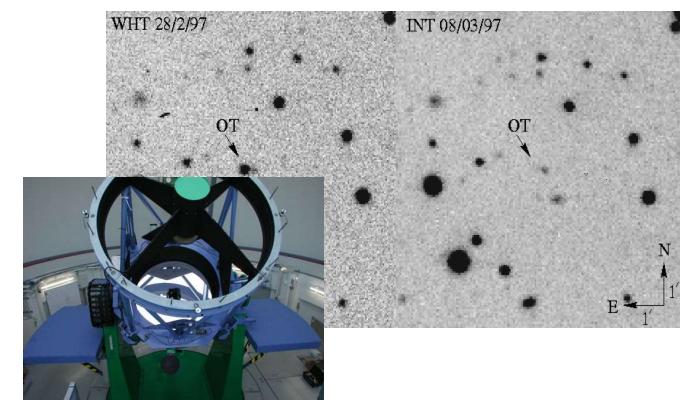
重力波、ガンマ線バースト発生



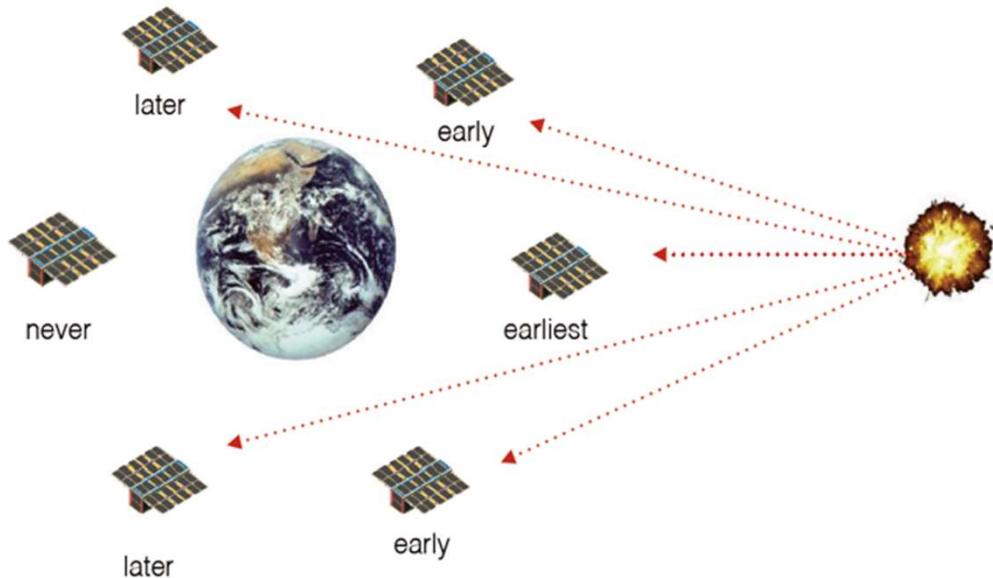
ガンマ線衛星で
粗く方向決定



可視光望遠鏡で詳細観測
(多くは視野0.5度以下)

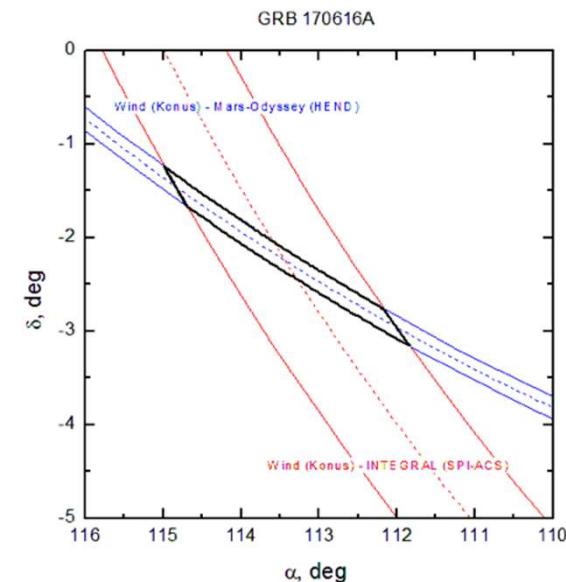


超小型衛星群によるガンマ線 全天監視



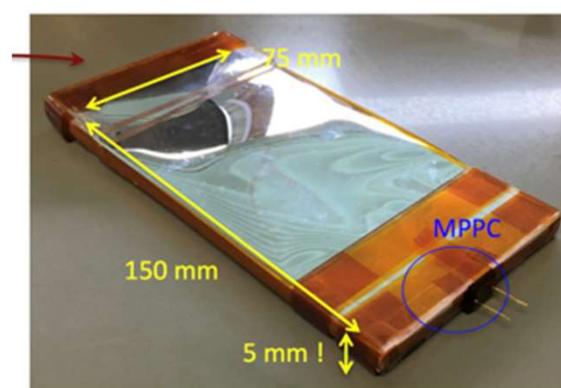
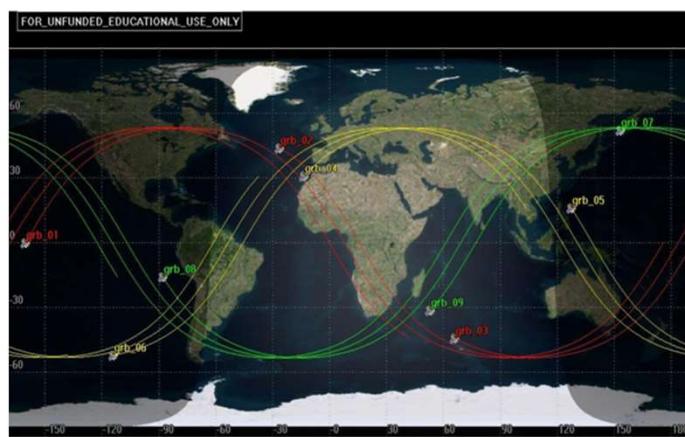
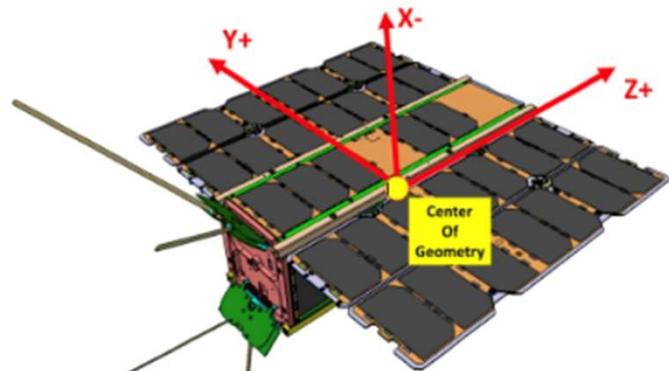
- 10を超える超小型衛星による観測
→ 常時全天監視
大面積ガンマ線観測

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

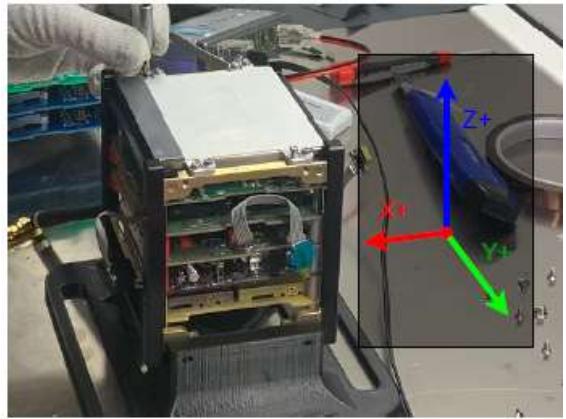


- 検出時刻差を利用した天体位置決定
GPSによる衛星間の高精度時刻同期
→ 100 us 以下の時刻同期精度で
degree~arcmin の位置決定が可能

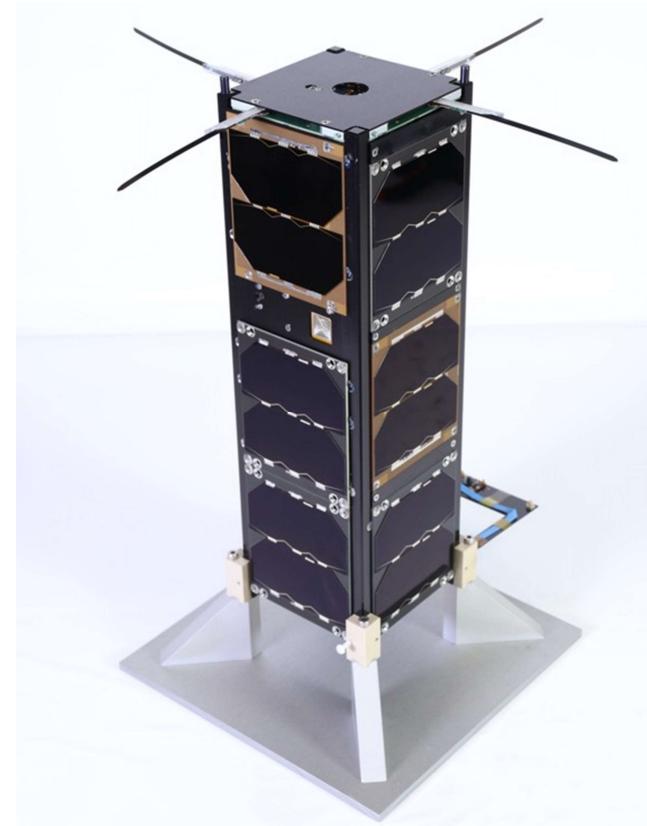
“CAMELOT” (Cubesats Applied for MEasuring and Localising Transients)



Satellite platform	3-U Cubesat platform
Target orbit	>9 satellite consternation in LEO with various orbital configuration
Payload	150x75x5 mm³ 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 VZLUSAT-2
2021.3- 2022.1-

GRB(short)	39(4)	25(6)
Solar flare	17	24
SGR	3	5

As of 2023.9.8

Event type/name	Peak time (UTC)	T90 [s]	Count rate [cts/s]	Band [keV]	S/N [et]	Raw LC	Bkg-sub LC	LC perf [d]	GCN circ.	References	Comment
GRB 221119A	2022-11-19 15:05:55.2	54	299.8	-70-890	23.5	PNG EPS	PNG EPS	1	32653	GRB-AM INTEGRAL-SPIACS Fermi-GBM	
GRB 221112A	2022-11-12 06:18:04.2	15	39.6	-70-890	3.4	PNG EPS	PNG EPS	1	32637	Fermi-GBM	
Solar flare	2022-11-11 13:49:12.2	10	92	-70-890	7.4	PNG EPS	PNG EPS	1		Fermi-GBM GOES GCOM	
Solar flare	2022-11-11 05:54:49.2	44	52	-70-890	4.6	PNG EPS	PNG EPS	1		Fermi-GBM GOES	
GRB 221107A	2022-11-07 01:23:58.2	265	105.8	-70-890	9.3	PNG EPS	PNG EPS	1	32617	Fermi-GBM Suzaku-BAT GCAM	
GRB 221029A	2022-10-29 01:05:27.8	36	57.3	-70-890	9.8	PNG EPS	PNG EPS	4	32690	Fermi-GBM INTEGRAL-SPIACS	
GRB 221022B	2022-10-22 23:46:11.8	32	170.5	-70-890	22.8	PNG EPS	PNG EPS	4	32644	Fermi-GBM MAGIC-IM-AL Wind-Konus	

GRBAlpha



extraordinarily bright GRB

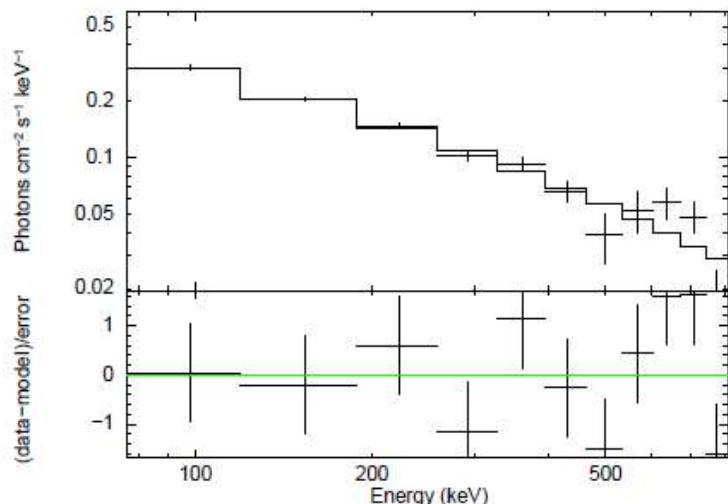
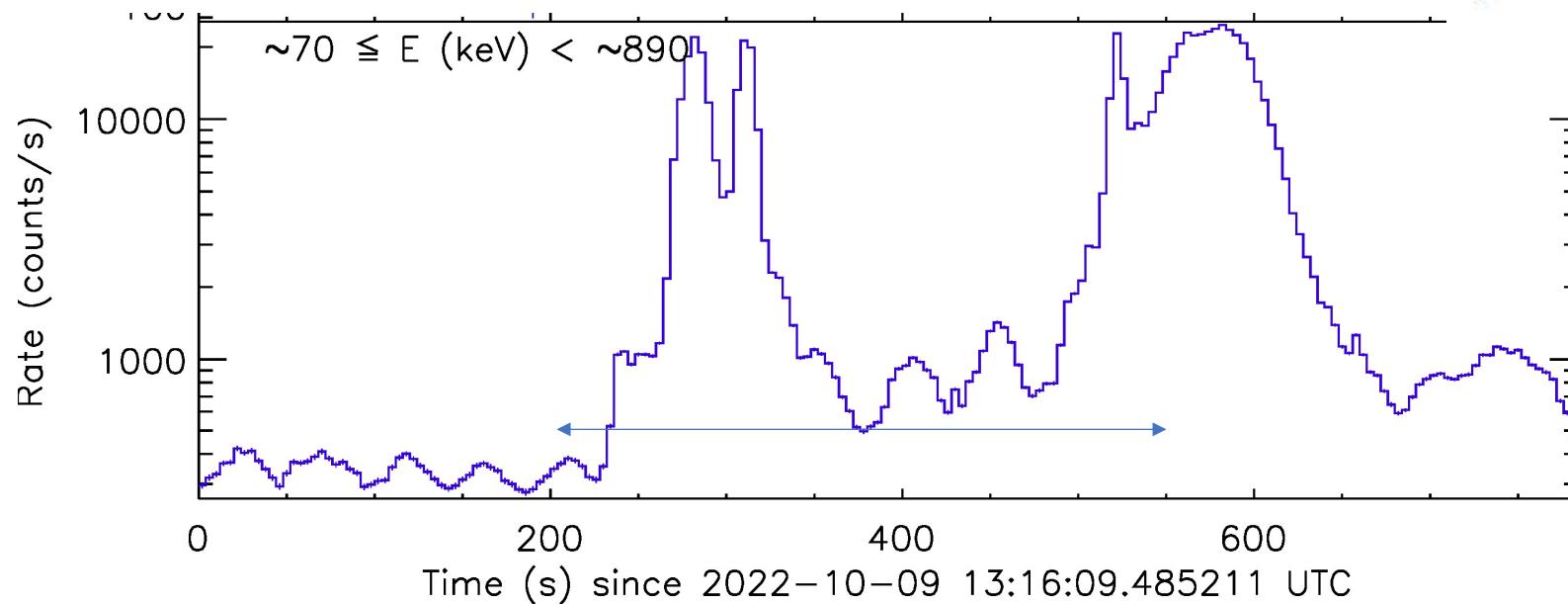
We acknowledge help by Aaron Tolosayevich

near outer Van Allen radiation belt



VZLUSAT-2

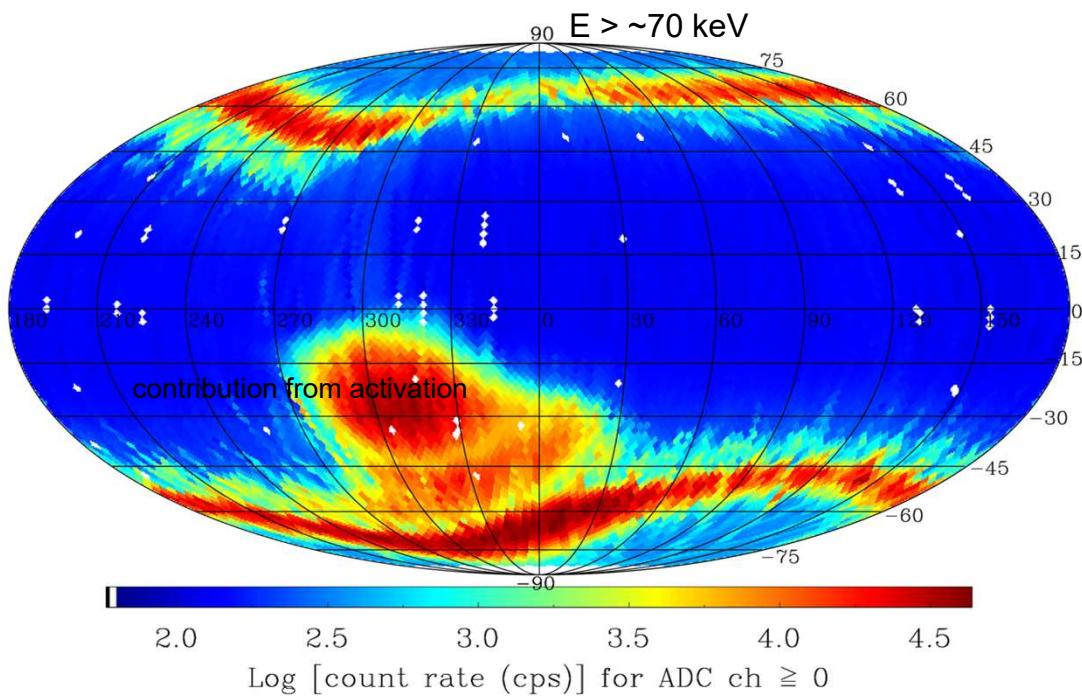
GRBAlpha detected and measured the flux
of the brightest **GRB 221009A**.



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

