

Observations, modelling, interpretation of Gamma Ray Bursts

"PROGRAMMA"



Giancarlo Ghirlanda on behalf of the GRB@MI group - 25/05/2021

GRB@MI



Scientific context

Stellar & Galactic astronomy



Relativistic Astrophysics

Gravitational waves

UHECR & ν

Program Objectives: 1) Physics of GRBs 2) Nature of progenitors 3) Cosmic evolution 4) GRBs in MM context •GW counterparts •UHE particles 5) Early Universe

Early Universe







Team composition

M.G. Bernardini S. Campana S.Covino



A. Melandri



L. Nava



R. Salvaterra

P. D'Avanzo

O.S. Salafia



M. Branchesi





S. Ronchini





R. Spinelli



M. Colpi



M. Toffano





S. D. Vergani







Galaxies Étoiles Physique et Instrumentation





Team composition & roles

Swift (G. Tagliaferri)

GRB @ OAS (E. Pian)

M. Branchesi

GRAWITA (E. Brocato)



A. Melandri

M.G. Bernardini



T. Sbarrato P. D'Avanzo



G. Tagliaferri



Onde Gravitazionali d controparti

M. Colpi

polazione & struttura get



R. Spinelli



S. Ronchini

Einstein Telescope (M. Branchesi)

VIRGO

(L. Grado)



O.S. Salafia

GraPhJC (A. Stamerra)

> PROGRESS (L.A. Antonelli)



G. Ghirlanda







Highlights 1 - The physics of prompt and afterglow





Signatures of Synchrotron emission

Infer properties of emission region

Explore role of proton emission

Objectives: 1.Prompt emission 2.MeV-GeV-TeV 3.Particle acceleration UHE and Neutrinos 4.Energy content/transport/dissipation 5.Ambient medium 6.... the unexpected

Data: Swift; MW (+TNG, LBT, SRT, EVN)

Constrain the ambient medium properties and jet structure/energy

Model of afterglow emission:

- Jet structures
- Jet dynamics
- Forward and Reverse shock emission
- SSC



Highlights 2 - Jet structure and progenitors





Data: GRB with redshifts

Orientation dependent properties Towards an unification scheme Objectives:

1.Jet structure - ambient - progenitor

2.Key signatures of jet structure

3.Constrain the free parameter space

4.Unification models

5.... the unexpected

Semi-analytical and numerical studies of jet structure

SHORT GRB progenitors



n black hole - neutron star merger



Highlights 3 - Gravitational Waves and their EM counterparts



time after merger [days]

Successful jet and its structure

Objectives:

1.KN physics & diversity

2.MM inferences

3.BHNS systems

4.Standard sirens

5.... the unexpected



Highlights 4 - Hosts and cosmic evolution



Long GRBs and hosts characteristics

Data: GRB with redshifts (Swift complete sample)

Cosmic evolution of the population(s)

Objectives:

1.Host clues on progenitors

2.GRB-SN connection

3.Cosmic reionization

4.First (metal free) stars

5.Constraints on SFR at high redshifts

6.... the unexpected



Organization and activities





Impact and Leadership



GRB@MI				
Collaboration/project	Working Group	Role		
Swift	Operation, data and scientific expl.	Italian Pi-ship		
GRAWITA	Science Board, WG1, WG3	Member, Leader, Le		
STARGATE	Short GRB program, polarimetry	Co-Chair, Co-Chair		
ENGRAVE	GC, EC, WG-EXT	Member, Member, L		
CIBO	Italian GRB follow up	Co-Chair		
LVC	Prometeo sub-group	Member		
MAGIC	Transient Working Group	Convener		
SVOM	Science Working Group	Co-Ivestigator		
THESEUS	WG4 population and science	Coordinator		
Hermes	Science Working Group	Deputy coordinator		
Athena	Transients Working Group	Member		
COSI	INAF participation	Member		
СТА	Transients Science Working Group	Coordinator GRB cc		
SKA	Transient Science Working Group	Member		
Einstein Telescope	OSB Div.4 - MM Observations	Co-Chair		

Alta formazione (solo personale INAF):

- 1) PhD ~ 2 ogni ciclo
- 2) Tesi magistrali ~ 5 ogni anno
- 3) Tesi triennali ~ 3 ogni anno





Funds, personnel and critical aspects

Programma: inizio 2000

Stima inviluppo complessivo FTE INAF (TI) fino a 2020 ~ 83 (45) Stima inviluppo complessivo FTE fino a 2020 ~ 105

PRIN - INAF (2005, 2009, 2012, 2017) ASI - 2006 Premiale - MIUR 2018

Fino $2020 \approx 30 - 40 \text{ K/yr}$ (Excluding contracts)

Fondi	2021	2022	2023
PRIN-INAF (SKA-CTA)	(7)	0	0
Premiale MUR FIGARO (INAF co-I)	(10)	0	0

Proposte					
PRIN MUR	0	115	115		

- 1) Assegni di ricerca
- 2) Materiale per la ricerca scientifica
- 3) Missioni
- 4) Organizzazione meeting

2 TI (Dir. Ric.) INAF in quiescenza entro 2023

Necessario assumere personale a TI per sostenere lo sviluppo del programma con profili:

- Osservazione/analisi dati multi-frequenza 1) e multi-messenger
- 2) Sviluppo di modelli teorici per l'interpretazione

Supporto al (co)finanziamento di borse di dottorato dedicate





anchesi A. Sum Melandri V Tagliaferriscon L Stolla AL South V. D'Elia M. E. Ravasio S. Ronchini T. Startsto alafia G. Tagliaferri L. Stella M. Y. 200 States Starts G. Tagliaferri L. Stella M. Y. 200 States Starts S. Ronchini T. Startsto M. J. Startsto S. Ronchini T. Startsto M. Startsto M. J. Startsto M. J. Startsto M. Startsto M. Startsto M. J. Startsto M. J. Startsto M. J. Startsto M. J. Startsto M. Startsto M. J. Startsto M. Startsto M. J. Startsto M. Startsto M. J. Startsto M. J. Startsto M. J. Startsto M. J. Startsto M. Star R Salvaterra RS Au S. D. Vergani M. Branchesi M. Carer FL Nesha Campana L. Narh M. Startin F. Dirihang Willia Marrow M. Schwein O. Rossini S Corgania R O. COMO S. Ronchini P. Dirvance G. Ghirlanda

GRBANI

Thank you

