{{Infobox GRB

| name = GRB 970508

| image = [[File:StisI.gif|200px|center]]

| caption = GRB 970508爆發一個月後拍攝。

| credit =

| detected = 21:24 [[UTC]]</br>[[1997年]][[5月8日]]

| detected\_by = [[BeppoSAX衛星]]</br>[[康普頓伽瑪射線天文台]]</br>[[尤利西斯號]]

| duration = 15秒

| ra = {{RA|06|53|49}}<ref name="Djorgovski">[[#Djorgovski|Djorgovski 1997]]</ref>

| dec = {{DEC|+79|16|19.6}}<ref name="Djorgovski"/>

| z = 0.835 ≤ ''z'' ≤ 2.3

| dist\_ly = 6 × 10<sup>9</sup>[[光年]]

| host =

| appmag\_v = 19.6

| energy = 5 × 10<sup>50</sup>[[爾格]] (5 × 10<sup>43</sup>[[焦耳]])

| names =

}}

'''GRB 970508'''是一次於1997年5月8日21:42 UTC發生的[[伽瑪射線暴]]（GRB） 。伽瑪射線暴是一次伽瑪射線的瞬間增強，通常與遙遠星系的爆炸相關，放射出[[電磁波]]中能量最強的波頻：[[伽瑪射線]]，並且在之後的一段長時間內放射波長較短的“餘輝”（[[X射線]]、[[紅外線]]、[[可見光]]、[[紅外線]]和[[無線電波]]）。

GRB 970508是被安裝在[[X射線天文學]]衛星[[BeppoSAX衛星|BeppoSAX]]上的伽瑪射線暴監視系統探測到的。天文學家Mark Metzger斷定了GRB 970508的爆發點距離地球60億[[光年]]，這是人們第一次量度伽瑪射線暴的距離。

這次爆發前，天文學界並沒有一致認同伽瑪射線暴會在距離地球多遠的地方發生。一些學家認為它們發生在[[銀河系]]以內，但因為能量不高而顯得暗淡；其他學家則認為它們發生在宇宙[[物理宇宙學|大尺度]]距離上，並不發生在銀河系內，而且能量極高。儘管伽瑪射線暴可能有很多種，意味著兩種理論可以共存，但是這次量度出來的大距離明確地證明射線暴發生在銀河系外。

GRB 970508也是第一個探測到放射[[無線電波]]“餘輝”的伽瑪射線暴。天文學家Dale Frail利用無線電波強度的波動，得以算出其來源膨脹的速度幾乎達到[[光速]]。這提供了有力的證據，證明伽瑪射線暴是[[相對論]]性的爆炸。

==發現==

[[File:BeppoSAX.jpg|thumb|left|藝術家對BeppoSAX衛星的假想圖]]

第一個伽瑪射線暴是在1967年由[[維拉號]]人造衛星（一系列用於探測太空中核爆的衛星）。<ref>[[#Schilling|Schilling 2002]], pp. 12&ndash;16</ref>第一個被觀測到的伽瑪射線暴餘輝是[[GRB 970228]]的X射線餘輝，<ref>[[#Costa|Costa 1997]]</ref>由[[BeppoSAX衛星]]（一顆意大利—荷蘭人造衛星，主要任務是研究X射線）發現。<ref>[[#Schilling|Schilling 2002]], pp. 58&ndash;60</ref>

於1997年5月8日21:42 UTC，BeppoSAX衛星上的伽瑪射線監視儀器記錄到了一個伽瑪射線暴，其時長為15秒。<ref>[[#Pedersen|Pedersen 1997]]</ref><ref name=Sc115/>這次爆發也被研究太陽的[[尤利西斯號]]及[[康普頓伽瑪射線天文台]]上的“爆炸及瞬時爆發源實驗”探測到，<ref>[[#Kouveliotou|Kouveliotou 1997]]</ref>並位於BeppoSAX衛星兩個X射線廣角相機的拍攝範圍內。幾個小時以內，BeppoSAX衛星工作小組就將其位置固定在一個直徑大約10[[角分]]的誤差範圍內。<ref name=Sc115>[[#Schilling|Schilling 2002]], pp. 115&ndash;116</ref>

<br clear=all/><!---This formatting is in place for wide shallow screens. If you can't see what it does, then it doesn't apply on your screen. Leave it.--->

==觀測==

[[File:USA.NM.VeryLargeArray.02.jpg|thumb|left|位於[[新墨西哥州]]的[[甚大天線陣]]]]

確定好射線暴的粗略位置之後，BeppoSAX工作小組成員Enrico Costa聯絡了[[美國國家射電天文台]][[甚大天線陣]]的天文學家Dale Frail。Frail在01:30 UTC（發現後4小時內）開始於20厘米[[波長]]做觀測。<ref name=Sc116/>Frail在準備觀測的時候，聯絡了正在操作[[海爾望遠鏡]]的天文學家Stanislav Djorgovski。Djorgovski馬上對照了他的照片與[[數位巡天]]的較老照片，但並沒有發現誤差範圍以外的新信號。Djorgovski在[[加州理工學院]]的同事對數據進行了更多分析，但也找不到任何新信號。<ref name=Sc116>[[#Schilling|Schilling 2002]], pp. 116&ndash;117</ref>

第二晚，Djorgovski再次觀測同一區域。他比較了兩晚的圖片，但沒有天體在5月8日至9日明顯減弱了光度。<ref name="teams"/>Metzger注意到有一顆星體增加了亮度，但他估計那是顆[[變星]]，而不是伽瑪射線暴。由Jan van Paradijs率領的一個[[阿姆斯特丹]]研究團隊成員Titus Galama和Paul Groot對比了WIYN望遠鏡於8號和[[威廉·赫歇爾望遠鏡]]於9號所拍攝的照片，同樣未能發現在此時段減弱亮度的光源。<ref name="teams"/>

發現了此次射線暴的X射線余光之後，BeppoSAX團隊提供了一個更準確的方位，而Metzger之前以為是變星的星體仍然在這個誤差較小的範圍內存在。加州理工大學團隊和阿姆斯特丹的團隊均未發布任何有關這顆天體的結論。5月10日[[空間望遠鏡研究所]]的[[霍華德·邦德]]發布了他的發現，<ref>[[#Bond|Bond 1997]]</ref>並由之後的可見光余光證實。<ref name="teams">[[#Schilling|Schilling 2002]], pp. 118&ndash;120</ref>

1997年5月10日晚之11號清晨，Metzger的同事Charles Steidel在[[凱克天文台]]錄得了該星體的[[光譜]]，<ref name="S121"/>並將數據交給Metzger。Metzger其後辨認了一組[[鎂]]和[[鐵]]的[[吸收譜線]]，得出[[紅移]]值為''z'' = 0.8349 ± 0.0002，<ref>[[#Varendoff|Varendoff 2001]], p. 383</ref><ref name="MetzCircular">[[#MetzCircular|Metzger 1997a]]</ref><ref name="MetzJournal">[[#MetzJournal|Metzger 1997b]]</ref>表示來自射線暴的光線已被大約60億[[光年]]以外的物質吸收。<ref>[[#Katz|Katz 2002]], p. 148</ref>儘管射線暴本身的紅移還未被確認，但是我們能夠推論射線暴來自更加遙遠的地方，因為吸收光譜的物質必須處於地球與射線源之間。<ref name="S121">[[#Schilling|Schilling 2002]], pp. 121–123</ref><ref>[[#Katz|Katz 2002]], p. 149</ref>光譜中缺少[[莱曼α森林]]，因此限制了紅移值''z'' ≤ 2.3。<ref name="MetzCircular"/><ref name="MetzJournal"/>[[芝加哥大學]]的Daniel E. Reichart進一步的研究指出''z'' ≈ 1.09。<!--Lyman-alpha forest needs a short explanation.-->這是第一次科學家能夠量度伽瑪射線暴的紅移<ref>[[#Schilling|Schilling 2002]], p. 120</ref><ref>[[#Reichart|Reichart 1998]]</ref>[[卡拉阿托天文台]]錄得了數條可見光光譜，波長位於{{convert|4300| angstrom|nm|lk=on|abbr=on}}至{{convert|7100| angstrom|nm|lk=on|abbr=on}}和{{convert|3500| angstrom|nm|abbr=on}}至{{convert|8000| angstrom|nm|abbr=on}}，但並未發現發射譜線。<ref name="Castro">[[#Castro|Castro-Tirado 1998]]</ref>

GRB 970508被發現後5天，於5月13日，Frail繼續用甚大天線陣進行觀測。<ref name="Sch124"/>他在射線暴處觀察波長3.5[[厘米]]，並立即探測到強信號。<ref name="Sch124"/>24小時之後，這個信號明顯增強，另外他也探測到波長為6厘米和21厘米的信號。<ref name="Sch124"/>這是第一次確認發現了伽瑪射線暴的無線電余光。<ref name="Sch124">[[#Schilling|Schilling 2002]], p. 124</ref><ref name="Katz147">[[#Katz|Katz 2002]], p. 147</ref><ref>[[#NRAO|NRAO 1997]]</ref>

之後的一個月內，Frail觀測到這個無線電源的亮度各天有著明顯的波動，但平均持續上升。不同波長信號的波動並不一致，[[普林斯頓大學]]的Jeremy Goodman解釋這是因為銀河系中星體間的[[電漿]]導致了無線電波的曲折。<ref name="Katz147"/><ref name="Sch125"/>只有當放射源的視直徑小於3微角秒，這種無線電亮度的迅速變化才會發生。<ref name="Sch125">[[#Schilling|Schilling 2002]], p. 125</ref>

==特性==

在能量範圍為40至700[[電子伏特|keV]]間運作的BeppoSAX伽瑪射線暴檢測器錄得了(1.85 ± 0.3) × 10<sup>−6</sup> [[爾格|erg]]/cm<sup>2</sup> （1.85 ± 0.3 [[焦耳|nJ]]/m<sup>2</sup>）的[[積分通量]]，而Wide Field Camera（2&ndash;26 keV）測得(0.7 ± 0.1) × 10<sup>−6</sup> erg/cm<sup>2</sup>（0.7 ± 0.1 nJ/m<sup>2</sup>）的積分通量。<ref>[[#Galama|Galama 1998]]</ref>爆发和瞬变源试验设备（BATSE）（20&ndash;1000 keV）錄得(3.1 ± 0.2) × 10<sup>−6</sup> erg/cm<sup>2</sup>（3.1 ± 0.2 nJ/m<sup>2</sup>）的積分通量。<ref>[[#Kouveliotou|Kouveliotou 1997]]</ref>

爆發後大約5小時，該天體在[[測光系統|U頻]]（光譜的紫外線區域）的[[視星等]]為20.3 ± 0.3，在R頻（光譜的紅色區域）為21.2 ± 0.1。<ref name="Castro"/>首次探測到爆發後大約兩天，余光在兩個光譜區域達到亮度頂峰值，U頻的19.6 ± 0.3於5月11日02:13 UTC，和R頻的19.8 ± 0.2於5月10日20:55 UTC。<ref name="Castro"/>

在[[基特峰國立天文台]]的天文學家James E. Rhoads分析了射線暴，並發現它的輻射的方向性不強。<ref>[[#Rhoads|Rhoads 1999]]</ref><!--When did Rhoads become involved in studying the GRB? Who did he suggest this to?-->Frail和他的同事進行進一步的分析，算出爆發放出的總能量約為5×10<sup>50</sup> ergs（5×10<sup>43</sup> J），而Rhoads得出伽瑪射線的總能量約為3×10<sup>50</sup> erg（3×10<sup>43</sup> J）。<ref name="Pac"/>這表示此次爆發的伽瑪射線與噴射物的動能相當，因此可以排除任何不能有效製造伽瑪射線的射線暴模型。<ref name="Pac">[[#Pac|Paczyński 1999]], p. 2</ref><!--Did it rule out the models? Did other astronomers agree that the models were invalidated?-->

==距離尺度與發射模型==

這次爆發之前，天文學家對伽瑪射線暴的距離並沒有一致的觀念。儘管爆發的[[均向性]]表示他們並不在[[銀河系]]平面上發生，一些天文學家提出這些射線暴在銀河系的[[螺旋星系#星系的扁球體|扁球體]]內發生，而其亮度不高是因為放射的能量不高。也有人認為射線暴發生在[[物理宇宙學]]範圍內的其他星系中，它們能被探測到是因為能量極高。所量度的距離和計算出來的射線暴釋放的總能量都支持後者理論，一場爭論就此結束。<ref>[[#Schilling|Schilling 2002]], p. 123</ref><!--This is a very confusing conclusion. Are there multiple types of GRBs, or did this end the debate in favor of one type? -->

整個5月，無線電訊號的波動逐漸消失。這表示自從探測到爆發之後，這無線電源顯著地擴大了。利用已知的距離和波動消失的時間，Frail算出無線電源幾乎以[[光速]]膨脹。<ref>[[#Waxman|Waxman 1998]]</ref>現有的模型已經包括了以[[相對論]]速度膨脹的可能性，但這是第一次有強烈的證據支持這一理論。<ref>[[#Schilling|Schilling 2002]], p. 126</ref><ref>[[#Piran|Piran 1999]], p. 23</ref>

==主星系==

[[File:GRB 970508 STIS August 1998.gif|thumb|right|GRB 970508的主星系，攝於1998年8月]]

GRB 970508的余光在爆發被探測之後19.82天後達到頂峰亮度值，並其後以[[冪定律]]斜度減弱超過100天。<ref name="Fruchter"/>余光最終消失，顯示出其寄主：一個不斷製造恆星的矮星系，[[視星等]]為''V'' = 25.4 ± 0.15。<ref>[[#Bloom|Bloom 1998]]</ref><ref name="Fruchter"/>這個星系符合[[扁率]]為0.70 ± 0.07的[[指數盤]]。<ref name="Fruchter"/>GRB 970508可見光余光的紅移為''z'' = 0.835，與主星系''z'' = 0.83的紅移值相符，表示與過去觀測的射線暴有所不同，GRB 970508可能和一個[[活動星系核]]相關。<ref name="Fruchter">[[#Fruchter|Fruchter 2000]]</ref>

==備註==

{{reflist|colwidth=25em}}

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