台灣宇宙電波爆廣角監測實驗（BURSTT）

什麼是快速電波爆(Fast Radio Bursts)？

快速電波爆(簡稱FRB)是現代天文學中的一個謎團！FRB源於太空、持續時間約千分之一秒、是物理機制未知的明亮電波瞬變事件。自2007年以來，已經有600多個FRB被記錄，其中有二十幾個有重複爆發過。科學家已經提出超過50種模型想解開這個謎團，但目前還沒有一個模型可以解釋所有的觀測現象。隨著越來越多的觀測結果出現，天文學家正在就幾個重要問題進行爭論，「所有FRB都會重複嗎？」就是其中一個懸而未決的謎題。使用特長基線干涉儀(VLBI)技術對其宿主(星系)和環境定位，將是了解FRB性質的關鍵。由於FRB在天空中無處不在，一座同時具有大視野(廣角)和超長基線定位能力的新型望遠鏡將能得到大量FRB與宿主的觀測資料，這無疑能改變未來FRB時代的知識前沿。大視野確保能看到大量的明亮爆發源，也就是離我們較近的事件。

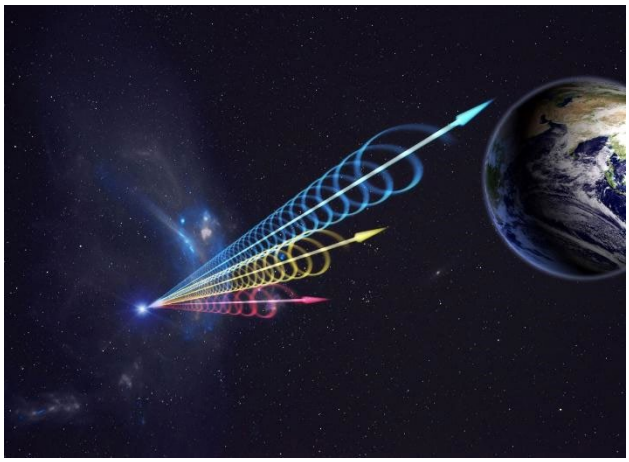
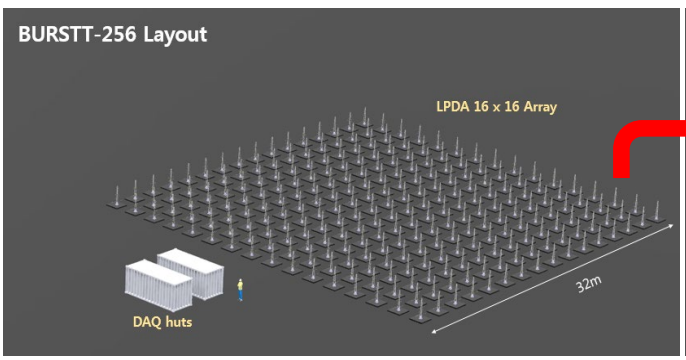


圖1：插畫家筆下FRB傳訊到地球的示意圖。顏色代表不同波長的電波，波長較長（紅色）的訊號會比波長較短（藍色）的訊號延遲幾秒鐘到達，這是由於電波穿越宇宙電漿造成的現象，稱為色散。圖片來源：喻京川/北京天文館

BURSTT: 定位與追蹤的“一石兩鳥”計畫

由中研院天文所主導的BURSTT計畫（Bustling Universe Radio Survey Telescope in Taiwan）同時有大視野和超長基線定位能力，每個月都可以定位幾個銀河系附近的快速電波爆及其宿主(星系)。天文學家可以透過多波段追踪觀測揭露快速電波爆周圍的環境。此外，BURSTT的大視野將是頻繁監測已知FRB的關鍵，因此BURSTT將成為能回答「是否所有FRB都會重複？」的關鍵望遠鏡。BURSTT將由位於臺灣北部的一個擁有256座天線的主站以及其他位於臺灣和夏威夷的支站組成。VLBI的基線分布從60公里到8000公里，這樣的配置可以分別在南北方向和東西方向達到角秒和毫角秒的分辨率。



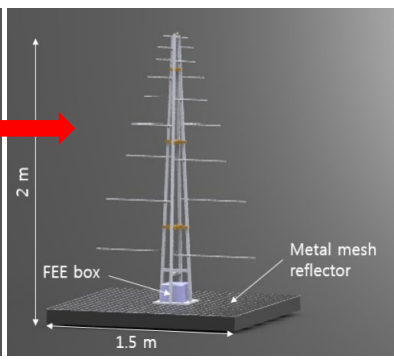


圖2：(左)可以在臺灣各離島設置支站，延伸基線距離以提高太空定位解析度。(中)BURSTT主站的設計，將配置256座天線。(右)BURSTT單座天線模型。

BURSTT計畫網站：http://www.asiaa.sinica.edu.tw/project/burstt_c.php

Bustling Universe Radio Survey Telescope in Taiwan (BURSTT)

What are Fast Radio Bursts (FRBs)?

Fast Radio Bursts (FRBs) are bright radio transients with millisecond-duration, cosmological origin, and unknown physical mechanism. Over 600 FRBs have been published since 2007, of which two dozen sources show repetition. Theorists have proposed over fifty models for deciphering the enigma, but none of the models could explain all observational properties. As the field is expanding with more hints from observations, astronomers are debating on several important questions. For instance, "Do all FRBs repeat?" is an open question in the field. The Very Long Baseline Interferometry (VLBI) localization to their hosts and environment would be the key to understanding the nature of FRBs and answering the open questions. Since FRBs are ubiquitous on the sky, a new telescope with large Field of View (FoV) as well as VLBI capacity would yield a large sample with hosts, it undoubtedly would be the game changer in the upcoming FRB era. The large FoV guarantees a large sample of bright, and thus nearby, events.

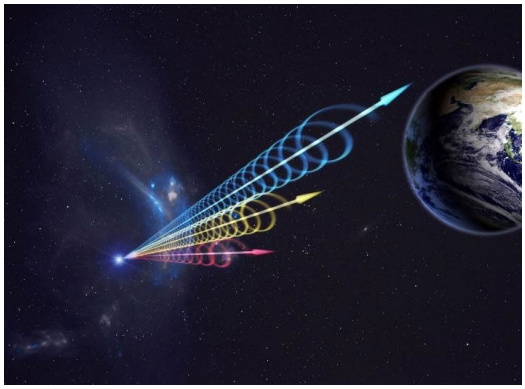


Figure 1. Artist impression of a Fast Radio Burst (FRB) reaching Earth. The colors represent the burst arriving at different radio wavelengths, with long wavelengths (red) arriving several seconds after short wavelengths (blue). This delay is called dispersion and occurs when radio waves travel through cosmic plasma.
Credit: Jingchuan Yu, Beijing Planetarium

BURSTT: Large samples with hosts, a "two birds with one stone" project

BURSTT (Bustling Universe Radio Survey Telescope in Taiwan), a project led by ASIAA, equips with a large field-of-view and VLBI capacity to localize a few nearby FRBs within their hosts per month. Astronomers could unveil the local environment of FRBs through multi-wavelength follow-up observations. In addition, the large FoV of BURSTT would be the key to monitor known FRBs with high cadence, and thus BURSTT would be the critical telescope to answer the open question – "Do all FRBs repeat or not?''. BURSTT would be composed of one main station with 256 antennas in Northern Taiwan as well as other outrigger stations in Taiwan and Hawaii. The baseline of the VLBI in N-S and E-W would be 60 km and 8000 km, which yields arcsecond and milli-arcsecond resolutions, respectively.

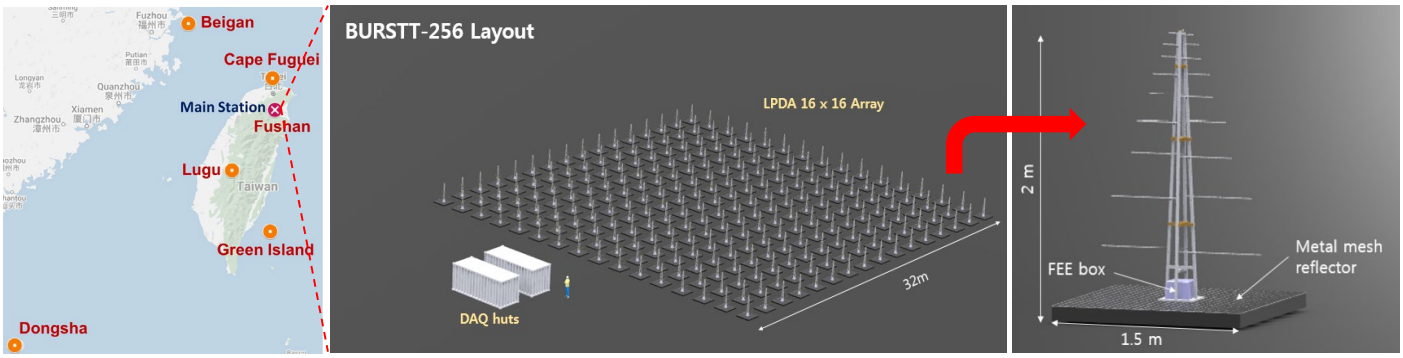


Figure 2. (Left) BURSTT will equip with other outrigger stations in Taiwan to improve the localization capacity. (Middle) A plot shows the design of the main station of the BURSTT. (Right) BURSTT antenna model.

BURSTT website: http://www.asiaa.sinica.edu.tw/project/burstt.php

BURSTT