A Masquerading Magnetar in the Galaxy NGC 253

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Nature, Dmitry Svinkin et al.
Ioffe Institute, St. Petersburg, Russia
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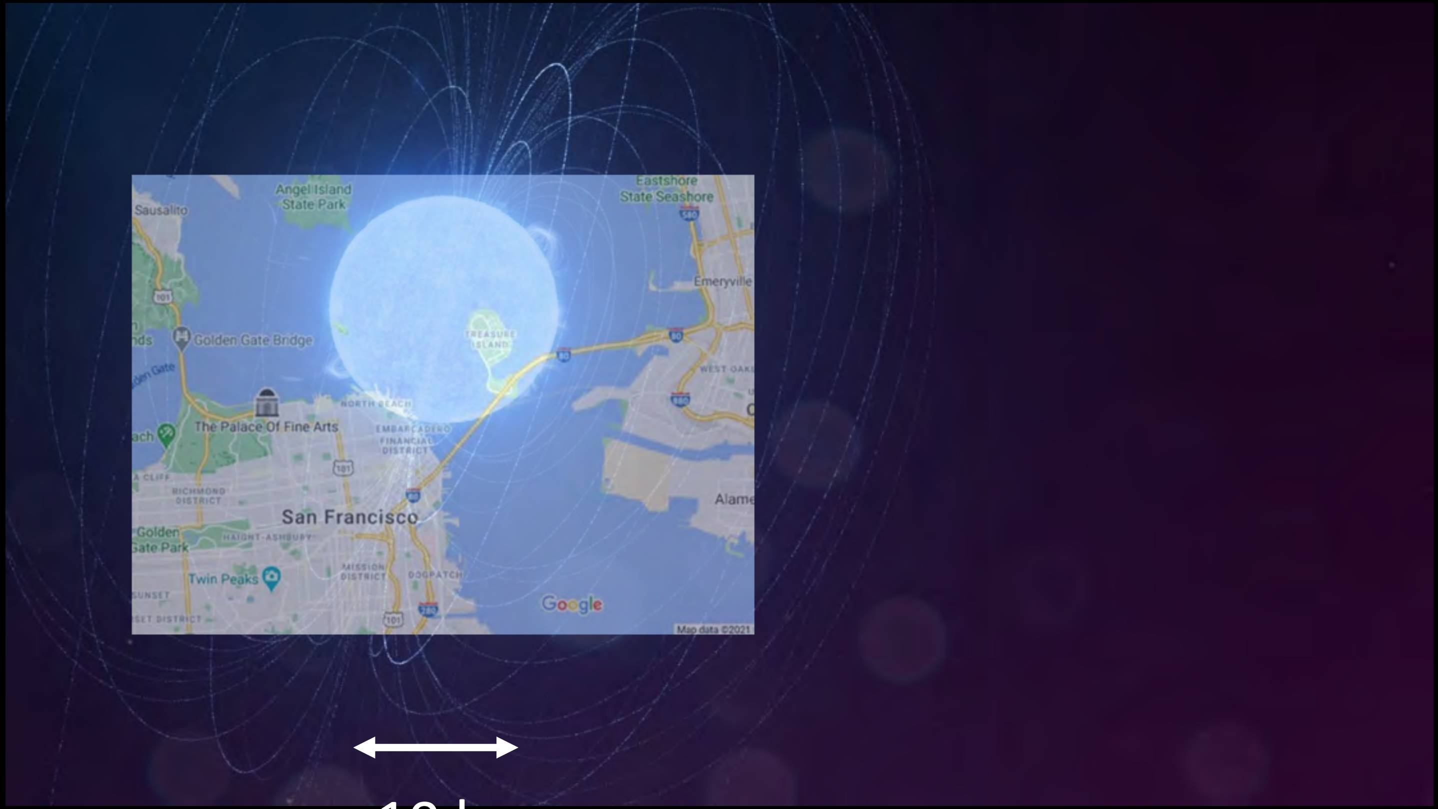
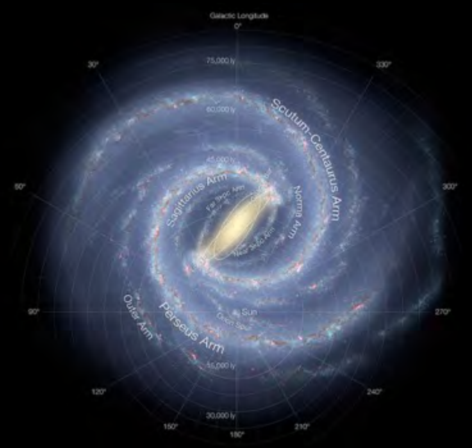
A magnetar is a neutron star with a magnetic field so intense ($\geq 10^{14}$ x terrestrial, 10^{13} refrigerator) that magnetic energy dominates all other forms of energy release

A *giant flare* is the most extreme manifestation of the magnetic energy, observed in gamma-rays.



10 km
One solar mass



Milky Way

M81, 11.7 M l-y

Andromeda (M31, 2.5 M l-y)

The Southern Pinwheel (M83, 14.7 M l-y)

Sculptor (NGC 253, 11.4 M l-y)

We believe that giant flares are triggered by extreme starquakes, induced by the large magnetic field.

When a magnetar giant flare (MGF) occurs in our own galaxy, it is so intense that it saturates all detectors, making it difficult to study.

When a giant flare occurs in a nearby galaxy (10’s of millions of l-y), we can often get more precise information about it, such as its distance, its energy spectrum, its luminosity, and its light curve, without saturation.

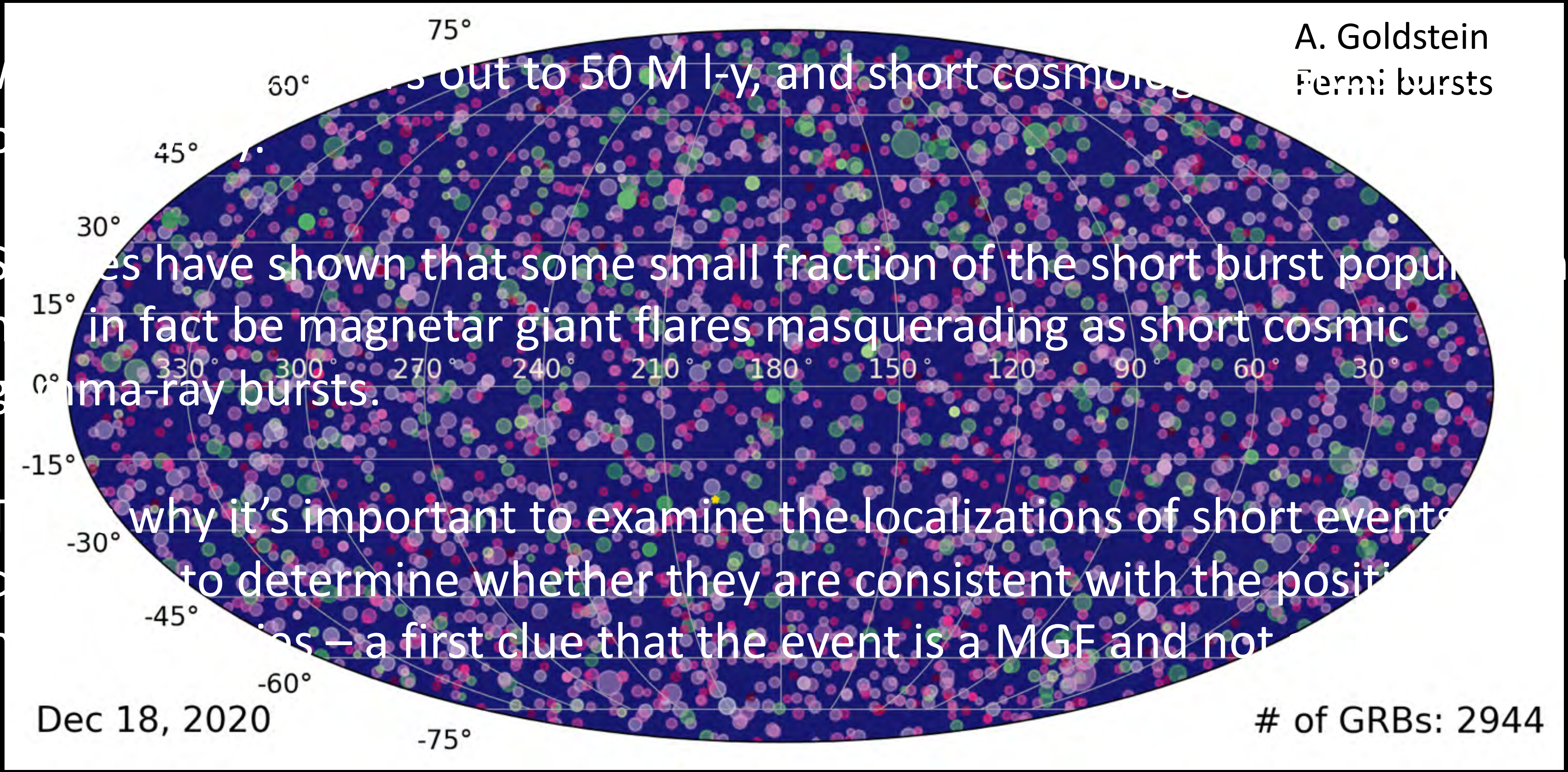
When observed in a nearby galaxy, a giant flare may superficially resemble a short cosmological gamma-ray burst (GRB).

Spacecraft detect hundreds of GRBs per year, and the short ones (<2 s long) are due to the merger of two neutron stars.

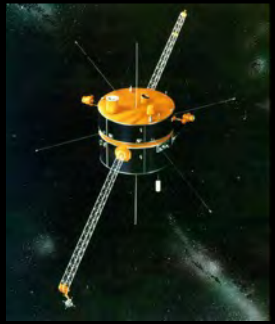
W… s out to 50 M l-y, and short cosmolog…
b… y.

S…es have shown that some small fraction of the short burst popu… n
m… in fact be magnetar giant flares masquerading as short cosmic
g…ma-ray bursts.

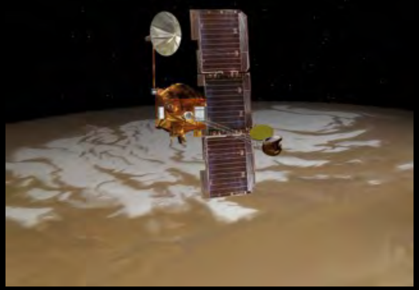
T… why it's important to examine the localizations of short events
c… to determine whether they are consistent with the positi…
n… ies – a first clue that the event is a MGF and not …



On April 15 2020, a short burst was detected by 5 missions with GRB detectors that we call the Interplanetary Network (IPN).

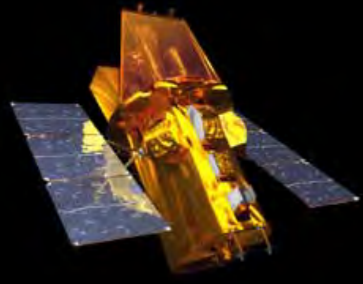


Wind
Konus



Mars Odyssey
HEND

INTEGRAL
SPI-ACS

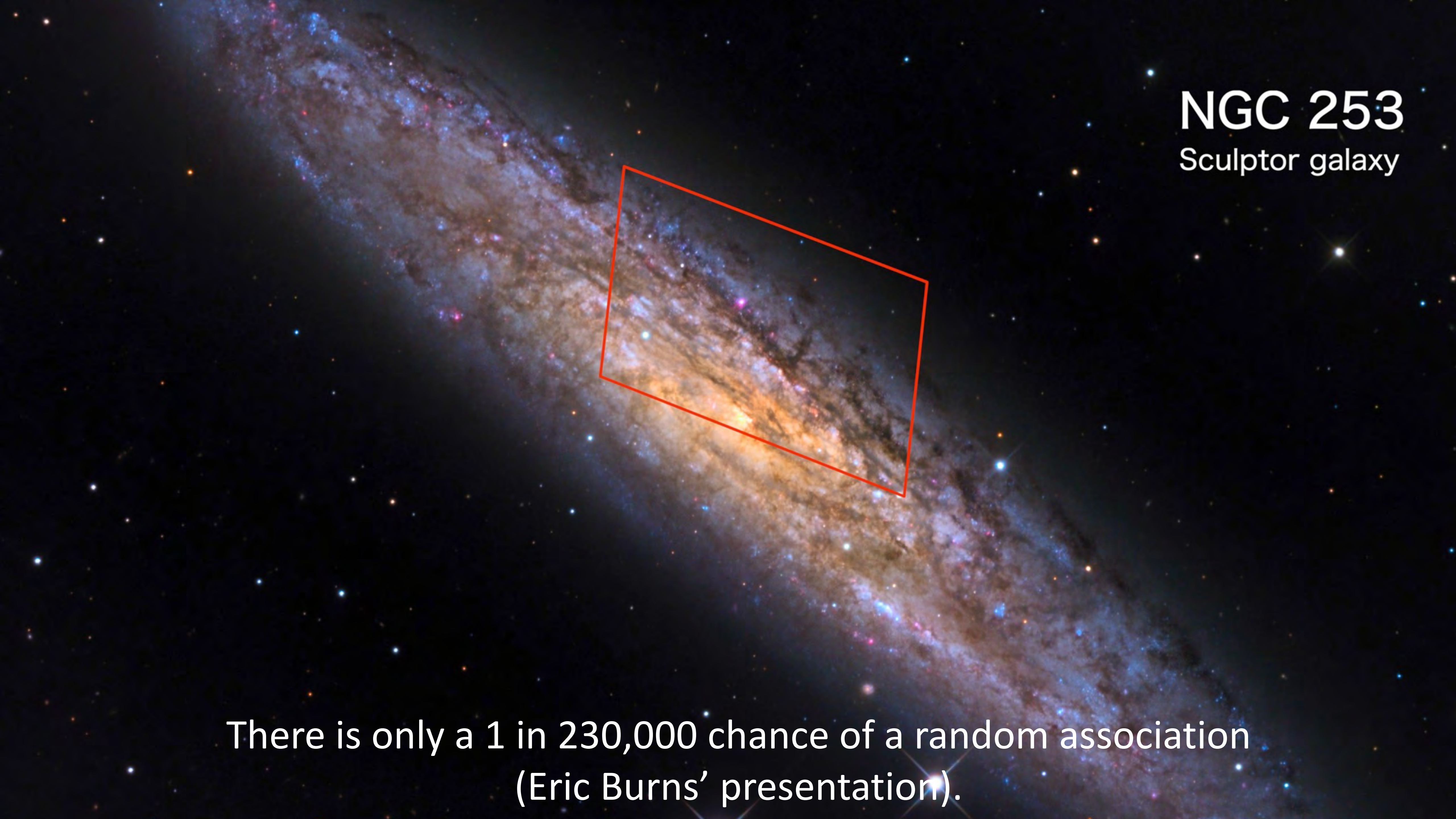


Swift
BAT

Fermi
GBM & LAT

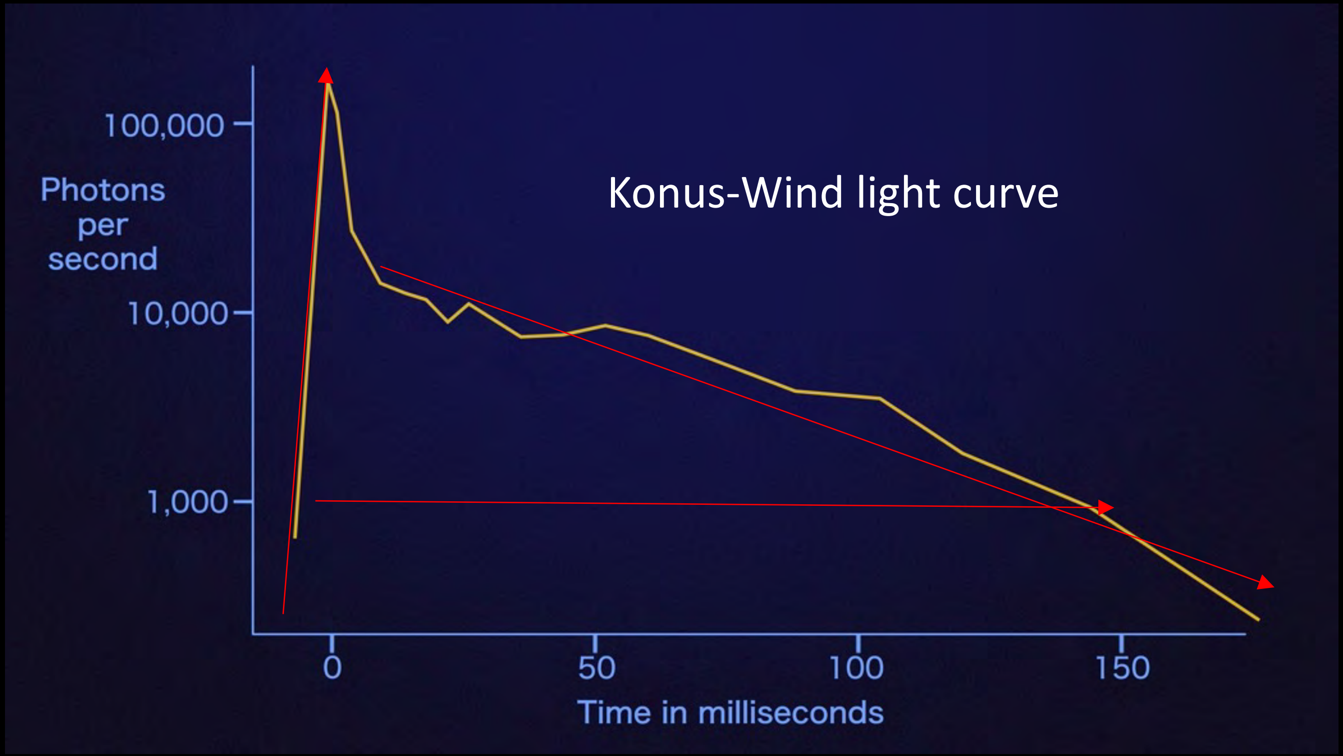
The IPN triangulates bursts by timing the arrivals at these spacecraft.

This burst was triangulated to a small error box consistent with NGC 253 (the Sculptor galaxy).



There is only a 1 in 230,000 chance of a random association
(Eric Burns' presentation).

- The light curve this burst* is unusual.
- <2 millisecond rise
- 50 millisecond decay
- 140 millisecond duration
- Unlike any cosmological short GRB



*Oliver Roberts’ presentation

April 15, 2020
NGC 253 (Sculptor) 
11.4 M l-y
1.3x10^{46} erg*

*~100,000 years of solar energy – released in 140 milliseconds
A magnitude 27.8 starquake – 10^{27} times bigger than the magnitude 9.5 quake in Chile, 1960 (assuming isotropic energy release)

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