Science Alerts and Supernovae

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Abstract

In this brief note we show how the expected number of Supernovae alerts, discoverable within the first look data, is a very strong function of the magnitude limit of this data set. Rapid access (timescales of days) to the full Gaia photometric dataset is required to detect Supernovae on the rise towards maximum brightness, and to trigger the follow-up programs which will enable full characterisation of the events.

Document History

Issue	Revision	Date	Author	Comment
1	0	2007-09-14	SHO	Creation
2	0	2009-03-01	SHO	Changed my initials as STH already taken

1 Simulations

Belokurov and Evans (2003) simulated the detection of ($z \leq 0.14$) Supernovae by GAIA throughout the mission. They estimated that GAIA would catch some 16000 type I and 6000 type II events, of which around 40% would be observed on the rise at a rate of around 5 SNe alerts per day.

In this note, we revisit the simulations of Belokurov and Evans, and make adjustments to account for the current mission parameters (the biggest change from the published numbers arising from the scanning law which roughly halves the number of observations of each part of the sky).

A population of Supernovae, their brightnesses and distribution in space, are simulated and lightcurves generated for each event. The lightcurves are sampled according to GAIA's scan law, and it is simple to compute the number detected, and the number detected before maximum.

2 Supernova Catch

The Detailed First Look will be performed within about 24 hours of receipt of the data to the Science Operations Centre. If the flux-based science alert software runs within the IDT/FL framework, then it will provide triggers on a comparable timescale.

The current plan is that the First Look data will contain only sources brighter than G=16. In Figure 1 we show the number of detected Supernovae events in 5 years as a function of G sensitivity. For a limit of G=16, then we expect to detect < 200 Supernovae in total, compared to > 6000 for G=19. Around 30% of these will be detected before maximum.

The typical rise-time for Supernovae ranges from 5 days for SN II-P to >20 days for SN Ia. If the initial pipeline processed data (using nominal zeropoints) were available in shorter timescales, then the search for Supernovae down to G=19 is viable.

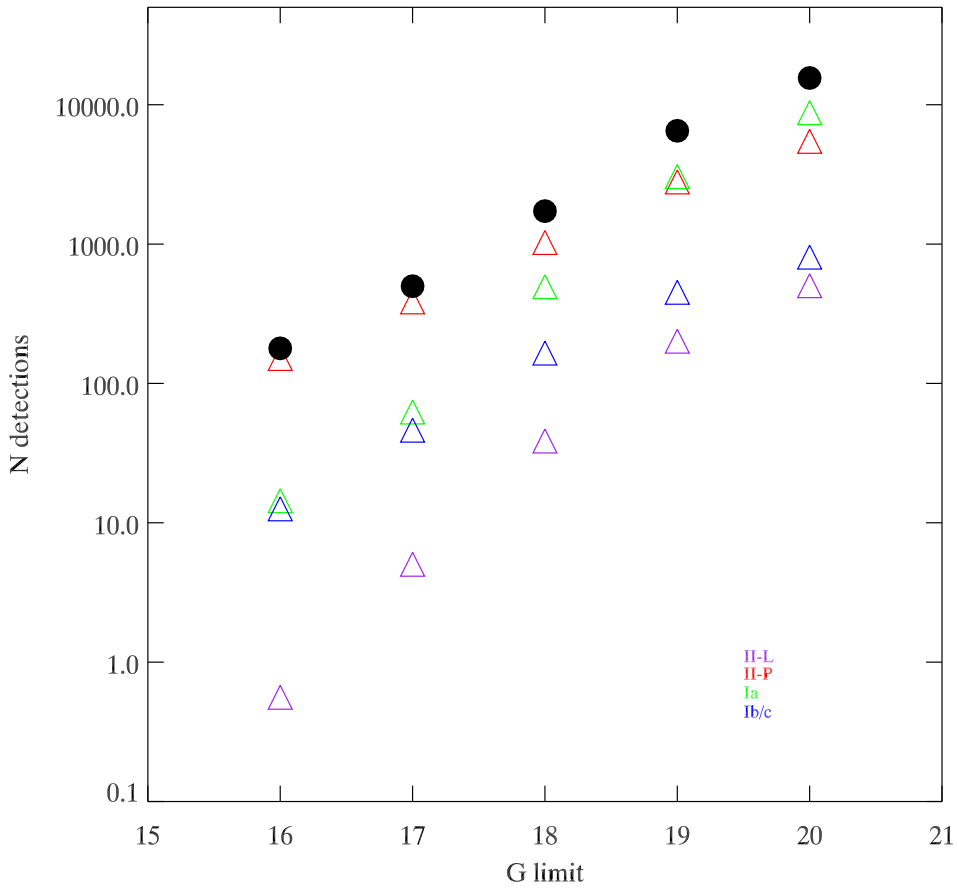

Figure 1: Total umber of SNe detected in 5 years by GAIA as a function of magnitude (black circles), and split by type (colour symbols).

3 References

Belokurov V.A. & Evans N.W., 2003, MNRAS, 341, 569