The Variable Sky in the Multi-Messenger Era

Electromagnetic counterparts of GW events

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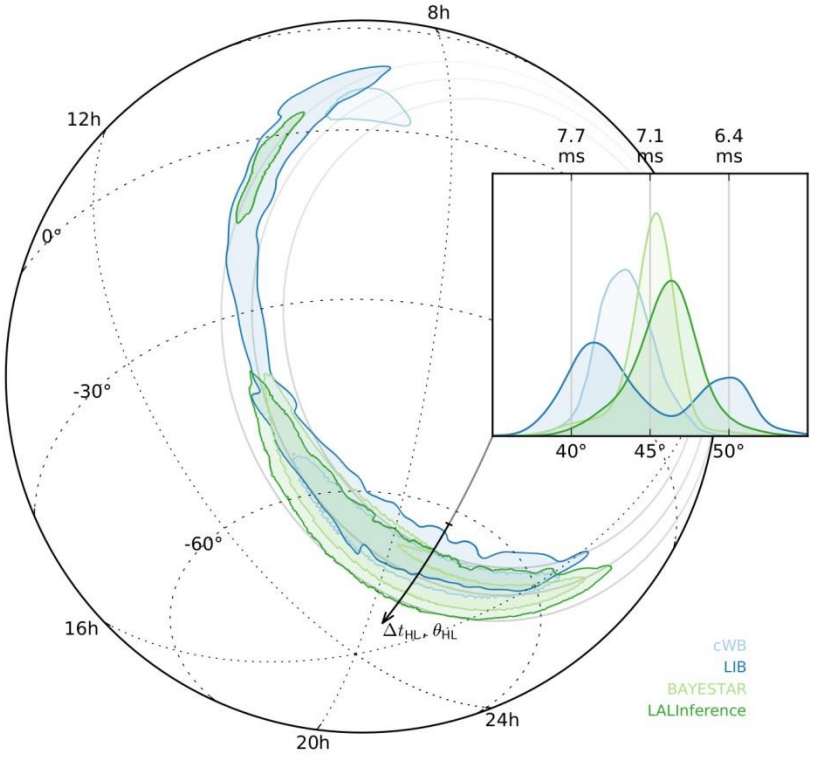
IAP and UPMC, Paris

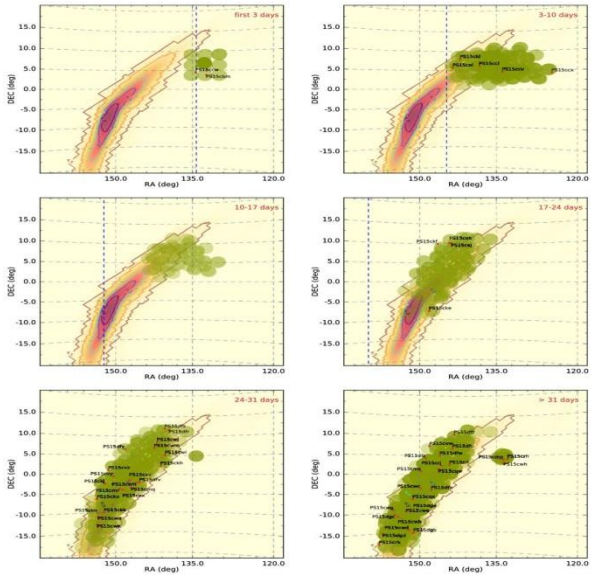
Search for GW150914

- Detected on 14/09 at 09:50 UT
- Announced on 16/09 at 06:39 UT to MOU
- Large error ellipse (300 □ ++), sun…
- Difference between rapid and refined localisation
- Physical nature not given initially



Search for GW150914: Pan-STARRS/PESSTO follow-up

- Northern part observed by Pan-STARRS (30%-4%)
- Difficult to start (first unreachable, first night cloudy, started 17/09, 14:50 UT
- Large error ellipse in North, 300 □, in twilight

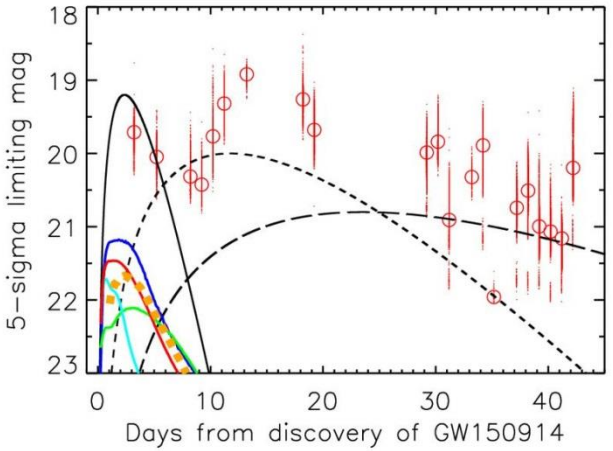


56 transients over 41 days

19 spectra + 13 redshifts

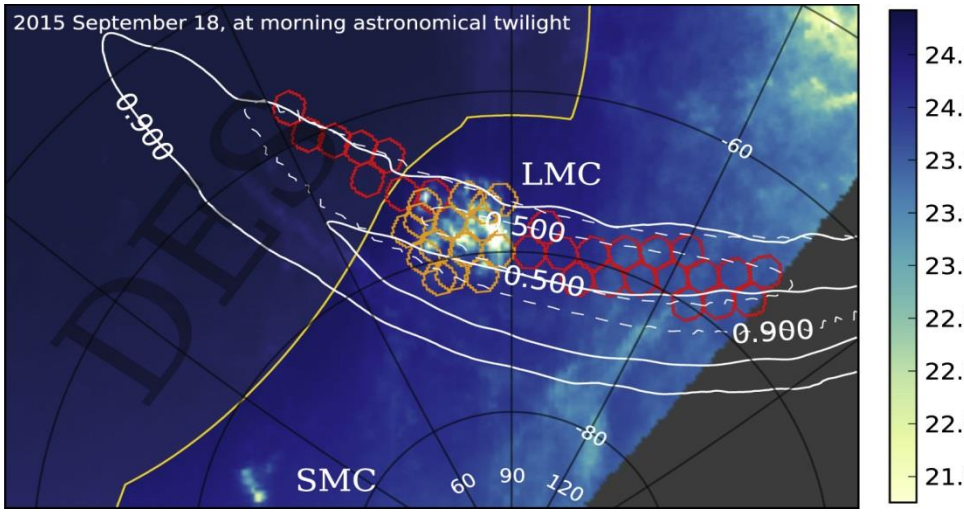
5 SNe possibly close in time

But none related: a Ia, a luminous IIP, a closeby II, a normal Ic, a late IIn



Search for GW150914:
DES follow-up

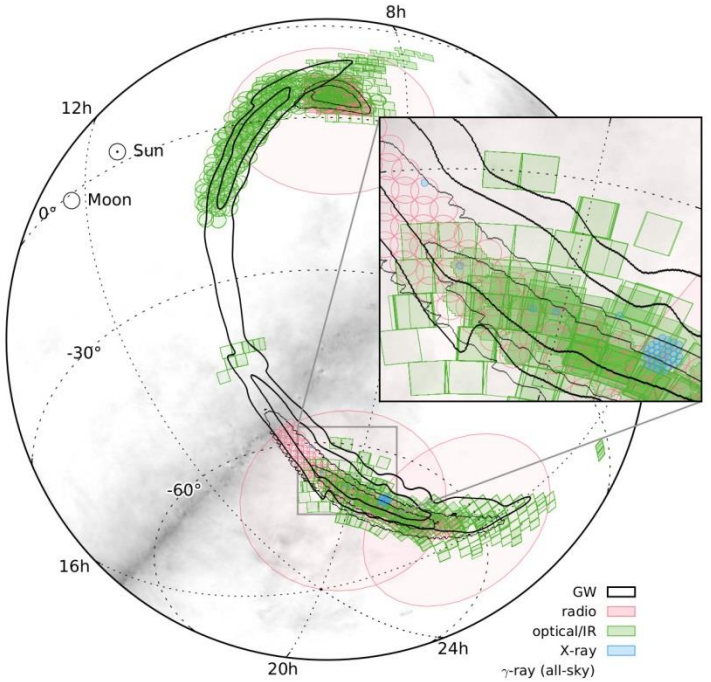
- Covered 102 □ ²
- At +4, 7 and 24 days
- 12% initial, 3% final map…
- At i = 22.5, no declining object..??
- Specific LMC search: no missing supergiants!



Search for GW150914: Summary

- No plausible optical counterpart
- A possible FERMI-GBM source??
- Nothing in neutrinos (but sensitivity too low)
- Nothing in X-rays and in radio
- WHAT do we expect from

a BH-BH merger ??

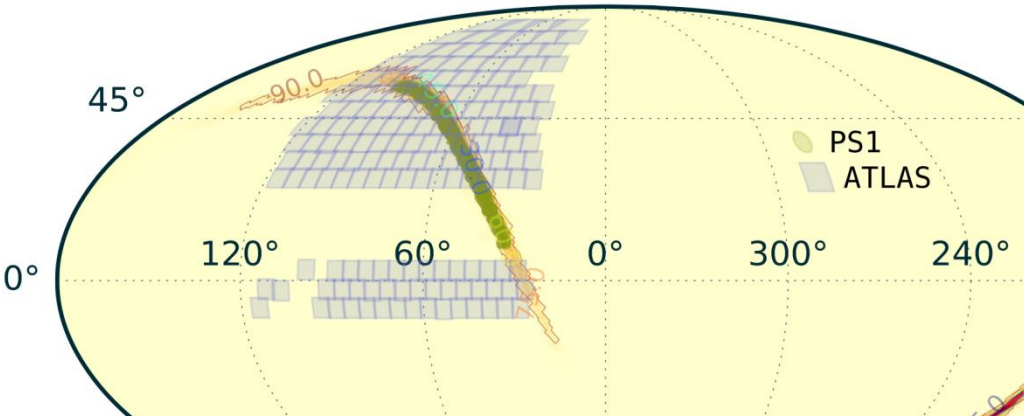


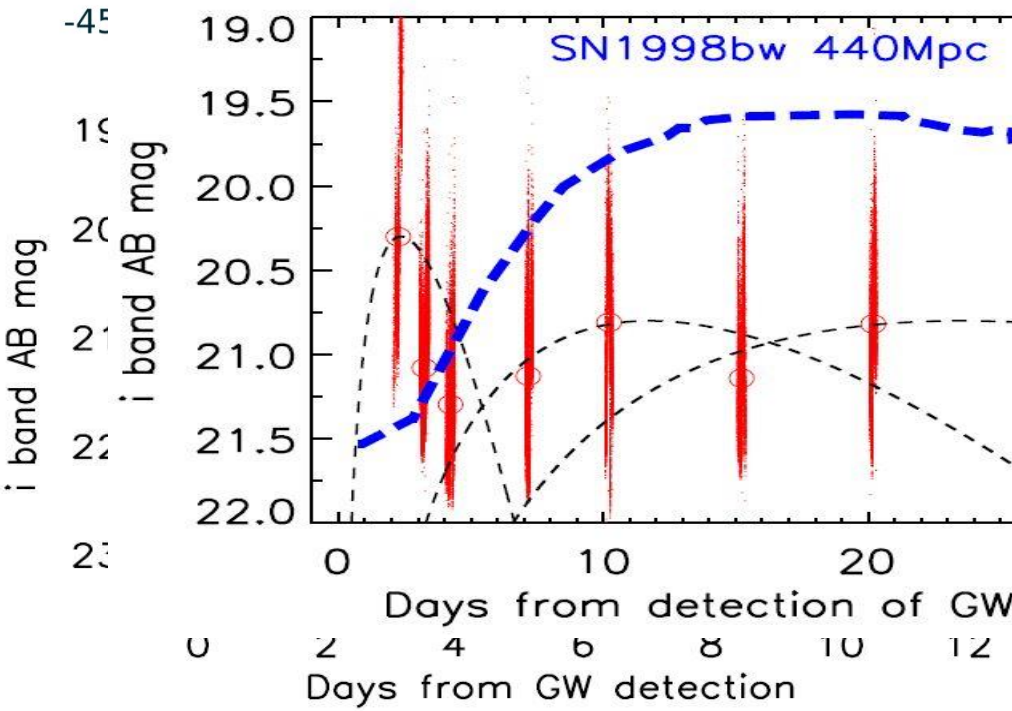
Gravitational Waves: search for GW 151226

- GW trigger by LIGO on 151226
- Rapid response needed ?? but large error box (~430 *)
- Error box will diminish with arrival of Virgo and Ligo-Indi
- A lot of SN candidates (46), but nothing related (27%)

Note: PSN15dpn = I bn, z=0.1

- GW = explosion time, not th same as max light !!
- Need to know the probabilit of unrelated transients in th same error-box

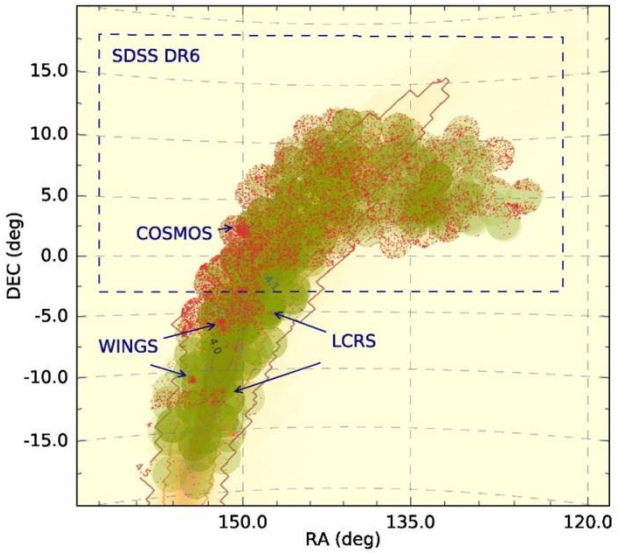


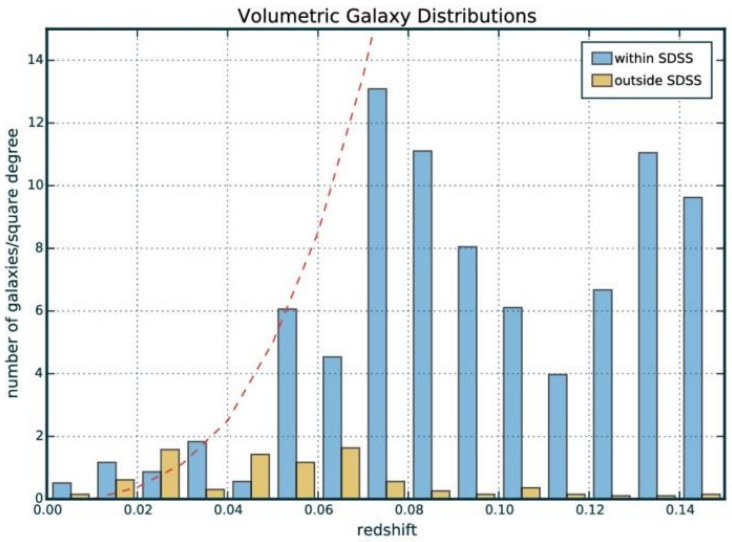


Smartt et al. 2016

GW: what is the best observing strategy ?

- Observe rapidly (?) large chunks of sky at shallow magnitudes?
- Or deep pointings (with larger telescopes) on catalogued galaxies?
- The catalogues are fairly uncomplete to z ~ 0.1 !! (many dwarfs missing…)

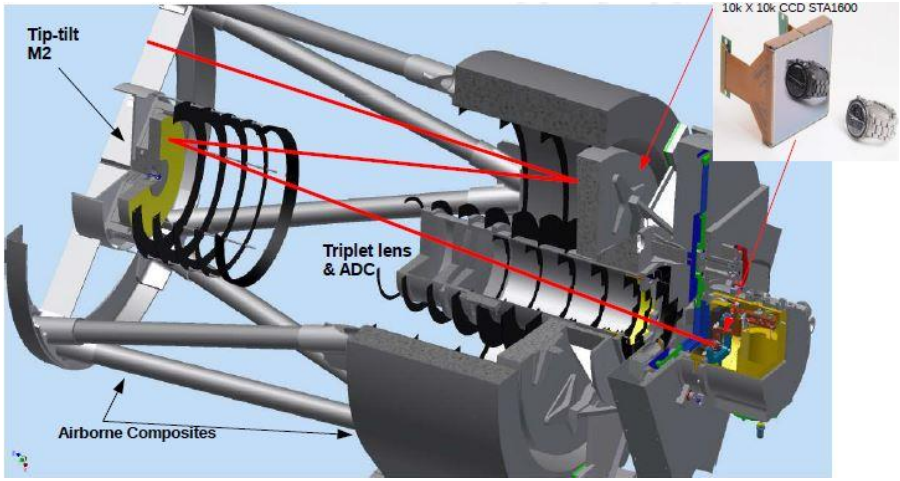


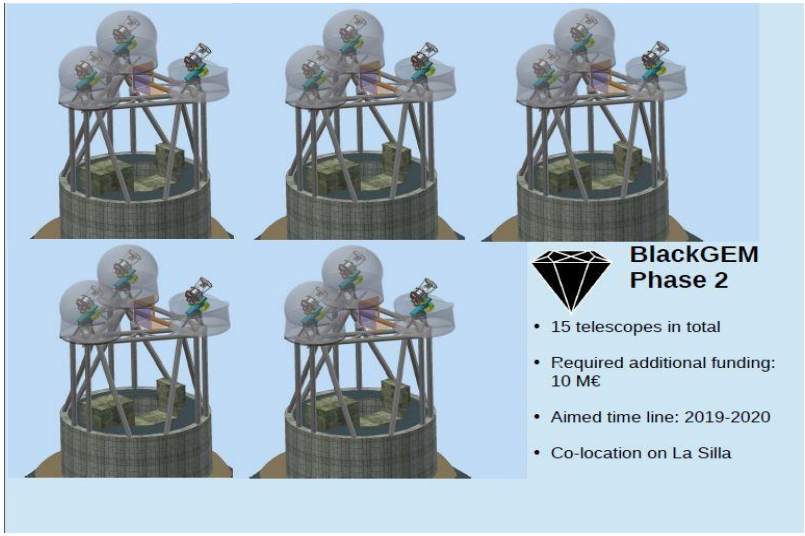


With which telescopes for French ??

Black Gem

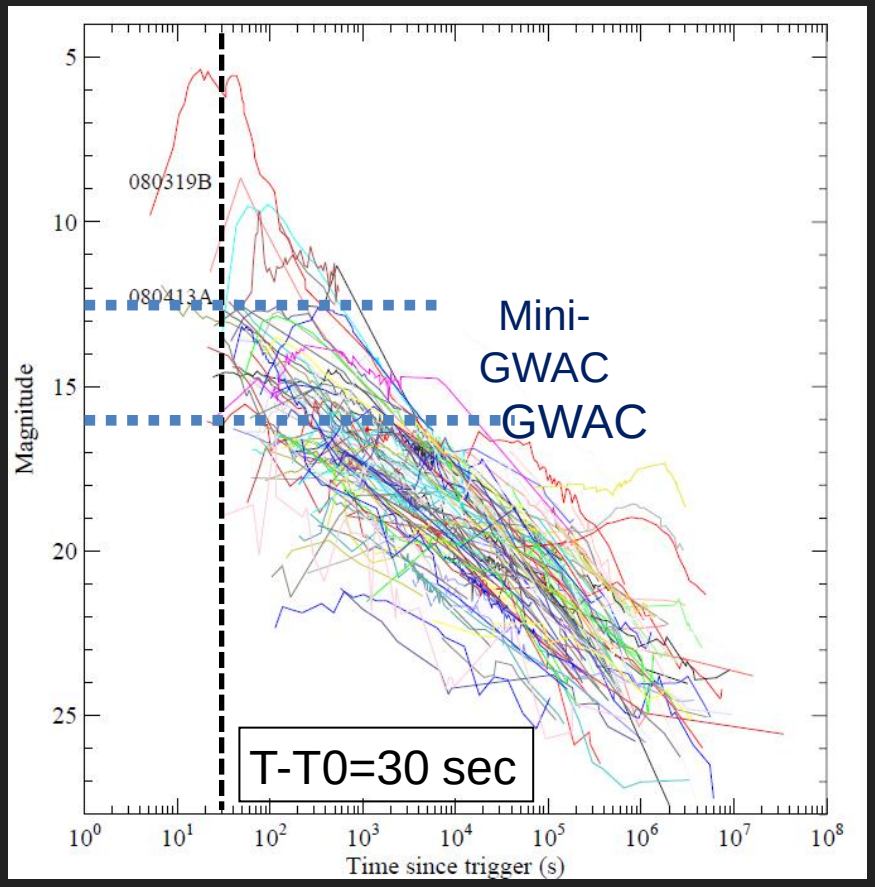
- Dedicated optical array for GW
- 15 telescopes Ø 65cm
- FOV 2.7 ^{o2}, total 40+
- u,g,r,l,z,q, 0”57/pix
- ESO LaSilla (GPO site)
- Prototype 3 tel. 2017, 15 in 2019-2020
- Radbout Univ. (NL), Paul Groot PI
- 100 KE for joining…



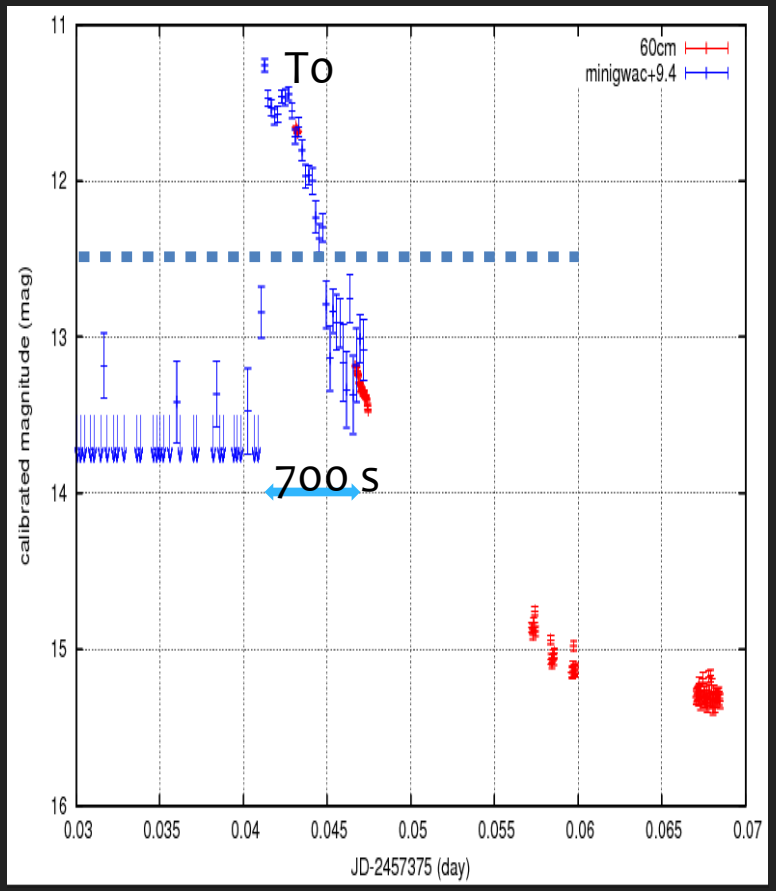


Status : mini GWAC

Light curves of GRBs
（Wang et al. 2013）



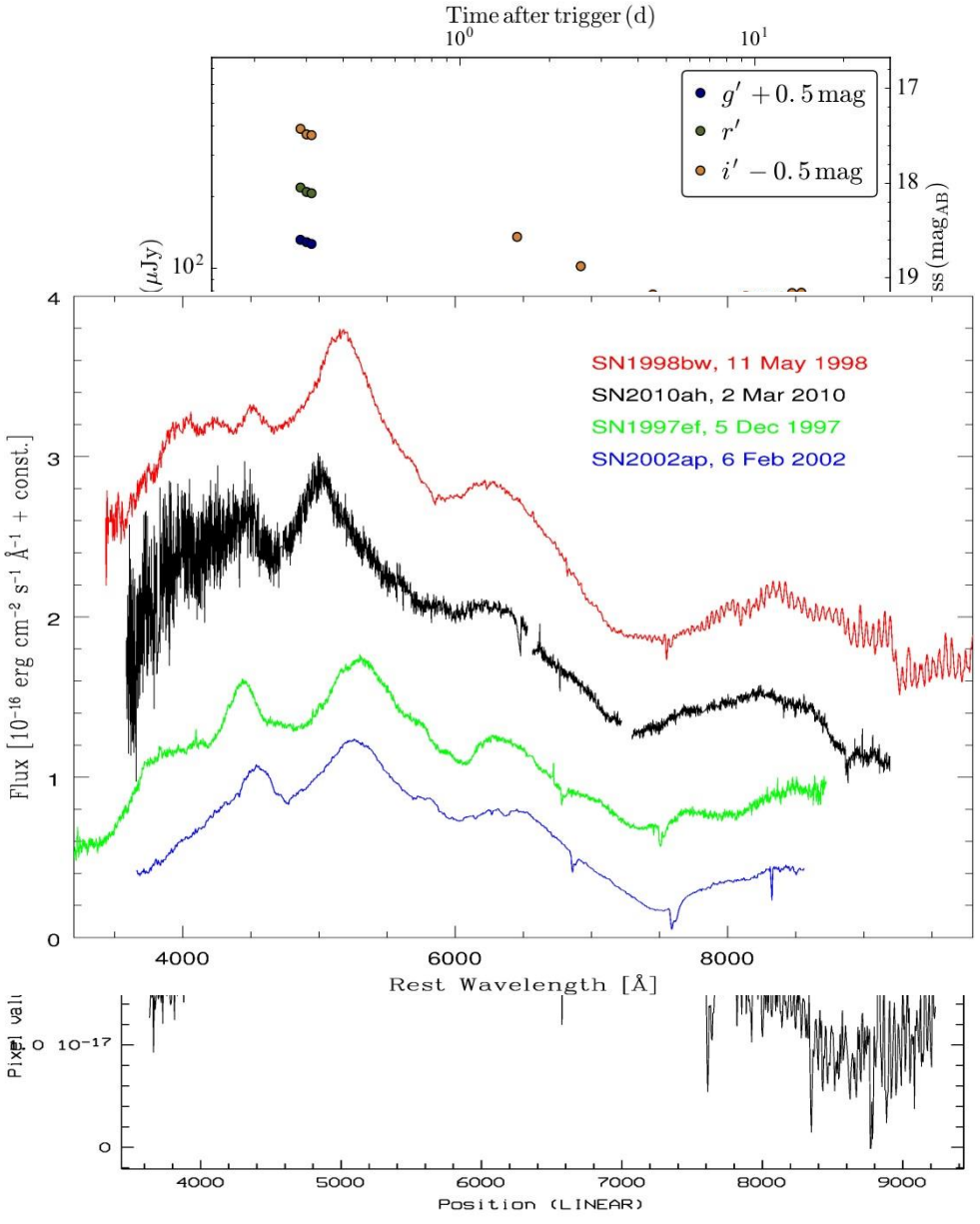
A light curve of a flare star
（Mini-GWAC 2015）



GRB-SNe connexion…

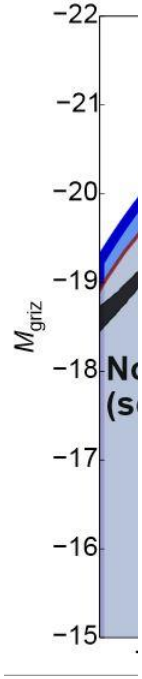
- Recent example of GRB 161219B….
- Light curve…
- SN Ic after ~ 2 weeks
- Broad-line Ic (Pessto spectrum Jan 03)

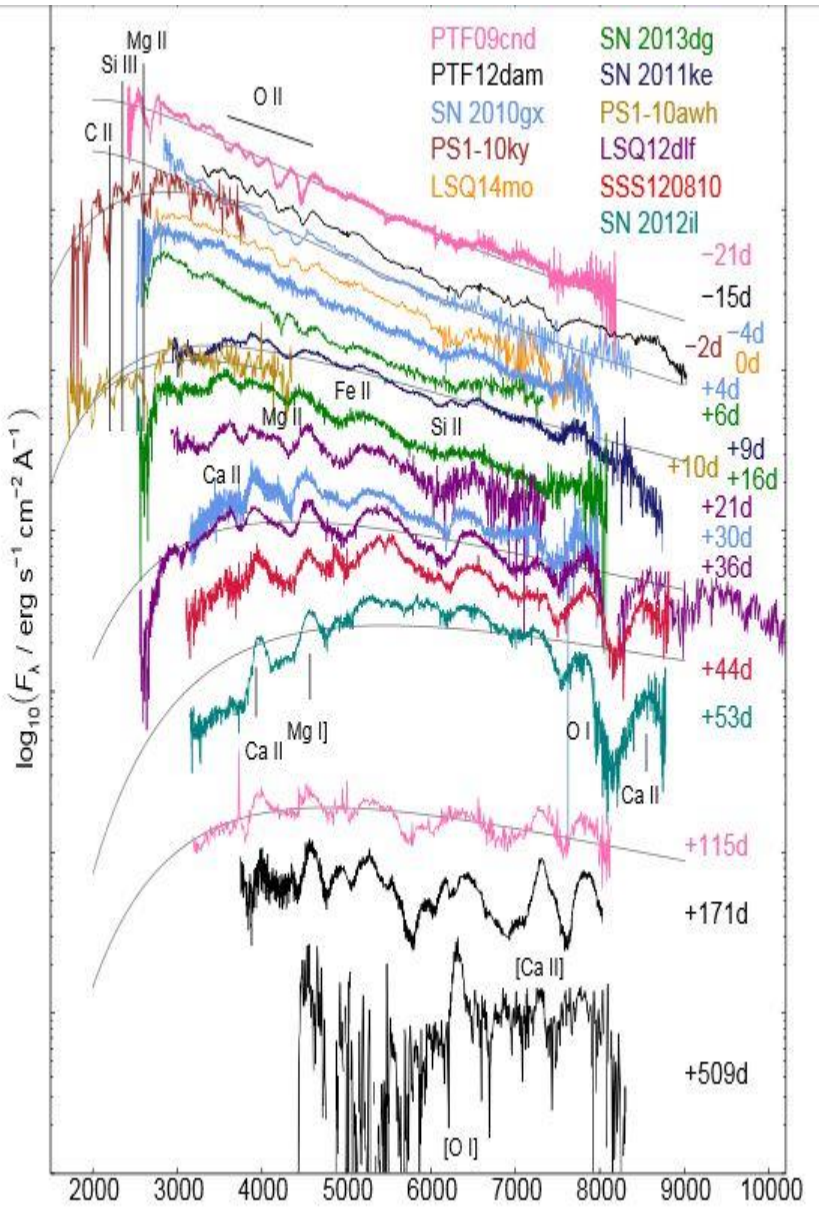
How many broad-lined Ic's in general ??
Orphan GRB's ??



Sources of BH's: SLSNe's ??

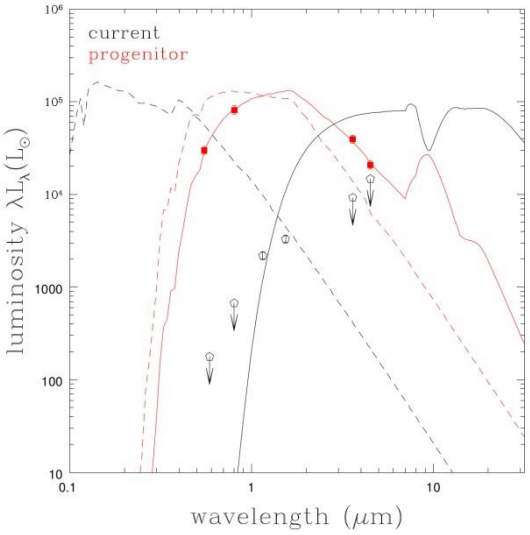
- SL Ic's: + about -3 mag
- Stretch factor ~ 3
- Require additionnal central energy source
- Magnetar or CSM ?
- ~ a dozen known
- Need more pre-max data !

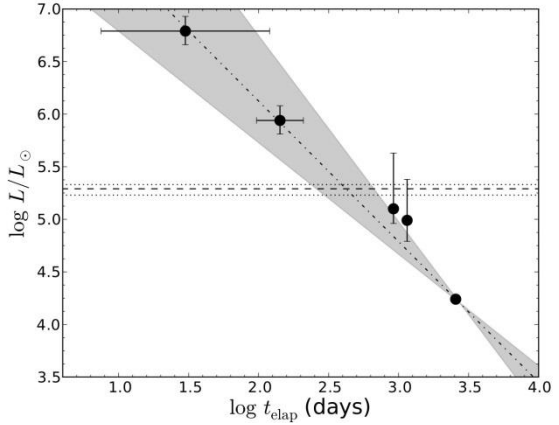




Sources of BH's: failed SNe's ??

- Lack of high-mass SNe progenitors (> ~ 18 M_o) which is well below RSG
- Absence of IIP nucleos.
- Models difficult to explode in range 20-40 !
- SFR > SN rate ..??
- Recent case N6946-BH1 (Adams+ 2016)
- Another case N3021-BH1 (Reynolds+ 2015)
- Need reference maps of stellar populations



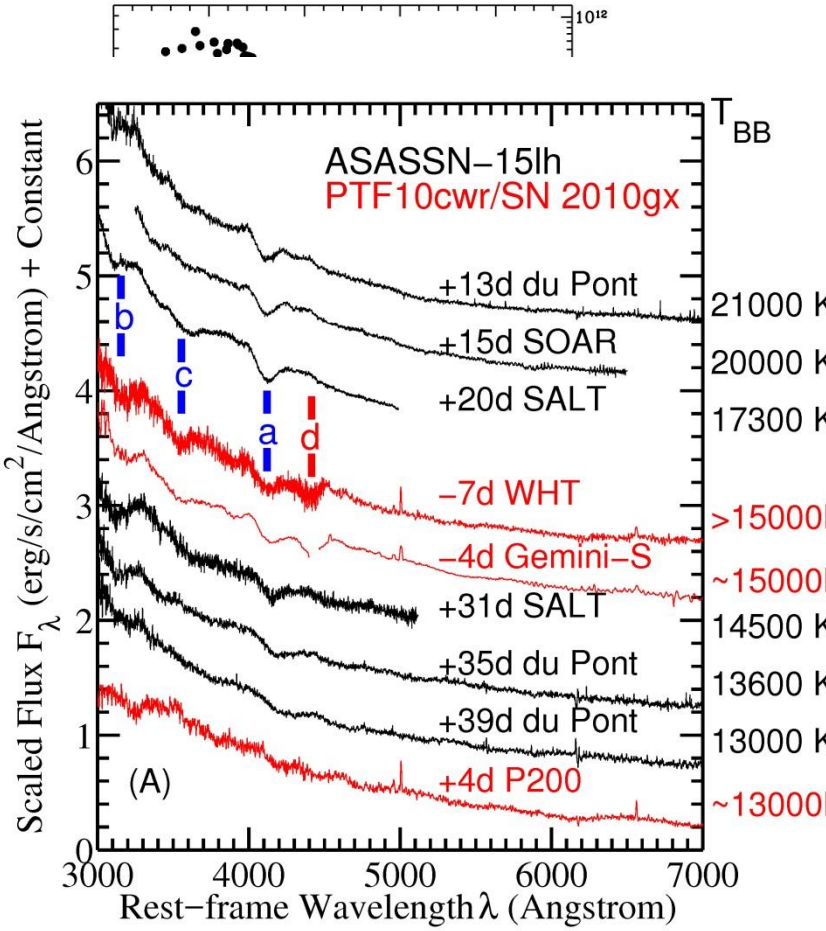


Evidence for BH's : Tidal Disruption Events

- Close to center (< 1")
- Blue continuum
- Almost featureless Spectra
- e.g. PS1-10jh (Strubbe '15), or

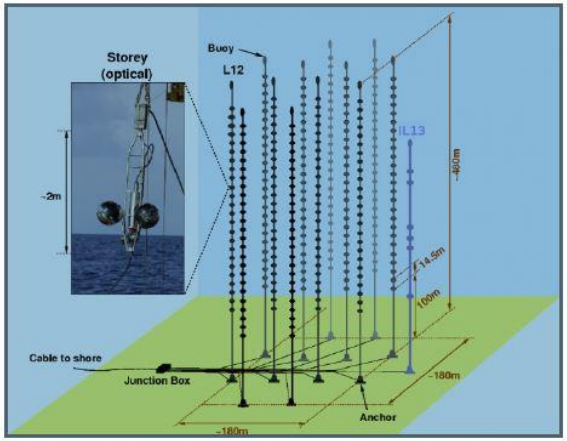
ASASSN-15lh (Dong et al. '16) or 14ae

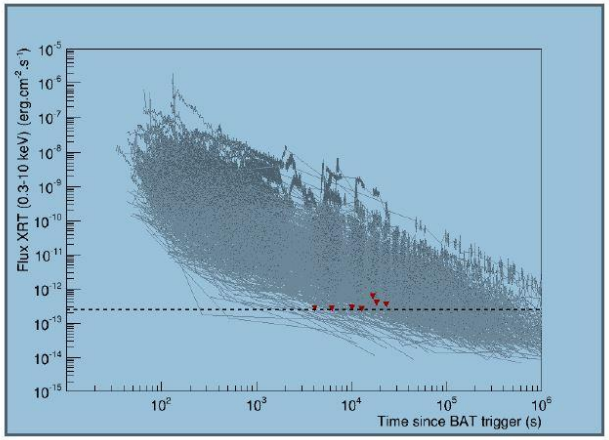
- H, He or nothing, depending on progenitor…
- **Not to confuse with AGN variability…**



Non-photon astrophysics: Neutrinos

- Antares detector in the Mediterranean see (limited angular def. R=0.3°)
- Needs optical follow-up, also X-rays
- Like for GRB's, Rapid response + sensitivity…
- No candidates yet, but good prospects (IceCube, Km³, + larger Telescopes)





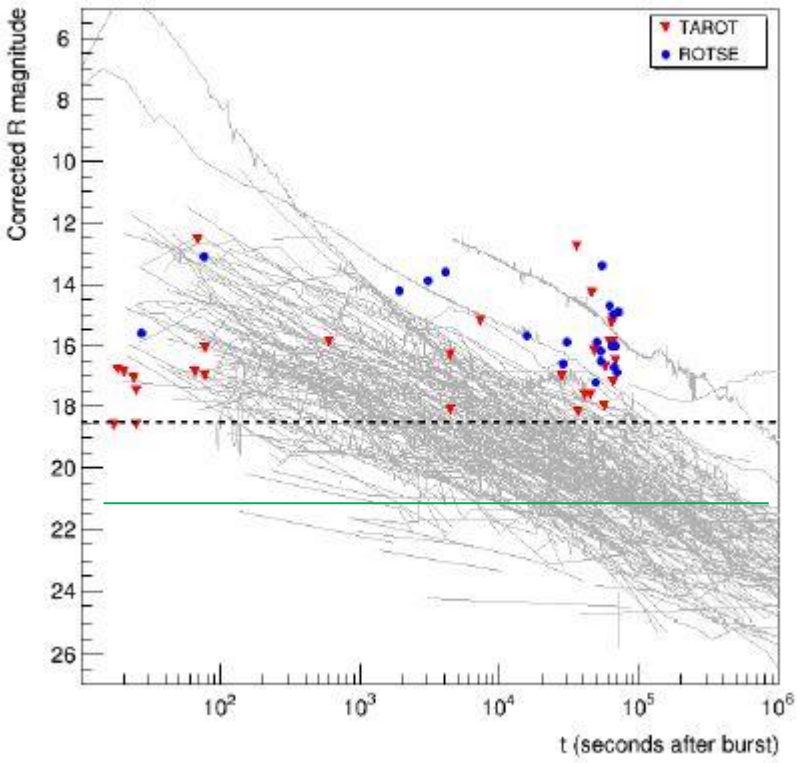
Swift follow-up

Non-photon astrophysics: Neutrinos
How to improve ??

- Antares limited to ~~ 10 Mpc
- Huge improvement foreseen with Icecube and KM3Net (~2020)
- **Increase diameter of optical telescopes….**

Gain ~1.5 mag going from 0.4 to 1m !

See SVOM-GFT…



Need rapid response, higher sensitivity

Future of Neutrino detectors

For astrophysics : towards the highest energies

KM3NeT :

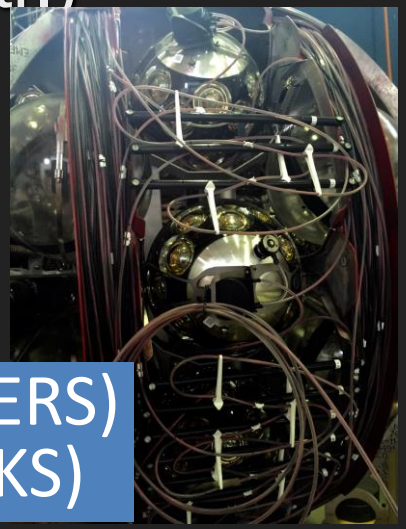
ARCA (HE) : Sicily

ORCA (LE) : France

Phase 1 (31 str.) : 2016-2017

Phase 2 (230 str.) : 2020 ? (ICx2)

Phase 3 (600 str.)



ΔΘ=2° (SHOWERS)
ΔΘ=0.2°(TRACKS)

IceCube extensions

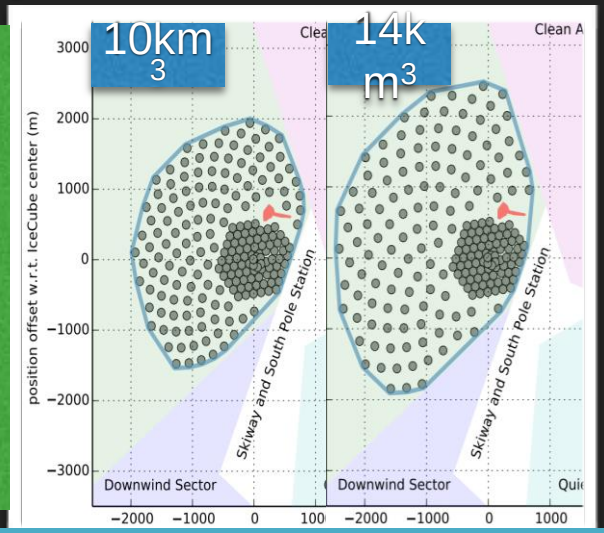
IceCube-Gen2 (HE)

PINGU (LE)

Optimistic prediction :

deployment starts in 2020

IceCube-Gen2



MOST PROBABLE SCENARIO FOR 2021 : ICECUBE + KM3NET-PHAS

Non-photon astrophysics: Neutrinos
Astrophysical counterparts ??

- Pb: separate between atmosph. and astron. events
- One Alert yielded a plausible candidate (ATel7987, Sept. 1st 2015) (out of 71….)
- Swift X-rays follow-up shows a bright X- transient: R=12.6 star
- Identified by NOT and SALT spectroscopy, as unrelated K-type flaring star…

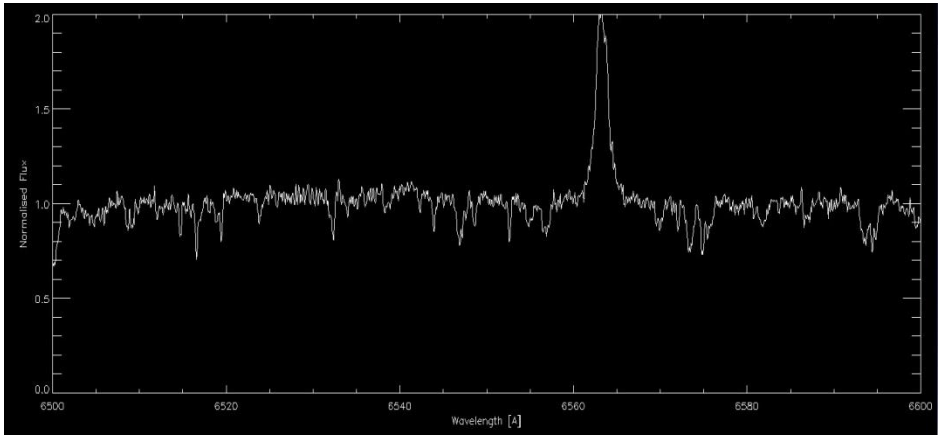
- **Need to know the probability of unrelated transients in the same error-box**

"On September 1st, 2015, at 07:38:25 UT, ANTARES has detected a bright neutrino at a location of:

RA(J2000) = 16h 25m 42s

DEC (J2000) = -27d 23m 24s

with an uncertainty of 18 arcmin (radius, 50% containment)"



Alerts from Space: GAIA Scanning Trigerred by Vis. Phot.: (Full Sky Coverage)

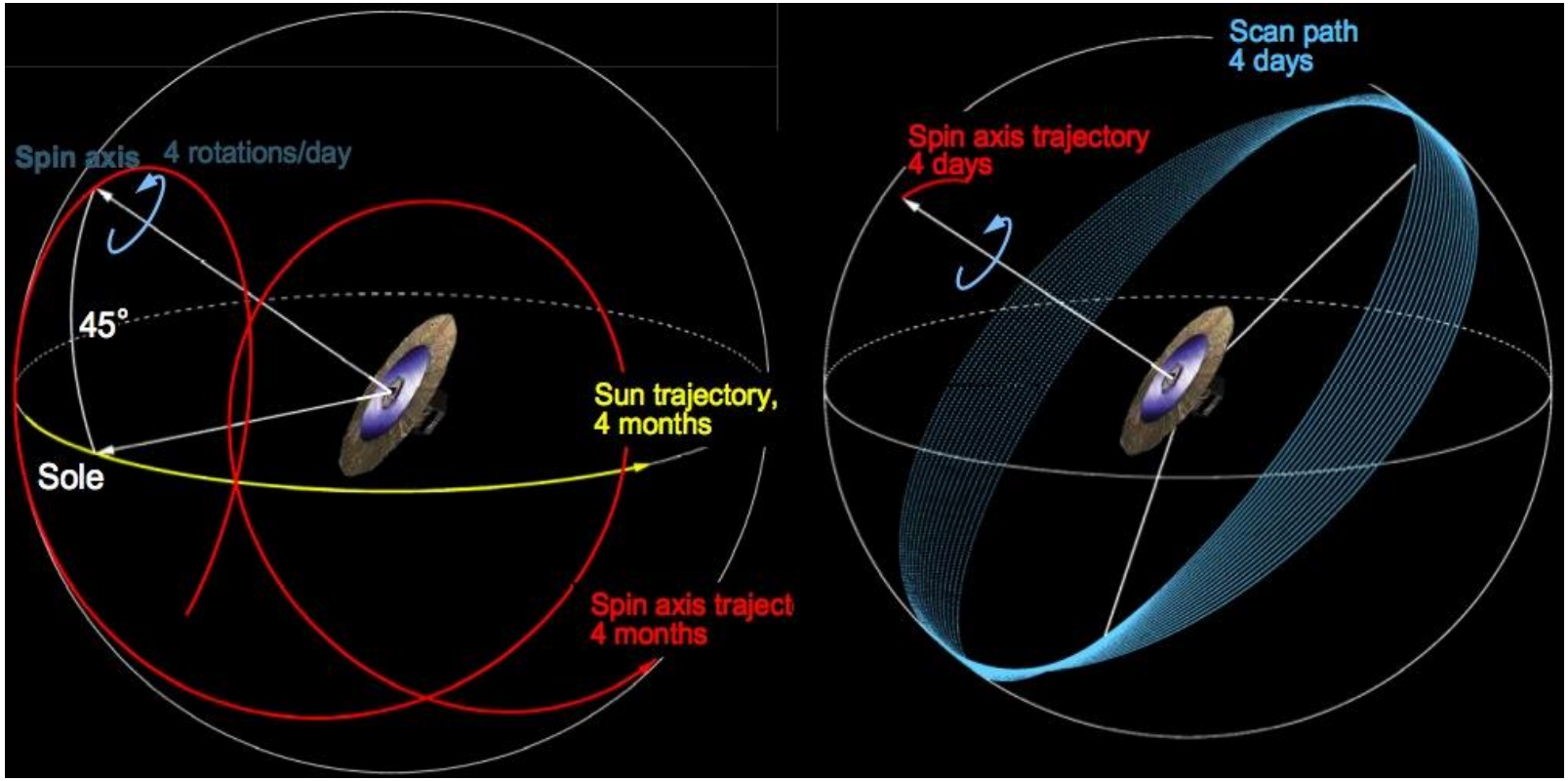


Figure courtesy Karen O'Flaherty

Spin axis :	45° to Sun
Scan rate:	60 arcsec/s (1° / mn)
Spin period:	6 hours
Precession:	63 days

GAIA Alerts

- Time coverage:
  - 4.4 sec/CCD, ~ 40 sec total crossing time
  - 106mn (two independant viewings, 1’/s)
  - 6 hours (spin rate)
  - Again after ~~63 days (precession period)
  - On average, 80 times over 5 years

- **Alerts generated on photometric variablity on those time scales**

(except maybe the shortest one)

Timeline for the data flow

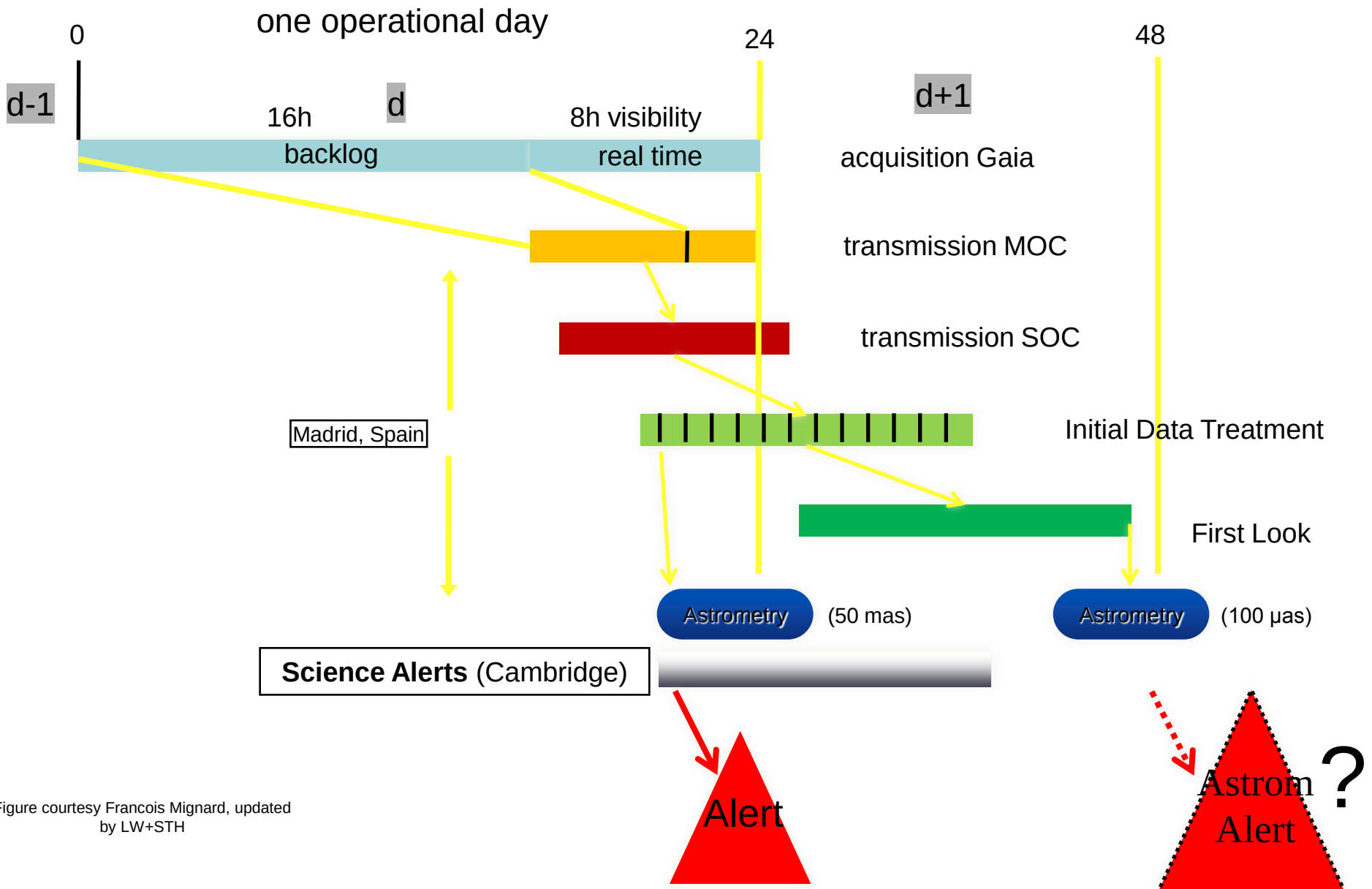


Figure courtesy Francois Mignard, updated by LW+STH

Gaia Alerts: Examples

Show 10 entries

Search:

Name	TNS	Observed	RA (deg.)	Dec. (deg.)	Mag.	Historic mag.	Historic scatter	Class	Published	Comment
Gaia16ceu	AT2016jaa	2016-12-21 19:00:35	149.13117	-3.66027	18.62			unknown	2016-12-23 10:18:48	candidate SN near galaxy 2MASX J09563092-0339454
Gaia16cet	AT2016izz	2016-12-21 21:25:17	324.40953	-22.30277	18.65			unknown	2016-12-23 10:15:30	blue transient near galaxy MRSS 531-134909, GS-TEC predicts SN Ia
Gaia16ces	AT2016izy	2016-12-21 02:00:56	181.46059	-67.95879	17.17			unknown	2016-12-23 10:12:49	hostless blue transient near Galactic plane
Gaia16cer	AT2016izx	2016-12-21 01:47:48	167.33976	-55.03898	18.67			unknown	2016-12-23 10:10:37	hostless blue transient near Galactic plane
Gaia16ceq	AT2016izw	2016-12-21 14:46:30	149.42166	-3.21282	17.74			unknown	2016-12-23 10:08:15	rising candidate SN, GS-TEC predicts SN Ia
Gaia16cep	AT2016izv	2016-12-21 01:02:17	151.68953	-6.19608	18.36			unknown	2016-12-23 10:04:07	blue transient, candidate SN near galaxy 2MASX J10064452-0611584
Gaia16ceo	AT2016izu	2016-12-21 01:02:25	151.69571	-6.34140	18.76			unknown	2016-12-23 09:59:56	hostless blue transient
Gaia16cen	SN2016ijc	2016-12-20 10:54:49	321.46732	-37.40385	17.62			SN Ia	2016-12-22 23:07:35	confirmed SN Ia near galaxy 2MASX J21255058-3724071
Gaia16cem	AT2016izt	2016-12-20 08:03:07	193.13214	-69.08113	18.56			unknown	2016-12-22 23:04:59	blue transient
Gaia16cel	AT2016izs	2016-12-10 10:04:14	267.80840	-75.26208	20.39			unknown	2016-12-22 23:03:52	rising, hostless, blue transient

Showing 1 to 10 of 1,750 entries

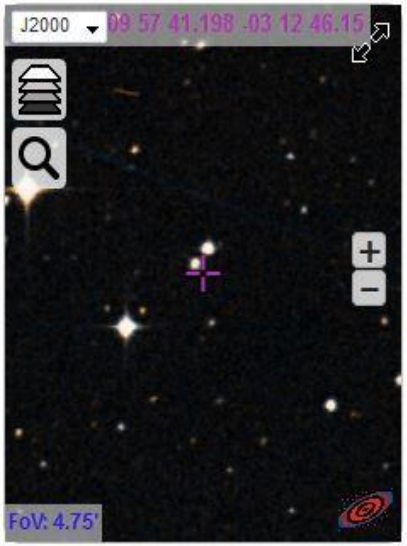
Previous 1 2 3 4 5 ... 175 Next

http://gsaweb.ast.cam.ac.uk/alerts/alertsindex

Details: comment, finding-chart, light-curve, SED, etc…

Gaia16ceq

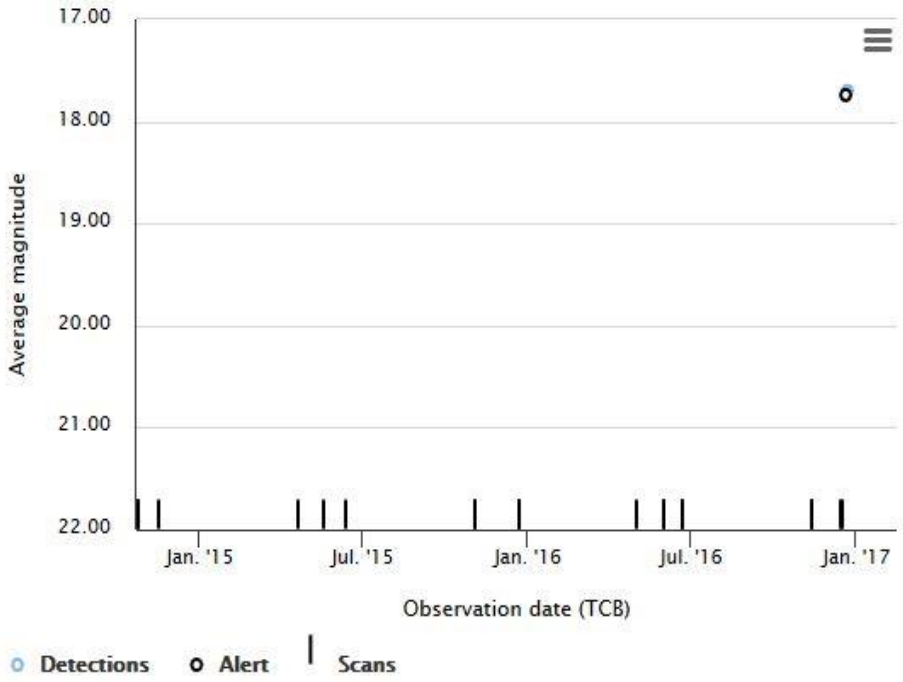
Details | Follow-up



RA - DEC
149.42166 -3.21282
09:57:41.20 -03:12:46.15

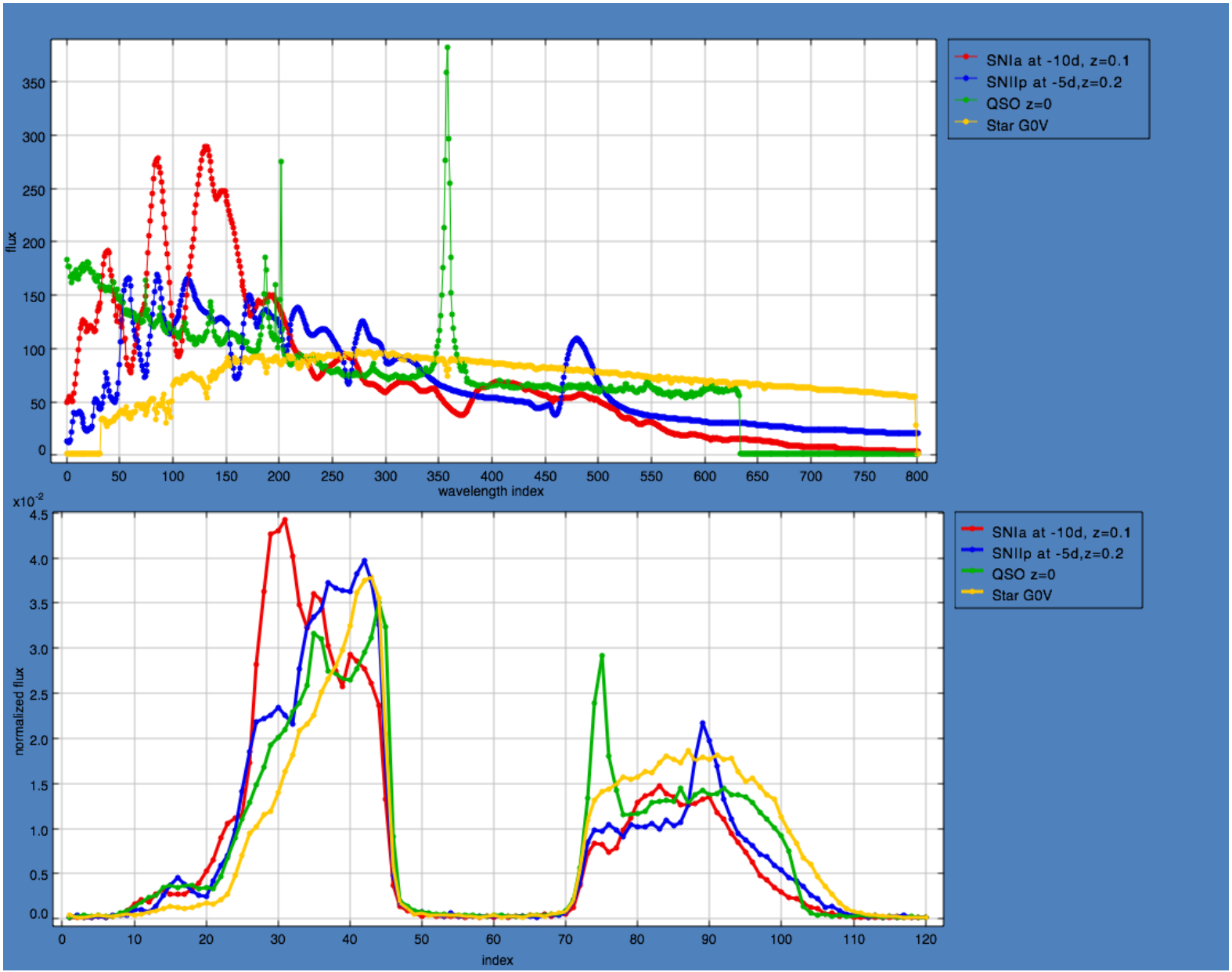
Alerting date
2016-12-21 14:46:30
Julian date
2457744.12
Alerting magnitude
17.74
Historic magnitude
None
Historic StdDev
None
Class
unknown
Publication date
Dec. 23, 2016, 10:08 a.m.

Other surveys detections
None
Comments
rising candidate SN, GS-TEC predicts SN Ia
ATels
None



Get lightcurve data

SED and BP/RP


SNIa at -10d, z=0.1
SNIIp at -5d,z=0.2
QSO z=0
Star G0V
flux
wavelength index
x10^-2
normalized flux
index

GAIA Alerts: Expected results

- Millions of « ordinary » variable stars
- ~ 70,000 RR Lyrae, ~8,000 Cepheids
- ~ 100 Novae/yr: complete Galactic census
- Symbiotic stars, Be stars, LBV's, etc...
- Cataclysmic variables: full census to ~2 kpc
- **~ 6000 SNe /5yrs, ~ 1/3 before maximum**
- Thousands of AGN'S and Quasars (+10^6 ...)
- Orphan γ-rays burst, etc...
- **and many UNKNOWNS !**

All brighter than V ~ 19.5 - 20

GAIA Alerts: present situation

- At the moment, a dozen per week
- Semi-automatic selection
- Δm ~~ 0.5 mag, to avoid faulse alerts
- Try to do pre-classification with BP, RP (60%)
- Progressively improving
- Found SNe, CV, eruptive stars, ….
- Many AGN's (or TDE's ??)

- **GAIA workshop: Nice, April 24-28 !!**
- GAIA alerts worskhop every year, since 8 years!

Today, many ground-based surveys also…

- Not dedicated to SNe only… (e.g. lensing, planets,…)
- Mainly Near-Earth Orbiting asteroids…(fear!)
- Only partial sky coverage
- Some data are public, others not
- CRTS, PTF, PanStarrs, SN Factory, MASTER, OGLE, LaSilla Quest, SkyMapper, ASAS-SN, etc…

- **But all need a large amount of telescope time for follow-up !**

Catalina Real Time Survey

CSS 0.7m Schmidt
8.1 Square D, V 19.5

MLS 1.5m Cass
1.2 Squ D, V 21.5

SSS 0.5m Schmidt
4.2 Squ D, V 19.0

About 2000°² /night, 1-4 times per lunation

Telescope	All OTs	Supernovae	Cataclysmic Variables	Blazars	Asteriods/Flares	CV or SN	AGN	Other
CSS	4408	1345	854	241	314	511	573	660
MLS	4633	690	91	90	286	771	2155	756
SSS	697	105	254	18	12	109	33	171
SNhunt	197	197	0	0	0	0	0	0
Total	9935	2337	1199	349	612	1391	2761	1587

On average, only a ~ dozen objects confirmed spectroscopically per month!!

CRTS Data

1. Automatically selected transient candidates (updated in real-time, table info):

CRTS Events												
ID	New	Alert Time (UT)	Event Date (UT)	RA (deg)	Dec (deg)	R1	R2	R3	R4	Finder	Data Link	DataScope
1505301211124110625	yes	2015-05-30T11:36:37	2015-05-30T10:04:29	332.7153000	20.2232800	19.23	18.95	19.08	18.99	625	625	View data
1505301180584103599	no	2015-05-30T11:23:59	2015-05-30T04:46:32	169.4343000	17.2503600	12.83	12.80	12.80	12.83	3599	3599	View data
1505301150564112335	no	2015-05-30T11:08:55	2015-05-30T04:24:32	160.2136200	15.1927300	15.92	15.88	15.87	15.92	2335	2335	View data
1505301120584121330	no	2015-05-30T10:56:36	2015-05-30T04:27:26	165.0613900	13.2644400	14.35	14.35	14.39	14.37	1330	1330	View data
1505291291084133681	no	2015-05-29T11:03:01	2015-05-29T10:56:26	342.8520900	29.6629400	15.41	15.40	15.39	15.41	3681	3681	View data
1505291600484128199	no	2015-05-29T09:29:11	2015-05-29T09:31:56	258.5290600	60.7895700	15.16	15.16	15.15	15.16	8199	8199	View data
1505291460504131731	no	2015-05-29T06:10:01	2015-05-29T06:08:32	197.5486300	47.7525900	13.07	13.05	13.06	13.04	1731	1731	View data
1505291490504116681	yes	2015-05-29T06:07:17	2015-05-29T06:04:56	206.6053900	49.2058500	18.56	17.02	19.04	18.91	6681	6681	View data
1505291460544110639	no	2015-05-29T05:59:43	2015-05-29T06:02:46	215.1602200	46.0419400	13.70	13.68	13.69	13.67	639	639	View data
1505291460544131663	no	2015-05-29T05:59:43	2015-05-29T06:02:46	213.8091000	47.7873100	15.61	15.61	15.57	15.56	1663	1663	View data
1505291460624115886	no	2015-05-29T05:30:09	2015-05-29T05:33:24	246.8497000	46.1943700	18.90	19.09	19.29	19.15	5886	5886	View data
1505291460624138404	no	2015-05-29T05:30:09	2015-05-29T05:33:24	247.1566500	47.5694600	18.38	18.29	18.17	18.18	8404	8404	View data
1505291400514120160	no	2015-05-29T05:05:34	2015-05-29T05:01:27	184.2138500	41.3361100	18.41	18.22	18.30	18.55	160	160	View data
1505291400514125641	yes	2015-05-29T05:05:34	2015-05-29T05:01:27	183.6693700	41.8220000	17.51	17.42	17.57	17.51	5641	5641	View data
1505291350554114510	no	2015-05-29T05:00:33	2015-05-29T05:00:44	186.6448400	35.2194500	17.10	17.00	17.07	17.24	4510	4510	View data
1505291400534102756	yes	2015-05-29T04:56:44	2015-05-29T04:57:08	189.2142900	39.7543700	16.23	16.13	n/a	16.17	2756	2756	View data
1505291350584118330	no	2015-05-29T04:52:08	2015-05-29T04:54:14	194.5389000	35.3286300	16.02	16.04	16.04	16.05	8330	8330	View data
1505291460464129735	no	2015-05-29T04:43:41	2015-05-29T04:26:23	182.2812700	47.6002600	13.50	13.51	13.49	13.50	9735	9735	View data
1505291460464129856	no	2015-05-29T04:43:41	2015-05-29T04:26:23	182.2814000	47.5918400	14.32	14.36	14.35	14.36	9856	9856	View data
1505291460464118043	no	2015-05-29T04:43:41	2015-05-29T04:26:23	182.9139900	46.6624300	18.89	18.94	18.64	18.80	8043	8043	View data

Other northern Surveys: PTF

- Palomar Transient Factory

Uses the 1.2m Schmidt, with
a 12k x 8k camera, since ~ 2009
2d release in August 2015 (but < 2012 !)

Supernovae Discovered by PTF			
All SNe	SNe Ia	SNe Ibc	SNe II
2,367	1,587	107	587

- Then iPTF 2013-2016 (refurbished)
  R band, 60 sec, ~ 20.5m - 3σ, More SNe
  (cadence: few mn to ~ 5 days, depending on topic)
- **Now ZTF 2017-2019, new 47°² camera,**
  high cadence to 21th mag., full sky every night
- Follow-up with the 1.5m and 5m telescopes at Palomar…

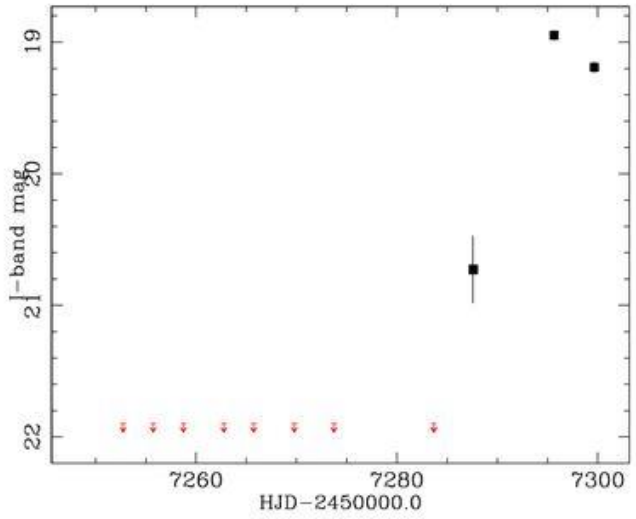
(SN Factory used NEAT cameras, Palomar + Maui,
+ 2.2m MaunaKea with SNIFS (IFU))

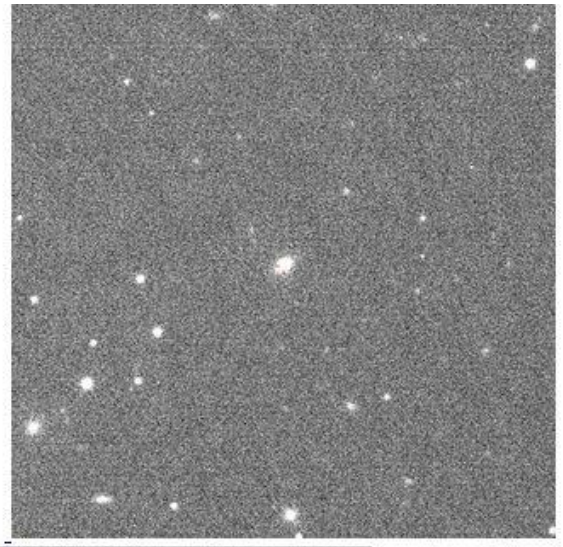
Other northern Surveys…

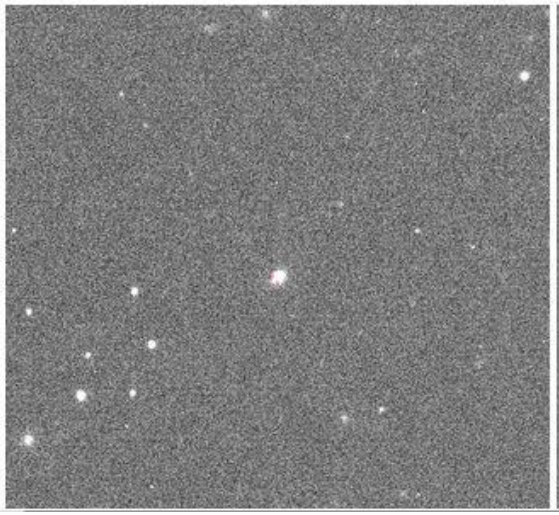
- MASTER (Russia) 40cm tel, FOV 8 squ. deg.,
  ~ 20th mag, + smaller VWF (14th mag)
  (Kislovodsk, Ural, SAAO, IAC,…)
  No spectral classification…!
- Pan-Starrs PS1 1.8m in Haleakala
  8 x 8 (4k x 4k) OTA-CCD's, ~ 3° FOV, ~ 24th mag.
  Data not public immediately…
- ASAS-SN: V 17, Hawaii: 4x14cm, CTIO: 2x14cm
  ½ sky per night; 150th SN in May 2015
- "Publishing" on ATel…

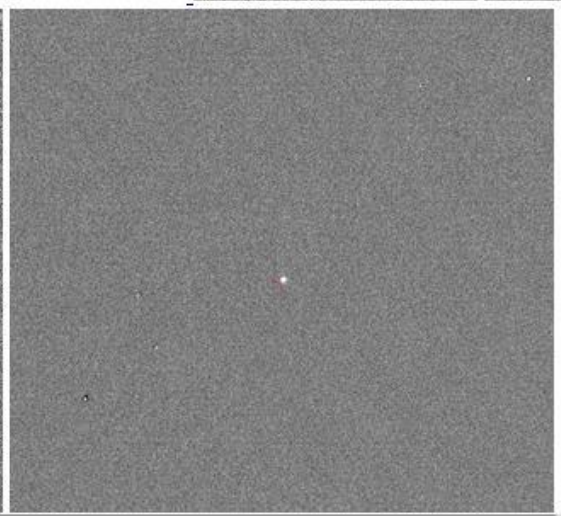
Southern surveys

- **OGLE IV**: 1.3
  Grav. Lensing, F
  32, 2k x 4k CCD
  50-70 fields/ni
  3000°² covered
  now extending
- Early Warning
- On-line data b









Since Oct 12: 457 SN candidates, 119 class. (1/4)

Other Southern surveys

- LaSilla Quest: Yale at ESO 1m Schmidt, 10°², 112 CCD's
  from Sept. 2009 till March 2016
  2 day cadence, south of +25°, 60s exposures (21.5 mag)
  390 out of 459 candidates are SNe…
  (classified mainly by PESSTO…)
- SkyMapper: 1.35m telescope in Siding Springs
  20' field, 100s exposures, ugriz, 19-21 mag
  mainly Galaxy and MC's stars…
  but SN search just starting (follow-up mainly at MountStromlo)

More projects…

- SURVEY

ATLAS: 2 x 50cm, NASA funded, Hawaii

All-Sky, twice a night, from δ -40° up North (~ 18 mag)

- FOLLOW-UP

SOXS: copy of X-Shooter for the NTT in LaSilla

Accepted by ESO, consortium exists

Now distribution of tasks (and funding…)

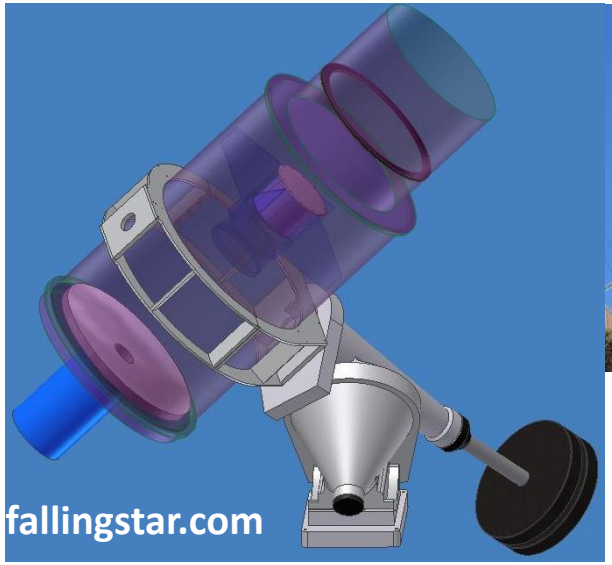
Lead by Italy (S. Campana, Milano) First light: 2019

NTE at the NOT (PI J. Fynboo (DK), possible FR contr.)

MISTRAL at OHP

Fills the gap between now and the LSST

ATLAS : Asteroid terrestrial impact last alert system



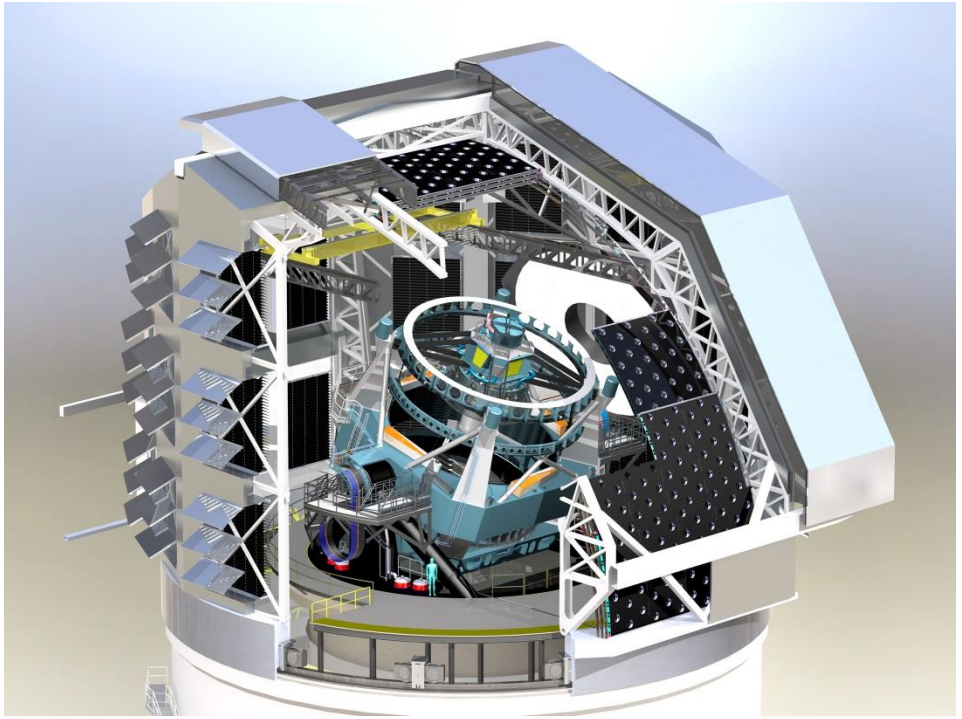
NASA funded (PI: J. Tonry)
Project team (IfA): Tonry, Denneau, Stalder, Koposov, Rest
QUB software team : Smith, Smartt
2 Units : Haleakela and Mauna Loa

- 2 x 50cm telescopes : 7º diameter, with 10k x 10k CCDs (from STA)
- f/2 Wright-Schmidt telescopes (1.8" pixels)
- **60,000 sq degrees per night**
- ***All sky (from δ -40° up) twice per night to m ≈ 20 (W-band AB)***
- *Pathfinder system has been run and tested – end to end software testing ongoing*

- Telescope and camera delivery : Haleakela installed.
  Science started from July/August 2015
- Huge potential for all sky (north of -40) transient searches

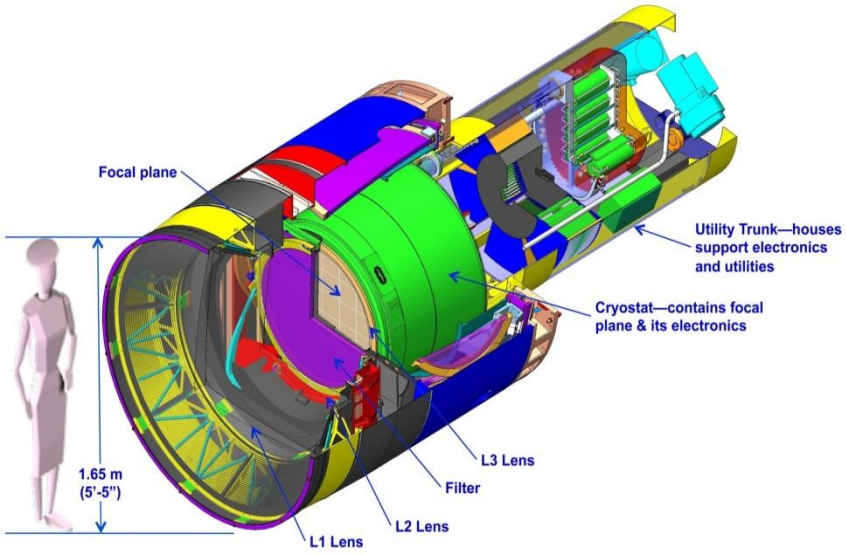
The Large Synoptic Survey Telescope

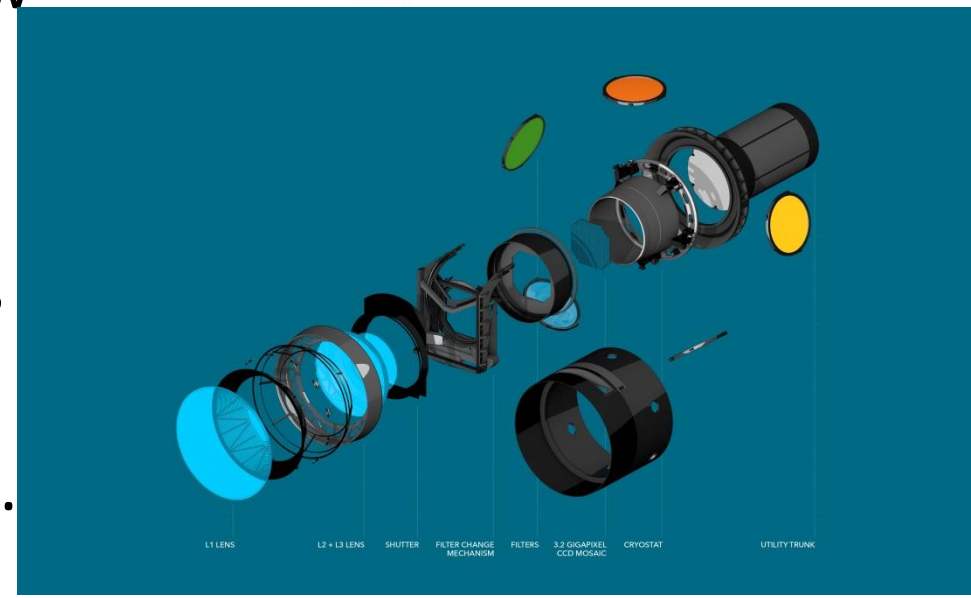
- 8.4m telescope
- 3.5° FOV
- ugrizy filters
- 22-25 mag/visit
- Cerro Pachon
- Start: ~ 2022



The LSST camera and strategy

- 189 4k x 4k, 10µ, CCD' s
- Readout 2 sec !
- Pairs of exposures: 15s +1s +2s +15s +1s +5s, thus new position every 39s
- Revisit after 15-60 mn
- Visit pairs every 3-4 nights
- + special (deep, 1h; fast time domain; LMC-SMC; …





Total: 2 10^{10} Gal., and Stars; ~ 2 10^{6+} alerts per nights….

LSST follow-up: spectro. versus photo. z … !

	u	g	r	i	z	y
1 visit	23.9	25.0	24.7	24.0	23.3	22.1
10 yrs	26.1	27.4	27.5	26.8	26.1	24.9

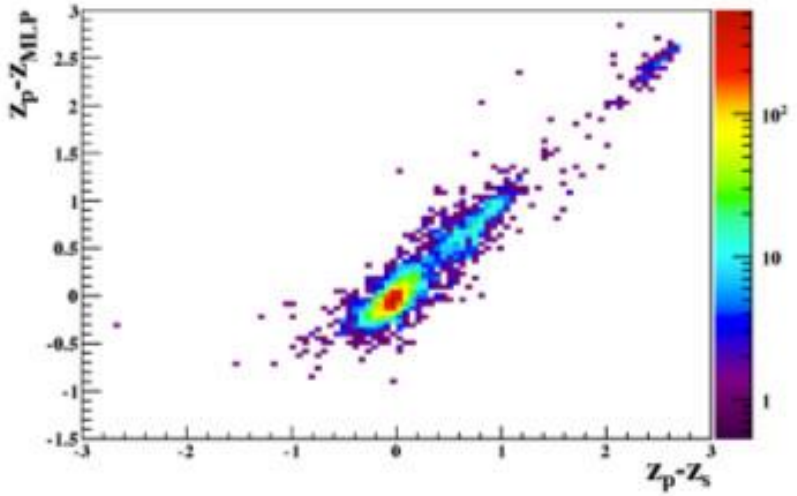
- Spectro impossible for 2E10 objects….
- Photo z mandatory:

-Training: colour ∞ z (30,000+ objects needed)

-Calibration: minimize systematics and dispersion

(~ 100,000 needed…)

(Newman et al. 2009)



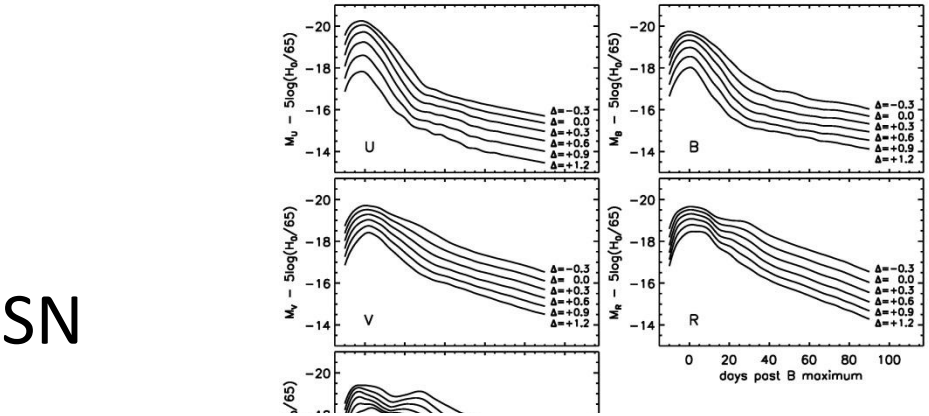
How discrepancy between two phot-z methods scales with Zp- Zs

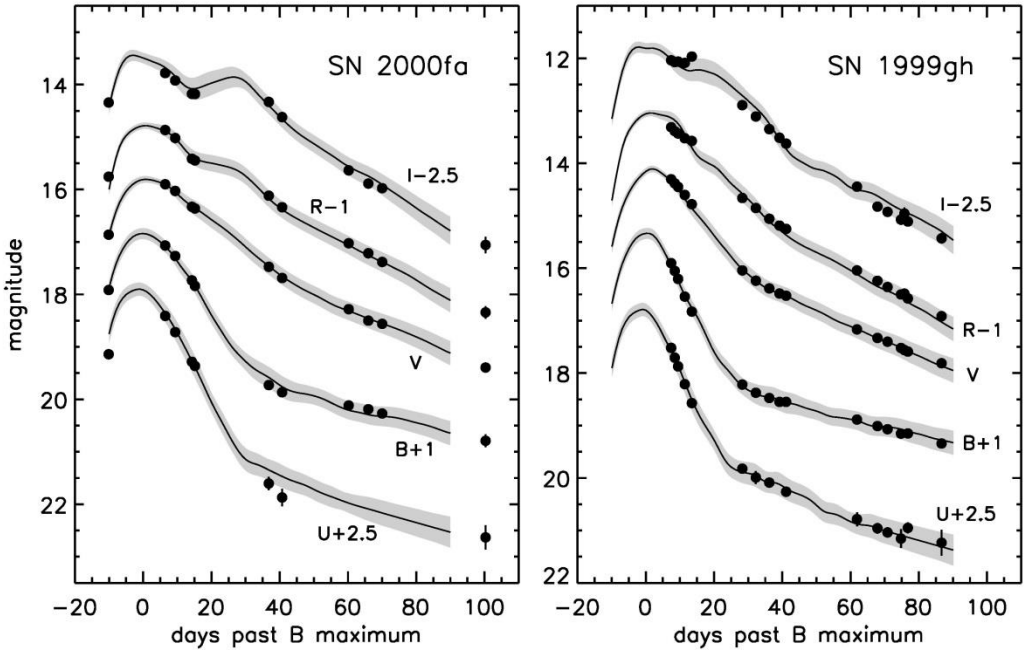
No need to wait for LSST… or SVOM…

- There is a lot to do with present surveys…
- Training, and refining the selection strategy
- Define specific science topics
- Organise/coordinate the follow-up
- Mobilise smaller communities
- Modernise equipment
- Involve amateurs (and public?)

SNe: photometric follow-up

- Uncomplete light-curves to fill-in…
- Use of templates per SN type (e.g. Jha et al. 2007 for Ia's)
- Can easely complete Gaia scarce sampling
- Important to find Ia's maximum

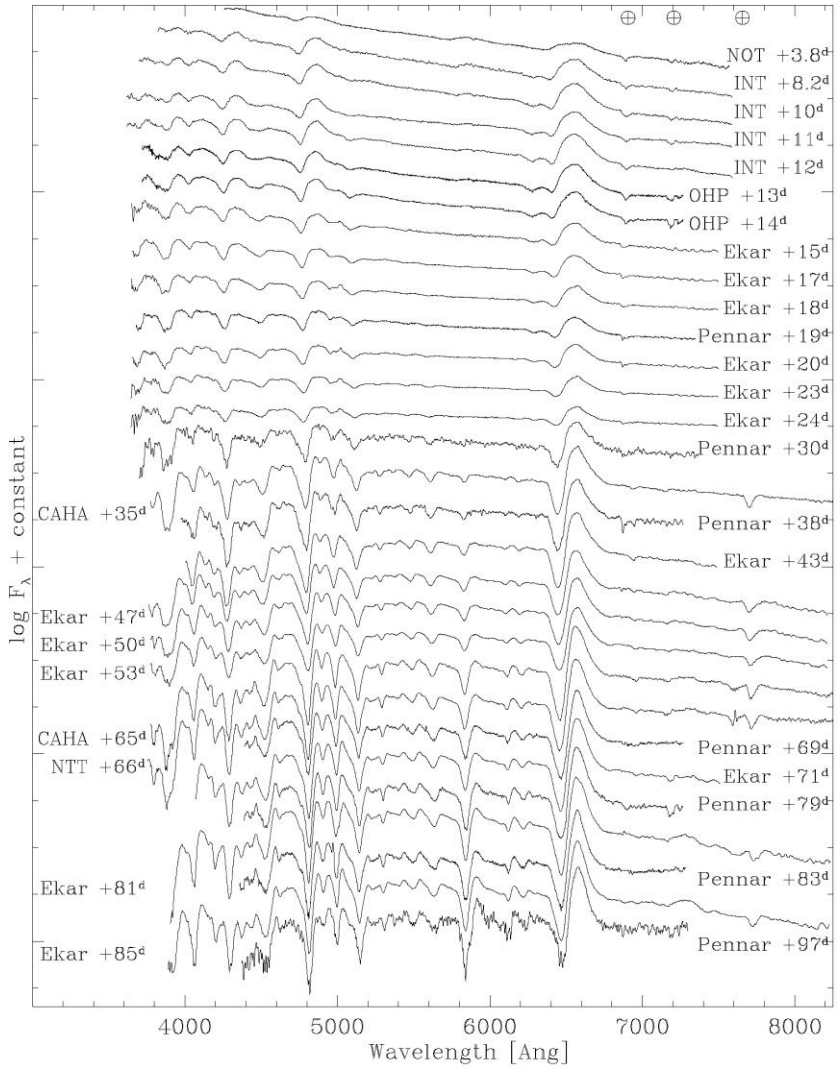




Spectroscopic follow-up

- Long-term follow-up (here SN 2012 A)
- To determine Mass and Nickel mass (II P here)
- Need of regular observing time
- Low dispersion adequate

  (R ~ 1000)



Ground based follow-up

- We need a lot of telescope time (2-4m class) for the initial classification
- And 1-2m class time for photometry

  (e.g. light-curve of Ia' s to get the Max)
- The situation is difficult in the North, and even more difficult in the South…
- A PESSTO-like organisation could be generalised,

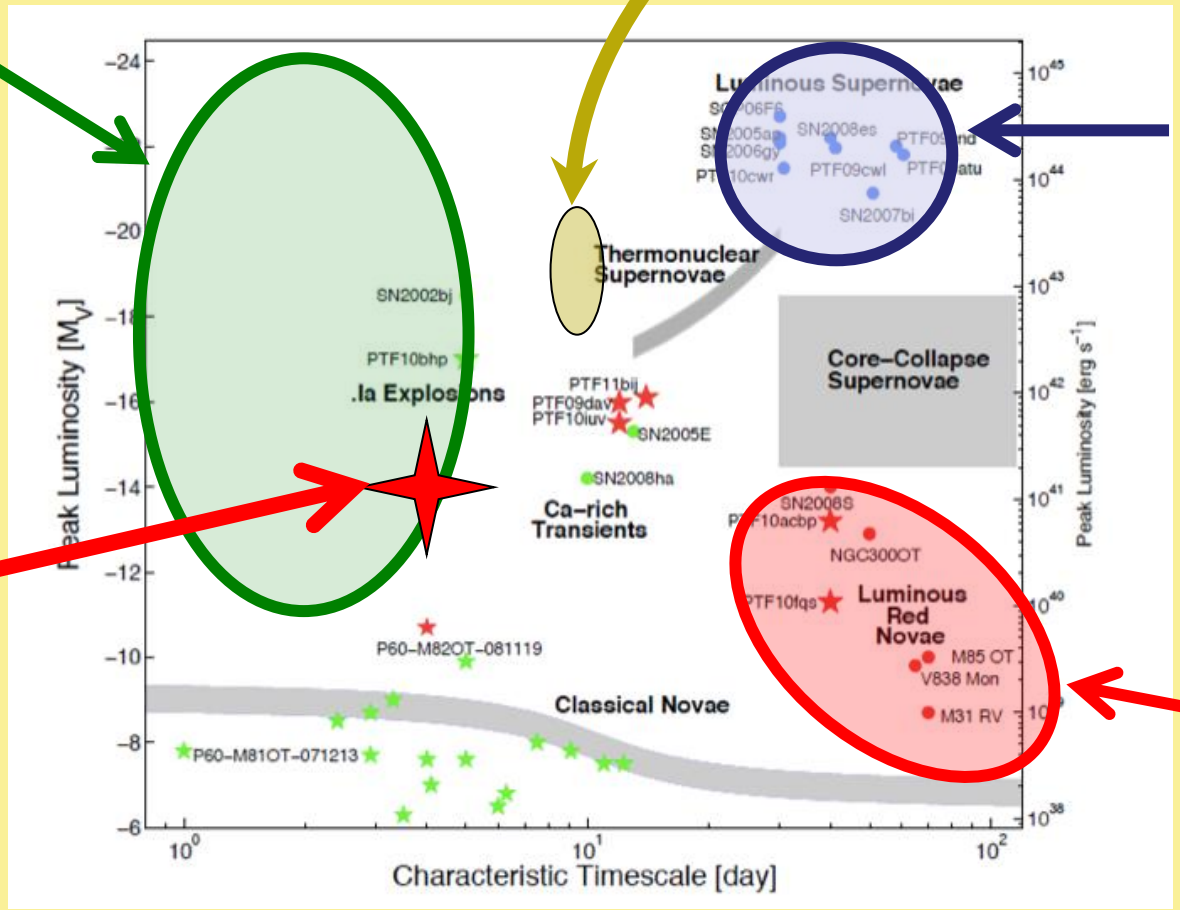
  Gaia-Alerts is going that way.

The PESSTO follow-up

- S. Smartt (QUB) et al. (~ 100 co-I's)
- 90n per year : 9 months, 10n per month at the NTT in LaSilla
- 5 yrs (2012-2016) granted, with regular formal NTT review (now!)
- Will classify ~2000 (667) SNe – all spectra reduced, classified and released within 24hrs (WiseRep)
- Will follow approx 150 (131) with full spectr. and phot. time series coverage
- ~50 papers published up to now
- Two more years granted (2017-2018)

Optical Transients

the unknown



The first "kilonova" ?

the bright

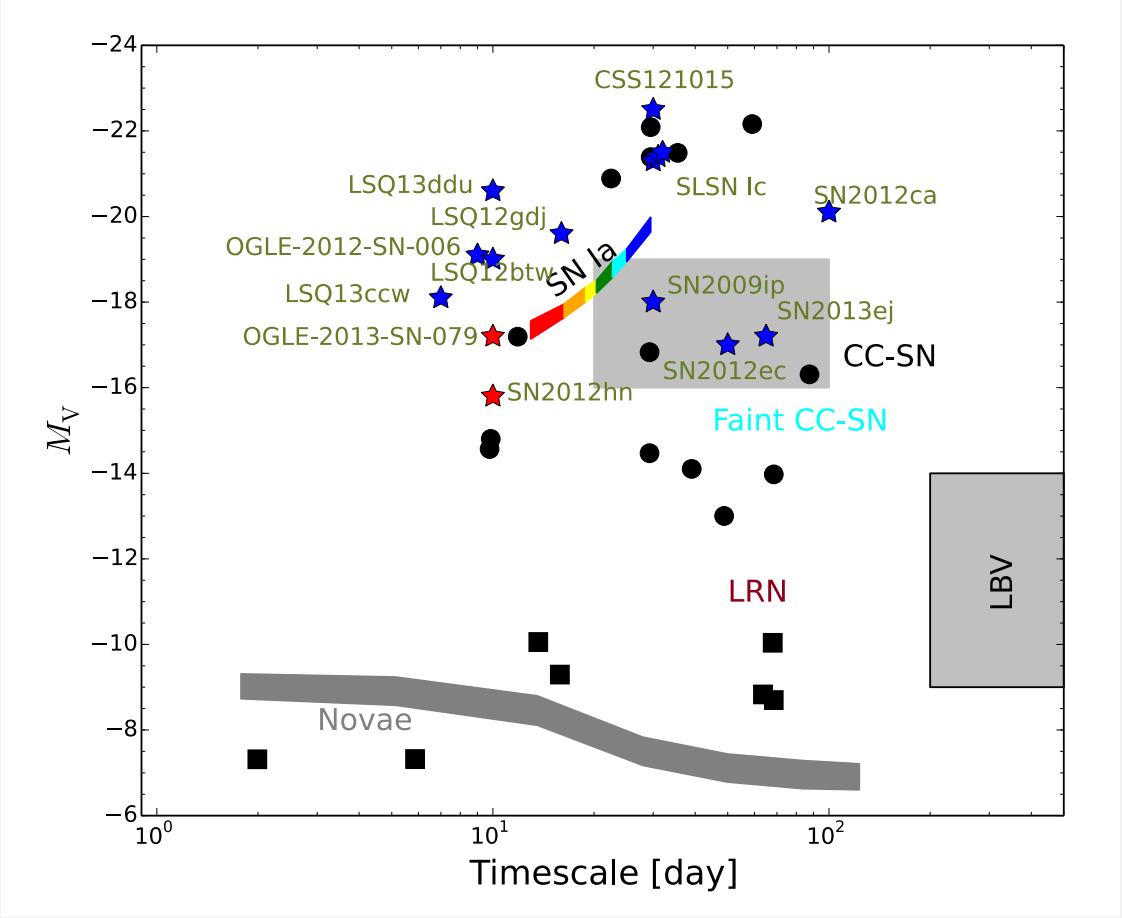
the faint

What are the limits of physical explosions and transients ?

Image credit : Shri Kulkarni, Mansi Kasliwal

Transients : current science

Smartt et al.
2015:
Survey description and products from the first data release by PESSTO,
A&A, 579, 40



What are the limits of physical explosions and transients ?

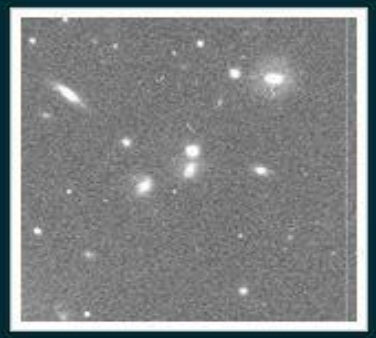
Image credit : Shri Kulkarni, Mansi Kasliwal, C. Inserra

PESSTO Marshall

latest comment (1 day ago): Nuclear and rapidly evolving, history is quiet, potentially very interesting, current mag is about 20, and looks like that's the peak - Iair Arcavi

identity

OGLE15lo



priority: HIGH

list: classification targets

pessto id: 883189

object info

ra & dec:

03:33:09.91 -64:07:15.2

[53.29129 -64.12089]

predicted type:

SN

pre-disc non-detection:

276 days ago

(2015-01-04)

discovery date:

272 days ago

(2015-01-08)

date added to marshall:

1 days ago

(2015-10-05)

host info

contextual classification:

NT/SN/VARIABLESTAR/?

lightcurve

lastest magnitude:

19.75 OGLE I-band 2015-10-03 +4d

current mag estimate:

20.00

actions

Ground-based classification/follow-up: Need 1-4m class telescopes

Various observatories interested

For photometry:

- Asteroids, SNe… follow-up (+GBOT)
- FOV ~~10 arcmin ideal
- CCD Pixel : 1/3 seeing
- Large infrastructure preferable

to allow flexibility (several telescopes)

For spectroscopy:

- Low dispersion for classification
- Large spectral range (3500-10000+)
- Single set-up adequate for most targ
- Teams agreements
- Select topics of interest
- Can expect a few alerts/week

Lack of spectroscopy, specially in France !!

Most telescopes interested in variables could join similar process

How to operate?

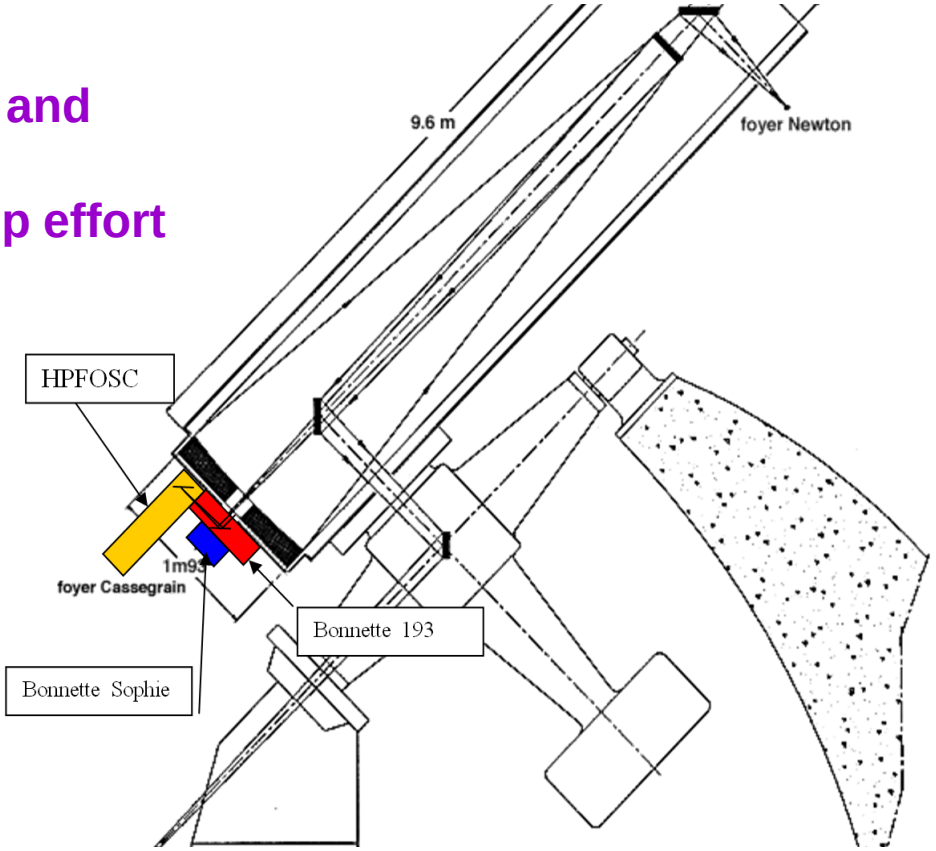
- Alerts = Targets of Opportunity
- Not all objects need a fast response…(24h +)
- Combine regular runs (e.g. 1 week per month) with ToO mode inbetween runs
- Team agreements to **choose/combine topics**
- Photometric alerts: a few frames only…
- SSO: maybe 20-30 per week?
- Alerts: One classification spectrum to start with…
- **To contribute, one needs to provide observing time!**
- Good opportunity for EU-French telescope,
  and later, SVOM + GFT What can we bring ??

New low-disp.Spectrograph at OHP: 'EFOSC' type: MISTRAL at T193

New Spectro-imager, multi-purpose and versatile...
Fits well in the coordinated follow-up effort at the european level.

Concept allows future innovations in the parallel beam.
or entrance plate.

International support most welcome!



Rapid changes /Sophie, no dismounting
Large versatility (filters, , FP, multi-object,...)
R ~500 à 2000, λ~3 600-10 000 Å
Deep-Depletion CCD, Research AND Teaching

Simpler concept: Mistral/Sprat 2016

Inspired from LT Telescope

Imaging and long slit

~ 4000-8000 Å

VPH grating R ~ 700

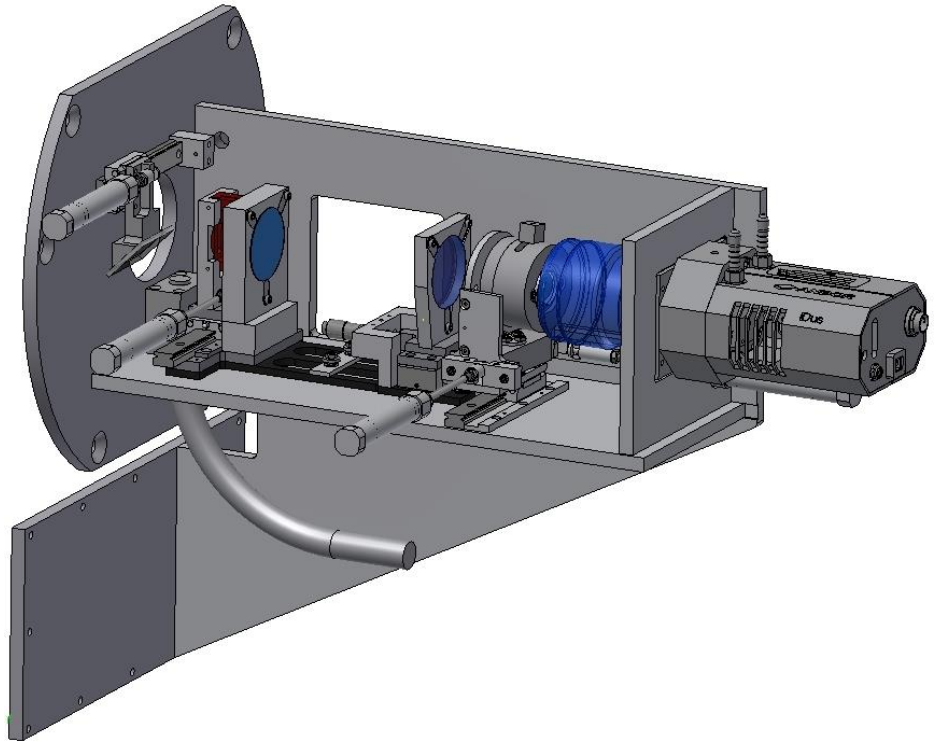
Andor camera 2k x 2k

FOV ~ 5’

Design close to finished

First light end 2018

Mag ~20 in 1h, S/N ~10



+ operations….

Conclusions

- No need to wait for LSST or SVOM…use the present surveys!
- We need to prepare anyway to be able to select the most interesting objects (otherwise too many…)
- **Use the present surveys (ground or space) to investigate the variety of SNe….+ statistics**
- **Complementarity X/optical/GW, whichever is first!**
- **We need a lot of telescope time (particularly in spectroscopy), where, how ??**
- Prepare groups and telescope time requests…

and instruments !!

The variety of topics should interest a lot of people…