Transient Facebook

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1 The Problem

Astronomy is transforming from a data-starved to data-swamped discipline. Data to be accumulated by next-generation astronomical surveys, such as Zwicky Transient Facility (ZTF), Large Synaptic Survey Telescope (LSST), and Wide Field Infrared Survey Telescope (WFIRST), will expectedly exceed the total volume of existing data by orders of magnitude. Particularly in the field of transients, ZTF, which will start its survey within a year, is going to deliver 10^5 events per night, while LSST is expected to send out 10^6 event alerts per night after the year 2022.

Follow-up observations for classification and detailed characterization of discovered transients have equally important scientific values as discoveries. However, given the limited telescope resources around the globe, not only will filtering events to select interesting candidates for follow-up observations become essential, but orginazation and coordination of follow-up observations as well as follow-up data sharing imposes another challenge to researchers and the community as a whole. For instance, fast-evolving transients (such as orphan GRB afterglows, electromagnetic counterparts of gravitational events) require rapid and intensive follow-up observations within the first 24 hours of discovery. Distant transients or late-time transients need big mirrors to observe. Obviously, traditional methods such as emails and phone calls are not sufficient to handle organization of timely follow-up observations of such large numbers of alerts.

2 Transient Facebook

Inspired by popular social media, in which people from all over the world make friends, form groups, make requests and communicate information, we propose a "Transient Facebook" system as a data center for transients, an information center for follow-up requests, and a workplace for individuals and collaborations. The main funcionalities of "Transient Facebook" includes:

- Users can register a transient by its coordinates and create a "Facebook" page for it. The registration procedure does not depend on transient alerts from any specific survey. However, it will check whether a transient has been registered or not.
- For a registered transient, "Transient Facebook" provides application program interaces (APIs) for users to upload relevant data at any time. The relevant data includes archival and follow-up data.
- "Transient Facebook" visualizes uploaded data and provides basic analysis tools, such as light curve fitting, spectral matching and spectral line identification.
- "Transient Facebook" allows users to post formal and informal analysis and comments on the transient "Facebook" page, facilitating communications and potentially fast publications.
- "Transient Facebook" provides APIs for users to share information about their telescope times with collaborators. Collaborators then will be able to send observation requests about particular transients to observers.
- "Transient Facebook" provides easy APIs for Users to download data of transients for further analysis.

- "Transient Facebook" provides a basic search function for users to query transients based on their locations and types.
- "Transient Facebook" will design a user adminnstration system to manage users and collaborations. Users will have privileges to decide how to share their data and postings to others within or outside collaborations.

2.1 Relations With Other Tooling In Development

The "Transient Facebook" provides a downstream tool for investigating transients. In the upstream, the transient discovery pipelines process survey data and produce transient alerts (such as ZTF IPAC image differencing pipeline and LSST Level 1 products). In the midstream, a broker annotates these alerts within information from external sources and a cascade of filters to select interesting candidates (ANTARES in LSST). In the downstream, interesting transients with all available data are collected in the "Transient Facebook" which provides a one-stop station to organize further observations and analysis.

3 Prototype: PTF Marshal System

Since 2009, the Palomar Transient Factory (PTF) has been using a prototype "Transient Facebook" called "Marshal" within its collaboration. Experience has shown that "Marshal" has greatly improved efficiency in communication, organization and publication within the PTF collaboration. Figures 1 to 3 shows screenshots of "Marshal" pages for PTF11kly (SN2011fe).

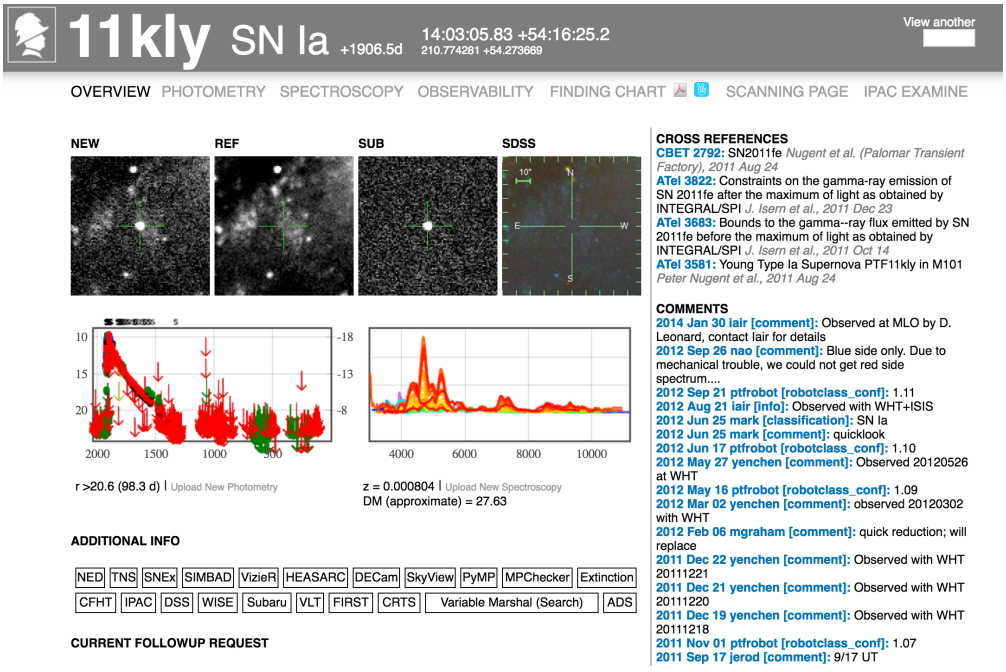

Figure 1: Screenshot of "Marshal" overview page of PTF11kly (SN2011fe)

The "Marshal" system was designed to match the discovery rate of PTF. The technologies behind it, including backend database and frontend web server, were also outdated. As a result, the whole system is not scalable to meet the data challenges in ZTF and LSST.

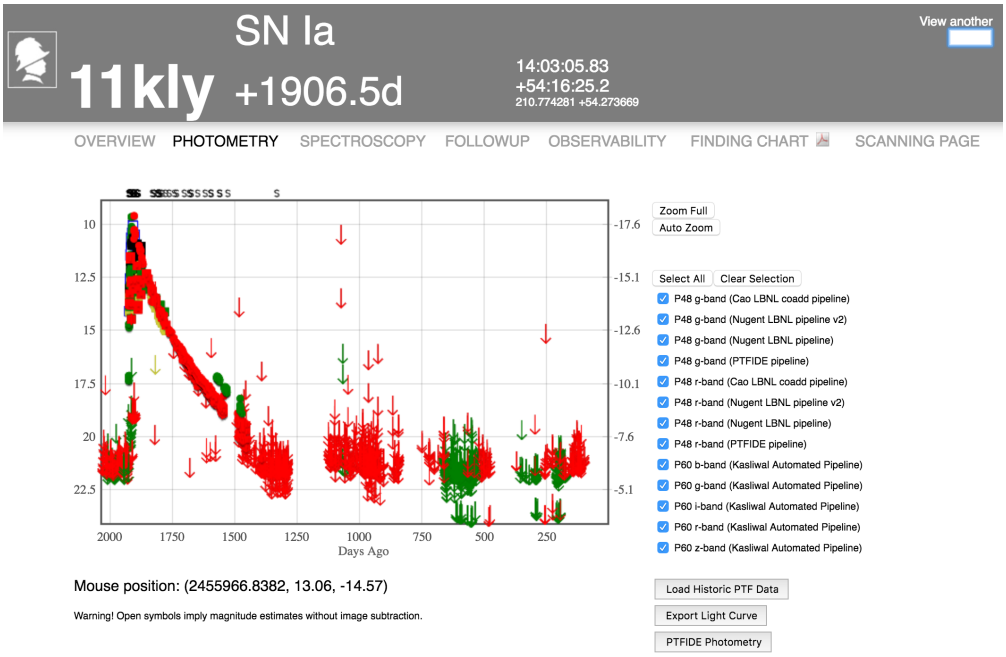

Figure 2: Screenshot of "Marshal" light curve page of PTF11kly (SN2011fe)

4 Requests

Based on the prototypical PTF Marshal system, we request funding in support of developing the "Transient Facebook" software system. The upcoming ZTF project (which is scheduled to run between mid-2017 and mid-2020) with an unprecedentedly large rate of transient discovery provide an apropriate testbed for the "Transient Facebook", before LSST comes online.

Specifically, we ask for money in the next three years for the following items

- Salary for personnels to develop and improve the "Transient Facebook" system.
- Purchases of computing resources to run the system either on local machines or on commercial clouds.
- Conferences and workshops to introduce the "Transient Facebook" system to the community.

The total amount is TBD.

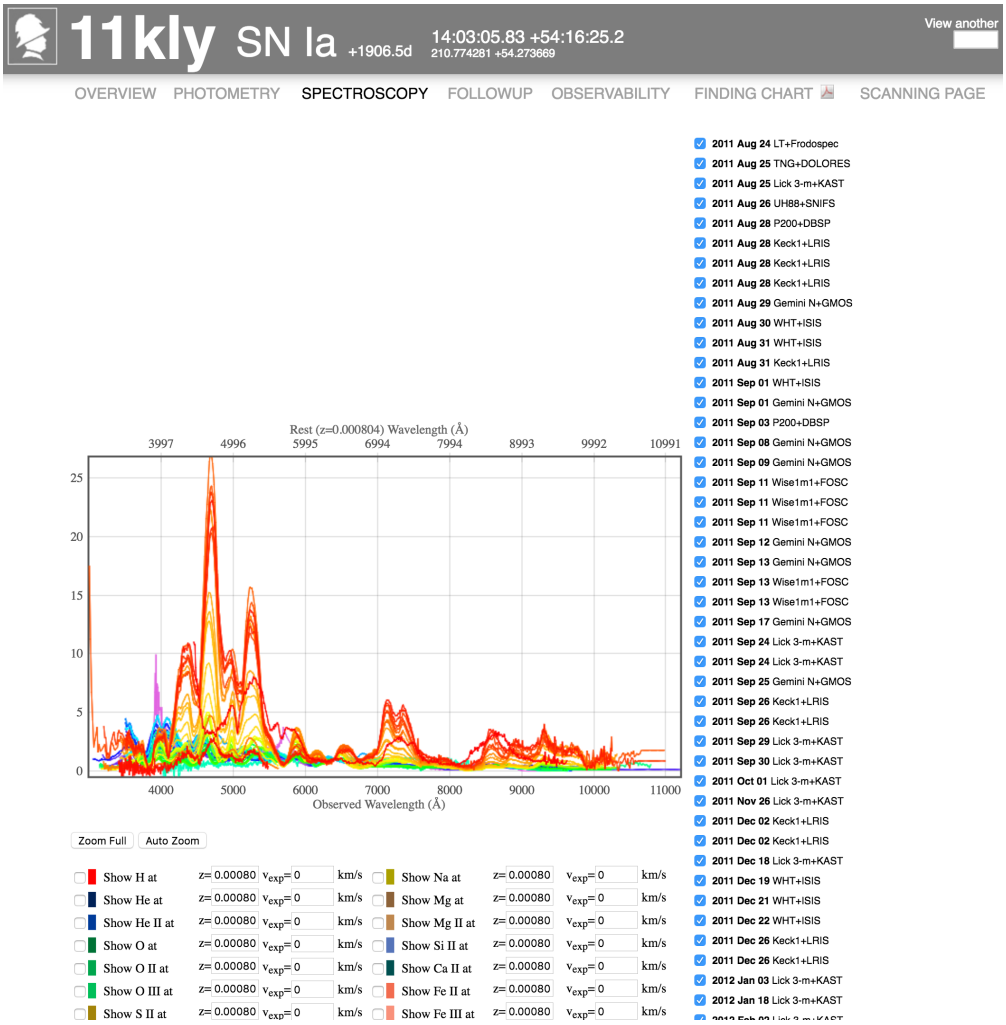

Figure 3: Screenshot of "Marshal" spectral page of PTF11kly (SN2011fe)