SUPERNONA SCIENCE (SNE)
WITH THE ONE METRE INITIATIVE (OMI)

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Abstract. Type 1a supernovae are the only direct way to observe the equation of state of dark energy. A change of equation of state with redshift would reveal an evolving scalar field. The OMI offers the possibility to narrow the constraints and improve our understanding of the equation of state.

1 Introduction

Large samples of SNIa offer a direct tool to refine the cosmological parameters. Random errors can be significantly reduced by observing the large number of SNIa; this requires the ability to see large volumes of space. The wide-field imaging capabilities and deep limiting magnitude of the OMI provide a good platform to refine the Hubble Constant and learning about the properties of dark energy.

2 Survey Requirements

By using 0.5 OMI years, 500 hours, a large number of SNIa could be detected and measured.

2.1 Filters

The OMI employs the ugriz filter set; these are suitable to measure a range of redshift.

2.2 Depth

Table 1. Peak of supernova luminosity function as AB magnitudes as a function of redshift

z	B	V	R	I	Z	J
0.05	17.2	17.4	17.5	18.3	18.3	18.6
0.20	20.6	20.3	20.4	20.8	21.3	21.9
0.50	23.9	22.6	22.3	22.5	22.5	23.2
0.70	25.4	24.0	23.2	23.1	23.2	23.9
1.00	26.6	26.0	24.8	23.9	23.9	24.1

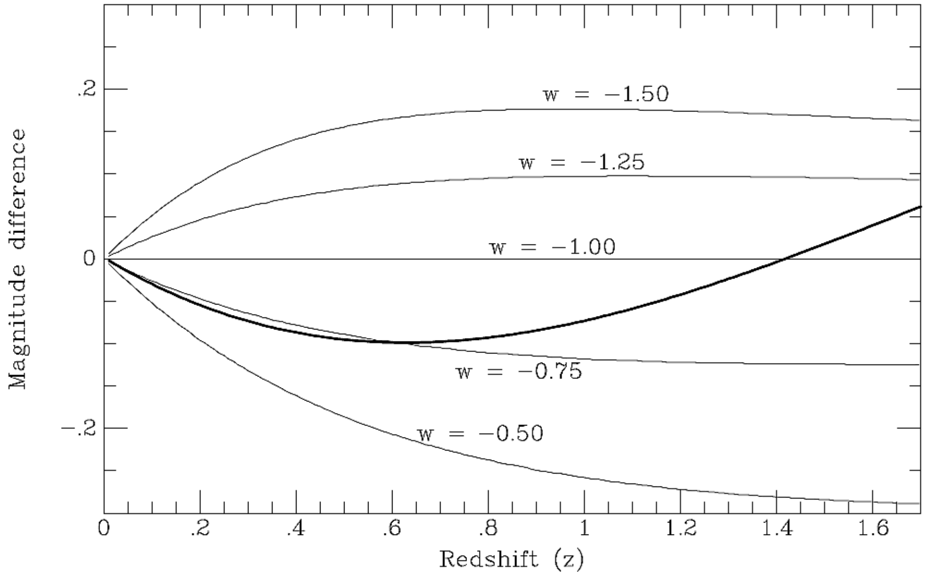

Figure 1. Hubble diagram for various possible constant values of the equation of state parameter ω (light line), and a example of a time-varying ω(z) (heavy line).

We need to follow at least one magnitude below peak in order to determine its decline rate and thus luminosity. In order to reach a systematic noise floor a reasonable accuracy is required 0.05 mag, at 1 magnitude below the filters in table 3. Thus the OMI could detect z= 0.7 in the i' with 2.5 hours, where the strongest leverage on ω(z) is found.

Table 2. Redshift vs. Magnitude (peak)

z	B	V	R	I	Z	J
0.05	17.2	17.4	----	----	----	----
0.20	----	20.3	20.4	----	----	----
0.50	----	----	22.3	22.5	----	----
0.70	----	----	----	23.1	23.2	----
1.00	----	----	----	----	23.9	24.1

Table 3. Magnitude to determine decline rate (1 mag below peak)

z	B	V	R	I	Z
0.05	18.2	----	----	----	----
0.20	----	21.3	----	----	----
0.50	----	----	23.3	----	----
0.70	----	----	----	24.1	----
1.00	----	----	----	----	24.9

Table 4. OMI Exp. (s) for various lim. mag. with a s/n = 20, FWHM = 1.25", zθ = 0º

Mag.	g'	r'	L	i'	z'
17	1.7	0.7	0.3	0.5	0.8
18	4.5	1.7	0.8	1.5	2.2
19	13	45	2.6	4	7
20	42	16	7.4	14	31
21	172	65	30	56	156
22	849	319	145	278	894
23	4800	1824	825	1500	5400
24	29000	10838	4900	9400	33000

2.3 Sky Coverage

A range of RA of high north galactic latitude would be of most interest for minimal interstellar extinction and altitude at our location (45 deg N.) and in order to follow a given field for as long as possible. Each field would be revisited every few days, 4 being the optimum, for the natural timescale of SNIa is 20 days FWHM between rise and fall. ½ OMI year (500 hours), with 5 deg² FOV, would yield 141 fields and 705 deg² of annual sky coverage with reduced s/n in the r' 1250 sec (s/n =10) and z' 2100 sec (s/n =5) and 9500 sec in the i' to m = 24, we could therefore observe 59 deg²/mth. According to Tonry et al. (2003) we can expect about 3 SNIa per square degree, i"<23, thus we would net:

- 2000 SNIa
- 4000 SNII

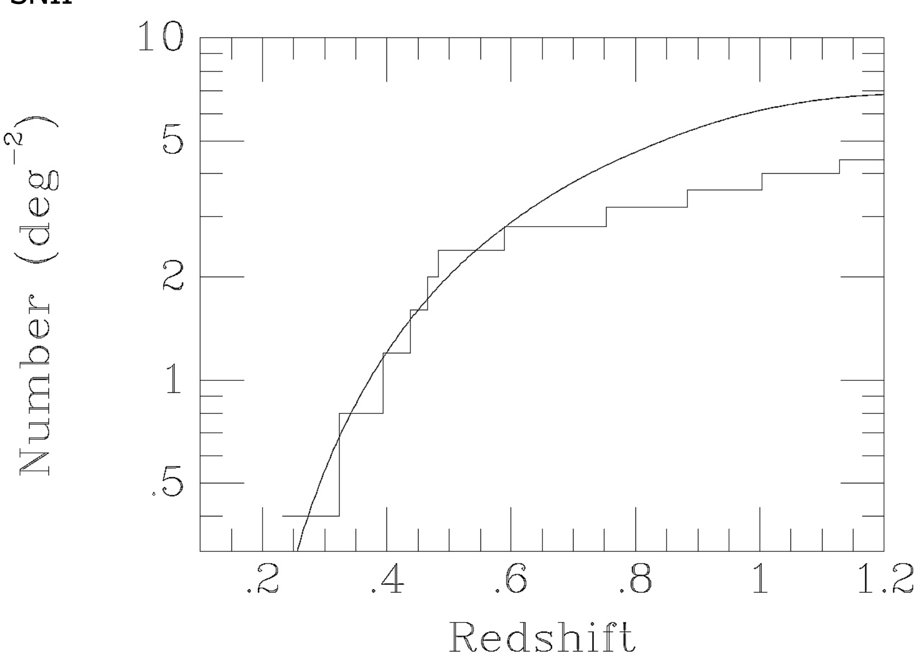

Figure 2. Cumulative number of SNIa discovery is shown as a function of redshift. The histogram are the SNIa observed by Tonry et al.

2.4 Follow Up through Photometric Redshifts from Supernova Light curves.

Pinto et al. (LSST) have demonstrated that it is possible to determine Photometrically a redshift from the light curve.

3 Canadian Perspective

The OMI will be the only telescope on Canadian soil able to search for SNIa in any volume. Indeed the CFHT Megaprime Wide Synoptic has so far detected about 250 SNIa (December 2008).

Reference: Pan-STARRS Supernova Science (SNE) Tonry et al. 2003
CFHT SuperNova Legacy Survey (December 2008)
Pinto, Smith and Ganavich: A deep Supernova Survey With Photometric Redshifts using the LSST.