

SNe Imaging Linear Polarimetry

Antonia Morales-Garoffolo



1st CRISPINHO workshop

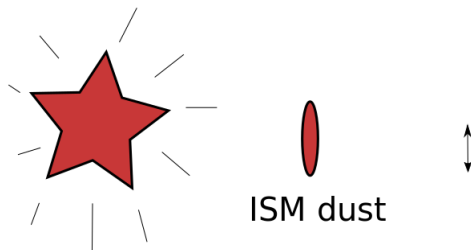
Granada, January 28th 2020

Outline

- 1 Introduction
 - Continuum Linear Polarimetry Mechanisms in Supernovae
- 2 Our project at CAHA
 - SN Imaging polarimetry with CAFOS

- 1 Interstellar non spherical dust grains
- 2 Light Scattering due to circumstellar material
- 3 Electron scattering in aspherical photospheres

1. Interstellar non spherical dust grains



Characterized in the optical by the Serkowski curve

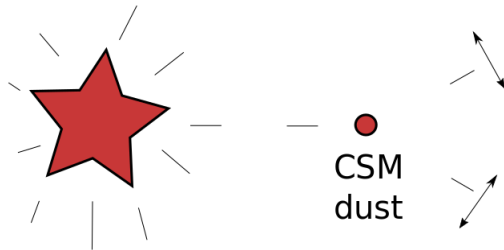
$$p(\lambda)/p_{max} = \exp[-K \ln^2(\lambda_{max}/\lambda)]$$

- p_{max} is the degree of polarization
- λ_{max} is the wavelength of peak polarization
- K is a constant that depends on the width of the curve

1. Interstellar non spherical dust grains

- Smaller dust grains, shorter λ_{max}
- Larger dust grains, longer λ_{max}
 \implies grain size distribution
- $R_V = A_V / E(B - V) \approx 5.5 \lambda_{max}$
 \implies extinction in the line of sight

2. Light Scattering due to circumstellar material



$$p(\lambda) = c_R \lambda^{-4}$$

- c_R is the amplitude of scattering

3. Electron scattering in aspherical photospheres

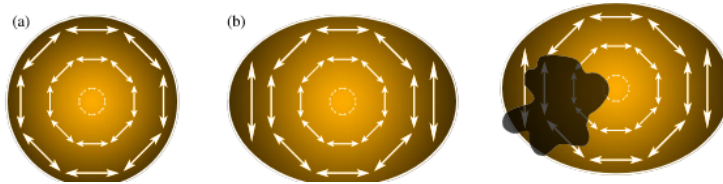
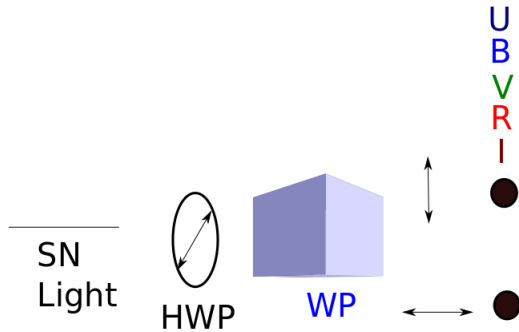


Figure: Cikota et al. 2019

⇒ asphericities

How do we measure continuum polarization?



- Intensity of orthogonal beams:
Stoke parameters \Rightarrow Q,U
- $P = \sqrt{Q^2 + U^2}$ (Pol degree)

First Proposal: Autumm 2017

1. Telescope: 2.2-m ☒ 3.5-m ☐

2.1 Applicant	<u>Dr. M. E. Moreno-Raya</u>	<u>CAHA</u>
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2.2 Collaborators	<u>S. González-Gaitán, L. Galbany</u>	<u>U. Lisboa, U. Pitt</u>
	<small>name(s)</small>	<small>institute(s)</small>
	<u>M. Mollá, J. L. Prieto, J. M. Vilchez</u>	<u>CIEMAT, U. Diego Portales, IAA</u>
	<small>name(s)</small>	<small>institute(s)</small>
2.3 Observers	<u>M. E. Moreno-Raya</u>	<u>S. González-Gaitán</u>
	<small>name</small>	<small>name</small>

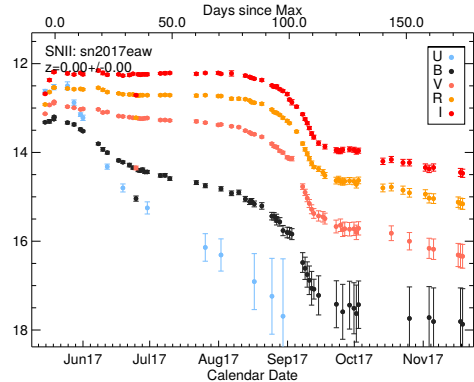
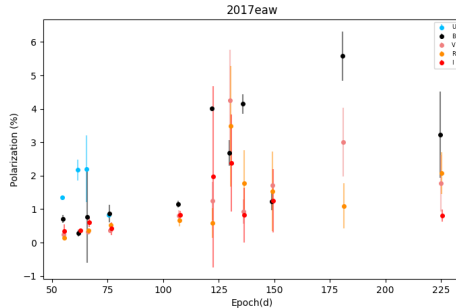
CAHA points out that by specifying the names under item 2.3 it is obligatory to also send out these observers to Calar Alto. Correspondence on the rating of this application will be sent to the applicant (P.I.) as quoted under 2.1 above.

3. Observing programme and method: Category: ☐ E

Title : **Revealing supernova explosions asymmetries and intervening dust
with imaging linear polarimetry**

First Proposal: Autumm 2017

- 12 SNe observed, e.g. IIP SN 2017eaw:

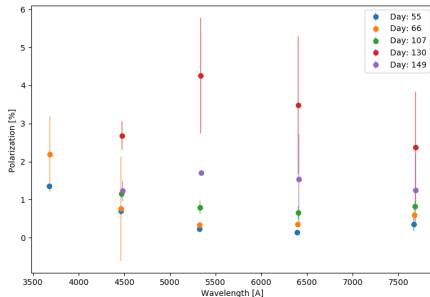


- SN 2017eaw: Polarization increase after plateau \rightarrow asphericities.

Figure: From Tsvetkov et al. 2018

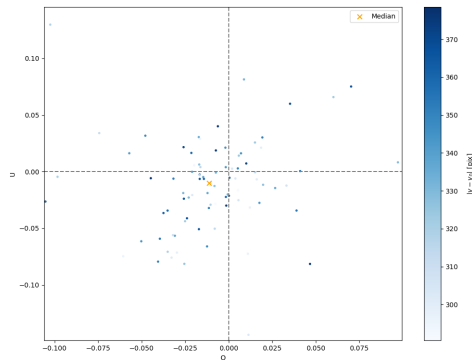
First Proposal: Autumm 2017

● SN 2017eaw Serkowski curves:



- Early → blue λ_{max} smaller dust (CSM?)
- Late → red λ_{max} (asphericities)

● Background:



- No significant contribution.

Second Proposal: Spring 2020 approved!

1. Telescope: 2.2-m ☒ 3.5-m ☐ H17-2.2-023 ☐ C

2.1 Applicant

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2.2 Collaborators

<u>S. González-Gaitán, A. Mourao, J. Silvestre</u>	<u>Instituto Superior Técnico Lisboa</u>
<small>name(s)</small>	<small>institute(s)</small>
<u>L. Galbany, I. Domínguez</u>	<u>University of Granada</u>
<small>name(s)</small>	<small>institute(s)</small>

2.3 Observers

<u>L. Galbany, S. González-Gaitán, A. Morales-Garoffolo, J. Silvestre, MSc/PhD students</u>
<small>name</small>

CAHA points out that by specifying the names under item 2.3 it is obligatory to also send out these observers to Calar Alto. Correspondence on the rating of this application will be sent to the applicant (P.I.) as quoted under 2.1 above.

3. Observing programme and method: Category: ☐ E

Title : Exploring Supernova explosion asymmetries and line of sight dust through imaging linear polarimetry

Second Proposal: Spring 2020 approved!

Observing time:

7. April to 7. April 2020, 0,5 night.

16 April 2020, 0,75 night.

28 April 2020, 0,75 night.

5 May 2020, 0,5 night.

13 May 2020, 0,75 night.

25 May 2020, 0,75 night.

9 June 2020, 0,5 night.

18 June 2020, 0,5 night.

In this week we will organize the runs.

Second Proposal: Spring 2020 approved!

- Aim: ~ 5 bright ($m_V < 16.5$) SNe
 - ASAS-SN, ePESSTO, Carnegie etc.
- Objectives:
 - Serkowski $\rightarrow \lambda_{max} \rightarrow R_V$
 - Grain size evolution
 - Asphericities
 - Stacking \rightarrow SN Host Galaxy polarization

Second Proposal: Spring 2020 approved!

- Results from this proposal in the next CRISPINHO meeting :)

Thank you!!