EAS Colloquia Report

INTERNATIONAL SCHOOL ON "COSMIC ACCELERATORS"

April 29 – May 8 2013, Cargèse, France

A total of 57 young researchers from around the world, but with strong European participations, recently attended the international school on *"Cosmic Accelerators"*. Held in the beautiful Cargèse Corsica (FR), the school offered a unique educational experience for promising young scientists.

The school was developed around the theme of particle acceleration mechanisms and the associated radiative processes that play a role in numerous phenomena observed in different astrophysical objects. The program was divided into fourteen sessions and the invites speakers, all well recognized senior scientists, covered the different themes.
The presentations given by the different lecturers were stored electronically on the School webpage and are accessible to the students, but also to the scientific community.

The complete participants list and the school program can be found in Appendix A and B (for more information we refer to the school webpage: http://www.issibern.ch/cargese2013).

At the end of every day and session the school gave the opportunity to **ten students to present a summary of their work** in front of the speakers and the other students. A total of 27 **posters** have been exposed during the whole duration of the school allowing for informal discussions during the lectures breaks.

The talks and the posters of all the participants were of very high quality, however, the SOC/LOC decided to **award a prize to two students** based on the (*i*) scientific case, (*ii*) the general communication effort, (*iii*) individual involvement, and (*iv*) original results. The winners received a symbolic prize consisting in local gastronomic products. A summary of the work of the two selected students can be found below.

Based on the young scientists feedback the **objectives** of the school in providing the young researchers with a global view of the particle acceleration problem, and to help them to make the fundamental connections between communities, in order to have a more comprehensive approach to the proposed scientific theme have been achieved. To bring closer the students to each other the school organized the first day a Concert (J .S. Bach) and offered a welcome Cocktail afterwards. To trigger informal discussions between the lecturer and students the school organized at the end of the first week a social dinner in Cargèse, and the day after a social tour to the UNESCO World Heritage site of Piana. All the young researchers and lecturer participated actively.

The registration fee was set at 600 €, which included the student's housing, lunch, coffee brakes (for 10 days), and all the social events. Based on the total budget we could full support (600 Euro) several young researchers, or partially supported (300 Euro) several young researchers. Thanks to the **EAS grant** of 3500 € we support six EU students to participant at the school. The LOC paid very much attention in supporting students who had little or no support from research contracts or grants coming from EU countries. If requested, we can provide the paid invoice.

Conclusions:

We would be very happy to help if EAS envisages to produce a short web story for this EAS Colloquia School.

Based on the very positive feedback of the teachers and students, the main organizers envisage to resubmit a new proposal for 2016 to the Insitut d'Etudes Scientifiques de Cargèse with the same aims and goals as the previous one but with a different theme.

Sincerely yours,

Dr. Maurizio Falanga
International Space Science Institute (ISSI)
E-mail: mfalanga@issibern.ch

Appendix:

Fig 1. School attendees

Fig 2. An introduction about all the supporting institutions has been given, and, of course, EAS has been presented to the speakers and students.

- **Best poster prize**

Herman Lee (Riken, JP)

"TeV-bright non-thermal supernova remnants (SNRs) within our Galaxy are promising sources of cosmic-rays (CRs), presumably up to the so-called 'knee' energy around a few PeV. Discerning the true origin of the gamma-ray emission from these particle accelerators is extremely important since it relates directly to the long-standing question of whether SNRs can explain the energy budget of the Galactic CR population. We have developed a robust modeling platform, the "CR-hydro-NEI" code, that is specifically designed to model broadband emission of SNRs using a self-consistent framework coupling the essential physics relevant to strong collisionless shock systems found in young SNRs. These include a fully non-linear diffusive shock acceleration (NLDSA) calculation, a non-equilibrium ionization code and a 1-D (spherically symmetric) Lagrangian hydrodynamical code. We have recently applied this framework to the SNR Vela Jr, a well-known example of non-thermal SNRs of which the origin of the strong GeV-TeV gamma-ray emission is under heated debate. Our comprehensive modeling has provided compelling evidence that the broadband emission of Vela Jr is best explained by a scenario in which the gamma-rays are emitted through the inverse-Compton process by the accelerated electrons up-scattering the surrounding ambient photon fields rather than a hadronic origin, although the CR protons is still dominating the overall energetics. The spatial (radial) variation of the synchrotron X-ray spectral index, which our leptonic model has successfully reproduced, has also pointed to the strong possibility of a low (micro Gauss level) B-field in the NW rim where sharp X-ray filamentary structures are found. Alternative explanation(s) for the sharpness other than fast radiative loss of electrons are thus strongly called for. Lastly, we have proposed the intriguing prediction that future X-ray missions like Astro-H with unprecedented spectral resolving power will probably be able to discern thermal line emission from 'non-thermal' SNRs like Vela Jr, prospectively providing us with critical information on the plasma properties in these systems."

- **Best talk prize**

Katie Auchettl (Harvard, CfA, USA)

Observational evidence from thermal and non-thermal emission of supernova remnants (SNRs) has provided increasing support in favour of cosmic ray (CR) acceleration at their rapidly-expanding shock fronts. Accelerated charged particles lose their energy via a number of different mechanisms and the production of gamma-ray emission can be a diagnostic signature of these processes. Whether this gamma-ray emission is hadronic or leptonic in nature is currently a hotly debated topic in the literature. SNRs that are known to be interacting with dense MCs provide effective targets for detecting and analysing the acceleration of hadrons. The interaction of a SNR's shockwave with dense molecular material is often inferred from the detection of 1720 MHz hydroxyl (OH) masers in the direction of the SNR . Additionally, the combination of: the detection of molecular line broadening and/or asymmetric profiles, enhancement of excitation line ratios such as J=2 -> 0 and J=1 -> 0, detection of IR emission or morphological agreement of molecular features with SNR features, all provide persuasive evidence for SNR-MC

interaction . In this presentation, we reported on the detection of gamma-ray emission coincident with the Galactic SNR, Kesteven 79 (Kes 79). Kes 79 is thought to be interacting with adjacent molecular clouds due to the presence of strong ^{12}CO J = 1 -> 0 and HCO^+ J = 1 -> 0 emission and the detection of 1720 MHz line emission towards the east of the remnant. We analysed approximately 52 months of data obtained with the Large Area Telescope (LAT) on board the *Fermi Gamma-ray Space Telescope* and performed a detailed spatial and spectral analysis of this emission. This analysis allows us to constrain the origin of the gamma-ray emission as observed in this remnant. Assuming that the observed gamma-rays can arise from the SNR itself, we modelled this spectrum using a pion decay arising from an exponential power law distribution of protons being accelerated by the SNR shockwave. If one makes a reasonable assumption about the properties of a SNR such as assuming 40 % of the explosion energy goes into acceleration particles, we can use this model to estimate the density of the surrounding medium that the SNR shock wave is interacting with. To test whether this inferred density agrees with other observations, we performed a spectral analysis of the X-ray emission from Kes 79 using 21 archival XMM observations. The ambient density derived using X-ray measurements is an order of magnitude smaller than the density inferred from the pion decay model. This discrepancy between the two ambient densities could indicate that the SNR shockwave is interacting with cold, dense clumps of material that do not radiate significant in X-rays. Another possibility is that, there could be particles, which have escaped the acceleration region and streamed ahead of the shock. These escaped particles can interact with the material upstream of the shock, enhancing the detected gamma-ray emission.

Students

Family name	First name	Country	Institution
Heyl	Jeremy	CA	University of British Columbia
Pavlovic	Marko	RS	Faculty of Mathematics, University of Belgrade
Grudzinska	Mira	PL	University of Warsaw
Jermak	Helen	GB	Liverpool John Moores University
Khiali	Behrouz	BR	University of Sao Paulo (USP)
Onic	Dusan	RS	Faculty of Mathematics, University of Belgrade, Serbia
Rani	Bindu	DE	Max-Planck-Institut für Radioastronomie
Cui	Yudong	TW	Astronomy Department of Tuebingen University
Dominik	Michael	PL	University Of Warsaw
Joshi	Jagdish	IN	Raman Research Institute
Vuillaume	Thomas	FR	Université Joseph Fourier, Grenoble, France
Siemieniec	Grazyna	PL	Jagellonian Univ. Cracow
Vaupre	Solenn	FR	Université Joseph Fourier
Peresano	Michele	IT	Università degli Studi di Trieste
Babyk	Iurii	IE	Dublin Institute for Advanced Studies
Vovk	Ievgen	CH	University of Geneva
Dejong	Sandra	FR	François Arago Centre
Bayirli	Arif	TR	Bogazici University
Khalil	Mohamad	FR	IN2P3
Vila	Gabriela	AR	Instituto Argentino de Radioastronomia
Rodriguez Barrer	Isabel	GB	University of St Andrews
Ghezali	Karima	DZ	Université des Sciences et de la Technologie Houari Boumediene (USTHB)
Sun	Shangyu	DE	Max-Planck-Institute for Physics
Olmi	Barbara	IT	Università degli Studi di Firenze
Fouka	Mourad	DZ	Centre de Recherche en Astronomie, Astrophysique et Géophysique (CRAAG)
Lipatova	Lilia	RU	Lebedev Physical Institute of Russian Academy of Sciences
Delgado	Laura	ES	Consejo Superior de Investigaciones Cientificas-CSIC
Auchettl	Katie	US	Monash University/Harvard-Smithsonian Center for Astrophysics
Weidl	Martin	DE	Max Institute for Plasma Physics
Clavel	MaÃ¯ca	FR	Université Paris Diderot
Schanne	Stephane	FR	CEA Saclay
Kundu	Esha	IN	Tata Institute of Fundamental Research, Mumbai, India
Borwankar	Chinmay	IN	Bhabha Atomic Research Center
Verma	Murli	IN	Lucknow University
Biteau	Jonathan	FR	CNRS / Ecole polytechnique
Supsar	Markus	DE	Ruhr Universität Bochum
Chang	Xiaochuan	CN	School of Astronomy and Space Sciences of Nanjing University
Desgardin	Thibaut	FR	CNRS
Dreyer	Frederic	FR	Institut d'Astrophysique de Paris
Malanchev	Konstantin	RU	Sternberg Astronomical Institute (SAI MSU)
Lee	Shiu-Hang (H	JP	Kyoto University
Tchernin	Celine	CH	University of Geneva, Switzerland
Fedorova	Elena	UA	Kiev National Taras Shevchenko University
Antolini	Elisa	IT	University of Perugia
Saeedi	Sara	DE	Institut für Astronomie und Astrophysik Tübingen (IAAT)
Lecoz	Sandra	FR	In2p3
Hervet	Olivier	FR	Observatoire de Paris
Kudryashova	Nina	DE	Ludwig Maximilian University of Munich
Rosen	Anna	US	University of California, Santa Cruz
Burgess	Michael	US	University of Alabama in Huntsville
Antecki	Thorsten	DE	Ruhr-Universität Bochum
Malacaria	Christian	DE	Institut für Astronomie und Astrophysik Tübingen (IAAT)
Yuan	Yajie	CN	Stanford University
Gill	Ramandeep	CA	Canandian Institute for Theoretical Astrophysics
Loh	Alan	FR	Observatoire de Paris, Univsersité Paris 7
Araudo	Anabella	MX	Universidad Nacional Autonoma de Mexico (UNAM)
Rueda	Jesus	ES	University of Valencia
Dumas	Alexis	FR	Université Blaise Pascal
Elmellah	Ileyk	FR	APC Paris 7
Romoli	Carlo	IE	Dublin Institute for Advanced Studies
Kumar	Sajan	US	University of Delaware

LOC Members

Falanga	Maurizio	CH	ISSI
Götz	Diego	FR	CEA Saclay
Beckmann	Volker	FR	CNRS
Chavegrand	Pascale	FR	CEA Saclay

Speakers

Markowith	Alexander	FR	Université de Montpellier
Kaastra	Jelle	NL	SRON
Vink	Jacco	NL	UvA
Bykov	Andrei	RU	St. Petersburg State Polytechnical University
Ellison	Don	USA	NC State University
Spruit	Henk	DE	MPA
Amato	Elena	IT	INAF
Daigne	Frederic	FR	Université Paris 6
Sironi	Lorenzo	USA	Harvard University
Ptuskin	Vladimir	RU	IZMIRAN
Lemoine	Martin	FR	CNRS
De Luca	Andrea	IT	INAF
Dubus	Guillaume	FR	Université de Montpellier

GMT+01	lun. 29/4	mar. 30/4	mer. 1/5	jeu. 2/5	ven. 3/5	sam. 4/5	dim. 5/5
09:00		09:00 – 10:30 Radiative Processes I (A. Marcowith)	09:00 – 10:30 Acceleration Processes I (A. Bykov)	09:00 – 10:30 Acceleration Processes II (D. Ellison)	09:00 – 10:30 SNRs (J. Vink)	09:00 – 10:30 Simulations (L. Sironi)	
10:00		10:30 – Coffee Break	10:30 – Coffee Break	10:30 – Coffee Break	10:30 – Coffee Break	10:30 – Coffee Break	
11:00		11:00 – 12:30 Radiative Processes I (A. Marcowith)	11:00 – 12:30 Acceleration Processes I (A. Bykov)	11:00 – 12:30 Acceleration Processes II (D. Ellison)	11:00 – 12:30 SNRs (J. Vink)	11:00 – 12:30 Simulations (L. Sironi)	
12:00	12:30 – 14:30 Registration & lunch	12:30 – 15:00 Lunch Break	12:30 – 15:00 Lunch Break	12:30 – 15:00 Lunch Break	12:30 – 15:00 Lunch Break	12:30 – 14:00 Lunch Break	
13:00							
14:00	14:30 – Welcome Speech						14:00 – 18:00 Social Tour
15:00	15:00 – 16:30 Introduction to the school (D. Götz on behalf of F. Aharonian)	15:00 – 16:30 AGNs (V. Beckmann)	15:00 – 16:30 Radiative Processes II (J. Kaastra)	15:00 – 16:30 PWNe (E. Amato)	15:00 – 16:30 Acceleration Processes III (H. Spruit)		
16:00	16:30 – 18:00 Coffee Break & Registration	16:30 – Coffee Break	16:30 – Coffee Break	16:30 – Coffee Break	16:30 – Coffee Break		
17:00		17:00 – 18:30 AGNs (V. Beckmann)	17:00 – 18:30 Radiative Processes II (J. Kaastra)	17:00 – 18:30 PWNe (E. Amato)	17:00 – 18:30 Acceleration Processes III (H. Spruit)		
18:00		18:30 – 2 Students' Prese	18:30 – 2 Student's Prese	18:30 – 2 Students' Prese	18:30 – 2 Student's Prese		
19:00	19:00 – 20:00 Concert (J.S. Bach)						
20:00	20:00 – 21:00 Welcome Cocktail					20:00 – 23:00 Social Dinner in Cargèse	
21:00							

GMT+01	lun. 6/5	mar. 7/5	mer. 8/5
09:00	**09:00 – 10:30** Cosmic Rays LE (V. Ptuskin)	**09:00 – 10:30** Isolated Neutron Stars (A. De Luca)	**09:00 – 10:30** HE Binaries (G. Dubus)
10:00	**10:30** – Coffee Break	**10:30** – Coffee Break	**10:30** – Coffee Break
11:00	**11:00 – 12:30** Cosmic Rays LE (V. Ptuskin)	**11:00 – 12:30** Isolated Neutron Stars (A. De Luca)	**11:00 – 12:30** HE Binaries (G. Dubus)
12:00	**12:30 – 15:00** Lunch Break	**12:30 – 15:00** Lunch Break	**12:30** – Conclusions
13:00			**13:00 – 14:00** Bus to Ajaccio
14:00			
15:00	**15:00 – 16:30** Gamma-Ray Bursts (F. Daigne)	**15:00 – 16:30** Cosmic Rays HE (M. Lemoine)	
16:00	**16:30** – Coffee Break	**16:30** – Coffee Break	
17:00	**17:00 – 18:30** Gamma-Ray Bursts (F. Daigne)	**17:00 – 18:30** Cosmic Rays HE (M. Lemoine)	
18:00	**18:30** – 2 Student's present		
19:00			
20:00			
21:00			