Acquisition of an EMCCD detector for PISCO. for mass determination of young/low-mass binaries (Appendix)

J.-L. Prieur[1], M. Scardia[2], P. Lampens[3], E. Aristidi[4], L. Pansecchi[2]

R.W. Argyle[5], A. Strigachev[5], M. Kurspinska-Winiarska[6], D. Bonneau[7]

[1] : Laboratoire d'Astrophysique de Toulouse-Tarbes, Université de Toulouse, CNRS, 14 avenue E. Belin, 31400 Toulouse, France
[2] INAF – Osservatorio Astronomico di Brera, Via E. Bianchi 46, 23807 Merate, Italy
[3] Koninklijke Sterrenwacht van België, Ringlaan 3, B-1180 Brussel, Belgique.
[4] UMR 6525 Astrophysique, Université de Nice Sophia-Antipolis – C.N.R.S., Valrose, 06108 Nice Cedex 2, France.
[5] Institute of Astronomy, Madingley Road, Cambridge, CB3 0HA, United Kingdom
[6] Cracow Observatory, Jagiellonian University, 171 ulica Orla, 30244 Krakow, Poland.
[7] Observatoire de la Côte d'Azur, Avenue Copernic, 06130 Grasse, France

1 Technical documentation, pricing, and calendar

1.1 Distribution of the work within our team

There propose to continue working as we have been used to, for the last ten years or so. Here is the general overview of the tasks and the associated people :

- The mechanical design will be done by the optical laboratory of Brera Observatory.
- The fabrication of the mechanical parts will be done by the workshops of Brera Observatory.
- The specialized software will be written by Jean-Louis Prieur.
- The observations will be done by Marco Scardia, Luigi Pansecchi and Eric Aristidi.
- The data reduction will be done by Robert Argyle, Luigi Pansecchi, and Jean-Louis Prieur.
- The orbit computation will be done by Marco Scardia.
- The interpretation concerning young, low-massive stars, eclipsing binaries, will be done in collaboration with Patricia Lampens, Maria Kurpinska-Winiarska, Anton Strigachev, and researchers from OCA and OMP, but of course we are also open to any other collaboration/contribution.

1.2 Calendar

If we obtain the financing of the EMCCD IXON camera by INSU, we should be able to observe with this detector during the second semester of 2011.

During the first semester of 2011, we will design the mechanical parts and have them done in the workshops of Brera Observatory. The dedicated software will be done in Toulouse and should also be ready mid-2011. A preliminary version of the software has already tested with PISCO in Merate, with a LUCA Andor detector (which uses a USB link instead of the dedicated link with a PCI board that is used for the IXON model).

1.3 Budget and technical documentation of the Andor EMCCD

We have selected the Andor/IXON+ model with a 512x512 pixel back-illuminated EEV chip (see Fig. 1), since it provides a substantial gain compared to our present ICCD detector and since it is the cheapest camera in this category currently available. This model was also chosen by the Observatoire de la Côte d'Azur in 2005.

Some tests were done on PISCO with a LUCA model in september 2010. This model is cheaper than the IXON, but is less sensitive and has a lower image transfer rate. The tests have shown that this camera does not have a good sensitivity and is not adequate to our needs. The LUCA model do not show any significant advantages compared to the old ICCD that we have been using. So we need to acquire the IXON+ that has shown good performances on the tests made by R. Gili in 2010 with speckle observations on the "Grande Lunette" of OCA.

The price of the Andor IXON+ camera is 28 keuros (see Fig. 2), and the total cost is 36 keuros (8 keuros are needed for the optics, mechanics and computer fees that are required for using it with PISCO on the Merate Zeiss telescope). We propose the following repartition :

- 8 keuros for Brera Observatory (Italy) : for the optics, mechanics and computer) : already obtained
- 8 keuros for the IRAP UMR (Toulouse) : to be asked in 2011
- 15 keuros for the PNPS : asked for 2011
- 5 keuros for the BQR of OMP (Toulouse) : to be asked for 2011

We would thus like PNPS to contribute to financing 15 keuros for this detector.

The mechanical parts necessary for interfacing the camera to PISCO will be designed and paid by Brera Observatory, as well as the induced fees concerning the optics (re-aluminizing of the telescope) and the acquisition of the computer and software.

We also give in the end of this appendix the overal estimation of the financial contribution of the Brera observatory for the exploitation of PISCO in the period 2004-2010.

iXon^{EM}+ 897 (back-illuminated)

ANDOR™ TECHNOLOGY

low-light imaging

Features & benefits

EMCCD Technology
Ultimate in Sensitivity from EMCCD gain – even single photon signals are amplified above the noise floor. Full QE of CCD chip is harnessed (no intensifier).

TE cooling to -100°C
Critical for elimination of darkcurrent detection limit.

RealGain™
Absolute EMCCD gain selectable directly from a linear and quantitative scale.

EMCAL™
Innovative user-initiated self-recalibration of EM Gain.

iCam
Unique innovation that empowers the EMCCD to operate with market-leading acquisition efficiency through live cell microscopy software.

> 90% QE back-illuminated sensor Maximum possible photon collection efficiency.

UltraVac™♦1
Critical for sustained vacuum integrity and to maintain unequalled cooling and QE performance, year after year.

Variable readout rates up to 10 MHz
Quantitative accuracy at all speeds and slower readout rate for enhanced 16-bit dynamic range.

Selectable amplifier outputs – EMCCD and conventional
Highly flexible camera optimized for both fast, ultra low-light imaging and 'bright-field' or conventional fluorescence imaging.

High dynamic range and 16-bit digitization available
Extended sensor dynamic range (readout speed dependent) and matched digitization for quantization of dim and bright signals.

Minimal Clock-Induced Charge
Unique pixel clocking parameters, yielding minimized spurious noise floor.

Cropped sensor mode
Specialised acquisition mode for continuous imaging with fast temporal resolution

Enhanced Baseline Clamp
Essential for quantitative accuracy of dynamic measurements.

Built-in C-mount compatible shutter (optional)
Easy means to record control dark images- excellent for optimization of experimental set-up.

"Extracting the absolute best from EMCCD technology"

Andor's iXon^{EM}+ 897 back-illuminated EMCCD has single photon detection capability combined with >90% QE. iXon^{EM}+ is designed to extract the absolute best from quantitative EMCCD technology across all critical performance parameters.

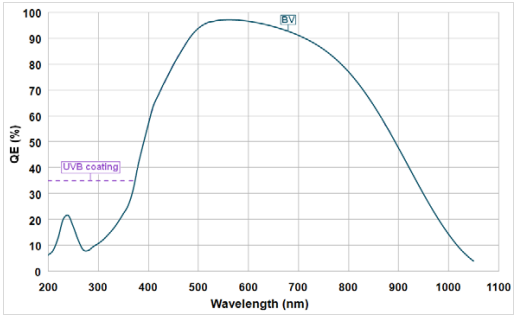
This highly popular 512 x 512 frame transfer format delivers unequalled thermoelectric cooling down to -100°C, industry-lowest clock induced charge noise, and operates at 35 frames/sec (full resolution). Andor's rapid vertical shift capability gives distinct speed advantages when operated with binning/sub-array, whilst minimizing vertical smear. EMCCD and conventional CCD readout modes provide heightened application flexibility.

The absolute EM gain multiplication can be varied linearly from unity up to a thousand times directly via RealGain™, a true quantitative EM gain scale. To combat the gain-ageing phenomenon inherent to back-illuminated EMCCDs, Andor's EMCAL™ is a unique and innovative user-initiated routine, performing auto-recalibration of the EM Gain scale, without need for a light source, and circumventing the need for factory recalibration.

Camera overview

Active Pixels	512 x 512
Pixel Size (W x H; µm)	16 x 16
Image Area (mm)	8.2 x 8.2
Active Area Pixel Well Depth (e⁻)	
Typical	160000
Maximum	220000
Gain Register pixel well depth (e⁻, typical)	800000♦2
Max Readout Rate (MHz)	10
Frame Rates (frames per sec)	35 - 549
Read Noise (e⁻)	< 1 to 49 @ 10 MHz

Quantum efficiency♦3



Peak Quantum Efficiency (%)	
CCD Type	**Typical**
BV @ 575 nm	92.5

FIG. 1 – Documentation about the back-illuminated EMCCD ANDOR IXON+ camera.

7 Millennium Way, Springvale Business Park, Belfast,
N. Ireland BT12 7AL
Tel: +44 (0) 2890237126, Fax: +44 (0) 2890310792

www.andor.com

Quotation Ref: O9QTSA10002P

Issue Date: Tuesday, 06 July 2010

Valid Until: 30 beyond issue date

Mr. Jean-Louis Prieur
Observatoire Midi-Pyrénées - LAO
14, Avenue Edouard Belin
Toulouse, 31400
FRANCE
Email : jean-louis.prieur@ast.obs-mip.fr

Technical Inquiries: Jean-Michel Laurent
Tel: +33 6 07 09 18 98
Order Inquiries: Delphine Gibson
Tel: +44 (0) 2890270809

Item	Description	Part #	Qty	SubTotal
1	Caméra iXon+ - 512 x 512 pixels, 16 µm, - Sorties EMCCD 14bits @10, 5 et 3 MHz et 16 bits @ 1 Mhz - Illumination arrière, QE >90% - Refroidissement à – 85°C à l'air et – 100°C à l'eau - Lecture en mode EMCCD - Vitesse verticale ajustable (réduction des CIC) - Connections SMB, Fire, Shutter, Arm, Ext. Trig. - Chambre à vide garantie 5 ans UltraVAC™ - Linéarisation du gain, Realgain™ - Calibration automatique du gain, EMCAL™ - Fonction Icam pour le multi-dimensionnel - Monture C	DU-897D-C00-#BV	1	23,500.00
2	IXON PCI Controller Card	CCI-23	1	1,600.00
3	Software Develop Kit - CCD PCI System	ANDOR-SDK-CCD	1	450.00
4	Oasis 150 Ultra Compact Chiller Unit	XW-CHIL-150	1	2,780.00

TOTAL :	28,330.00
Livraison :	125.00
TOTAL :	28,455.00

All prices in EUR, exc. VAT

- Pricing is valid for 30 days from issue date.
- Andor's standard Terms and Conditions apply

Estimated shipping date:	6-8 weeks
Payment Terms :	NET 30 days upon approval.
Shipping method:	Air Freight
Warranty:	1 year parts and labor from date of shipment

Authorized by:

Jean-Michel Laurent

_____

THIS PRICING INFORMATION IS CONFIDENTIAL

FIG. 2 – Price offer for the back-illuminated EMCCD ANDOR IXON+ camera.

Istituto Nazionale di Astrofisica
OSSERVATORIO ASTRONOMICO
DI BRERA

Merate, 20 luglio 2010

Prot. 621 /2010

Titolo III Classe 01

a Jean-Louis Prieur
Observatoire Midi.Pyrenées
avenue E. Belin 14
31400 TOULOUSE
France

Oggetto: Trasmissione del documento di stima delle spese sostenute per PISCO nel periodo 2003-2010.

Si trasmette in allegato il documento nel quale si elencano e si stimano le spese sostenute nel periodo 2003-2010 da questo Osservatorio Astronomico per la gestione ed il mantenimento della speckle camera PISCO applicata al fuoco cassegrain del telescopio Zeiss di Merate.

Distinti saluti.

(Marco Scardia)

OSSERVATORIO ASTRONOMICO DI BRERA - I.N.A.F. -

I.N.A.F. - Istituto Nazionale di Astrofisica
Sede Legale - Viale del Parco Mellini, 84 00136 ROMA - Codice Fiscale 97220210583 P.Iva 06895721006
Osservatorio Astronomico di Brera
Via Brera, 28 - 20121 MILANO -Telefono 39 02 72320-1 - Fax 39 02 72001600
Via E. Bianchi, 46 - 22055 MERATE -Telefono 39 039 99911-1 - Fax 39 039 9991160

Istituto Nazionale di Astrofisica
OSSERVATORIO ASTRONOMICO
DI BRERA

Estimation des frais engagés dans la période 2003-2010 pour l'exploitation de PISCO à Merate

Voici la liste estimée des frais engagés par l'Observatoire de Brera pour l'exploitation de l'instrument PISCO sur le télescope Zeiss de Merate, pendant la période 2003 - 2010 :

Nature des frais engagés	Montant (en euros)
Transport de PISCO à Merate (en 2003)	456
Carte PCI de numérisation Ellips/Rio (en 2003)	725
Etude et réalisation de la bride de liaison de PISCO au télescope Zeiss et achat de 3 chariots (en 2003)	(estimé à) 2500
Aluminure des miroirs du télescope Zeiss (en 2003)	(estimé à) 3500
Révision du magnétoscope et dépannage de l'électronique de PISCO en 2004 et en 2005 (masse et alimentation)	(estimé à) 2000
Etude et réalisation du réseau de calibration (en 2006)	(estimé à) 2000
Achat de 17 cassettes vidéo SVHS pour enregistrer les images (2005)	202
Achat de 2 disques durs 2 TB (en 2009)	388

Achat d'un PC HP Pavilion A6530 et d'une carte PCI Express avec une porte serie (en 2008)	574
Entretien courant du télescope Zeiss et de la coupole (période 2003-2010)	(estimé à) 8000
Réparation du système de mouvement rapide en déclinaison du télescope Zeiss, avec construction de nouvelles cames (en 2009)	(estimé à) 2000
Transports aller-retour vers l'aéroport de Malpensa pour les missionnaires de l'OMP (J.-L. Prieur et L. Koechlin) 2003-2010	(estimé à) 700
Utilisation des services d'hébergement à la "Foresterie" de l'Observatoire par ces mêmes missionnaires de l'OMP	2000
Coût d'exploitation du télescope: 500 nuits d'observations en 2003-2010 (100 euros par nuit)	(estimé à) 50000
Etude et réalisation des pièces mécaniques pour fixer la nouvelle caméra sur PISCO (en 2010)	(estimé à) 2000
	Total : 77045

Fait à Merate le 20 juillet 2010

IL DIRETTORE
(dott. Giovanni Pareschi)

OSSERVATORIO ASTRONOMICO DI BRERA - I.N.A.F.

I.N.A.F. - Istituto Nazionale di Astrofisica
Sede Legale - Viale del Parco Mellini, 84 00136 ROMA - Codice Fiscale 97220210583 P.Iva 06895721006
Osservatorio Astronomico di Brera
Via Brera, 28 - 20121 MILANO -Telefono 39 2 72320-1 - Fax 39 2 72001600
Via E. Bianchi, 46 – 23807 MERATE -Telefono 390395971100 - Fax 39 0395971001