Gemini MCAO System
- GeMS -
First Science Results

AO4ELT3 – Florence – 26-31th May 2013
Presented by B. Neichel
Introducing the team

Constanza Araujo, Alvaro Arias, Gustavo Arriagada, Maxime Boccas, Andrew Cardwell, Rodrigo Carrasco, Emanuel Costa, Sarah Diggs, Céline d’Orgeville, Camila Duran, Vincent Fesquet, Ramon Galvez, Vincent Garrel, Gaston Gausachs, Ariel Lopez, Javier Lurhs, Claudio Marchant, Eduardo Marin, Vanessa Montes, Cristian Moreno, Benoit Neichel, Peter Pessev, William Rambold, Francois Rigaut, Rolando Rogers, Carlos Segura, Andrew Serio, Chad Trujillo, Cristian Urrutia, Marcos VanDam, Patricio Veliz, Fabrice Vidal, Tomislav Vucina, Claudia Winge
The GeMS bus
Introduction to GeMS

First science results

Status of the project & Future upgrades

Conclusions
### Talks:

<table>
<thead>
<tr>
<th>Time</th>
<th>Name</th>
<th>Topic</th>
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<tbody>
<tr>
<td>2pm</td>
<td>Neichel</td>
<td>GeMS First science results</td>
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<tr>
<td>12:20pm</td>
<td>Ammons</td>
<td>Astrometry with MCAO</td>
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<td>11:50am</td>
<td>Plantet</td>
<td>Linearized focal plane WFS on GeMS</td>
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<tr>
<td>10am</td>
<td>Vidal</td>
<td>GeMS performance analysis</td>
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<tr>
<td>2:20pm</td>
<td>Cortes</td>
<td>Cn2 profiling with GeMS</td>
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<td>4pm</td>
<td>Fiorentino</td>
<td>Galactic satellites with GeMS/GSAOI</td>
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<tr>
<td>09:50am</td>
<td>Lu</td>
<td>GeMS astrometric performance</td>
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<tr>
<td>2pm</td>
<td>Ammons</td>
<td>Fourier based tomography</td>
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</tbody>
</table>

### Posters:

- P. Hibon – Performance of GeMS+GMOS
- C. Bechet – A 2-DMs concept to improve laser efficiency
- A. Guesalaga – Cn2 profiling in presence of strong dome seeing
- V. Fesquet - Review of the GeMS Laser Guide Star Facility
- A. Otarola – Analysis of Fratricide effect observed with GeMS
- L. Gilles - PSF reconstruction for MCAO
Introduction to GeMS
**GeMS** = Gemini (South) MCAO system

**GeMS** = Facility instrument delivering AO corrections in the NIR, and over a 2arcmin diameter FoV

**GeMS** = Multiple sub-systems.
50W Laser
Beam Transfer Optics (BTO)

50W Laser
Beam Transfer Optics (BTO)

50W Laser
Beam Transfer Optics (BTO)

50W Laser
Beam Transfer Optics (BTO)

50W Laser
Poster - V. Fesquet
Review of the Gemini South Laser Guide Star Facility

Poster – C. Béchet
A 2-DMs concept to improve laser efficiency
Instruments fed by GeMS

**GSAOI**

*Near-Infrared wide field imager*

- 2 x 2 mosaic Rockwell HAWAII-2RG 2048 x 2048 arrays
- 0.9 - 2.4 µm wavelength
- 85” x 85” field-of-view
- Pix. scale of 0.02”/pixel

**Flamingos-2**

*Near-Infrared wide field imager and multi-object spectrometer*

- 0.95-2.4 µm wavelength
- FoV = 120” diameter
- Pix. Scale 0.09 arcsec/pix
- Long Slit (slit width from 1 to 8 pixels)
- MOS (custom masks)
- R = 1200-3000

**GMOS**

- 0.36-0.94 µm (New Hamamatsu-Red-Sensitive CCDs)
- Imaging, long-slit and multi-slit spectroscopy
- **Integral Field Unit (IFU)** - pix = 0.1arcsec - FoV = 17arcsec - R150 to 1200
### Instruments fed by GeMS

#### GSAOI
- **Near-Infrared wide field imager**
- 2 x 2 mosaic Rockwell HAWAII-2RG 2048 x 2048 arrays
- 0.9 - 2.4 µm wavelength
- 85" x 85" field-of-view
- Pix. scale of 0.02"/pixel

#### Flamingos-2
- **Near-Infrared wide field imager and multi-object spectrometer**
- 0.95-2.4 µm wavelength
- FoV = 120" diameter
- Pix. Scale 0.09 arcsec/pix
- Long Slit (slit width from 1 to 8 pixels)
- MOS (custom masks)
- R = 1200-3000

#### GMOS
- 0.36-0.94 µm (New Hamamatsu-Red-Sensitive CCDs)
- FoV = 2.4 arcminute diameter
- Imaging, long-slit and multi-slit spectroscopy

**Integral Field Unit (IFU)** - pix = 0.1arcsec - FoV = 17arcsec - R150 to 1200
**GeMS performance summary**

*IQ20 == 20% of the time*

<table>
<thead>
<tr>
<th></th>
<th>FWHM</th>
<th>IQ20</th>
<th>IQ50</th>
<th>IQ70</th>
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<tr>
<td><strong>K-Band</strong></td>
<td>76mas</td>
<td>95mas</td>
<td>110mas</td>
<td></td>
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<tr>
<td><strong>H-Band</strong></td>
<td>64mas</td>
<td>75mas</td>
<td>90mas</td>
<td></td>
</tr>
<tr>
<td><strong>J-Band</strong></td>
<td>64mas</td>
<td>87mas</td>
<td>110mas</td>
<td></td>
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<table>
<thead>
<tr>
<th></th>
<th>SR</th>
<th>IQ20</th>
<th>IQ50</th>
<th>IQ70</th>
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<tr>
<td><strong>K-Band</strong></td>
<td>26%</td>
<td>17%</td>
<td>13%</td>
<td></td>
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<tr>
<td><strong>H-Band</strong></td>
<td>15%</td>
<td>11%</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td><strong>J-Band</strong></td>
<td>8%</td>
<td>5%</td>
<td>3%</td>
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</table>

Wednesday - 10am  
F. Vidal  
GeMS performance analysis
**GeMS performance summary**

**Wednesday - 10am**

F. Vidal

GeMS performance analysis

---

**FWHM** | **IQ20** | **IQ50** | **IQ70**
--- | --- | --- | ---
**K-Band** | 76mas | 95mas | 110mas
**H-Band** | 64mas | 75mas | 90mas
**J-Band** | 64mas | 87mas | 110mas

**SR** | **IQ20**
--- | ---
**K-Band** | 26%
**H-Band** | 15%
**J-Band** | 8%

**SR**
---
**K-Band** | 55%
**H-Band** | 35%
**J-Band** | 16%

---

**Performance are not at the requirement level yet.**

---

http://www.gemini.edu/scoliops/instruments/adaptiveOptics/MCAOPerformance.html
What’s limiting performance?

1. Generalized fitting
Following an issue with one of the DM, GeMS currently uses 2DMs instead of 3.
Current DM config.:
DM0 @ Ground (pitch = 0.5m)
DM9 @ 9km (pitch = 1m)

2. Laser photon return
Laser performance are stable, with 45W average, but transmission and laser format are under spec.
=> LGS loop runs @ [100-600]Hz instead of 800Hz
Performance are not at the requirement level yet. HOWEVER, we can already do unique science.

### GeMS performance summary

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[http://www.gemini.edu/sciops/instruments/adaptiveOptics/MCAOPerformance.html](http://www.gemini.edu/sciops/instruments/adaptiveOptics/MCAOPerformance.html)
Science with MCAO
System Verification

<table>
<thead>
<tr>
<th>SV Program ID</th>
<th>PI Name</th>
<th>Title</th>
<th>Band</th>
<th>Time Awarded (hrs)</th>
<th>Group</th>
<th>Status (2013-Mar-05)</th>
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<tr>
<td>GS-2012B-SV-401</td>
<td>J. Bally</td>
<td>The Explosive Orion OMC1 Outflow</td>
<td>1</td>
<td>5.0</td>
<td>Extended Source</td>
<td>Completed</td>
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<tr>
<td>GS-2012B-SV-402</td>
<td>R. Blum</td>
<td>The double cluster R136/R141-142 in 30 Doradus: Definitive SV for GEMS</td>
<td>1</td>
<td>4.0</td>
<td>Crowded Field</td>
<td>Completed</td>
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<tr>
<td>GS-2012B-SV-403</td>
<td>R. Carrasco</td>
<td>GeMS/GSAOI view of superdense compact galaxies in nearby galaxy clusters</td>
<td>1</td>
<td>3.0</td>
<td>Faint Source (extended)</td>
<td>Completed</td>
</tr>
<tr>
<td>GS-2012B-SV-404</td>
<td>E. Egami</td>
<td>Ultra-Deep K’-band Imaging of the Bullet Cluster Core</td>
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<td>5.0</td>
<td>Faint Source (extended)</td>
<td>Completed</td>
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<td>GS-2012B-SV-405</td>
<td>D. Geisler</td>
<td>Blood ties: unveiling true cluster pairs in the Large Magellanic Cloud</td>
<td>1</td>
<td>3.0</td>
<td>Crowded Field</td>
<td>Not observed. Guide Stars too faint</td>
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<tr>
<td>GS-2012B-SV-406</td>
<td>A. McConnachie</td>
<td>The space motion and stellar content of Galactic satellites seen with GeMS/GSAOI</td>
<td>1</td>
<td>3.0</td>
<td>Crowded Field</td>
<td>Completed</td>
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<tr>
<td>GS-2012B-SV-407</td>
<td>S. Ryder</td>
<td>Confirmation of a supernova candidate with GeMS</td>
<td>1</td>
<td>2.6</td>
<td>Faint Source (point)</td>
<td>Completed</td>
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<tr>
<td>GS-2012B-SV-408</td>
<td>L. Stanghellini</td>
<td>Narrow-band images of NGC 2346: a study of bipolar ejection in planetary nebulae</td>
<td>1</td>
<td>3.0</td>
<td>Extended Source</td>
<td>Completed</td>
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<tr>
<td>GS-2012B-SV-409</td>
<td>T. Davidge</td>
<td>Young 'Gems' in the Outer Galaxy</td>
<td>2</td>
<td>4.5</td>
<td>Crowded Field</td>
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<td>GS-2012B-SV-410</td>
<td>D. Floyd</td>
<td>The structure of quasar host galaxies</td>
<td>2</td>
<td>4.5</td>
<td>Faint Source (extended)</td>
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<tr>
<td>GS-2012B-SV-411</td>
<td>P. McGregor</td>
<td>Local Turbulent Disks: Analogs of High-Redshift Vigorously Star-Forming Galaxies</td>
<td>2</td>
<td>8.6</td>
<td>Faint Source (extended)</td>
<td>On-going</td>
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<tr>
<td>GS-2012B-SV-412</td>
<td>R. Mennickent</td>
<td>The nature of the IR excess in the spectrum of the Vela pulsar</td>
<td>2</td>
<td>1.3</td>
<td>Point Source</td>
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<tr>
<td>GS-2012B-SV-413</td>
<td>H. Plana</td>
<td>Star Formation triggered by HII regions</td>
<td>2</td>
<td>6.0</td>
<td>Extended Source</td>
<td>Completed</td>
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</tbody>
</table>
Science with MCAO

1. Large field of view
2. Sky coverage
3. Astrometry
1. MCAO for the field of view

Orion

Star Clusters
Planetary Nebulae
Extra-Galactic
Discover the cosmos! Each day a different image or photograph of our fascinating universe is featured, along with a brief explanation written by a professional astronomer.

2013 January 10

The Orion Bullets

Image Credit: GeMS/GSAOI Team, Gemini Observatory, AURA
3 Fields:
OMC1 – North
OMC1 – Center
OMC1 – South-East

Filters:
Mol. Hydrogen (H2) - 2.122 µm (orange)
[Fe II] - 1.644 µm (blue)
Ks continuum - 2.093 µm (white)

Exposure Time per field:
H2 = 12min
[Fe II] = 10min
Ks continuum = 10min

<FWHM>:
H2 = 90mas
[Fe II] = 100mas
Ks continuum = 90mas

Natural seeing:
0.6” to 1.1” @ 550nm

Team:
J. Bally, A. Ginsburg
Univ. of Colorado
EXPLOSIVE OUTFLOWS POWERED BY THE DECAY OF NON-HIERARCHICAL MULTIPLE SYSTEMS OF MASSIVE STARS: ORION BN/KL

John Bally¹, Nathaniel J. Cunningham², Nickolas Moeckel³, Michael G. Burton⁴, Nathan Smith⁵, Adam Franx⁶, and Ake Nordlund⁷

Team:
J. Bally, A. Ginsburg
Univ. of Colorado
Altair – 2007

GeMS – 2012
Altair – 2007
Comparison with MAD?

With LBT?

θ1B
Comparison with MAD?

With LBT?
Multiple systems

New multiple systems

MAD

GeMS

TCC-094

TCC-055

0.5"

200mas

70mas
1. MCAO for the field of view
FWHM = 0.08"
FWHM = 0.33"
FWHM = 0.75"

GSAOI
HAWK-I
8" x 8" WFI

Courtesy M. Schirmer
Star Clusters, the MAD experience

LETTER TO THE EDITOR

Resolving stellar populations outside the Local Group: MAD observations of UKS 2323-326

M. Galliuz, 1, L. Greggio, 1, E. V. Held, 1, A. Moretti, 1, C. Arcidiacono, 1, P. Bagnara, 1, A. Baruffolo, 1, E. Diolaiti, 1, R. Falomo, 1, J. Farinato, 1, M. Lombini, 1, R. Ragazzoni, 1, R. Bras, 1, R. Donaldson, 1, J. Kohl, 1, E. Marchetti, 1, and S. Tordo 3

DOI: 10.1051/0004-6361:200809631
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A MAD view of Trumpler 14

H. Sana, 1, Y. Momany, 1, M. Gieles, 1, G. Carraro, 1, X. Beletsky, 1, V. D. Ivanov, 1, G. De Silva, 4, and G. James 4

DOI: 10.1088/0004-637X/708/1/14
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ON A NEW NEAR-INFRARED METHOD TO ESTIMATE THE ABSOLUTE AGES OF STAR CLUSTERS: NGC 3201 AS A FIRST TEST CASE

G. Bon 1,2, P. B. Stetson 3,4, D. A. VandenBerg 1, A. Calamida, 1, M. Dall’Ora, G. Iannicola, 4, P. Amico, 4, A. Di Cecco, 1, E. Marchetti, 1, M. Morelli 1, N. Sanna, 1, R. K. Walker, 1, G. Zoccali, 1, R. Bono, 1, F. Caputo, 1, C. E. Corsi, 1, S. Doglioni, 1,1,1 S. D’Odorico, 1,1,1, I. Ferraro, 1, R. Gilmozzi, 1,1,1, J. Melnick, 1, M. Nonino, 1, S. Ortolani 1,1,1, M. Pace, 1,1,1, T. Savietri, 1,1,1, J.敛, and S. Origlia 1,1,1

DOI: 10.1111/j.1365-2966.2010.17161.x

The R136 star cluster hosts several stars whose individual masses greatly exceed the accepted 150 M⊙ stellar mass limit

Paul A. Crowther, *, Olivier Schnurr, 1,2 Raphael Hirschi, 1,4 Norhasliza Yusof, 4 Richard J. Parker, 1 Simon P. Goodwin 1 and Hasan Abu Kassim 4

DOI: 10.1111/j.1365-2966.2008.14019.x

Multi-Conjugate Adaptive Optics VLT imaging of the distant open cluster FSR 1415

Y. Momany, 1,2 S. Ortolani 3 C. Bonatto 4, E. Bica 4 and B. Barbudd 5

DOI: 10.1111/j.1365-2966.2010.17167.x

VLT-MAD observations of the core of 30 Doradus

M. A. Campbell, 1, C. J. Evans, 1, A. D. Mackey, 1, M. Gieles, 1, J. Alves, 4, J. Ascenso 5, N. Bastian 6 and A. J. Longmore 2

DOI: 10.1051/0004-6361:200809631
© ESO 2008

MAD about the Large Magellanic Cloud

G. Fiorentino, 1,2 E. Tolstoy, 1, E. Diolaiti, 1, E. Valentí, 1, M. Cignoni, 4, and A. D. Mackey 4

DOI: 10.1088/0004-637X/737/1/31
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A FOSSIL BULGE GLOBULAR CLUSTER REVEALED BY VERY LARGE TELESCOPE MULTI-CONJUGATE ADAPTIVE OPTICS

SERGIO ORTOLANI, 1 BEATRIZ BARBUY 2 YAZAN MOMANY 3,4 IVO SAVIANI 1 EDUARDO BICA 5 LUCIE JELKOVA 1,3,6, GUSTAVO M. SALERNO 6, and BRUNO JUNGHWERT 7,8

DOI: 10.1111/j.1365-2966.2011.19561.x

A benchmark for multiconjugated adaptive optics: VLT-MAD observations of the young massive cluster Trumpler 14

B. Rochau, 1 W. Brandner, 1 A. Stolle, 2 T. Henning, 1 N. Da Rio, 1,3 M. Gennaro, 1,5 F. Hornmuth, 1 E. Marchetti 6 and P. Amico 4

The cluster Terzan 5 as a remnant of a primordial building block of the Galactic bulge


A&A 493, 539-546
DOI: 10.1051/0004-6361:200809851
© ESO 2009

MCAV near-IR photometry of the globular cluster NGC 6388: MAD observations in crowded fields

A. Moretti 1, G. Piotti 2, C. Arcidiacono 1, A. P. Milone 1, R. Ragazzoni 1, R. Falomo 1, J. Farinato 1, L. Bedin 3, J. Anderson 3, A. Sarajedini 1, A. Baruffolo 1, E. Diolaiti 1, M. Lombini 1, R. Bras 4, R. Donaldson 3, J. Kohl 6, E. Marchetti 6, and S. Tordo 5

DOI: 10.1051/0004-6361/201016904
© ESO 2011
The space motion and stellar content of Galactic satellites seen with GeMS/GSAOI

Wednesday 4pm – G. Fiorentino
The space motion and stellar content of Galactic satellites seen with GeMS/GSAOI
1. MCAO for the field of view

Orion
Star Clusters
Planetary Nebulae
Extra-Galactic
Galactic planetary nebula NGC 2346 with GeMS/GSAOI - SV408 - (L Stanghellini, A. Manchado, R. Shaw, A. Garcia-Hernandez, E. Villaver, P. Garcia-Lario)- thanks to R. Carrasco+GSAOI Team

Filter = H2 1-0 S(1) (2.122μm)
40min exposure time
FWHM = 80mas
The images show unprecedented detail (FWHM 0.08" across field) which is ideal to study in details the knots and filaments expected in such a PN. The pixel size is 7 AU at the distance of NGC 2346, by comparison, the Helix program on HST was based on resolving knots of 28 AU.
1. MCAO for the field of view

Orion
Star Clusters
Planetary Nebulae
Extra-Galactic
Wide-field Infra-Red Camera (WIRC)
Palomar Observatory’s
Filter = Ks
Exposure time = 19.4 min
Seeing limited
<FWHM> = 0.9”
Wide-field Infra-Red Camera (WIRC)  
Palomar Observatory’s  
Filter = Ks  
Exposure time = 19.4 min  
Seeing limited  
<FWHM> = 0.9"
Wide-field Infra-Red Camera (WIRC)
Palomar Observatory's
Filter = Ks
Exposure time = 19.4min
Seeing limited
\(<\text{FWHM}> = 0.9''\)

GeMS/GSAOI
Filter = Ks
Exposure time = 8min
\(<\text{FWHM}> = 0.1''\)
2 NGS
A HIGH ANGULAR RESOLUTION SEARCH FOR THE PROGENITOR OF THE TYPE Ic SUPERNOVA 2004gt


Division of Physics, Mathematics, and Astronomy, California Institute of Technology, MS 105-24, Pasadena, CA 91125; avishay@astro.caltech.edu

Received 2005 June 21; accepted 2005 July 25; published 2005 August 10
Luminous Infrared Galaxy ESO 440-IG058
Gemini South GeMS/GSAOI Jan 2013
S. Ryder (AAO) & the GeMS Team

$JHK_s$ composite

Exposure Time = 160s. / Filter

2''
Luminous Infrared Galaxy ESO 440-IG058
Gemini South GeMS/GSAOI Jan 2013
S. Ryder (AAO) & the GeMS Team

*JHKs* composite
Exposure Time = 160s. / Filter

2"
2. MCAO for the sky coverage

Small Object
Extra-Galactic
MCAO for Sky Coverage

Pulsar

Isolated galaxy

Quasar

SV412 – R. Mennickent

SV411 – P. McGregor

SV409 – D. Flyod
The Vela pulsar and its likely counter-jet in the $K_s$ band

D. Zyuzin,1† Yu. Shibanov,1,2 R. E. Mennickent,3 A. Danilenko1 and S. Zharikov4

1Ioffe Physical Technical Institute, Politekhnicheskaya 26, St. Petersburg, 194021, Russia
2St. Petersburg State Polytechnical Univ., Politekhnicheskaya 29, St. Petersburg, 195231, Russia
3Department of Astronomy, Universidad de Concepcion, Casilla 160-C, Concepcion, Chile
4Observatorio Astronómico Nacional SPM, Instituto de Astronomía, UNAM, Ensenada, BC, Mexico
2. MCAO for the sky coverage

Small Object

Extra-Galactic
Abell 780 – z ~ 0.1
85” ~ 150kpc

SV403
R. Carrasco & I. Trujillo
Filter = Ks
1h on-source
<FWHM> = 77mas
2 NGS only
COSMOS Field

FWHM 80mas
SR ~ 25% in Ks
FWHM = 70mas
20min exposure

85"
COSMOS Field

FWHM 80mas
SR ~ 25% in Ks
FWHM = 70mas
20min exposure

GeMS

HST-ACS

Z = 0.37

Z = 0.72
3. MCAO for astrometry
Why MCAO is good for astrometry?

- Active control of plate scales
- Large FoV => more reference stars
- PSFs are uniform over the field
Why MCAO is good for astrometry?

- Active control of plate scales
- Large FoV => more reference stars
- PSFs are uniform over the field
Why MCAO is good for astrometry?

- Active control of plate scales
- Large FoV => more reference stars
- PSFs are uniform over the field
3. MCAO for astrometry

Galactic Center

Star Clusters
Exo-planets
Galactic Center
Filter = Ks
Exposure Time = 5min
<FWHM> = 90mas
Galactic Center

Filter = Ks
Exposure Time = 5min
<FWHM> = 90mas
The Shortest Known Period Star Orbiting our Galaxy’s Supermassive Black Hole

L. Meyer,1 A. M. Ghez,1* R. Schödel,2 S. Yelda,1
A. Boehle,1 J. R. Lu,3 T. Do,4,5 M. R. Morris,1
E. E. Becklin,1 K. Matthews6

1University of California Los Angeles, Department of Physics and Astronomy,
The Shortest Known Period Star Orbiting our Galaxy’s Supermassive Black Hole

L. Meyer,¹ A. M. Ghez,¹ R. Schödel,² S. Yelda,¹ A. Boehle,¹ J. R. Lu,³ T. Do,¹,⁴,⁵ M. R. Morris,¹ E. E. Becklin,¹ K. Matthews⁶

¹University of California Los Angeles, Department of Physics and Astronomy,
3. MCAO for astrometry

Galactic Center
Star Clusters
Exo-planets

Tuesday - 12:20pm M. Ammons
On-Sky Pathfinder Tests of Calibrated MCAO Astrometry and Implications for MCAO on ELTs

Wednesday 4pm – G. Fiorentino
The space motion and stellar content of Galactic satellites seen with GeMS/GSAOI
What’s coming next for GeMS?
1. Regular Science operations
   GeMS/GSAOI are offered in regular queue mode:
   - 80 hours of 13A (on-going)
   - 160 hours for 13B
   - 160 hours for 14A
   - ...
1. Regular Science operations

GeMS/GSAOI are offered in regular queue mode:
- 80 hours of 13A (on-going)
- 160 hours for 13B
- 160 hours for 14A
- ...

2. Performance upgrades

- **Restore a 3DMs configuration**
  A third DM will be restored, to be conjugated at 4.5km (pitch = 0.5m)

- **Improve NGS limiting magnitude**
  Due to design flow and alignment issues, current limiting magnitude is R=15.5
  => New NGSWFS design will provide R=17.5

- **Improve laser photon return**
  - Improve BTO transmission & polarization control
  - Improve laser beam quality (See C. Bechet’s poster)
  - Plan more observations during high sodium season
  - Change WFS CCD for low noise ones (?)
  - Add laser power (?)
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GeMS/GSAOI are offered in regular queue mode:
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3. Offering more science capabilities
- NIR Spectroscopy: **GeMS + F2** (2013-14)
- Visible imager and spectro: **GeMS + GMOS** (2014-15)
Conclusions

MCAO is fulfilling its promise

GeMS is delivering science.
- 60 hours of SV (completed)
- 80 hours of 13A (on-going)
- 160 hours for 13B

It took:
- 10 years
- 100 nights of commissioning

Tuesday - 2pm
F. Rigaut
LGS MCAO systems experience applied to ELTs

http://www.gemini.edu/documentation/webdocs/mcao_sc.zip
-- Extra Material --
- 1 x 50W laser is divided in 5 x 10W beams placed on the corner and center of a 1' FoV
- 5 (16x16)SHWFS - 3DMs (totaling 917 actuators) - 800Hz
- 3 APDs based NGS TT WFSs - 800Hz - Plate scale modes - Slow Focus Sensor
- 2 dedicated NIR instruments (GSAOI 4k²-80"-20mas, F2 MOS-2')
- Many 2nd loops, LUT, offloads...
Project Status
Pulsar

Isolated galaxy

Quasar

MCAO for Sky Coverage

FWHM = 0.13 arcsec
Filter = Ks
Exposure Time = 92min
SV411 P. McGregor

Clumpy K-band continuum structure

1 arcsec
IRS8 - Bow shock

Galactic Center

Filter = Ks
Exposure Time = 5min
\(<\text{FWHM}\>) = 90\text{mas}
A BOW SHOCK OF HEATED DUST SURROUNDING GALACTIC CENTER SOURCE IRS 8


Received 2003 August 27; accepted 2003 October 30

Hokupa‘a (2000)
Multi-conjugate adaptive optics images of the Trapezium cluster

H. Bouy, J. Kolb, E. Marchetti, E. L. Martín, N. Huéliamo, and D. Barrado y Navascués
VLT/NACO infrared adaptive optics images of small scale structures in OMC1*
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F. Lacombe¹, E. Gendron¹, D. Rouan¹, Y. Clénet¹, D. Fiebig², J. L. Lemaire³,⁴ M. Gustafsson², A.-M. Lagrange⁵, D. Mouillet⁶, G. Rousset⁶, T. Fusco³, L. Rouset-Rouvière⁶, B. Servan⁷,⁸ C. Marlot¹, and P. Feautrier⁹

*This work is based in part on data obtained with Telescopio Nazionale Galileo (TNG) at the Roque de los Muchachos Observatory (RLOM) in the Canary Islands, Spain. The TNG is operated by the Instituto de Astrofísica de Canarias (IAC).
VLT/NACO infrared adaptive optics images of small scale structures in OMC1

Proplyds

Multi-conjugate adaptive optics images of the Trapezium cluster*

H. Bouy$^{1,2}$,** J. Kolb$^1$, E. Marchetti$^1$, E. L. Martín$^{3,4}$, N. Huélamo$^5$, and D. Barrado y Navascués$^5$
HAFFNER 16: A YOUNG MOVING GROUP IN THE MAKING; Version 5.0; May 8, 2013

T. J. Daigle

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Victoria, BC Canada V9E 2E7

Rodrigo Carrasco, Claudia Winge, Peter Pessev, Benoit Neichel, Fabrice Vidal

Gemini Observatory, La Serena, Chile

Francois Rigaut
Australian National University
Why MCAO is good for astrometry?

- Active control of plate scales
- Large FoV => more reference stars
- PSFs are uniform over the field

But astrometry is challenging:

Distortions in Science and NGSWFS plane are difficult to calibrate. Impact:

- Distortion pattern is constellation dependent
- Image stacking in sparse fields is challenging

Friday - 09:50am
J. Lu
GeMS astrometric performance