

Center for Adaptive Optics

Year 9 Proposal Package

Funding period: November 1, 2007 – October 31, 2008

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1.0 Mission and Goals of the CfAO

CfAO Mission: To advance and disseminate the technology of adaptive optics in service to science, health care, industry, and education.

CfAO Goal: To lead the revolution in AO, by developing and demonstrating the technology, creating major improvements in AO systems, and catalyzing advances nationwide within the next decade.

CfAO Strategies: CfAO will pursue its purpose and achieve its goal by:

1. Demonstrating the power of AO by doing forefront science.
2. Increasing the accessibility of AO to the scientific community.
3. Developing and deploying highly capable AO systems and laser beacons.
4. Coordinating and combining research efforts to take advantage of the synergies afforded by the Center mode of operations.
5. Integrating education with our research.
6. Building a Center community that is supportive of diversity through vigorous recruiting, retention, and training activities.
7. Encouraging the interaction of vision scientists and astronomers to promote the emergence of new science and technology.
8. Leveraging our efforts through industry partnerships and cross-disciplinary collaborations.

2.0 Background, Evaluation Process and Criteria

NSF funding for CfAO ends on October 31, 2009. In Year 9, NSF funding will be reduced by 17% relative to Year 8, and in Year 10 it will be reduced 20% relative to Year 9. The actual funding for Y9 and 10 follows.

Year 9	~\$3.3M
Year 10	~\$2.7M

- *Students and postdocs to be funded on an annual basis* - Commencing in Year 8, the CfAO funding commitment for graduate students and postdocs is for one year. While support may be provided in subsequent years, continuity of funding is not assured and PIs are advised to actively seek student and postdoc support from other sources.
- *Need to plan transition to external funding*- PIs should develop external (non-NSF STC) funding sources for proposed projects in Years 9 and 10 so they could transfer to these external funding sources either during Years 9 and 10 or after Year 10.

Criteria for Year 9

1. The “fit” of the proposed activity into the Center’s Mission, Themes, thematic goals, and EHR activities.
2. The technical or research merits of the activity.
3. The project feasibility – time and funding constraints, staffing, duration etc.
4. Your progress against previous years’ specific milestones on this project.
5. Active Participation in Center sponsored activities – Retreats etc.
6. Planning and progress that has taken place to transition the project to external funding should be included with the proposal.
7. Projects that contribute to CfAO legacies (what we’ll be remembered for.)

Evaluation Process

1. Center Evaluation: Final review of all proposals is by the Proposal Review Committee (PRC) appointed by the Director. The PRC consists of the Theme Leaders, Managing-Director and members of the EC identified by the Director. Each proposal will be evaluated in-depth by two members of the Executive Committee – the Theme leader and another member of the EC. The proposer can if he/she wishes identify up to three “outside reviewers.” All new Year 9 proposals will be sent to at least one external reviewer, together with the Center’s evaluation criteria. The reviewer will be requested to comment on the proposal based on the criteria provided. Proposals may be sent to external reviewers selected by the Proposal Review Committee in addition to those suggested by the proposer. Continuing multi-year proposals will, in general, be internally evaluated and sent to an external reviewer only if deemed necessary.
2. All proposals will subsequently be reviewed and discussed by the PRC. The evaluations of all reviewers will be presented and taken into account in the PRC recommendation to the Director, who makes the final decision.
3. The Program Advisory Committee (PAC) meets following the PRC meeting, and is composed of non-CfAO researchers. The PAC will receive copies of
 - a. all proposals, and
 - b. recommendations (PRC’s and the external evaluators’)
4. Proposal Review Committee meets June 11th and 12th, 2007.
5. PRC presents results to PAC June 14th, 2007, and PAC advises Director.
6. Decisions and reviews will be distributed to proposers by June 29th, 2006.
7. Proposers should identify a member of their team who would be able to visit UC Santa Cruz, or to be available via videoconference in the review period, if requested by the Director. (At least one week’s notice will be provided.) This applies to all proposals.

Seed funding proposals

The Director will set aside part of the Director's Discretionary fund for seed funding related to the transition to external support for Center related activities. There will be a separate category of proposal for these seed funding projects. Center members are encouraged to explore ideas for collaborative AO research or education projects having potential to attract external funding and to be sustainable beyond Year 10. Examples of seed funding projects would include specific workshops on "cutting edge" AO related topics, or a feasibility study proposal (research or education) to determine if a new idea is worth pursuing further. It is anticipated that the upper limit for a seed funding project will be about \$30K.

3.0 Theme Goals

The goals for each of the Themes in Years 9-10 follow:

3.1 Theme 1 Goals - CfAO Education and Human Resources

Currently funded programs:

Programs that are currently funded within the CfAO EHR theme include

- Professional Development Program
- Akamai Programs:
 - Maui Program
 - Hawaii Island Program
- COSMOS/Stars, Sight, and Science
- Mainland Internship Program
- Hartnell Short Course

A description of each program may be found at: <http://cfao.ucolick.org/EO/>

Strategic Directions for Theme 1

Professional Development Program

The Professional Development Program (PDP) is merging with some elements of the Center for Informal Learning and Schools (CILS) and evolving into the Institute for Scientist and Engineer Educators (ISEE), which will be based on the mainland.

Overview of ISEE: The proposed Institute for Scientist and Engineer Educators (ISEE) is an innovative program at UC Santa Cruz. It will help provide science and engineering (S&E) graduate students the teaching skills needed for their role as future faculty members, and their science and engineering careers requiring in general. ISEE will supplement existing S&E doctoral programs by providing a new certificate in higher education S&E teaching. The program will offer courses, workshops, teaching experiences, and a community that is actively engaged in S&E education. Educational research will be integrated into all elements of ISEE, utilizing research-based teaching strategies and generating new knowledge about methods of teaching, learning, and professional development. A unique aspect of ISEE will be the "teaching

laboratories,” model of courses and programs where participants can develop new curricula in conjunction with researchers who are knowledgeable in best teaching practices. ISEE will produce a new generation of “scientist and engineer educators,” who excel at both research and teaching, which will positively impact S&E undergraduate education at UC Santa Cruz.

ISEE development team: Lisa Hunter (CfAO), Candice Brown (CILS), Rod Ogawa (CILS, UCSC Education), Claire Max (CfAO, UCSC Astronomy)

Goals for Years 9-10: In Years 9-10, the development team will be actively engaged in generating a detailed outline of ISEE components, expanding the team, and implementing new activities to build a foundation for ISEE. The following projects are needed to transition the PDP / ISEE integration, and could be initiated with a CfAO Seed Proposal:

- Development of new workshops or course components that aid S&E graduate students in:
 - Designing science, technology, or engineering courses
 - Designing instruction to address diversity and equity
 - Designing and using a range of assessment tools
 - Designing effective research experiences for undergrads
- Integrating industry professionals into instructions On the mainland in addition to the Hawaii-serving PDP
- Publications describing the PDP and/or inquiry activities that were developed through the PDP
- Research and/or evaluation on the outcomes of the PDP that can provide publishable results.

Akamai Programs in Hawaii:

CfAO EHR has focused on education and workforce development on Maui and the Big Island. The Akamai program has been implemented on both islands, providing internships to local college students, unique short courses on observatory and high tech industry topics, curriculum development, adaptive optics hardware and training, and extensive partnership building. The CfAO is now actively pursuing long-term institutionalization and funding for both programs, building and expanding upon past successful program components. The Maui partnership has established the Akamai Workforce Initiative (AWI), and has submitted a proposal to the National Science Foundation (NSF) and the Air Force Office of Scientific Research (AFOSR) (see below). Efforts are now underway to establish a similar initiative and new funding for Big Island activities.

Akamai Workforce Initiative: Overview of proposal submitted to NSF & AFOSR

The Akamai Workforce Initiative forms a regional consortium of academic, industry, and community organizations to address technical workforce needs in the state of Hawaii. It is an interdisciplinary project that partners high-tech industry, cutting-edge research, and inventive education to meet needs in astronomy, remote sensing, and other technology industries in Maui County and the state. The Center for Adaptive Optics, University of Hawaii - Maui Community College, Maui Economic Development Board, and the University of Hawaii Institute for Astronomy propose the AWI to provide training in electro-optics for a diverse student population

through an innovative, culturally relevant curriculum, designed to meet workforce needs. The AWI will advance these *akamai* – smart, clever, expert – students into the technology workforce on Maui, and more broadly in Hawaii. Maui is uniquely positioned to lead this initiative that will begin with a certified electro-optics training program at Maui Community College, and establish the building blocks for a statewide program that reaches from K-12 to the workforce.

Goals for Years 9-10: In Years 9-10 of CfAO, Theme 1 will be actively engaged in establishing funding for Big Island activities, working on electro-optics curriculum, and in creating an Akamai initiative that partners the Big Island, Maui, and other Hawaiian islands. The following projects are under consideration, and would be very desirable areas to address with a CfAO Seed Proposal:

- Development of new electro-optics lab activities that engage college-level students in learning content through scientific and engineering processes.
- Revision of existing, traditionally taught, electro-optics lab activities to incorporate inquiry and other innovative approaches
- Development of a hands-on AO workshop for observatory personnel (an idea that emerged from the CfAO Fall Retreat); perhaps that college students may also attend
- Development of a new workshop (or workshop component) that assists industry professionals in designing educational activities, teaching, and/or, designing effective research experiences
- Development of a workshop (or workshop component) that addresses teaching S&E in a cultural context
- Research or evaluation on the impact of CfAO’s internship programs, including projects that establish a methodology

COSMOS Program Astronomy Course

COSMOS is a 4-week residential program for students enrolled in California high schools with low college enrollment rates. Participants in the program spend four weeks at UC Santa Cruz, attending special course clusters offered through the COSMOS program at the Educational Partnership Center at UCSC. From 2002-2006, the CfAO developed and taught a course cluster, which included astronomy and vision science courses. In 2007, the CfAO will teach the astronomy course only, and has partnered with the Molecular, Cellular, and Developmental Biology Department, who will design and teach a new biology course to be paired with CfAO’s astronomy course.

The COSMOS program has become an increasingly important “teaching lab” for CfAO members who participate in the Professional Development Program. It is an ideal environment for integrating new (to the instructor) teaching strategies, such as inquiry and project-based learning.

Goals for Years 9-10: In Years 9-10 of CfAO, Theme 1 will be working toward complete institutionalization of the CfAO COSMOS Astronomy course. Significant progress has already been made and the final steps include establishing a “home” for the course, such as in the Astronomy Department, which could provide ongoing instructional support and other elements necessary for the long-term continuation of the course.

Mainland Internship Program and Hartnell Short Course

The Mainland Internship Program places college students at CfAO sites around the country each summer, and then continues to work with students to achieve their educational and career goals. There are several unique elements to the program: a preparatory short course, a communication curriculum, and a “teaching lab” for graduate students who teach the short course. The Hartnell Short Course is connected to the Mainland program in that it serves to recruit and prepare students who are not yet ready for an internship experience. The Short Course has stimulated a growing partnership between Hartnell College and UC Santa Cruz.

Goals for Years 9-10: The Mainland Internship Program has the potential to become a UC Santa Cruz-based program, involving astronomy and engineering-related researchers. Interest and funding for this concept will be explored in Year 9. The Mainland program has developed a number of unique elements, for example the short course or the communication curriculum, that could be considered separately for funding and continuation. The Hartnell Short Course is highly valued at Hartnell College and in Year 9 effort will be put into creating a plan to institutionalize the course. In addition to exploring long-term funding options for the Mainland Program and the Hartnell Short Course, publications describing the impact would create a legacy for the CfAO. Projects of interest are:

- Documentation of the courses and unique activities
- Assessment, evaluation, or research on the impact of either program
- Publication of the “communication curriculum” used in the Mainland Program.

3.2 Goals of Theme 2 – Extremely Large Telescopes

The highest recommendation of the National Academy of Sciences’ Astronomy and Astrophysics Survey Report for ground-based astronomy was the design and construction of a 30-m telescope equipped with adaptive optics. Developing an adaptive optics system for such a telescope is extremely challenging and requires an extension of almost every aspect of AO system design and component technology. The objective in this Theme for the second five years of the Center is to make a major contribution towards achieving this national priority, especially in areas where cross-institutional and multidisciplinary collaboration is required.

Prior to CfAO Year 7, the main technical emphasis of Theme 2 was to develop feasible point designs for AO systems for the extremely large telescopes and to develop the modeling and analysis tools for multi-guidestar tomography and multi-conjugate adaptive optics. Having largely accomplished this (with the kickoff of system designs for the TMT and Keck Next Generation AO projects benefiting from this work), beginning in CfAO Year 7, we changed the emphasis of the technical part of Theme 2 to focus on CfAO "legacy projects." There are two AO technology areas in which CfAO is making a major impact: MEMS deformable mirrors and pulsed sodium lasers. By focusing on these promising technical areas we hope to establish the legacy of the CfAO as a developer of new AO component technologies.

Theme 2 also continues to support work in astronomy research using existing AO systems and the development of quantitative methods of analyzing AO data.

The above statement along with abstracts of ongoing projects can be found on the LAO/CfAO/Theme2 web page: <http://lao.ucolick.org/twiki/bin/view/CfAO/CfAOTHEME2>

3.3 Goals of Theme 3 – Extreme Adaptive Optics

The Extreme Adaptive Optics (ExAO) theme is centered around use of adaptive optics in high-contrast imaging to study the formation and properties of extrasolar planetary systems. In Year 7, CfAO ExAO efforts resulted in a major instrument proposal, the Gemini Planet Imager (GPI), being selected and funded by the Gemini Observatory. The CfAO supports research in both advanced ExAO technology and ExAO astronomical observations.

ExAO Technology

Year 9-10 technology projects should be aimed at supporting the development and deployment of ExAO systems through testing and verification of ExAO control algorithms, concepts, and technology. The CfAO will also consider studies of advanced wavefront sensing, coronagraph, and wavefront control concepts that could enhance the capabilities of near-future ExAO systems or lead to ExAO systems on future Extremely Large Telescopes.

ExAO Science

The primary emphasis of Year 9-10 observations should be astronomical observations that will lead to the most productive scientific use of future ExAO systems such as GPI. This can include ExAO astronomy using existing AO systems that helps develop techniques (e.g. PSF subtraction or polarimetry) that can be applied to future ExAO observations, scientific modeling of ExAO targets and operations, and observations to identify optimal target sets for ExAO surveys. The Center will also consider related astronomical AO projects (e.g. studies of circumstellar dust and faint companions to stars) that addresses the core Theme 3 science mission of understanding the formation and properties of extrasolar planetary missions.

3.4 Goals of Theme 4: Vision Science Instrumentation for Clinical and Scientific Use

1. Improve technology to image the retina in vivo at the 3-D resolution limit, exploiting confocal methods, OCT, fluorescence, polarization, retinal tracking, and post-processing in addition to adaptive optics
2. Improve and commercialize AO systems for correcting vision, such as AO phoropters that are superior to and replace conventional subjective refraction, and the use of such systems to clarify the role of optical and neural factors in visual performance.
3. Expand the capabilities of adaptive optics instrumentation for vision science, such as improving wavefront sensing, deformable mirrors, control algorithms, or system calibration.
4. Disseminate knowledge about vision AO by increasing connections with science, medicine and/or industry. Demonstrate possibilities for fundable research beyond Year 10.

4.0 General Instructions for Year 9 Proposals

All PIs must complete Section 5: Proposal Cover Page. On the cover page, indicate whether this is a one or two year proposal.

- A one year proposal is for a project that will be completed in Year 9. The milestones identified for project evaluation will be for that year only.
- Goals and Milestones for a project that will be completed in Year 10 must be provided for the full two years. PIs should anticipate that multi-year projects will be funded *at progressively lower levels* in Years 9 and 10; this should be reflected in the proposal body and in the budgets for Years 9 and 10.
- The progress of continuing multi-year programs will be evaluated against the milestones stated in previous proposal years. As the project develops, the milestones can be changed, but rationales will be required for the proposed changes.
- In all cases, it is important to incorporate strategies and milestones for dissemination of results and/or data to the astronomical and vision science communities.

PI's submitting:

- Astronomy and Vision Science proposals complete Section 6.
- EHR proposals complete Section 7.
- Seed Funding proposals complete Section 8.

Leaders of Collaborative Proposals must, in addition, provide a separate cover page and a brief proposal summarizing how the collaboration will work. They must also submit a summary budget that integrates the budgets of all the collaborating co-PIs. (Collaborative projects are those involving multiple institutions within the CfAO.)

As required by NSF, Section 6 summarizes the results of your CfAO funded Year 8 research **and must be completed by all PIs** even if you are not applying for Year 9 funding.

The Budget Template is found on the last page of this document.

5.0 Proposal Cover Page

Institution:

Theme:

Principal Investigator (Your Name):

Proposal Title:

Proposals affiliated with a Theme are strongly preferred.

- Collaborative Project
- Lead Proposal*
 - Sub-Proposal*

Single investigator project

New multi-year project Continuing project New single year project

Seed funding proposal (If seed funding, this box and the collaborative project box should be checked)

Check all appropriate Boxes

Phone:

Email:

BUDGET: Total Funds Requested from CfAO:

- Provide a draft but accurate budget for **your** activities at your institution using the Excel spreadsheet format at the end of this document
- On this cover page, list the summary budget for Year 9
- If a multi year proposal, do the above two items for **each year**.
- List any other sources of co-funding, and potential for future external funding
- List any funding that has been obtained as a direct result of CfAO funding of this project

In addition, Collaborative Project Leaders must provide a brief summary proposal and a summary budget for the entire collaboration

6.0 Year 8 Reports: Additional Information Required by NSF for Inclusion in the CfAO Annual Report

Note: This section must be completed at the time of the Year 9 proposal submission. **PIs who are not requesting Year 9 funding but received funds in Year 8 are required to complete this section, since it provides the substance of the required CfAO Annual Report to the NSF.**

List all Center publications (those that acknowledge Center support) in standard format, dated from May 2006 to the present. Distinguish among the following types: peer-reviewed, books and book chapters, and other non-peer reviewed publications.

List all of your Center participants (an individual who spends 160 or more hours on Center activities over a 12 month period).

List each CfAO graduate student or postdoctoral researcher who has left. Designate degrees achieved and/or number of years to degree. Also designate her/his new placement.

List all awards and honors with names of those honored, reason for award, award name and sponsor, and the date of the award.

Provide demographic information for each NEW Center participant

- Name
- Category: Undergraduate, graduate student, faculty, visiting faculty, other research scientist, postdoctoral researcher, pre-college, teacher, educator, other
- Institutional Affiliation: (the primary institution at which the person is affiliated)
- Department
- Gender
- Disability—Select one or more of the following: hearing impairment, visual impairment, mobility/orthopedic impairment, other, none
- Ethnicity: (Choose one) Hispanic or Latino, not Hispanic or Latino
- Race: (Select one or more) American Indian or Alaskan Native, Asian, Black or African American, Native Hawaiian or other Pacific Islander, White
- Citizenship: (Choose one) U.S. Citizen, Permanent Resident, Other non-U.S. Citizen

List all Patents and Licenses with patent name, inventors/authors, patent/license number, application date, and receipt date.

List names of all start-up companies and designate their main product(s).

Describe any other outputs of knowledge transfer activities made during the reporting period not listed above.

7.0 Research Proposal Format: Single PI Project or Co-PI of a Collaborative Project

Proposal Participants

- List names, titles and email addresses of all individuals at **your** institution who will participate in your proposal. This includes those whose salaries are not funded by NSF.

Time Scale *Specify if this is a one or two year proposal.*

Abstract

- A technical abstract plus a brief non-technical abstract of your research proposal.

Proposal *4-5 pages of justification must include:*

- Technical description of your proposed research
- Relation to a CfAO Theme
- Nature of planned Center collaborations
- Roles of each participant and site
- Collaborations outside CfAO
- Cross disciplinary links between Astronomy and Vision Science, if any
- Starting in Year 8, CfAO funding was committed for graduate students and postdocs on an annual basis only. While CfAO will endeavor to maintain continuity of support, PIs should actively be seeking student and postdoc support from other sources. PIs should describe potential non-CfAO funding options for graduate students and postdocs
- Plans and/or possibilities for obtaining external (non-NSF STC) funding for the proposed project in Years 9 and 10
- Plans for developing external funding for the project after Year 10.

Specific Year 9 and 10 Schedule and Milestones

- List major milestones during Year 9 with expected dates.
- For two-year proposals, present two-year plan milestones and dates.
- For a continuing proposal describe any changes in the previously assigned milestones for Year 9 and the reasons for those changes.

Note: Milestones refer to technical achievements only. For example do not include the hire of a post-doc or the purchase of equipment in this category.

Proposed Education & Human Resources Activities

- List and briefly describe the participation in Year 8 in CfAO sponsored EHR activities of the PI, postdocs, and grad students. Include identified milestones and their status.
- Describe your proposed participation for Year 9 (also see Section 7). If proposing a CfAO funded internship activity, briefly outline possible projects.

Progress Report on Year 8 CfAO funded Research

- Clearly identify Technical Milestones and progress relative to them.
- Describe current technical challenges and status.
- Include images or figures (if appropriate) for use in the CfAO Annual Report to NSF.

Potential Partnerships with Industry that you intend to pursue

CfAO Service other than EHR

- e.g. workshop organization, committee service, website etc.

Funding requests related to this research for Workshops, Colloquia, etc.

List up to three external reviewers for your proposal (optional)

8.0 Proposal Format: Education and Human Resources Projects

Project Title

Proposal Participants

- List names, titles, CfAO member status, and e-mail addresses of all individuals who will participate in your proposal. This includes those whose salaries are not funded by NSF.
- If name is unknown, list as “to be hired” and describe position to be filled (e.g. postdoc)
- Describe roles and responsibilities in the project of each participant.

Time Scale *Specify if this is a one or two year proposal.*

Abstract

- A technical abstract plus a brief non-technical abstract of your research proposal.

Proposal *4-5 pages of justification must include:*

- Description of your proposed activities
- Relation to a CfAO Theme
- Nature of planned collaborations
- Collaborations outside CfAO
- Cross disciplinary links between Astronomy and Vision Science, if any
- Indicate the major educational aim(s) of this project or program and how it relates to one or more CfAO educational goals
- List the measurable objectives related to each goal (short term measures of success)
- Please be sure the major goal(s) are clearly stated in a short succinct sentence
- Starting in Year 8, CfAO funding for graduate students and postdocs was committed on an annual basis only. While CfAO will endeavor to maintain continuity of support, PIs should actively be seeking student and postdoc support from other sources. PIs should describe potential non-CfAO funding options for graduate students and postdocs.
- Plans and/or possibilities for obtaining external (non-NSF STC) funding for the proposed project in Years 9 and 10
- Plans for developing external funding for the project after Year 10

Need *(Approximately 1 paragraph)*

- Describe the need for this project relative to research, projects, and potential barriers to implementation
- Start with a general introduction and then develop the specifics that will clearly show the relationship between your activities, measurable outcomes, and the need which this project addresses

Activities *(1-2 pages)*

- Describe the activities that will be developed and/or implemented. These should clearly relate to your identified need, measurable objectives and goals.

Evaluation and Assessment *(A paragraph or table)* Describe how you will:

- Evaluate the progress and success of this project, including questions that you will ask.

- Use evaluation to gain insight into how well your program is performing and what adjustments may be necessary to keep it on track.
- Track participants (the beneficiaries of your project) over time and for how long. Also list the relevant participant background information that will be provided to the CfAO (or include copy of application, etc.).

Specific one and two year Schedules and Milestones

- List major milestones during Year 9 with expected dates.
- For two-year proposals, present two-year plan milestones and dates.
- For a continuing proposal describe any changes in the previously assigned milestones for Year 9 and the reasons for those changes.

Note: Milestones refer to educational or technical achievements only. For example do not include the hire of a post-doc or the purchase of equipment in this category.

Progress Report on Year 8 CfAO funded Research

- Clearly identify Milestones and progress relative to them.
- Describe current challenges and status.
- Include progress report through April 2007.

Potential Partnerships with industry or educational institutions that you intend to pursue

CfAO Service other than EHR:

- E.g. workshop organized, committee service, website etc.

Funding Requests related to this research for Workshops, Colloquia, etc.

List up to three external reviewers for your proposal (optional)

9.0 Proposal Format for Seed Funding Projects

Cover page Standard cover page (Section 5). Seed funding proposals are for one year only. They should involve multiple CfAO institutions (collaborative research), and focus on developing sustainable funding for scientific or education activities that take advantage of the CfAO's "Center mode of operations". Proposals will be accepted for workshops, meetings, and feasibility studies. It is anticipated that the upper limit for a seed-funding project will be about \$30k.

Proposal Participants

- List names, titles and email addresses of all individuals at your institution who will participate in your proposal. This includes those whose salaries are not funded by NSF.

Abstract

- A technical abstract plus a brief non-technical abstract of your seed-funding proposal.

Proposal 3-4 pages of justification must include:

- Description of proposed project
- Why it is needed
- How it relates to "life after Year 10" and/ or to augmented funding in Years 9 and 10
- Relation to a CfAO Theme
- Nature of planned Center collaborations
- Roles of each participant and site
- Collaborations outside CfAO (industry, educational institutions, observatories, etc)
- Cross disciplinary links between Astronomy and Vision Science, if any

Specific Year 9 Milestones

- List major milestones during Year 9 with expected dates.

9.0 Budget Template

All PIs: For single year funding complete Year 9 column, for two years include Year 10 estimate

Note: Collaborative Research Group Leaders provide additional budget that integrates budgets of individual collaborators

	Your Name:	Year 9: Nov 2007 to Oct 2008	Year 10: Nov 2008 to Oct 2009
A	Senior Personnel		
A1			
A2			
A3	PI + Faculty Associates <i>names</i>		
A4	Visiting Faculty Associates names		
10A	Total Senior Personnel	0	0
B1	Post Doctoral Associates <i>names</i>		
B2	Other Professional		
B3	Graduate Students (acad) <i>names</i> Summer		
B4	Undergraduate Students acad summer		
B5	Secretarial-Clerical		
B6	Other (Shop Charges)		
A+B	Total Wages	0	0
C	Fringe Benefits		
ABC	Total Sal., Wages, Fringes	0	0
D	Permanent Equipment	0	0
E	Travel		
F	Visitor Support Costs	0	0
G1	Materials and Supplies		
G2	Pub. Costs/Page Charges		
G3	Consultant Services		
G4	Computer Services		
G5	Facilities Charges		
	Shop Charges		
	Tuition+ Ins.		
G	Total Other Direct Costs	0	0
H	Total Direct Costs (A thru G)	0	0
Ia	Facilities and Administrative Costs		
	Any other F&A Costs		
	Total F&A Costs	0	0
J	Total	0	0