

KANAL'S

# MAGNETIC RESONANCE PHYSICS COURSE

Clinical MRI, MRA, and MRS:  
Understanding and Applying



January  
19-23  
2014

ANTLERS AT VAIL

Vail,  
Colorado





## Program Director

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MD, FACR, FISMRM, AANG**

Professor of Radiology and Neuroradiology and Director of Magnetic Resonance (MR) Services, University of Pittsburgh Department of Radiology

Emanuel Kanal graduated cum laude from Yeshiva University in New York with a double major in premedicine and biology and a minor in physics. He then graduated from the University of Pittsburgh School of Medicine with membership in the Alpha Omega Alpha Medicine Honors Society and completed his internship in internal medicine and his residency in diagnostic radiology at the University Health Center of Pittsburgh. Kanal completed his first fellowship in magnetic resonance imaging (MRI) and a second fellowship in neuroradiology at what was then the Pittsburgh NMR Institute and University of Pittsburgh Medical Center (UPMC). He was the medical director of the Pittsburgh NMR Institute until its incorporation into UPMC, when he became director of MR services in the University of Pittsburgh Department of Radiology, a position he maintains to date.

Kanal is a founding member, board member, officer, and/or member of numerous national and international professional societies and serves as a consultant to the

U.S. Food and Drug Administration on MR safety issues. He has chaired and/or served on MR safety committees for 25 years, was chair of the first national and international MR safety committee, and served as chair of the American College of Radiology's Blue Ribbon Panel on MRI Safety. He is the lead author of the ACR's White Paper on MR Safety and its contained MR Safe Practice Guidelines and their numerous updates. Kanal also created and founded the first MR safety Web site in 1995 and is coauthor of the first MR safety textbook.

In 1991, Kanal was the first to have developed and presented the usage of timed bolus contrast-enhanced magnetic resonance angiography (MRA) in humans. He has published numerous original peer-reviewed articles, reviews, monographs, abstracts, books, and book chapters and lectures extensively on clinical MR and MR safety-related topics. He also is the author of the most comprehensive clinical MR tutor/simulator software ever created, which he uses throughout his courses and lectures.

### EDUCATIONAL OBJECTIVES

Depending on the course attended, participants should be able to:

- Discuss gadolinium-based MR contrast agent use, including mechanism of action, distribution, time versus concentration considerations, and the clinical impact and benefits of higher relaxivity agents.
- Identify numerous MR imaging artifacts, how to recognize them, and how to decrease or eliminate them.
- Describe the unique advantages and clinical applicability of utilizing such MR pulse sequences as inversion recovery (including FLAIR and STIR), diffusion weighted imaging, perfusion weighted imaging, and MR spectroscopy.
- Identify various types of MR angiographic sequences and their specific advantages, limitations, and artifacts.
- Introduce the concepts underlying MR spectroscopy and spectroscopic imaging and demonstrate how these are clinically applied in routine patient care settings.

### CONTINUING MEDICAL EDUCATION (CME)

The University of Pittsburgh School of Medicine is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

The University of Pittsburgh School of Medicine designates this live activity for a maximum of 20.0 *AMA PRA Category 1 Credits*™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Other health care professionals are awarded 2.0 continuing education units (CEU's) which are equal to 20.0 contact hours.

# Course Description

### MR TUTORIAL SOFTWARE

Emanuel Kanal has custom developed and continues to expand on a Mac-based MR imaging tutorial program. Developed with the assistance of in-house programmers and the support of industry experts, the program addresses the often-difficult task of assimilating MR physics with the clinical goals of lesion detectability, scan time, imaged volume, and scanning efficiency.

The program combines graphic, text, and audiovisual formats to demonstrate the underlying concepts common to all MR imaging systems. Users can simulate the effects of changing the sequence type on any of the literally dozens of MR imaging parameters and observe the effects simulated on the computer screen. Features available include spin echo imaging, inversion recovery imaging, gradient echo imaging, and contrast-enhanced imaging techniques. Computer tutorials are integrated with the formal lectures of the Center for Magnetic Resonance Education.

### VIDEO/AUDIO RECORDING POLICY

Video and/or audio recording by course participants is not permitted during the lectures. Unauthorized recording equipment is not allowed in the meeting rooms.

### SPECIAL NEEDS OF DISABLED PERSONS

Participation by all individuals is encouraged. Advance notification of any special needs will help us provide better service. Please notify us of your needs at least two weeks in advance of the program by calling Robin DeAngelo at 412-647-3510.



### COURSE DETAILS

Since 1985, Emanuel Kanal has taught literally thousands of people the concepts underlying MR imaging physics and their clinical applications. His teaching style is informal, interactive, humorous, enthusiastic, energetic, and unique. Among the unique aspects of this course is that it takes full advantage of the graphic, interactive format of his custom-developed MR tutorial and simulator software programs, which permit real-time simulation of the effects of MR image parameter manipulation on the scanned images.

The course will review basic MR imaging principles, including explanations and applications of such parameters as T1, T2, T2\*, proton density, TR, TE, TI, flip angle, contrast agents, relaxivity, etc. It will review spin echo, gradient echo, and inversion recovery (including FLAIR and STIR) imaging techniques and it will lead into a number of more complex MR issues, including several hours dedicated to MR angiography, diffusion and perfusion weighted

**“Very enthusiastic course ... I highly recommend this course for any radiologist or MRI tech!”**

**“Dr. Kanal is enthusiastic, entertaining, passionate, energetic, and very knowledgeable!”**

**“I wish I could put this in a bottle and pour it out again and again.”**

**“He tells you what he is going to do, does it, and reviews it, checking to make sure the audience is getting it!”**

**“Dr. Kanal’s lecture style is spellbinding and effective!”**

imaging, sequence optimization techniques for high relaxivity MR contrast agents, and MR spectroscopy.

Kanal is recognized as one of the most sought-after MR educators in the world today; is the first to have developed, applied, and presented dynamic bolus contrast-enhanced MRA; and is the pre-eminent physician authority on MR safety issues.

As is his style, Kanal will be available to answer questions and clarify concepts at and between each conference session. Participants will leave this conference with a solid understanding of complex but clinically vital MR imaging, angiography, and spectroscopy physics principles and how to apply them to routine clinical diagnostic patient care.

Participants are not required to purchase any special books. They will be given a workbook that contains articles and graphs to be used as a resource during the course.

### Target Audience

This is a unique, highly focused, and concentrated MR course developed by Emanuel Kanal and designed for radiologists, neurologists, cardiologists, physicists, technologists, industry specialists, and others who seek to understand how MR imaging works and how to clinically apply it.

The University of Pittsburgh, as an educational institution and as an employer, values equality of opportunity, human dignity, and racial/ethnic and cultural diversity. Accordingly, as fully explained in Policy 07-01-03, the University prohibits and will not engage in discrimination or harassment on the basis of race, color, religion, national origin, ancestry, sex, age, marital status, familial status, sexual orientation, gender identity and expression, genetic information, disability, or status as a veteran. The University also prohibits and will not engage in retaliation against any person who makes a claim of discrimination or harassment or who provides information in such an investigation. Further, the University will continue to take affirmative steps to support and advance these values consistent with the University's mission. This policy applies to admissions, employment, and access to and treatment in University programs and activities\*. This is a commitment made by the University and is in accordance with federal, state, and/or local laws and regulations.

For information on University equal opportunity and affirmative action programs, please contact: University of Pittsburgh; Office of Affirmative Action, Diversity, and Inclusion; Carol W. Mohamed, Director (and Title IX, 504 and ADA Coordinator); 412 Bellefield Hall; 315 South Bellefield Avenue; Pittsburgh, PA 15260; 412-648-7860.

For complete details on the University's Nondiscrimination Policy, please refer to Policy 07-01-03. For information on how to file a complaint under this policy, please refer to Procedure 07-01-03.

\*Except where exempt by federal or state laws.

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# Daily Schedule

SUNDAY January 19	MONDAY January 20	TUESDAY January 21	WEDNESDAY January 22	THURSDAY January 23
	6:30–7 a.m. Continental Breakfast	6:30–7 a.m. Continental Breakfast	6:30–7 a.m. Continental Breakfast	6:30–7 a.m. Continental Breakfast
	7–8:20 a.m. Review of Gradient Echo Imaging: The Role of TR, Flip Angle	7–7:50 a.m. MR Safety, Part 1: 2010 ACR Guidelines	7–7:50 a.m. MR Contrast Agents	7–8:20 a.m. Summary of Principles, Techniques, and Uses of MRA
	8:20–8:30 a.m. BREAK	7:50–8 a.m. BREAK	7:50–8 a.m. BREAK	8:20–8:30 a.m. BREAK
	8:30–9:30 a.m. Review of Gradient Echo Imaging: TE vs. T2*, How to Successfully Achieve T1, T2*, and/or Proton Density Weighting	8–9:30 a.m. MR Safety, Part 2: 2010 ACR Guidelines, ESRD, Gadolinium, and NSF	8–9:30 a.m. High Relaxivity GBCA and Associated Sequence Optimization Techniques	8:30–9:30 a.m. Magnetic Resonance Spectroscopy
	9:30–9:45 a.m. Question and Answer Session	9:30–9:45 a.m. Question and Answer Session	9:30–9:45 a.m. Question and Answer Session	9:30–9:45 a.m. Question and Answer Session
	9:45 a.m. Session Ends	9:45 a.m. Session Ends	9:45 a.m. Session Ends	9:45 a.m. Session Ends
3:30–4:15 p.m. Registration Desk Opens	SKI BREAK	SKI BREAK	SKI BREAK	
4:15–4:30 p.m. Welcome and Opening Announcements				
4:30–6 p.m. Basic MR Imaging Review, Part 1: T1, T2, and Relative Proton Density	4:30–5:30 p.m. Inversion Recovery Imaging and its Variants, Parts 1 and 2	4:30–5:30 p.m. Artifacts, Part 1: Fat Saturation, Water Saturation, Chemical Shift Artifact, and Magnetization Transfer Imaging	4:30–5:30 p.m. Diffusions/Perfusion Weighted MR Imaging, Part 1	
6–6:10 p.m. BREAK	5:30–5:40 p.m. BREAK	5:30–5:40 p.m. BREAK	5:30–5:40 p.m. BREAK	
6:10–7 p.m. Basic MR Imaging Review, Part 2: TR, TE, and Computer Simulation Review	5:40–7 p.m. Inversion Recovery Imaging and its Variants, Parts 1 and 2 (cont.)	5:40–7 p.m. Artifacts, Part 2: Truncation Artifact, Fat-Water Edge Enhancement, Fat Saturation Failure	5:40–7 p.m. Diffusion/Perfusion Weighted MR Imaging, Part 2	
7 p.m. Session Ends	7–7:15 p.m. Question and Answer Session	7–7:15 p.m. Question and Answer Session	7–7:15 p.m. Question and Answer Session	
	7:15 p.m. Session Ends	7:15 p.m. Session Ends	7:15 p.m. Session Ends	

Faculty for this activity have been required to disclose all relationships with any proprietary entity producing health care goods or services.

\*Schedule is subject to change without notice.



Vail,  
Colorado

## A Special Place

Whether you're planning a vacation, here for a ski season, or relocating to the area, find out what others have come to realize. Year-round, Vail is a special place.

Vail is home to 4,500 permanent residents plus another 5,000 part-time residents of vacation properties. Together, we share and value a lifestyle that combines one of the best alpine resorts in the world with a friendly, small-town feel. Not only do we enjoy the bountiful recreational and cultural opportunities that are available, we also take pride in a quality of life that provides alpine living at its best. Visitors and residents alike enjoy the 1,100 acres of open space accounting for 30 percent of Vail's town-owned land; 350,000 surrounding acres of national forest crowned by 5,289 skiable acres on one of the largest and best ski mountains in the world; 15 miles of recreation paths; countless special events; the highest botanical gardens in the world; and an outdoor amphitheater named for Vail's most famous resident, President Gerald R. Ford.

Besides being one of the favorite ski destinations in the world, Vail is a community people love to live in. There are numerous employment opportunities, especially at the peak of the ski season when valley employers hire more than 4,000 employees. Full-time professional opportunities also are available, and many employers offer housing assistance programs, free transportation, parking programs, and competitive wages and benefits.

Vail was founded as a ski resort in 1962, incorporated as a town in 1966, and became a Home Rule Charter municipality in 1972. Vail has a council-manager form of government and is led by a seven-member town council elected at large. A \$45.5 million net revenue annual budget provides essential services like police and fire protection, plus additional amenities such as the largest free transportation system in the country, which reduces pollution and traffic congestion year-round.

With world-renowned skiing, diverse shops and restaurants, luxurious accommodations, friendly neighborhoods, and breathtaking mountain views, Vail is arguably the finest resort destination in the world. See for yourself, Vail is a great place to live or visit.



  
**ANTLERS AT VAIL**  
 CONDOMINIUMS & CONFERENCE CENTER  
[www.antlersvail.com](http://www.antlersvail.com)

## Activities



### ANTLERS AT VAIL RESORT AND CONFERENCE CENTER

The Antlers at Vail lodge is renowned for its friendly atmosphere and is located on Gore Creek just 150 yards from the Vail Gondola, Vail ski school, and numerous hiking trails. A \$20 million expansion was finished just a few years ago and includes 22 new condominiums/lodging units, a brand-new lobby with courtyard entrance, new conference facilities, an exercise room, a new pool area, a business center, and heated parking. In 2004, the Antlers at Vail was named the Vail Valley Business of the Year.

#### ACCOMMODATIONS

Make your reservations as soon as possible, as our room block may sell out prior to the cutoff date of January 5, 2014. After this date, reservations will be accepted at the discretion of the hotel, on a space-and-rate-availability basis. Please identify yourself as an attendee for Group Leader 140389, University of Pittsburgh, to ensure the conference rate will apply to your reservation.

**A conference rate of \$412 per night for a one bedroom is available Saturday through Thursday.**

**Please note: Rates apply to course attendees only!**

Call **800-843-8245** or **970-476-2471** for hotel reservations, or register online at [www.antlersvail.com](http://www.antlersvail.com) (go to "book it," click on "group," and enter the group code).

Please remember when calling to identify yourself as an attendee for Group Leader 140389, University of Pittsburgh.

#### AMENITIES

The Antlers at Vail is your second home, a great Vail lodging experience for family and friends in a relaxed mountain setting.

Condos range from studios to four bedrooms and are complete with full-size, fully equipped kitchens, gas fireplaces, and private balconies.

Each unit also has the following amenities: humidifier, hair dryer, iron and ironing board, entertainment center, cable TV with HBO, VCR, and CD and cassette player. Daily housekeeping is provided. The Antlers offers top-of-the-line meeting facilities as well as elegant accommodations.

Other amenities include a pool, a hot tub, saunas, a conference center, a fitness room, a business center, free underground parking, and laundry facilities.



#### EAGLE COUNTY AIRPORT

Just minutes from Vail and the best skiing in North America, Eagle County Airport (EGE) gets you directly to the heart of the Colorado Rockies, year-round. Trade the long drives, snowy passes, and airport delays for friendly, world-class service and ASAP access to your favorite outdoor activities.

EGE has grown with the opening of its award-winning passenger terminal in 1996. In 2004, it served its millionth passenger and set an EGE record for commercial passenger enplanements. New at EGE is the addition of customs services for private aircraft and free wireless Internet service in the terminal. Just bring your laptop!

EGE is the quality airport of choice for people traveling to western Colorado. Whether you're visiting the area for business or pleasure, using private aircraft or scheduled commercial flights, EGE offers the best in convenience, security, and extra special customer service.

For further information, visit the EGE Web site at [www.eaglecounty.us/airport](http://www.eaglecounty.us/airport) or [flyvail.com](http://flyvail.com), e-mail EGE at [ecair@eaglecounty.us](mailto:ecair@eaglecounty.us), or contact the airport by phone at **970-328-2680**.

#### LOCAL ACTIVITIES

Adventure Ridge is Vail's mountaintop activity center. The Lionshead area offers a variety of activities, not to mention incredible skiing. Those on foot can ride the Eagle Bahn Gondola free after 2 p.m. Lift tickets can be prepurchased through the Antlers.

Play all day and well into the night at Adventure Ridge with ski bikes, a kids snowmobile track, a bungee trampoline, a slippery slope of rip-roaring tubing lanes, and more.

You can enjoy skiing, snowmobiling, tubing, ski biking, and even horse-drawn carriage rides through Vail Village at sunset. All of this and more are available just outside your door.

For more information, call **970-476-9090**, or visit [www.vail.com](http://www.vail.com).



### Family Fun

#### SKI BIKING

Part bike. Part skis. All adventure. If you're a skier looking for a challenge, you'll want to sign up for nighttime downhill guided tours, recommended for intermediate, expert, or advanced-level skiers or riders. Children must be at least 14 years old and 4'6" tall.

#### TUBING

Grab a tube, hop a lift, get a rush. The multilane tubing hill whisks you downhill and the easy-access surface lifts take you back up quickly. Children 5 years of age and younger must be accompanied by an adult on the hill.

#### SNOWSHOEING

Take a hike in the snow with the pros and learn about the montane, subalpine, and alpine zones in the region's highest-altitude nature center. All ages are welcome, but snowshoeing is recommended for adults and kids over 12.

### For the Kids

#### KIDS SKI AND SNOWBOARD SCHOOL

Little ones get lots of attention at Vail. Our kids' and teens' programs focus on all sorts of terrain to give them the confidence they need to hit the slopes or the parks. Vail instructors are experts at teaching technique, so kids improve instantly. It's the next best investment to college! Private lessons, groups, and specialty programs are all available. For more information or to book a lesson, call **800-475-4543**.

#### KIDS CAMPS: SKI AND SNOWBOARD

These fun five-day camps for intermediate and above skiers (levels 5-9) and advanced-beginner snowboarders (levels 3-9) run Monday through Friday at the Golden Peak Kids Center (the December camp runs Tuesday through Saturday). Book through Children's Online Reservations or on site; drop-ins will be accommodated on a space-available basis, pro-rated by day.

#### ICE SKATING

Swirl and twirl at the new outdoor ice rink at Vail Square in Lionshead next to the Eagle Bahn Gondola. Skate rentals are available.

